Universiti Malaysia Sabah MathViz Mathematics Visualization Research Group

MATHEMATICS AND VISUALIZATION RESEARCH MONOGRAPH SERIES: POSTER EDITION

2025

EDITORS

ABDULLAH BADE
SUZELAWATI ZENIAN
ARIF MANDANGAN
ROZAIMI ZAKARIA
ASDALIFAH TALIBE
RECHARD LEE

MCG Mathematics Computer Graphics Universiti Malaysia Sabah

MaGRAPH Mathematics and Computer Graphics Association

Universiti Malaysia Sabah 1994-2024

National OSH Award

UMS Universiti Malaysia Sabah

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FOREWORD

I sincerely congratulate the editorial team of the *Mathematics and Visualization Research Monograph Series: Poster Edition 2024,* for their effort in releasing this manuscript. This is the first research monograph produced by the Mathematics Computer Graphics Programme. I expect this book will augment and enrich the knowledge base in the domain of Mathematics and Graphics - Visualization in the future.

The domain of Mathematics and Computer Graphics has considerable significance in this decade. It forms a crucial component of the extensive knowledge foundation that supports a diverse range of fields, particularly in applied mathematics, computer vision, and artificial intelligence, an area now garnering significant interest. This field's distinctiveness stems from its amalgamation of Mathematics and Graphics - Visualization, which underpins the advancement of contemporary intelligent technology applications.

Moreover, the integration of computer components as a tangible manifestation of the amalgamation of these two disciplines establishes Mathematics and Graphics-Visualization as a domain with significant potential to advance technological sophistication both now and in the future.

Despite that, I am very gratified and optimistic that this manuscript will persist in enhancing the current corpus of knowledge while acting as a significant resource and reference for students in this faculty. Congratulations once again; strive to achieve excellence.

PROF. DR. JUALANG @ AZLAN ABDULLAH GANSAU
DEAN
FACULTY OF SCIENCE AND NATURAL RESOURCES
UNIVERSITI MALAYSIA SABAH

PREFACE

We are pleased to present the *Mathematics and Visualization Research Monograph Series: Poster Edition 2024,* a curated collection of research posters showcasing diverse explorations within mathematics and its applied domains. This monograph was born from the recognition that visualization serves as a powerful bridge in understanding complex mathematical concepts, enhancing comprehension, and fostering innovation. Within these pages, readers will find a variety of topics, ranging from foundational research to cutting-edge applications across key areas such as Mathematical Cryptography, Fuzzy Logic, Computational Geometry, Mathematical Programming, Digital Image Processing, Computer Graphics, Computational Photography, and Computer Vision.

Each poster included in this monograph offers a snapshot of innovative work, using visual elements to distill intricate mathematical frameworks, models, and methodologies. We hope this compilation not only serves as a valuable resource for those in academia and industry, but also inspires a deeper appreciation of how visualization techniques can elevate mathematical communication and understanding.

This publication is designed for researchers, practitioners, educators, and students seeking to explore mathematical ideas in a visually engaging format. We believe this collection will stimulate further exploration, foster collaboration, and encourage the next generation of mathematicians to pursue excellence in both research and visualization. We express our heartfelt gratitude to the contributors, reviewers, and the editorial team who have helped shape this publication.

May this monograph inspire and enlighten, and may it continue to grow as a platform for mathematical visualization.

TS. DR. ARIF MANDANGAN
HEAD OF MATHEMATICS COMPUTER GRAPHICS PROGRAMME
FACULTY OF SCIENCE AND NATURAL RESOURCES
UNIVERSITI MALAYSIA SABAH

DESK OF EDITOR-IN-CHIEF

Desk of Editor-in-Chief

Welcome to our series of *Mathematics and Visualization Research Monograph Series,* an exciting array of innovative research in Applied Mathematics and Graphics-Visualization, dedicated to developing advanced applications in critical domains such as Mathematical Cryptography, Fuzzy Mathematics, Computational Geometry, Computer Graphics, Digital Image Processing, Computational Photography, and Computer Vision, along with their numerous applications. Since March 2024, our researchers together with our committed and talented students, have dedicated our effort and endeavor to explore these disciplines in order to generating insightful works that expand the frontiers of knowledge. Our primary objective is to publish and document as much scientific work and research conducted in our department as feasible.

The target was to provide a platform that highlights substantial achievements in relevant fields of study, so enhancing awareness and appreciation of these dynamic subjects. For this commitment, we decided to divide the publishing into two annual series. The first series was a poster edition, followed by chapters in a book series.

The most commendable aspect of this series of publications is its broad spectrum of themes. Certainly, from pioneering Mathematical and Graphics-Visualization ideas to the inventive expansion of applications in these fields. We assert that each poster and chapter in the book provides a distinct viewpoint and enhances the corpus of knowledge in its relevant discipline. This research monograph, whether presented as a poster format or a book chapter, aims to disseminate our contributions and stimulate further research and collaboration among relevant stakeholders, particularly in advancing the fields of Mathematics and Graphics-Visualization in the future. We express our gratitude to all readers for their involvement in this endeavour and hope you find the content of our publication as motivating and illuminating as we do.

In a nutshell, I am privileged to oversee the curation and publishing of this monograph as the Editor-in-Chief. I express our gratitude to our editorial team for their work and devotion, particularly throughout the time-consuming editing process that upholds the highest standards of academic values.

PROF. DR. ABDULLAH BADE
EDITOR-IN-CHIEF
MATHEMATICS AND VISUALIZATION RESEARCH MONOGRAPH SERIES
FACULTY OF SCIENCE AND NATURAL RESOURCES
UNIVERSITI MALAYSIA SABAH

UMS
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PENDEKATAN PENGELOMPOKAN C-MIN KABUR INTUINISTIK SPATIAL (SIFCM) DALAM PENAMBAHBAIKAN SEGMENTASI IMEJ PERUBATAN BAGI PENGIMEJAN MRI

ANIS SHAHERA BINTI ABDUL LATIP & SUZELAWATI ZENIAN
FAKULTI SAINS DAN SUMBER ALAM, UNIVERSITI MALAYSIA SABAH, 88400, KOTA KINABALU, SABAH, MALAYSIA

ABSTRAK

Segmentasi imej perubatan, terutama dalam pengimejan MRI, memainkan peranan kritikal dalam menganalisis struktur anatomi dan proses diagnosis. Kajian ini memperkenalkan Pendekatan Pengelompokan C-Min Kabur Intuinistik Spatial sebagai strategi inovatif untuk meningkatkan hasil segmentasi imej perubatan, khususnya dalam pengimejan MRI. SIFCM memanfaatkan kekuatan konsep kabur intuinistik dan peningkatan kemampuan spatial untuk mengatasi kompleksiti imej MRI.

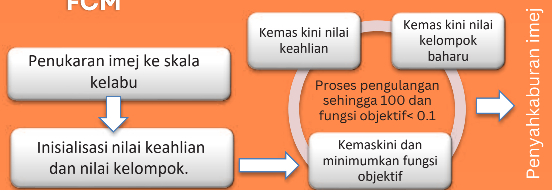
PENGENALAN

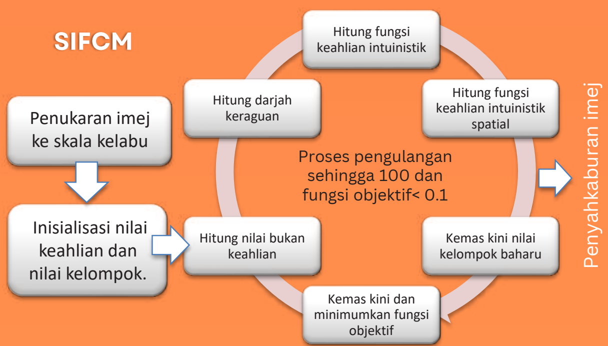
Kaedah konvensional sering menghadapi cabaran dalam menangani ketidakpastian dan kekurangan ketepatan penetapan keahlian piksel, terutama dalam proses segmentasi imej MRI. Pendekatan diambil untuk mengatasi cabaran ini adalah meningkatkan teknik c-min kabur intuinistik dengan memanfaatkan set intuinistik dan maklumat spatial pada imej. Dengan itu, kajian ini akan mengkaji keberkesanan teknik Pengelompokan C-Min Kabur Intuinistik Spatial (SIFCM) dalam meningkatkan ketepatan segmentasi imej MRI.

OBJEKTIF

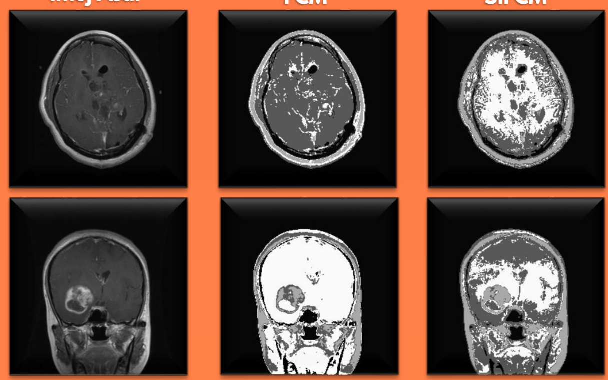
1. Meningkatkan kualiti segmentasi imej MRI dengan kaedah SIFCM, yang memanfaatkan maklumat spatial dalam meningkatkan ketepatan dalam menentukan keahlian piksel.
2. Membuat analisis perbandingan hasil segmentasi antara kaedah SIFCM dan kaedah konvensional iaitu Pengelompokan C-Min Kabur (FCM).

METODOLOGI





HASIL KAJIAN

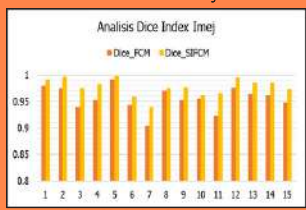


Hasil FCM - Kurang sensitif terhadap perbezaan dalam konteks spatial, menyebabkan penurunan ketepatan dalam menangkap butiran dalam segmentasi imej MRI

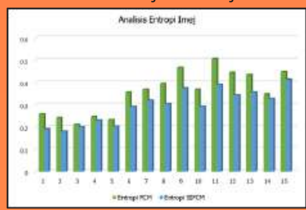
Hasil SIFCM - Memberikan penekanan yang lebih baik pada butiran-butiran kecil atau struktur halus, memberikan hasil segmentasi yang lebih tepat

ANALISIS DAN PERBINCANGAN

Penilaian kualiti imej dilakukan pada 15 data imej hasil kajian.



Analisis *Dice Index*



Analisis Penilaian Entropi

- Analisis menunjukkan nilai *dice index* imej data SIFCM adalah lebih tinggi berbanding SIFCM.
- Membuktikan SIFCM membentuk kelompok piksel yang serupa dengan piksel imej sebenar.
- Analisis nilai entropi data imej SIFCM mempunyai ketinggian yang lebih rendah berbanding FCM.
- Membuktikan SIFCM memberikan keahlian setiap piksel terhadap kelompok tertentu dengan lebih jelas dan pasti.

KESIMPULAN

Kajian ini menegaskan keberkesanan SIFCM dalam meningkatkan ketepatan segmentasi imej perubatan MRI berbanding dengan kaedah FCM konvensional. Hasil penilaian menggunakan *dice index* dan entropi menunjukkan kelebihan SIFCM, membuktikan bahawa kaedah ini merupakan pendekatan yang lebih baik.

RUJUKAN

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PENGHARGAAN

Penghargaan dan terima kasih kepada ibu bapa, penyelia, pensyarah, dan rakan-rakan yang telah membantu saya dalam projek ini. Saya juga ingin mengucapkan terima kasih kepada semua yang terlibat secara langsung atau tidak langsung dalam proses menyiapkan projek tahun akhir saya.

SW40106 PROJEK SAINTIFIK II
MATEMATIK DENGAN GRAFIK BERKOMPUTER

ATHIRAH BINTI ARASAN & SITI AISYAH TUMIRAN

RAINFALL CLASSIFICATION IN SABAH USING GREEDY ALGORITHM

RAINFALL CLASSIFICATION IN SABAH USING GREEDY ALGORITHM

ATHIRAH BT. ARASAN | DR. SITI AISYAH BT. TUMIRAN
FACULTY OF SCIENCE AND NATURAL RESOURCES, UNIVERSITI MALAYSIA SABAH
athirah_bs20@iluv.ums.edu.my | sitiaisyah.tumiran@ums.edu.my

ABSTRACT

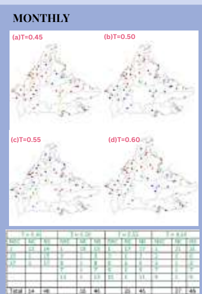
This study classifies rainfall in Asia Southeast, specifically Sabah, Malaysia, using the Greedy Algorithm method. It uses monthly rainfall data from 46 stations across the network. The system divides rainfall into groups based on common characteristics and network developments. Four communities have more than one stations, accounting for 63% of Sabah's total number of stations. 17 communities have only one station , accounting for 37% of the total number of rainfall station . The study uses elevation values and average monthly rainfall to identify rainfall communities.

OBJECTIVE

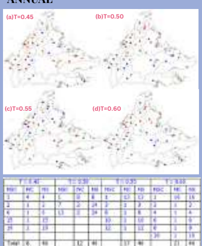
1. **Applying Community structure Method in Rainfall Classification**
   - To apply community structure methods, particularly Greedy algorithm to classify rainfall across Sabah (which covers different climatic conditions, topographic features, land use, and other relevant properties) to assess suitability and effectiveness the method.
2. **Investigate Rainfall Characteristic**
   - To investigate rainfall characteristic based on communities identified from rainfall classification by using Greedy Algorithm Method.
3. **Evaluate Rainfall Behaviour**
   - To evaluate rainfall behavior through seasons in Sabah (amount, intensity, duration, the frequency or return period, and the seasonal distribution) based on rainfall classification using Greedy Algorithm Method.

RESULT AND DISCUSSION

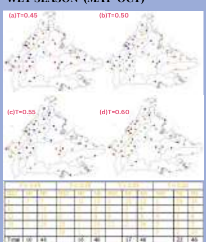
MONTHLY



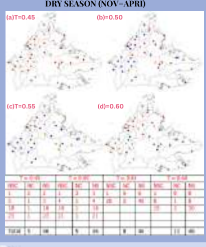
ANNUAL



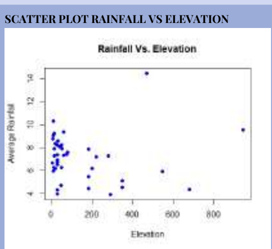
WET SEASON (MAY-OCT)



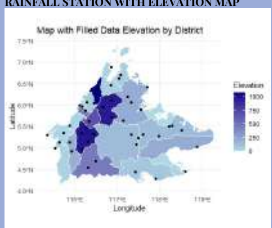
DRY SEASON (NOV-APRI)



SCATTER PLOT RAINFALL VS ELEVATION

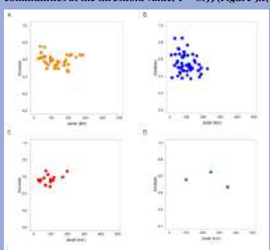


RAINFALL STATION WITH ELEVATION MAP



RAINFALL STATION BY DIVISION MAP

Distance-correlation comparison for the four largest communities at the threshold value, T = 0.55 (Figure 5.1(c))

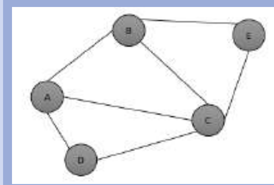


PROBLEM STATEMENT

- Increasing trend of the minimum and the mean surface temperature
- Climate changes reduces food production
- Smallholder farmers impacted by unpredictable rainfall
- Sustainable agriculture disturbed

METHODOLOGY

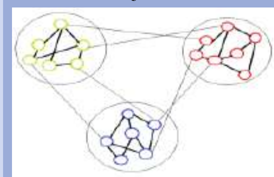
Network Structure



- A collection of nodes connected by linkages
- Mathematical representation :

G=V,E
V =set of nodes
E= collection of n links
V={A,B,C,D,E}
E={[A,B],[A,C],[A,D],[B,C],[B,E],[C,E],[C,D]}

Community Structure



A complex network grouping nodes into different, densely connected groups (independent of individual node properties and the network as a whole)

Greedy Algorithm Method

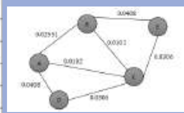
1. Calculate the initial modularity value for each link
2. Select the link with the highest Modularity (Qij) value and link removal for each node.
3. Repeat step 2 for the next nodes

Community Structure using Greedy Algorithm Method

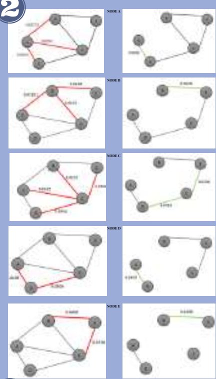
1

Linked Nodes	$\Delta Q_{ij} = \frac{1}{2m} - \frac{k_i k_j}{(2m)^2}$, 0	ΔQ_{ij}
A – B	$\frac{1}{2(7)} - \frac{3(3)}{(2(7))^2}$	0.02551
A – C	$\frac{1}{2(7)} - \frac{3(4)}{(2(7))^2}$	0.0102
A – D	$\frac{1}{2(7)} - \frac{3(2)}{(2(7))^2}$	0.0408
B – C	$\frac{1}{2(7)} - \frac{3(4)}{(2(7))^2}$	0.0102
B – E	$\frac{1}{2(7)} - \frac{3(2)}{(2(7))^2}$	0.0408
C – D	$\frac{1}{2(7)} - \frac{4(2)}{(2(7))^2}$	0.0306
C – E	$\frac{1}{2(7)} - \frac{4(2)}{(2(7))^2}$	0.0306

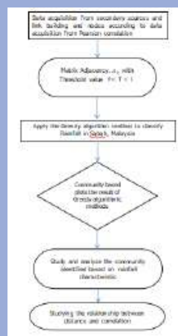
MODULARITY VALUES FOR EACH LINK IN THE NETWORK



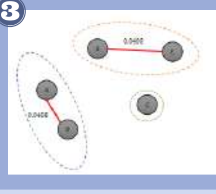
2



GREEDY ALGORITHAM FLOWCHART



3



Final Community Structure in Network based on the modularity value chosen

- Community 1 = Node A and D (Blue)
- Community 2 = Node C (Green)
- Community 3 = Node B and Node E (Orange)

CONCLUSION

- A small number of communities within each area contain a large number of rainfall stations; for instance, four of Sabah's largest communities together represent as much as 63% (29 of 46 rainfall stations)
- A large percentage of all communities only have a small number of rainfall stations; for instance, over 68% (17 from 25 communities have only one station, meaning that they only account for around 37% (17 out of 46 stations) of Sabah's total rainfall stations.
- Tiny percentage of the stations were located in high-elevation locations while the bulk of the stations were located in low-elevation areas.
- These communities are formed even though the stations are not in the same area and this suggests that the strong correlation is influenced by the geographical proximity factor or the natural nature of the rainfall stations.
- The findings demonstrate how well the correlation threshold value (T = 0.55) chosen in this investigation to examine monthly flow in the classification of rainfall is appropriate.

ACKNOWLEDGEMENT

I would like to express my gratitude to my supervisor, Dr Siti Aisyah bt. Tumiran for guidance in seeing this project through to completion and for all the concern, also to those who are directly or indirectly involved in the process of completing this final year project especially Department Of Irrigation and Drainage for providing Rainfall Data In Sabah for this project.

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SW40106 SCIENTIFIC PROJECT II
MATHEMATICS WITH COMPUTER GRAPHICS

PENYULITAN DAN PENYAHSULITAN IMEJ MENGGUNAKAN PETA *CHAOTIC* ARNOLD DAN PETA *CHAOTIC* LORENZ

Dian Natasha Din, Arif Mandangan

dian_natasha_bs20@iluv.ums.edu.my, arifman@ums.edu.my

Fakulti Sains dan Sumber Alam, Universiti Malaysia Sabah.

Abstrak

Penyulitan imej menjadi semakin penting dalam menghadapi cabaran keselamatan maklumat dalam era digital ini. Peta *Chaotic* Arnold dan Peta *Chaotic* Lorenz dikenali dengan sifat kekacauan dan ketidakdugaan mereka, yang menjadikan mereka pilihan yang menarik untuk penyulitan maklumat. Kajian ini membawa kepada pendekatan yang lebih dalam mengenai potensi Peta *Chaotic* Arnold dan Peta *Chaotic* Lorenz sebagai kaedah penyulitan dan penyahsulitan imej dari segi masa pelaksanaan.

Pengenalan

Kriptografi penting bagi melindungi kerahsiaan maklumat. Proses penyulitan ialah tindakan mengubah imej biasa menjadi imej sifer dengan teknik penyulitan dan kunci rahsia, manakala proses penyahsulitan bermakna pada bahagian sisi penerima, imej yang telah disulitkan akan ditukar kepada imej biasa menggunakan teknik penyahsulitan dan kunci rahsia. Dalam konteks ini, imej akan disulit menggunakan peta *chaotic* bagi melindungi maklumat imej. Peta chaotic ialah sistem dinamik yang mencipta keadaan rawak yang kelihatan sangat tidak teratur dan tidak teratur tetapi dikawal oleh keadaan benih asal. Hubungan antara keluaran huru-hara rawak sepenuhnya dan corak asas yang mendasari keluaran ini dijelaskan oleh teori huru-hara.

Matlamat dan Objektif

Tujuan kajian ini adalah untuk menjaga kerahsiaan maklumat imej dengan melaksanakan proses penyulitan imej menggunakan peta *chaotic* Arnold dan peta *chaotic* Lorenz dan menguji tahap kecekapan imej dari segi masa pelaksanaan dalam proses penyulitan dan penyahsulitan imej.

1. Untuk membangunkan algoritma penyulitan dan penyahsulitan imej bagi menjaga kerahsiaan maklumat imej menggunakan peta *chaotic* Arnold dan peta *chaotic* Lorenz.

2. Untuk menguji kebolehlaksanaan algoritma penyulitan dan penyahsulitan imej yang telah dibangunkan terhadap imej skala kelabu yang terdiri daripada pelbagai saiz.

3. Untuk menguji tahap kecekapan algoritma baharu dari segi masa pelaksanaan penyulitan dan penyahsulitan imej berbanding algoritma sedia ada.

Sumbangan

- Membantu menjaga kerahsiaan data atau maklumat dalam imej skala kelabu kerana ianya menjadi penting dalam konteks penyimpanan dan transaksi data sensitif.
- Dapat menyumbang dari segi kecekapan masa pelaksanaan, hanya mengambil masa yang singkat untuk menyulit dan menyahsulitkan imej.

Kesimpulan

Kajian ini akan menggunakan dua peta *chaotic* iaitu peta *chaotic* Arnold dan peta *chaotic* Lorenz. Peta *chaotic* Arnold digunakan dalam kajian ini kerana mampu menukar dan merombak kedudukan piksel imej menjadikan imej yang telah disulit sukar untuk dipecahkan kerahsiaannya oleh pihak yang tidak berhak. Seterusnya, peta *chaotic* Lorenz juga digunakan dalam kajian ini untuk menambah kesulitan kepada imej yang disulit agar menunjukkan perbezaan yang sangat tidak ketara.

Rujukan

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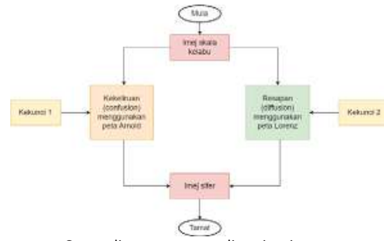
Metodologi

Peta *chaotic* Arnold

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = A \begin{bmatrix} x \\ y \end{bmatrix}$$

$$\begin{bmatrix} 1 & p \\ q & pq+1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} (mod\ n)$$



Carta alir proses penyulitan imej

Peta *chaotic* Lorenz

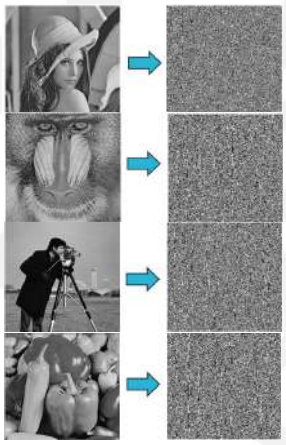
$$\dot{x} = a(y - x)$$

$$\dot{y} = (\sigma - z)x - y$$

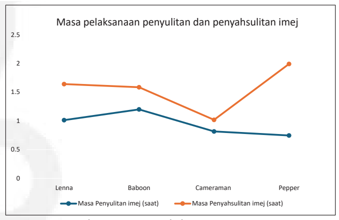
$$\dot{z} = xy - bz$$

Carta alir proses penyahsulitan imej

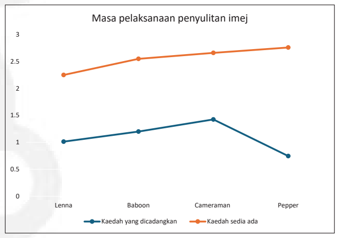
Keputusan & Perbincangan



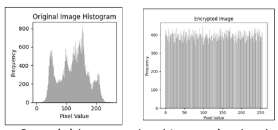
Imej asal dan imej yang telah disulit



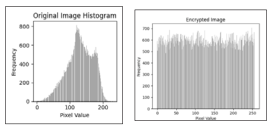
Analisis masa pelaksanaan



Perbandingan tahap kecekapan dari segi masa



Contoh histogram imej Lenna dan imej sifer Lenna



Contoh histogram imej Baboon dan imej sifer Baboon

- Masa pelaksanaan penyahsulitan imej lebih tinggi berbanding masa pelaksanaan penyulitan imej.
- Masa pelaksanaan bagi kaedah yang dicadangkan untuk proses penyulitan imej lebih rendah daripada kaedah sedia ada, menunjukkan kaedah yang dicadangkan lebih cekap dalam menyulit imej.
- Histogram menunjukkan taburan seragam yang memuaskan dan menunjukkan perbezaan imej sifer dan imej asal.

Penghargaan

Saya ingin mengucapkan terima kasih yang tidak terhingga kepada penyelia saya, Dr. Arif Mandangan atas bimbingan, tunjuk ajar, dan sokongan yang diberikan sepanjang menjalankan kajian ini. Terima kasih juga kepada keluarga dan rakan-rakan atas sokongan dan dorongan mereka.

SW40106 PROJEK SAINTIFIK II
MATHEMATIK DENGAN GRAFIK BERKOMPUTER

Transformasi Ke Arah UNIVERSITI INDUSTRI 4.0

UMS KAMPUS RAHMAH TERAS KECEMERLANGAN DAN KEUNGGULAN

FARAH RAHIMAH SABARUDDIN & ASDALIFAH TALIBE

EVALUATION OF ANXIETY USING INTERVAL-ANALYTIC HIERARCHY PROCESS (I-AHP): A CASE STUDY OF FACULTY OF SCIENCE AND NATURAL RESOURCES IN UNIVERSITI MALAYSIA SABAH, KOTA KINABALU CAMPUS

UMS UNIVERSITI MALAYSIA SABAH MCG

EVALUATION OF ANXIETY USING INTERVAL ANALYTIC HIERARCHY PROCESS (I-AHP): CASE STUDY OF FACULTY OF SCIENCE AND NATURAL RESOURCES UNIVERSITI MALAYSIA SABAH KOTA KINABALU CAMPUS| 2024

PRODUCED BY:

Farah Rahimah binti Sabaruddin

farah_rahimah_bs20@iluv.ums.edu.my

SUPERVISOR:

Pn Asdalifah Talibe

asdalifah@ums.edu.my

MATHEMATICS VISUALIZATION RESEARCH GROUP (MATHEMATICS COMPUTER GRAPHICS PROGRAMME

FACULTY OF SCIENCE AND NATURAL RESOURCES

UNIVERSITI MALAYSIA SABAH

ABSTRACT

This study try to determine the most common component of anxiety disorder among undergraduate students from Faculty of Science and Natural Resources (FSSA) in Universiti Malaysia Sabah (UMS) by using Interval-Analytic Hierarchy Process (I-AHP). All the components are based on Beck Anxiety Inventory (BAI). There are four main components, broken down into several sub-components in details. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 29. The Cronbach's alpha of 0.995 indicates that the questionnaire is reliable. A system is developed using Visual Studio Code, written in Python language by implementing the I-AHP method to obtain the weight vector and level of inconsistency of the components. The results of this study indicates that Fear of worst happening, a sub-component from Fear as the most common component of anxiety among the undergraduate students with weight vector of 0.1161. All the consistency ratios are lesser than 0.1, proving the levels of inconsistency are acceptable.

OBJECTIVE

a) To demonstrate the Interval-Analytic Hierarchy Process (I-AHP) analysis using Python in VS Code.

b) To determine the most common component of anxiety among undergraduate students from FSSA in UMS.

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Eco Campus Mengubah Idea Menjadi Realiti

UMS KAMPUS RAHMAH TERAS KECEMERLANGAN DAN KEUNGGULAN

Transformation towards UNIVERSITY INDUSTRY 4.0

INTRODUCTION

Higher education is associated with higher levels of anxiety, depression, and stress (Salari, *et al.,* 2020). The need to enhance wellness among college students and to reduce reciprocal negative impacts on our community has become critical because it is important to treat mental health concerns among adolescents and young people, the future leaders of our society (Shek & Wong, 2011).

METHODOLOGY

1. HIERARCHY CONSTRUCTION

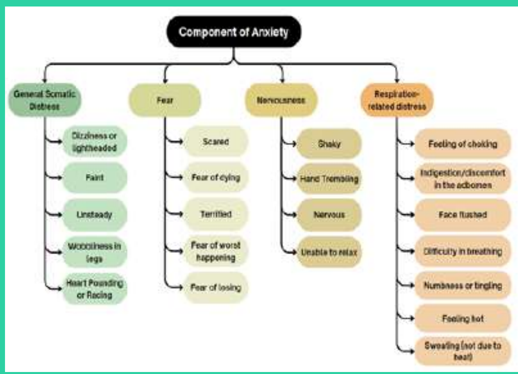


Figure 1. Hierarchy Model of Common Components of Anxiety.

2. INTERVAL PAIRWISE COMPARISON MATRICES CONSTRUCTION

$$A = \begin{bmatrix} [1,1] & [c_{12}^-, c_{12}^+] & \cdots & [c_{1n}^-, c_{1n}^+] \\ \left[\frac{1}{c_{12}^+}, \frac{1}{c_{12}^-}\right] & [1,1] & \cdots & [c_{2n}^-, c_{2n}^+] \\ \cdots & \cdots & & \\ \left[\frac{1}{c_{1n}^+}, \frac{1}{c_{1n}^-}\right] & \left[\frac{1}{c_{2n}^+}, \frac{1}{c_{2n}^-}\right] & \cdots & [1,1] \end{bmatrix} \quad (1)$$

where,

$$\frac{1}{9} \le c_{ij}^- \le c_{ij}^+ \le 9, \forall i = 1,2,\dots,n$$

$$and \;\; c_{ji} = \frac{1}{c_{ij}} > 0, \forall i = 1,2,\dots,n$$

$$A^- = (c_{ij}^-)_{nn} = \begin{bmatrix} 1 & c_{12}^- & \cdots & c_{1n}^- \\ \frac{1}{c_{12}^-} & 1 & \cdots & c_{2n}^- \\ \cdots & \cdots & \cdots & \cdots \\ \frac{1}{c_{1n}^-} & \frac{1}{c_{2n}^-} & \cdots & 1 \end{bmatrix} \quad (2)$$

$$A^+ = (c_{ij}^+)_{nn} = \begin{bmatrix} 1 & c_{12}^+ & \cdots & c_{1n}^+ \\ \frac{1}{c_{12}^+} & 1 & \cdots & c_{2n}^+ \\ \cdots & \cdots & \cdots & \cdots \\ \frac{1}{c_{1n}^+} & \frac{1}{c_{2n}^+} & \cdots & 1 \end{bmatrix} \quad (3)$$

3. CONSISTENCY CHECKING

A. Eigenvectors

$$\bar{w}_{bi}^- = \sqrt[n]{\prod_{j=1}^{n} c_{ij}^-} \quad (4)$$

$$\bar{w}_{bi}^+ = \sqrt[n]{\prod_{j=1}^{n} c_{ij}^+} \quad (5)$$

for $i, j = 1, 2, \dots, n.$ — feature vectors using Geometric Mean

$$w_{bi}^- = \frac{\bar{w}_{bi}^-}{\sum_{i=1}^{n} \bar{w}_{bi}^-} \quad (6)$$

$$w_{bi}^+ = \frac{\bar{w}_{bi}^+}{\sum_{i=1}^{n} \bar{w}_{bi}^+} \quad (7)$$

weight normalization

B. Maximum feature root

$$\lambda_{max}^- = \frac{1}{n}\sum_{i=1}^{n} \frac{(A^- w_b^-)_i}{w_{b\,i}^-} \quad (8)$$

$$\lambda_{max}^+ = \frac{1}{n}\sum_{i=1}^{n} \frac{(A^+ w_b^+)_i}{w_{b\,i}^+} \quad (9)$$

C. Consistency Ratio

$$CR^- = \frac{Consistency\ Index, CI^-}{Random\ Consistency\ Index, RI} \quad (10)$$

$$CR^+ = \frac{Consistency\ Index, CI^+}{Random\ Consistency\ Index, RI} \quad (11)$$

where,

supposed that n is the size of the comparison matrix, the consistency index, CI are given by,

$$CI^- = \frac{\lambda_{max}^- - n}{n-1} \quad (12)$$

$$CI^+ = \frac{\lambda_{max}^+ - n}{n-1} \quad (13)$$

The random consistency index, RI depicts the average ratio index of the judgment matrix using the formula,

$$RI = \frac{1.98(n-2)}{n} \quad (14)$$

CR<0.1, interval judgement matrices **CONSISTENT**

4. EVALUATION OF COMPONENTS' WEIGHTS

A. Components' basic weights

$$w_b = [w_{bL}, w_{bR}] = [\alpha w_b^-, \beta w_b^+] \quad (15)$$

where,

$$\alpha = \left[\sum_{j=1}^{n} \frac{1}{\sum_{i=1}^{n} c_{ij}^+}\right]^{\frac{1}{2}} \quad (16)$$

$$\beta = \left[\sum_{j=1}^{n} \frac{1}{\sum_{i=1}^{n} c_{ij}^-}\right]^{1/2} \quad (17)$$

B. Ranking the interval weights – Midpoints

- The midpoints of interval numbers are acquired to accomplish this objective (Qin, et al., 2022) to avoid further complex calculations in the final step of this study.

RESULT & DISCUSSION

From the final calculation of I-AHP for main and sub-components of anxiety, the most common component of anxiety disorder among FSSA undergraduate students in UMS is Fear: Fear of worst happening with the weight vector of 0.1161 as shown in Figure 7. This insight provides a clear focus for interventions and suggests that addressing anticipatory fears may be key in managing anxiety in this population.

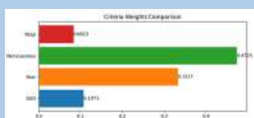


Figure 2. Histogram of weight vector of the main components of Anxiety.

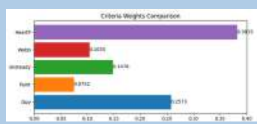


Figure 3. Histogram of weight vector of the sub-components of GSD.

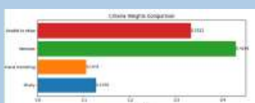


Figure 4. Histogram of weight vector of the sub-components of Nervousness.

Figure 5. Histogram of weight vector of the sub-components of Fear.

Figure 6. Histogram of weight vector of sub-components of Resp-related distress.

Figure 7. Final result - The most common component analyzed by the system.

CONCLUSION

The study conducted on undergraduate students from FSSA at UMS aimed to identify the most common component of Anxiety disorder. Employing the Interval-Analytic Hierarchy Process (I-AHP), the research utilized the Beck Anxiety Inventory to evaluate various components associated with Anxiety disorder. The execution of I-AHP throughout this study is successfully conducted using Visual Studio Code, written in Python language. The consistency test reveals that the interval pairwise comparison matrices for all components are consistent. The noteworthy finding of the study indicates that the Fear subcategory: Fear of worst happening, emerged as the most prevalent component among the surveyed undergraduate students.

Acknowledgement

This achievement stands as a testament to the profound impact of those who have believed in and supported this academic voyage.

UMS UNIVERSITI MALAYSIA SABAH

PENDEKATAN SET NEUTROSOFIK KE ATAS IMEJ SINAR-X UNTUK JANGKITAN PNEUMONIA

FATIHAH NURELIA BINTI MOHD BAHARUDIN & DR. SUZELAWATI ZENIAN

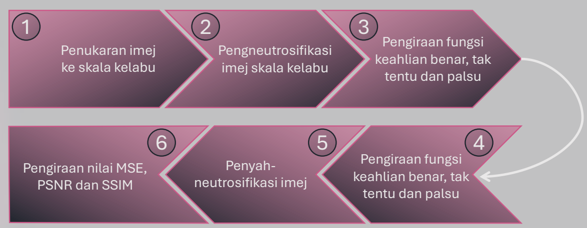
FAKULTI SAINS DAN SUMBER ALAM, UNIVERSITI MALAYSIA SABAH, 88999, KOTA KINABALU, SABAH, MALAYSIA

MCG Mathematics Computer Graphics Universiti Malaysia Sabah

ABSTRAK

Pneumonia adalah jangkitan paru-paru yang boleh disebabkan oleh bakteria, virus, atau kulat. Sukar untuk mendiagnosis radang paru-paru dari imej X-ray dada adalah hingar, kontras rendah atau samar-samar. Dalam projek, kaedah baru meningkatkan kualiti imej sinar-X dengan membandingkan setiap fungsi keahlian dan membandingkan setiap fungsi keahlian ke imej sinar-X. Kaedah ini dapat meningkatkan kualiti imej sinar-X dengan baik dan menghasilkan imej yang lebih jelas dan tinggi.

METODOLOGI

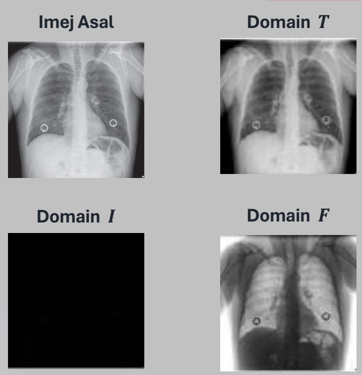


PENGENALAN

Sinar-X dada dan penambahbaikan imej dalam bidang perubatan.

- Sinar-X dada ialah alat diagnostik yang penting kerana keupayaannya untuk memberikan pandangan terperinci tentang struktur organ manusia.
- Kekaburan dan ketidaktepatan maklumat dalam imej sinar-X menyukarkan pembahagian dan pengelasan.
- Set kabur digunakan untuk mengurangkan kekaburan imej dan ketidakpastian, mengekalkan maklumat yang penting.
- Set Neutrosofik menggunakan rangkaian saraf untuk mengurangkan kekaburan dan mengekalkan maklumat penting untuk pengekstrakan ciri dalam jangkitan paru-paru.

HASIL KAJIAN

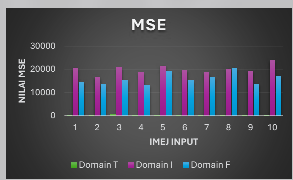


Teknik domain T menunjukkan peningkatan yang lebih baik berbanding teknik domain I dan domain F apabila dibandingkan dengan imej asal. Imej output bagi teknik domain T menunjukkan persamaan yang ketara dengan imej asal berbanding teknik domain I dan domain F.

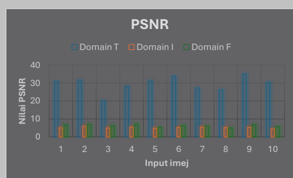
OBJEKTIF

- Mengaplikasikan kaedah set neutrosofik ke atas imej radiologi sinar-X dada yang dijangkiti pneumonia.
- Membuat perbandingan kualiti imej output yang menggunakan tiga fungsi keahlian iaitu kebenaran (domain T), ketidakpastian (domain I) dan kepalsuan (domain F) dalam penambahbaikan kontras imej dengan menggunakan penilaian kualiti imej seperti min ralat kuasa dua (MSE), nisbah isyarat-ke-hingar puncak (PSNR) dan sukatan keserupaan indeks (SSIM).

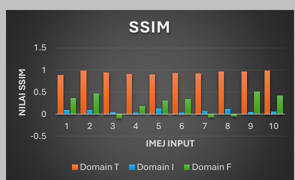
ANALISIS DAN PERBINCANGAN



Dari graf MSE ini menunjukkan hasil imej menggunakan domain T mempunyai nilai MSE yang paling rendah.



Dari graf PSNR ini menunjukkan hasil imej menggunakan domain T mempunyai nilai PSNR yang paling tinggi.



Dari graf SSIM ini menunjukkan hasil imej menggunakan domain T mempunyai nilai SSIM yang paling hampir dengan 1.

KESIMPULAN

Kesimpulannya, keputusan eksperimen ini telah menunjukkan bahawa strategi yang dicadangkan, iaitu set *neutrosophic* dengan tiga keahlian, lebih berjaya dalam meningkatkan kualiti imej. Penemuan perbahasan dan analisis untuk setiap strategi ini telah dibincangkan secara meluas. Penilaian kualiti imej atau penanda aras seperti MSE, PSNR dan SSIM telah digunakan untuk menentukan pendekatan optimum berdasarkan 10 imej X-ray. Berdasarkan pemeriksaan, pendekatan domain T lebih sesuai untuk meningkatkan imej X-ray radang paru-paru dan menghasilkan imej output yang lebih terang sambil mengekalkan butiran imej atau aspek kritikal.

PENGHARGAAN

Saya ingin mengucapkan terima kasih kepada penyelia saya, Dr. Suzelawati Zenian, atas kesediaannya untuk berkongsi pengetahuannya dan Dr. Rozaimi Zakaria untuk membaca dan menilai disertasi saya, dan kepada semua kuliah dalam program Matematik dengan Grafik Komputer yang menyampaikan pengetahuan dan kemahiran.

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SW40106 SAINTIFIK PFOJEK II
MATEMATIK DENGAN GRAFIK BERKOMPUTER

UMS
UNIVERSITI MALAYSIA SABAH

MCG
Mathematics Computer Graphics
UNIVERSITI MALAYSIA SABAH

Penjadualan Tugas Pegawai Peronda di Balai Polis Sook Daerah Keningau, Sabah Menggunakan Kaedah Pengaturcaraan Integer

Fleyziana Jack & Asdalifah Binti Talibe
Mathematics Visualization Research Group (MathViz)
Program Matematik Dengan Grafik Berkomputer
Fakulti Sains dan Sumber Alam,
Universiti Malaysia Sabah, Jln UMS, 88400 Kota Kinabalu, Sabah
fleyziana_jack_bs20@iluv.ums.edu.my & asdalifah@ums.edu.my

ABSTRAK

Kajian ini bertujuan membina jadual bagi pegawai polis peronda menggunakan kaedah Pengaturcaraan Integer di Balai Polis Sook, Keningau. Model ini dibina untuk 13 pegawai polis peronda untuk tempoh 28 hari. Model yang dibina menggunakan perisian LINGO 18.0 dan dieksport ke Microsoft Excel untuk membentuk jadual bertugas. Kaedah Pengaturcaraan Integer dapat memastikan penjadualan yang adil, cekap dan sistematik kerana ia dapat mematuhi peraturan dan objektif yang diberikan oleh pihak pengurusan balai polis.

PENGENALAN

Penjaduálan jadual kerja amat menyukarkan untuk dibina, lebih-lebih lagi apabila jadual yang dibina adalah secara manual kerana pihak pengurusan yang bertanggungjawab untuk membina jadual tersebut perlu melakukan pembahagian tugas bagi setiap pekerja mengikut syif, mengambil kira bilangan pekerja yang ada dengan teliti dan keperluan lain agar setiap pekerja mendapatkan jadual bertugas yang sama rata. Dalam penjadualan tugas, model Pengaturcaraan Integer merupakan salah satu kaedah matematik yang boleh digunakan bagi menghasilkan penjadualan tugas bagi pekerja yang lebih adil dan sistematik. Oleh itu, kajian ini bertujuan membina jadual bertugas bagi pegawai polis peronda di Balai Polis Sook, Keningau dengan menggunakan kaedah Pengaturcaraan Integer.

OBJEKTIF

1. Membina jadual bertugas polis peronda menggunakan model Pengaturcaraan Integer.
2. Membina Model Pengaturcaraan Integer bagi penjadualan tugas pegawai polis peronda di Balai Polis Sook, Keningau berdasarkan keperluan pegawai polis peronda.

METODOLOGI

- Langkah-langkah umum dalam menyelesaikan model Pengaturcaraan Integer (Taha, 2017) :
  1. Gantikan pemboleh ubah binari kepada nombor integer.
  2. Selesaikan Pengaturcaraan Integer dan kenal pasti nilai optimum.
  3. Dari titik optimum tambahkan kekangan sehingga menghasilkan titik optimum yang memenuhi keperluan integer.
- Model Pengaturcaraan integer secara umum (Chen *et al.*, 2011) dapat dinyatakan seperti berikut:

Maksimum atau Minimum:

$$Z = \sum_{j=1}^{n} C_j X_j \qquad (3.1)$$

Subjek kepada,

$$\sum_{j=1}^{n} a_j X_j \begin{bmatrix} \leq \\ = \\ \geq \end{bmatrix} b \qquad (3.2)$$

$X_j \geq 0$ dan integer untuk $j = 1, 2, \ldots, n$

dengan pembolehubah:

Z = fungsi objektif
X_j = pembolehubah Keputusan
C_j = pekali bagi fungsi objektif
a_j = pekali bagi fungsi kekangan
b = nilai sebelah kanan

- Model Pengaturcaraan Integer bagi penjadualan tugas pegawai polis peronda di Balai Polis Sook Keningau adalah seperti berikut:

Meminimumkan $Z = \sum_{j=1}^{m} \sum_{i=1}^{n} (A_{ij} + B_{i,j} + C_{i,j}) \qquad (3.3)$

Subjek kepada,

$$\sum_{j=1}^{m} A_{i,j} \geq 3 \qquad (3.4)$$
$$\sum_{j=1}^{m} B_{i,j} \geq 3 \qquad (3.5)$$
$$\sum_{j=1}^{m} C_{i,j} \geq 3 \qquad (3.6)$$
$$\sum_{j=1}^{m} A_{i,j} \geq 4 \qquad (3.7)$$
$$\sum_{j=1}^{m} B_{i,j} \geq 4 \qquad (3.8)$$
$$\sum_{j=1}^{m} C_{i,j} \geq 4 \qquad (3.9)$$
$$C_{i,j} + A_{i,j} \leq 1 \qquad (3.10)$$
$$A_{i,j} + B_{i,j} + C_{i,j} + H_{i,j} = 1 \qquad (3.11)$$
$$\sum_{i=1}^{n} A_{i,j} = 8 \qquad (3.12)$$
$$\sum_{i=1}^{n} B_{i,j} = 8 \qquad (3.13)$$
$$\sum_{i=1}^{n} C_{i,j} = 8 \qquad (3.14)$$
$$H_{i,j} + H_{i+1,j} + H_{i+2,j} + H_{i+3,j} + H_{i+4,j} + H_{i+5,j} + H_{i+6,j} = 1 \qquad (3.15)$$
$$\sum_{j=1}^{n} H_{i,j} = 4 \qquad (3.16)$$
$$H_{i,j} + H_{i+1,j} \leq 1 \qquad (3.17)$$
$$H_{i,j} + H_{i-27,j} \leq 1 \qquad (3.18)$$
$$\sum_{i=1}^{n} A_{i,j} + B_{i,j} + C_{i,j} = 24 \qquad (3.19)$$
$$A_{i,j} + A_{i+1,j} \leq 1 \qquad (3.20)$$
$$B_{i,j} + B_{i+1,j} \leq 1 \qquad (3.21)$$
$$C_{i,j} + C_{i+1,j} \leq 1 \qquad (3.22)$$
$$H_{i,j} + A_{i+1,j} + B_{i+1,j} + C_{i+3,j} + H_{i+2,j} \leq 2 \qquad (3.23)$$
$$A_{i,j} + A_{i+1,j} + A_{i+2,j} + A_{i+3,j} + A_{i+4,j} + A_{i+5,j} + A_{i+6,j} + B_{i,j} + B_{i+1,j} + B_{i+2,j} + B_{i+3,j} + B_{i+4,j} + B_{i+5,j} + B_{i+6,j} + C_{i,j} + C_{i+1,j} + C_{i+2,j} + C_{i+3,j} + C_{i+4,j} + C_{i+5,j} + C_{i+6,j} \leq 6 \qquad (3.24)$$

Dengan
$i = 1,2, \ldots, n$ dan $j = 1,2, \ldots, m$

Pembolehubah
A = Syif pagi, B = Syif Petang
C = Syif malam, H = Cuti

Tatanda
i = Indeks untuk hari ($n = 28$ hari)
j = Indeks untuk polis peronda ($m = 13$)
n = Bilangan hari bertugas
m = Bilangan polis peronda

HASIL DAN PERBINCANGAN

Jadual 1: Jadual yang dibina menggunakan kaedah Pengaturcaraan Integer

Berdasarkan jadual di atas, jadual yang dihasilkan menunjukkan bahawa semua kekangan yang dinyatakan dapat dicapai, kerana:

- Setiap pegawai polis peronda bertugas satu syif sehari.
- Minimum 3 pegawai polis peronda dan maksimum 4 pegawai polis peronda yang bertugas setiap syif.
- Setiap pegawai polis peronda mendapat satu hari cuti pada setiap minggu.
- Jumlah cuti bagi setiap pegawai polis peronda adalah 4 hari untuk tempoh 28 hari.

Jadual 2: Perbandingan antara jadual

Kaedah Manual	Kaedah Pengaturcaraan Integer
Jumlah syif bertugas bagi pegawai polis peronda berbeza-beza	Setiap pegawai mempunyai jumlah syif yang bertugas iaitu sebanyak 24 syif.
Jadual hanya kegunaan untuk satu hingga tiga hari sahaja.	Jadual adalah kegunaan untuk tempoh satu bulan iaitu 28 hari.

KESIMPULAN

Kesimpulannya, kedua-dua objektif yang dinyatakan dalam kajian ini dapat dicapai dan melalui kajian ini dapat menunjukkan bahawa penggunaan Pengaturcaraan Integer dapat menyelesaikan penjadualan tugas untuk pegawai polis peronda kerana ia dapat mengagihkan tugas yang lebih adil dan teratur untuk setiap pegawai polis peronda. Hasil penyelesaian juga menunjukkan bahawa setiap peraturan dan kekangan yang ditetapkan dapat dipenuhi. Kajian ini juga dapat membuktikan keberkesanan model Pengaturcaraan Integer untuk mencari hasil penyelesaian yang lebih optimum yang memenuhi keperluan pegawai polis peronda di Balai Polis Sook, Keningau.

PENGHARGAAN

Saya ingin mengucapkan terima kasih yang tidak terhingga kepada Puan Asdalifah Binti Talibe, penyelia saya atas bimbingan, tunjuk ajar dan dorongan dari awal sehingga akhir projek ini. Saya juga ingin mengucapkan terima kasih kepada keluarga saya atas semangat dan motivasi yang diberikan begitu juga dengan rakan-rakan seperjuangan terima kasih atas tunjuk ajar yang diberikan. Setinggi-tinggi penghargaan juga kepada ketua Balai Polis Sook yang sudi memberikan saya data dan maklumat untuk kajian ini.

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UMS UNIVERSITI MALAYSIA SABAH

MCG Mathematics Computer Graphics

UNDERWATER IMAGE QUALITY ENHANCEMENT THROUGH SWARM INTELLIGENCE BASED MEAN EQUALIZATION AND DEHAZING

GEROLNISHA ANAK KENDY & ABDULLAH BADE
MATHEMATICS VISUALIZATION RESEARCH GROUP (MATHVIZ)
MATHEMATICS COMPUTER GRAPHICS PROGRAMME
FACULTY OF SCIENCE AND NATURAL RESOURCES, UNIVERSITI MALAYSIA SABAH
gerolnisha_bs20@iluv.ums.edu.my & abb@ums.edu.my

ABSTRACT

Underwater photography is crucial for studying marine life and surveillance, but it often faces challenges like color cast and low contrast. An innovative system is introduced to tackle these challenges, using a sequential combination of techniques, including color enhancement, image fusion, swarm intelligence algorithm and dehazing. Collectively, these methods enhance image color, contrast, clarity, and preserve details. Experimental results show a consistent and significant improvement in various quality metrics, surpassing individual techniques. Visual comparisons confirm that the proposed method produces visually appealing outputs with balanced colors, enhanced contrast, and reduced haze, making valuable contributions to underwater photography.

INTRODUCTION

Underwater imaging is essential for coastal border security, fish farming, and deep-sea exploration applications. However, challenges like light attenuation and scattering in water lead to poor visibility and image quality. This impacts scientific research and industrial applications, necessitating accurate enhancement techniques. Underwater image enhancement involves color correction, contrast enhancement, and noise reduction, while restoration includes dehazing methods like Fusion-based, Multi-scale fusion, and Prior-based techniques. Swarm Intelligence (SI) algorithms, such as Particle Swarm Optimization (PSO), optimize enhancement parameters. The introduced method incorporates an inferior color enhancement based on gain factors, dual-intensity image fusion, swarm intelligence-based mean equalization, and a dehazing algorithm via boundary constraint and contextual regularization. A thorough comparison of the enhanced image using the proposed method with 25 raw underwater images has been provided based on average gradient, entropy, PCQI, UIQM, and UCIQE.

OBJECTIVES

1. To compensate for the color cast in underwater images using inferior color enhancement based on gain factors.
2. To apply a swarm-intelligence algorithm based on the mean equalization method for maximizing the performance of underwater image enhancement to achieve high-quality results.
3. To enhance underwater images through dehazing using Boundary Constraint and Contextual Regularization.

METHODOLOGY

Step 1: Enhancement of Inferior Color Channels (EICC)

- Divide RGB image into red, green, and blue channels.
- Classify channels as superior or inferior based on total pixel intensity.
- Compute J and K gain factors

$$J = \frac{sum(P_{max}) - sum(P_{int})}{sum(P_{max}) + sum(P_{int})}$$

$$K = \frac{sum(P_{max}) - sum(P_{min})}{sum(P_{max}) + sum(P_{min})}$$

- Compensate inferior color channels at each pixel position.

$$P_{int}(x) = P_{int}(x) + (J \times P_{max}(x))$$

$$P_{min}(x) = P_{min}(x) + (K \times P_{max}(x))$$

Step 2: Dual - Intensity Image Fusion (DIIF)

- For each image histogram:
  - Find the minimum, maximum, mean, and median values
  - Find the average point between the mean and median values

$$Average\ Point = \frac{mean(P) + median(P)}{2}$$

- Divide into lower-stretched region and upper-stretched region.

$$P_{out} = (P_{in} - i_{min})\left(\frac{o_{max} - o_{min}}{i_{max} - i_{min}}\right) + o_{min}$$

- Combine all upper-stretched histograms to create new image (same for lower-)
- Blend the dual-intensity images.

Step 3: Swarm-Intelligence based Mean Equalization (SIME)

- Apply gamma correction.
- Initialize population and variables.
- Establish objective functions.
- In each iteration for each particle :
  - Update personal best and global best.

$$v_i^t = \omega^t v_i^t + c_1 rand(p_{best} - x_i^t) + c_2 rand(g_{best} - x_i^t)$$

  - Update velocity and position

$$x_i^t = x_i^t + v_i^t$$

- Check convergence
- Iterate until the stopping condition is met. (max iteration = 100).

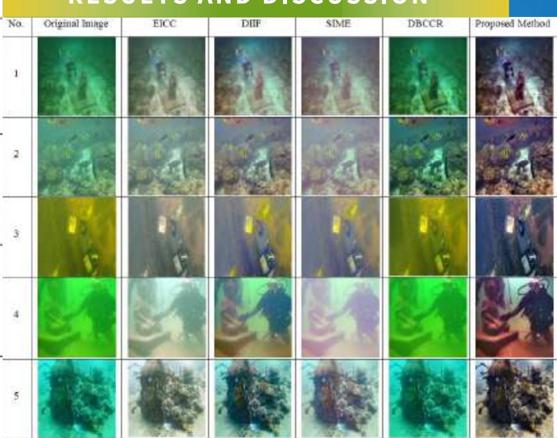
Step 4: Dehazing using Boundary Constraint and Contextual Regularization (DBCCR)

- Boundary Constraint:
  - Recover clean pixel using linear extrapolation
  - Derive patch-wise transmission
- Contextual Regularization:
  - Construct weighting functions
  - Apply to constraints
- Scene Transmission Estimation:
  - Estimate a suitable transmission function, t(x) and the global atmospheric light, A
- Recover Scene Radiance :

$$J(x) = \frac{I(x) - A}{[max(t(x)), \epsilon]^{\delta}} + A$$

RESULTS AND DISCUSSION

Image	Method	Quantitative analysis				
		Entropy	Average Gradient	PCQI	UIQM	UCIQE
Test Image 1	Original Image	25.3429	6.7881	0.9222	1.3552	56.3721
	EICC	31.3399	6.9894	1.0222	1.5166	57.5895
	DIIF	40.6049	7.3367	1.2659	1.5561	68.7420
	SIME	26.2466	6.7946	0.9256	1.4293	55.7148
	DBCCR	34.3190	6.7591	1.1086	1.3096	56.4215
	Proposed Method	**64.1999**	**7.4614**	**1.6019**	**1.5820**	**75.3310**
Test Image 2	Original Image	37.5987	6.2465	1.1136	1.4826	46.3129
	EICC	42.4212	6.3542	1.1585	1.4395	46.5467
	DIIF	49.7388	6.6034	1.2797	1.4717	51.0485
	SIME	33.7582	6.1787	1.0789	1.3097	45.6851
	DBCCR	62.3125	6.8360	1.4167	1.4911	58.6126
	Proposed Method	**79.9747**	**7.1038**	**1.5384**	**1.5537**	**63.9969**
Test Image 3	Original Image	17.6984	5.9599	0.5020	0.6914	43.2650
	EICC	21.6017	6.3585	0.5942	0.9568	46.4126
	DIIF	35.3717	6.2458	0.8862	0.9805	50.6485
	SIME	25.8064	5.9270	0.6417	0.9713	45.5950
	DBCCR	18.1656	6.0619	0.5154	0.7144	44.8673
	Proposed Method	**39.1930**	**6.6022**	**0.9517**	**1.2704**	**55.4735**
Test Image 4	Original Image	14.3528	6.3617	0.4816	1.0057	52.0180
	EICC	18.7588	6.7853	0.6120	1.2619	54.6411
	DIIF	26.0246	6.9841	0.7519	1.4134	67.9274
	SIME	12.4447	6.2917	0.4644	1.0600	52.4439
	DBCCR	16.2398	6.2797	0.5279	1.0029	52.0246
	Proposed method	**39.6174**	**7.1640**	**1.0258**	**1.6026**	**78.4540**
Test Image 5	Original Image	63.0150	7.4199	1.5796	0.9588	80.7421
	EICC	81.7691	7.5784	1.6324	1.6836	79.1357
	DIIF	96.7887	7.6219	1.6791	1.1161	86.2968
	SIME	92.4150	7.4424	1.7291	1.1298	79.1321
	DBCCR	63.9908	7.4173	1.5966	0.9323	80.1807
	Proposed Method	**121.8945**	**7.7121**	**1.7860**	**1.7002**	**89.6041**



- **Average gradient**: average increase of **125.36%.**
  - Significant increase in detail edges and sharpness.
- **Entropy**: average increase of **11.41%.**
  - The image's information content has increased complexity, texture, and pronounced features.
- **PCQI**: average increase of **52.91%.**
  - Increase in contrast quality.
- **UIQM**: average increase of **28.58%**
  - Increased in overall color, sharpness, and contrast quality.
- **UCIQE**: average increase of **36.73%.**
  - The image's color is more balanced and reduced in color cast.

- **EICC:** Reduce color cast
- **DIIF:** Improve image contrast and clarity
- **SIME:** Improve image contrast and naturalness
- **DBCCR:** Reduce haze effect /enhance visibility
- **Proposed (Combined) Method:** Improve in color quality, contrast, clarity and reduce haze

CONCLUSION

The combined approach significantly enhances the image's contrast, reduces color cast and haze, and improves detail clarity. Metrics like average gradient, entropy, PCQI, UIQM, and UCIQE confirm notable improvements across all test images. The use of advanced Particle Swarm Optimization for this project affirms a substantial boost in image quality. However, the computational demands of the comprehensive approach, especially the detailed optimization process, may slow down processing and increase system complexity. Therefore, there is always room for future improvement in making this system perform more efficiently and accurately to get the best possible output and solution to the complex problem.

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SW40106 SCIENTIFIC PROJECT II | MATHEMATICS WITH COMPUTER GRAPHICS

A COLOR IMAGE ENCRYPTION AND DECRYPTION SCHEME BASED ON 3D LORENZ CHAOTIC MAP AND 3D CHEN SYSTEM

Irene Lim Jin Ying[1] & Arif Mandangan[2]
Mathematics Visualization Research Group (MathViz)
Mathematics Computer Graphics Programme
Faculty of Science and Natural Resources
Universiti Malaysia Sabah, Malaysia
[1] irene_lim_bs20@iluv.ums.edu.my, [2] arifman@ums.edu.my

Abstract

Chaos-based image encryption system is an encryption method that uses chaotic systems in encrypting digital images for the purpose of enhancing security. An encryption method that applies the concept of chaotic systems will contribute to creating a complex relationship between the original and encrypted images, making it challenging for unauthorized individuals to extract the original content of the image without the appropriate decryption key. In this study, Lorenz and Chen chaotic maps are applied to generate random cryptographic keys for encrypting color images using permutation and diffusion mechanisms. The results prove that the proposed system is an effective encryption system that achieves excellent results in security.

Introduction

Chaos theory exhibits some distinctive characteristics, which include butterfly-like patterns, unpredictable behavior, and sensitive dependence to initial conditions. It is significant to be applied to an image encryption algorithm to increase the complexity and randomness of the system. However, it was found that encryption methods that using only a single chaotic map or low dimensionality chaotic system are not sufficient to provide high security in securing the privacy and secrecy of image data, despite its implementation being much simpler and uncomplicated.

Objectives

1. To develop chaotic-based encryption and decryption algorithms for color images by using the Lorenz chaotic map and Chen system.
2. To test the feasibility of the developed algorithm for encrypting and decrypting color images.
3. To analyze the security of the developed algorithm by comparing its security with existing image encryption algorithm based on a single three-dimensional chaotic map.

Methodology

Generation of Lorenz chaotic sequences:

$$\frac{dx}{dt} = 10y - 10x$$

$$\frac{dy}{dt} = 28x - y - xz$$

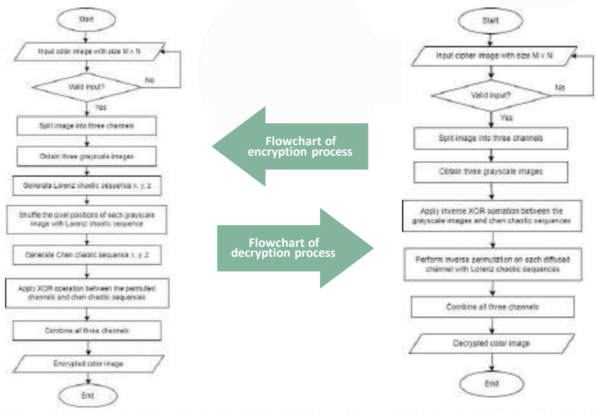
$$\frac{dz}{dt} = xy - \frac{8}{3}z$$

Generation of Chen chaotic sequences:

$$\frac{dx}{dt} = 35y - 35x$$

$$\frac{dy}{dt} = -7x + 28y - xz$$

$$\frac{dz}{dt} = xy - 3z$$



Acknowledgement

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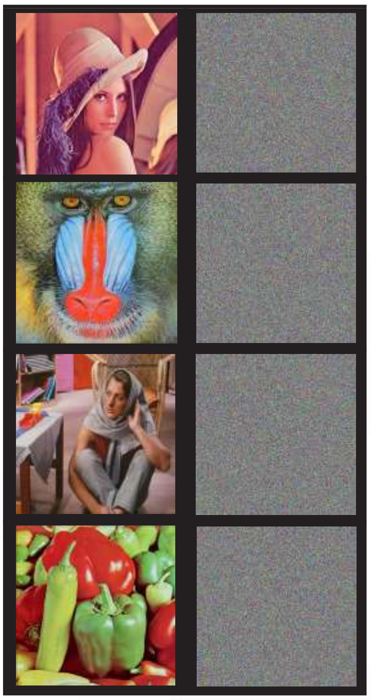
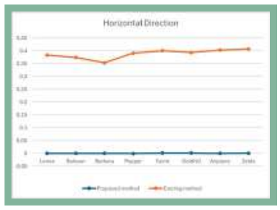
Result and Discussion

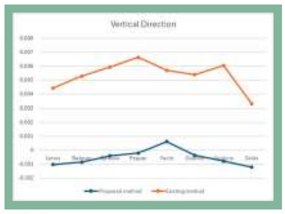
Input Image | Output Image



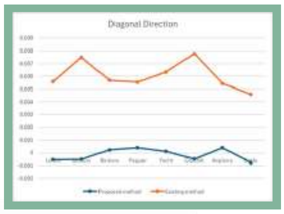
Original input images and their encrypted output images



Correlation coefficient in horizontal direction



Correlation coefficient in vertical direction



Correlation coefficient in diagonal direction

- Differential attack analysis - NPCR and UACI tests achieve the ideal theoretical values (99% and 33.33%)
- Information entropy analysis - Entropy tests achieve the ideal entropy values which are closer to 8
- Correlation coefficient analysis - The correlation coefficients of the proposed method are lower as compared to the correlation coefficients achieved by the existing algorithm.

Contribution

- Information security - It adds a layer of defense and contributes to information security as it helps protect image data from various cyber threats including unauthorized access, man-in-the-middle attacks, and data breaches.
- Image processing - It deals with image processing where the quality of encrypted image data needs to be enhanced to give the most ideal and secure final encrypted image.

Conclusion

In this study, 3D Lorenz and Chen chaotic systems are applied to generate random cryptographic keys to shuffle the image information. It can be seen from the results that the enhanced system is more secure than the existing system that uses only a single chaotic map, especially from correlation coefficient analysis that shows low linear relationships between adjacent pixels. In conclusion, the proposed system is proven to be an effective encryption algorithm that has higher robustness in resisting cryptanalysis attacks.

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UMS UNIVERSITI MALAYSIA SABAH

REAL-TIME STRAND-BASED HAIR RENDERING USING GUIDE HAIR INTERPOLATION AND DEPTH PEELING

MCG Mathematics Computer Graphics

Jonathan Liew Eu Jin & Rechard Lee
Mathematics Visualization Research Group (MathVis), Mathematics Computer Graphics Programme,
Faculty Of Science And Natural Resources, Universiti Malaysia Sabah
jonathan_liew_bs20@iluv.ums.edu.my & rechard@ums.edu.my

ABSTRACT

Hair is an important element in CGI and digital animation. However, it has been proven to be challenging to simulate hair properties when rendering hair. Lighting model that accounts for more than one light scattering direction renders physically-based hair strands in terms of visual appearance at the cost of performance, while overlapping hair strands produce incorrect occlusion when accounting for hair transparency. In this project, these challenges will be tackled.

INTRODUCTION

Lighting model that accounts for more than one light scattering direction produces a more physically accurate representation hair model but takes a long time to render. The next challenge is sorting the hair strands based on their depth values alone results in renders with incorrect occlusion as strands are highly overlapping. Thus, techniques are required to improve the hair rendering performance and sort the hair strands using order-independent transparency technique when accounting for hair transparency.

OBJECTIVES

- To render hair geometry in real-time using guide hair interpolation.
- To adapt order-independent transparency for correct occlusion of hair strands using depth peeling.

METHODOLOGY

RESULTS AND DISCUSSION

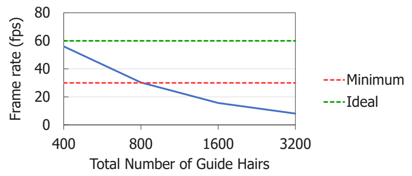

Figure 1 Rendering performance with increasing number of guide hairs used. Total number of hair strands are kept constant at 25600 strands.

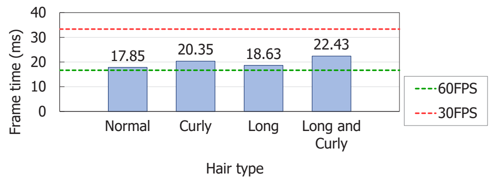

Figure 2 Average frame times of different hair type setups. Total number of hair strands are kept constant at 25600 strands.

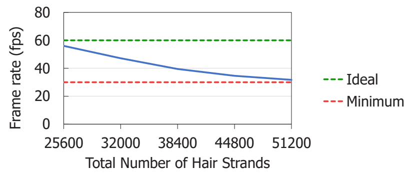

Figure 3 Rendering performance with increasing total number of hair strands used. Total number of strands per guide patch are kept constant at 64 strands.

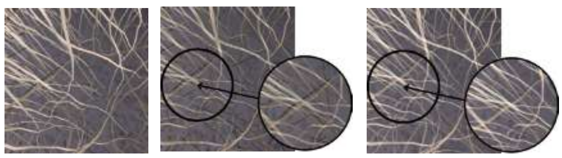

Figure 4 Zoomed in frame of rendered hairball model using without transparency (left), alpha blending (middle) and depth-peeling transparency (right).

CONCLUSION

- Tests carried out have shown both objectives of this project were achieved.
- Implementation of hair interpolation when rendering hair geometry achieved real-time performance.
- Depth peeling has allowed hair models to be rendered with correct occlusion.

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SW40106 PROJEK SAINTIFIK II
MATHEMATICS WITH COMPUTER GRAPHICS

Transformation towards UNIVERSITY INDUSTRY 4.0

Eco Campus

Segmentation of Lung Cancer Using Varies Types of Fuzzy C-Means Clustering in CT-scan images

Kam Siau Pey[1] & Suzelawati Zenian[2]
Mathematics Visualization Research Group (MathViz)
Mathematics Computer Graphics Programme
Faculty of Science and Natural Resources
Universiti Malaysia Sabah, Malaysia
[1] kam_siau_bs20@iluv.ums.edu.my, [2] suzela@ums.edu.my

ABSTRACT

Image segmentation is a widely used method in digital image processing. Applying image segmentation in medical imaging such as CT-scan images can help to extract the information. This paper presents the image segmentation technique which uses different types of fuzzy c-mean clustering in CT-scan images. The objective of this paper is to apply the techniques and compare the performance of the three methods in the same CT-scan dataset images. The results by using each method are evaluated with partition coefficient and dice similarity index. Based on the results by comparing the methods used, fuzzy c-mean clustering with cooperation center performs better compared to classical fuzzy c-mean clustering and type-II fuzzy c-mean clustering.

INTRODUCTION

Fuzzy image processing is a method that is known as a new type of computer vision technique. It is different from classical digital image processing as it has a new methodology, logic, and computer vision tool. In fuzzy image processing, the input image needs to be fuzzification, then the fuzzy techniques, and lastly defuzzification to produce the output. Image segmentation is widely used to divide the image into various portions or areas, based on the properties of the image pixels. There are four main classes of image segmentation in fuzzy which are clustering, thresholding, rule-based, and supervised. Image segmentation plays an important role in medical image processing to detect cancer cells. CT-scan is used to diagnose tumors and cancers in the lungs. The similar intensity of the gray level and the presence of noise in CT-scan images are the main issues that increase the difficulty for doctors and clinicians to detect the region of cancer cells and tumors.

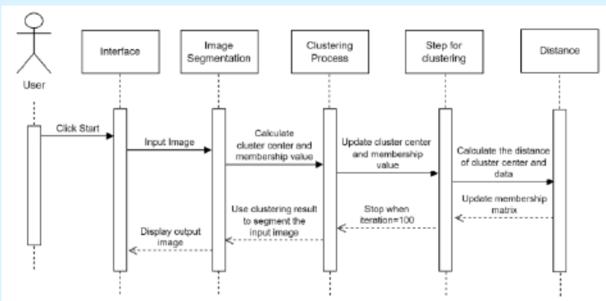
OBJECTIVES

1) To apply the classical fuzzy c-mean clustering, type-II fuzzy c-means clustering, and improved fuzzy c-means clustering in the segmentation lung CT-scan images.

2) To compare the results when applying classical fuzzy c-means clustering and type-II fuzzy c-means clustering in lung CT-scan images with the presence of noise.

3) To compare the results when applying classical fuzzy c-means clustering and improved fuzzy c-means clustering algorithm in lung CT-scan images.

METHODOLOGY



The sequnce diagram illustrates how the objects interact by exchanging messages in a function over time

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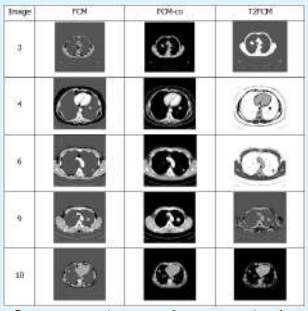
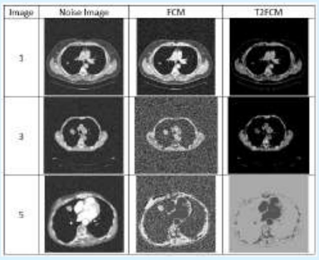
RESULT AND DISCUSSION

- The performance test is carried out in this experiment to validate the performance of the segmentation.
- The partition coefficient is under the clustering indices, closer the finest value, 1, the better the segmentation effect.



Some output images of segmentation by using FCM, FCM-co, and T2FCM

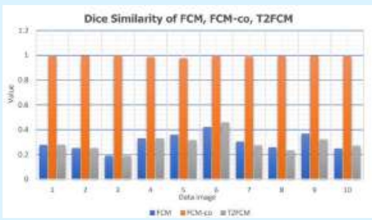
Graph representation of the partition coefficient between FCM, FCM-co and T2FCM based on the clustering result



Some output results by applying m = 0.20 of Gaussian noise and segmentation by using FCM and T2FCM

Graph representation of the partition coefficient between FCM and T2FCM with the presence of noise

- The use of a similarity test is to measure the similarity of the output image with the input image.
- The ideal value of the dice similarity index is 1.



Graph representation of the Dice similarity index based on the segmented result

CONCLUSION

This project discussed the application of fuzzy clustering techniques on lung CT-scan images to detect the cancer area. The fuzzy clustering techniques used in this project are FCM, FCM-co, and T2FCM. The application of these methods can observe the cancer area more clearly. Due to the first application of FCM-co and T2FCM on medical imaging for clustering, the resources found on the Internet are limited. In this project, the results show that **FCM-co** is the better fuzzy clustering method used to segment lung CT-scan images, followed by FCM and T2FCM. Unfortunately, based on the experiment carried out, the T2FCM did not produce a better segmentation effect when clustering the lung CT-scan images although it is an advanced fuzzy technique.

ACKNOWLEDGEMENT

I would like to thank my supervisor, Dr. Suzelawati Zenian for allowing me to complete the project under her supervision and willing to share her expertise with me when completing the dissertation. Next, I would like to express my gratitude to my examiner, Dr. Rozaimi Zakaria and all the lecturers of Mathematics Computer Graphics program.

SW40106 SCIENTIFIC PROJECT II

PENAMBAHBAIKAN IMEJ DALAM AIR MENGGUNAKAN GRAY SCALE REFERENCE DAN MIXTURE CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZATION

Kenny Charlman bin Piel[1] & Prof. Madya Dr. Abdullah Bade[2]

Fakulti Sains dan Sumber Alam, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah.

Kenny_charlman_bs20@iluv.ums.edu.my[1], abb@ums.edu.my[2]

ABSTRAK

Imej dalam air memainkan peranan yang penting sebagai bahan visualisasi pada persekitaran dalam air. Imej dalam air seringkali memberikan cabaran kepada jurugambar dan penyelidik dengan isu-isu seperti kehilangan warna, ketidakseimbangan warna, dan rendahnya kontras. Dalam menangani cabaran ini, kajian ini memfokuskan pada pengenalan kaedah dan teknik yang efektif untuk memulihkan warna, mengimbangi ketidakseimbangan warna, dan meningkatkan kontras secara efektif dalam konteks imej dalam air.

PENGENALAN

Kehidupan yang terdapat di dalam air merupakan sebuah alam kehidupan yang indah dan kaya dengan pelbagai spesies floara dan fauna. Imej atau video bawah air sering kali ditangkap dalam keadaan pencahayaan yang tidak menentu dan tidak terkawal. Oleh itu, pemprosesan imej diperlukan untuk menambah baik imej dalam air. Penambahbaikan imej merupakan proses penting dalam pemprosesan imej digital yang bertujuan untuk meningkatkan kualiti, kejelasan, dan penampilan visual sesuatu imej. Kepentingan penambahbaikan imej dalam air terletak pada keupayaannya untuk memberikan info dan maklumat daripada imej yang mungkin dalam keadaan samar-samar atau sukar dikenal pasti dalam bentuk asalnya.

OBJEKTIF

- Menyingkirkan warna berlebihan dan mengembalikan warna yang hilang pada imej dalam air.
- Mengimbangkan warna pada imej dalam air.
- Meningkatkan kontras dan keperincian imej dalam air.

KESIMPULAN

Hasil output adalah memuaskan dengan warna output imej yang lebih natural dan objek pada imej kelihatan lebih jelas. Dengan pemulihan dan pengimbangan warna yang efektif serta peningkatan kontras yang berkesan menyimpulkan kajian ini telah mencapai objektif dan matlamat kajian.

PENGHARGAAN

Ribuan terima kasih kepada penyelia saya, Prof. Madya Dr. Abdullah Bade, juga kepada semua pensyarah, rakan dan keluarga yang memberikan nasihat, dorongan dan motivasi kepada saya sepanjang kajian ini.

METODOLOGI

Gray Scale Reference (GSR)

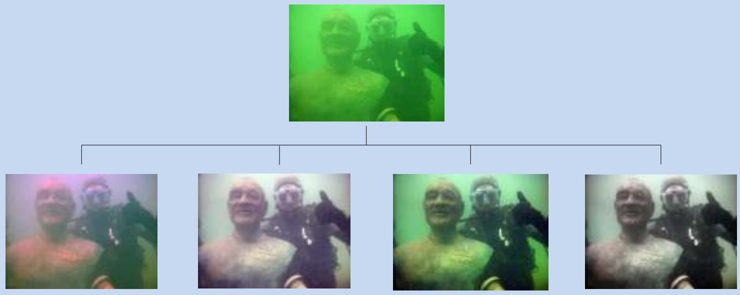
$$I_c^* = I_c + (\overline{I_{gray}} - \overline{I_c})\left(\frac{I_{gray}}{255}\right) + (I_{gray} - I_c)\left(\frac{\overline{I_{gray}}}{255}\right)$$

Purata keseluruhan keamatan piksel — Setiap keamatan piksel

Mixture Contrast Limited Adaptive Histogram Equalization (Mix-CLAHE)

1. CLAHE-HLS, I_{c_1} : Saluran S
   CLAHE-YUV, I_{c_2} : Saluran U,Y
   CLAHE-LAB, I_{c_3} : Saluran L
2. $I_{c4} = \sqrt{0.2(I_{c1})^2 + 0.3(I_{c2})^2 + 0.5(I_{c3})^2}$
3. CLAHE-RGB, I_{c_5}: Saluran R,G,B
4. $I_c^* = \sqrt{0.5(I_{c_4})^2 + 0.5(I_{c_5})^2}$

HASIL DAN PERBINCANGAN

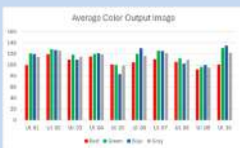


UIQM

- UWB: Agak rendah berbanding kaedah yang lain.
- GCC: Menghampiri Kaedah yang dicadangkan.
- Mix-CLAHE: Agak rendah berbanding GCC dan kaedah yang dicadangkan.
- Kaedah yang dicadangkan: Tertinggi secara keseluruhan.
- UWB < Mix-CLAHE < GCC < Kaedah yang dicadangkan.

UCIQE

- UWB: Rendah berbanding kaedah yang lain
- GCC: Agak rendah berbanding Mix-CLAHE dan Kaedah yang dicadangkan
- Mix-CLAHE: Tertinggi secara keseluruhan.
- Kaedah yang dicadangkan: Menghampiri Mix-CLAHE.
- UWB < GCC < Kaedah yang dicadangkan< Mix-CLAHE.



Purata Warna

- Imej output menghasilkan warna yang lebih stabil pada merah, hijau, biru dan kelabu berbanding imej input.

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TERAS KECEMERLANGAN DAN KEUNGGULAN

Transformasi Ke Arah UNIVERSITI INDUSTRI 4.0

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UNIVERSITI MALAYSIA SABAH

MCG

Goal Programming Model for Medical Officer Scheduling at Sultanah Aminah Hospital, Johor Bahru

LING AI WEN & ASDALIFAH TALIBE
Mathematics Visualization Research Group (MathViz)
Mathematics Computer Graphics Programme
Faculty of Science and Natural Resources
Universiti Malaysia Sabah
Email: ling_ai_bs20@iluv.ums.edu.my & asdalifah@ums.edu.my

Abstract

Scheduling problem is one of the challenges in a company. A scheduler needs to consider many factors regarding the company's rules and the employee's preferences. In this project, a schedule problem for medical officers in emergency and trauma department at Sultanah Aminah Hospital Johor Bahru will be studied. The method of goal programming model will be used to solve and generate a shifting roster in this project. This model is be built based on 49 medical officers, 28-days period of schedule, type of shifting: morning shift (AM), noon shift (PM), night shift (N) and type of zone in emergency and trauma department: green zone, yellow zone, red zone. In order to know the soft and hard constraints that are required in the shifting roster, an interview is be conducted with a senior medical officer in emergency and trauma department at Sultanah Aminah Hospital Johor Bahru. All the soft and hard constraints will be formulated in a goal programming model. LINGO software is be used to solve the model, the output of the result in the software has fulfilled all the rules and goals of the shifting roster for medical officers in emergency and trauma department at Sultanah Aminah Hospital Johor Bahru.

Introduction

Scheduling refers to the process of organizing, managing, and optimizing the work and workloads that are being performed. A scheduler needs to determine and specify the requirements of every shift by ensuring what tasks are required to be executed during each shift. The most important condition is a scheduler must follow the rules and regulations in the organization when scheduling staff timetable. A staff schedule can be created based on various time periods which are in hours, days, weeks or months. It takes a relatively significant amount of time to finish a schedule when it is constructed using manual methods.

Objectives

- To develop a goal programming model to solve scheduling problem for fulfilling the rules of the shifting roster for medical officers in emergency and trauma department at Sultanah Aminah Hospital, Johor Bahru.
- To develop a schedule for medical officers at the emergency and trauma department a Sultanah Aminah Hospital Johor Bahru from the result of goal programming model.

Methodology

Preemptive goal programming is a method that is used to optimize the goals by prioritizing the goals in order of importance. The optimization occurs one at a time starting with the highest-priority goal and terminating with the lowest, never regarding the quality of a higher-priority goal.

Step to generate roster schedule using goal programming model:

Define the aim of the study

Interview

Identify hard and soft constraints

Result

Conclusion

All the objectives in this study have been achieved. In short, the goal programming model is a systematic and useful mathematical technique to arrange a shifting schedule. The shifting schedule problem for 28-days for medical officers in emergency and trauma department at Sultanah Aminah Hospital Johor Bahru has been solved.

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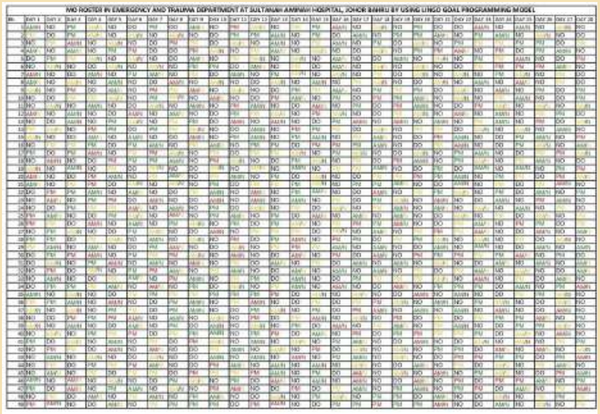
I would like to thank Mdm. Asdalifah, Dr. Salliza, all the MCG lecturers, my family and friends in helping me to complete this study.

Result & Discussion

The roster schedule which is generated using goal programming model has fulfilled all the hard and soft constraints.



The goal programming model is formed based on hard and soft constraints:

Minimize $G_1 = \sum_{i=1}^{m} S_1^-$

Minimize $G_2 = \sum_{i=1}^{m} S_2^-$

Minimize $G_3 = \sum_{i=1}^{m} S_3^-$

Subject to

$$\sum_{j=1}^{m} A_{G_{i,j}} \geq 4 \qquad \sum_{j=1}^{m} A_{R_{i,j}} \geq 2$$

$$\sum_{j=1}^{m} P_{G_{i,j}} \geq 4 \qquad \sum_{j=1}^{m} P_{R_{i,j}} \geq 2$$

$$\sum_{j=1}^{m} N_{G_{i,j}} \geq 4 \qquad \sum_{j=1}^{m} N_{R_{i,j}} \geq 2$$

$$\sum_{j=1}^{m} A_{G_{i,j}} \leq 6 \qquad \sum_{j=1}^{m} A_{R_{i,j}} \leq 3$$

$$\sum_{j=1}^{m} P_{G_{i,j}} \leq 6 \qquad \sum_{j=1}^{m} P_{R_{i,j}} \leq 3$$

$$\sum_{j=1}^{m} N_{G_{i,j}} \leq 6 \qquad \sum_{j=1}^{m} N_{R_{i,j}} \leq 3$$

$$\sum_{j=1}^{m} A_{Y_{i,j}} \geq 4 \qquad \sum_{j=1}^{m} P_{Y_{i,j}} \geq 4 \qquad \sum_{j=1}^{m} N_{Y_{i,j}} \geq 4$$

$$\sum_{j=1}^{m} A_{Y_{i,j}} \leq 5 \qquad \sum_{j=1}^{m} P_{Y_{i,j}} \leq 5 \qquad \sum_{j=1}^{m} N_{Y_{i,j}} \leq 5$$

$$N_{G_{i,j}} + N_{Y_{i,j}} + N_{R_{i,j}} + A_{G_{i+1,j}} + A_{Y_{i+1,j}} + A_{R_{i+1,j}} \leq 1$$

$$A_{G_{i,j}} + A_{Y_{i,j}} + A_{R_{i,j}} + A_{G_{i+1,j}} + A_{Y_{i+1,j}} + A_{R_{i+1,j}} \leq 1$$

$$N_{G_{i,j}} + N_{Y_{i,j}} + N_{R_{i,j}} + N_{G_{i+1,j}} N_{Y_{i+1,j}} + N_{R_{i+1,j}} \leq 1$$

$$A_{G_{i,j}} + A_{Y_{i,j}} + A_{R_{i,j}} + P_{G_{i+1,j}} + P_{Y_{i+1,j}} + P_{R_{i+1,j}} \leq 1$$

$$N_{G_{i,j}} + N_{Y_{i,j}} + N_{R_{i,j}} + P_{G_{i+1,j}} + P_{Y_{i+1,j}} + P_{R_{i+1,j}} \leq 1$$

$$A_{G_{i,j}} + A_{Y_{i,j}} + A_{R_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} + NO_{i,j} + DO_{i,j} \leq 1$$

$$\sum_{i=1}^{m} \left(A_{G_{i,j}} + A_{Y_{i,j}} + A_{R_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} + N_{G_{i,j}} + N_{Y_{i,j}} + N_{R_{i,j}} \right) - S_1^+ + S_1^- = 24$$

$$O_{i,j} - S_2^+ + S_2^- = 5$$

$$\sum_{i=1}^{m} \left(N_{G_{i,j}} + N_{Y_{i,j}} + N_{G_{i,j}} \right) - S_3^+ + S_3^- = 6$$

$$O_{1,j} + O_{2,j} + O_{3,j} + O_{4,j} + O_{5,j} + O_{6,j} + O_{7,j} = 1$$

$$O_{8,j} + O_{9,j} + O_{10,j} + O_{11,j} + O_{12,j} + O_{13,j} + O_{14,j} = 1$$

$$O_{15,j} + O_{16,j} + O_{17,j} + O_{18,j} + O_{19,j} + O_{20,j} + O_{21,j} = 1$$

$$O_{22,j} + O_{23,j} + O_{24,j} + O_{25,j} + O_{26,j} + O_{27,j} + O_{28,j} = 1$$

$$\sum_{i=1}^{d} 1 - A_{G_{i,j}} - A_{Y_{i,j}} - A_{R_{i,j}} + N_{G_{i,j}} + N_{Y_{i,j}} + N_{R_{i,j}} = 1$$

$$\sum_{i=1}^{d} 1 - N_{G_{i,j}} - N_{Y_{i,j}} - N_{R_{i,j}} + NO_{i+1,j} = 1$$

$$A_{G_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} \leq 1$$

$$A_{Y_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} \leq 1$$

$$A_{R_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} \leq 1$$

$$N_{G_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} \leq 1$$

$$N_{Y_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} \leq 1$$

$$N_{R_{i,j}} + P_{G_{i,j}} + P_{Y_{i,j}} + P_{R_{i,j}} \leq 1$$

for $i = 1,2,3,\ldots,d$ and $j = 1,2,3,\ldots,m$

SW40106 SCIENTIFIC PROJECT II
SESSION 1 2023/2024

UMS UNIVERSITI MALAYSIA SABAH

ANALYSIS OF DAILY SABAH STREAMFLOW USING KOLMOGOROV MEASURE AND LYAPUNOV EXPONENT

Loo Xin Yu & Siti Aisyah Binti Tumiran
Mathematics Visualization Research Group (MathVis), Mathematics Computer Graphics Programme
Faculty Of Science And Natural Resources, Universiti Malaysia Sabah
Email: loo_xin_bs20@iluv.ums.edu.my & sitiaisyah.tumiran@ums.edu.my

ABSTRACT

Analyzing the spatial and temporal variability of daily streamflow is crucial for water resources planning. Anthropogenic influences and climate change add complexity to streamflow records. In this study, daily discharge data from 2001-2019 at twenty-nine gauging stations in Sabah, Malaysia, were used. Novel tools like Kolmogorov complexity (KC) and Lyapunov time were applied. Results showed long memory and increasing down-flow tendency in all discharge series. High KC values indicated potential randomness or chaotic behavior. Lyapunov time highlighted predictability differences, with station having the longest (250 days) and the shortest (15 days). The inverse relationship between Lyapunov time correction and KC reinforced conclusions about anthropogenic impacts. Station 4278402, with lower complexity and higher predictability, appears suitable for modeling and forecasting daily streamflow.

INTRODUCTION

- The Daily Streamflow Data
- Sabah Malaysia
- 2001-2019
- 29 streamflow stations in Sabah
- Kolmogorov Measures access complexity
- Lyapunov exponent access predictability

OBJECTIVE

1. To apply Kolmogorov measure (KC) to assess complexity in the period 2001–2019 at twenty-nine gauging stations in Sabah (Malaysia).
2. To apply Lyapunov Exponent to assess predictability in the period 2001–2019 at twenty-nine gauging stations in Sabah (Malaysia).
3. To investigate the complexity and predictability get of daily streamflow in Sabah (Malaysia) through data analysis for the period 2001–2019.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my supervisor, Dr. Siti Aisyah for her valuable guidance throughout my dissertation. I would also like to extend my gratitude to my examiner, Dr Arif for providing me with much-appreciated feedback and advice. Also thanks for DID provide valuable data

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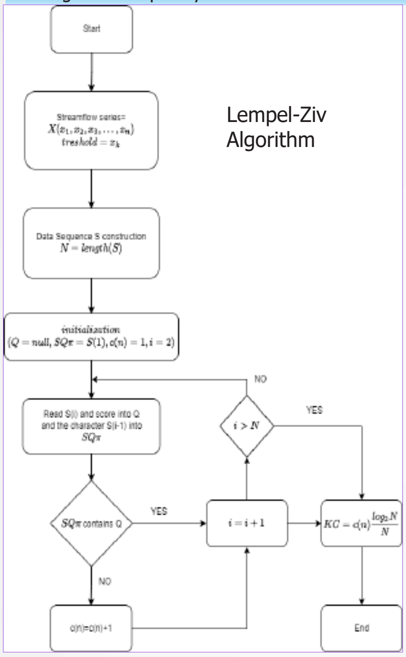
METHODOLOGY

Kolmogorov Complexity



Lempel-Ziv Algorithm

Lyapunov Exponent

Rosenstein Algorithm

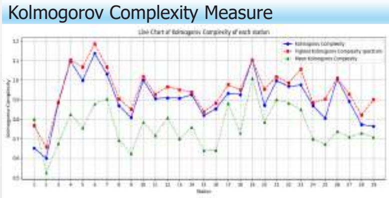
$$\lambda = \lim_{\tau\to\infty} \lim_{\varepsilon\to 0} \frac{1}{\tau} \ln\left(\frac{|x(\tau) - x_\varepsilon(\tau)|}{\varepsilon}\right)$$

1. Determine the time delay, τ
2. Determine the embedding dimension, m
3. Compute the Lyapunov exponent, λ

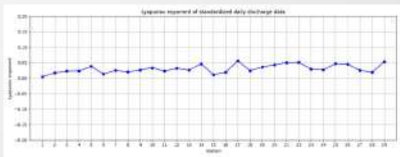
Station in Sabah

RESULT

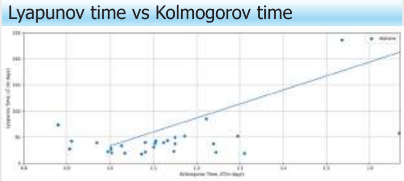
Kolmogorov Complexity Measure



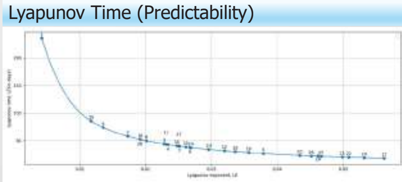
Lyapunov Exponent



Lyapunov time vs Kolmogorov time



Lyapunov Time (Predictability)



CONCLUSION

- The Kolmogorov Complexity (KC) values exceeding 1 at several stations (4, 5, 6, 7, 19, and 23) indicated potentially high randomness, irregularity.
- The Lyapunov Time (LT) units further highlighted predictability differences, with station 1 having the longest predictability (around 250 days) and station 17 displaying the shortest predictability (15 days).
- The presence of randomness reduced that number to 220 days when include the effect of complexity in predictability (Lyapunov time vs Kolmogorov time).

ENHANCED SUPER-RESOLUTION GENERATIVE ARVERSARIAL NETWORK WITH UNWANTED ARTIFACT REMOVEAL METHOD

Maltven Ong Mastin[1,2,3], Rechard Lee[2,4,5]

[1]Mathematics with Computer Graphics, [4]Mathematics Visualization Research Group (MathVis)

[2]Faculty of Science and Natural Resources (FSSA), Universiti Malaysia Sabah, Malaysia

[3]Maltven_ong_bs20@iluv.ums.edu.my, [5]Rechard@ums.edu.my

ABSTRACT

This paper introduces an improved approach to image super-resolution by integrating Enhanced Super-Resolution Generative Adversarial Networks (ESRGAN) with a new method for unwanted artefact removal. ESRGAN, known for generating photorealistic images, often produces unwanted artifacts. Our novel method effectively removes these artifacts without requiring matching artifact-corrupted data. The integration of ESRGAN with our artefact removal method enhances the visual quality of super-resolved images, making them more realistic and freer from unwanted artifacts. There are three techniques that are used in this paper, which is Laplacian Sharpen, Gaussian Blur, and Non-Local Means Denoising. Laplacian Sharpen is a technique used in image processing to enhance the edges in an image making it appear sharper. Gaussian Blur is widely used effect in graphics software, typically to reduce noise and detail. Non-Local Means Denoising is an algorithm that can restore well textures.

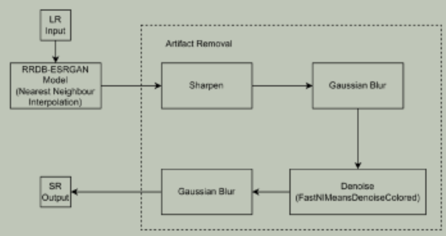
INTRODUCTION

A sequence of low quality, low-resolution (LR) photos or a single image can be used to create high quality, high-resolution (HR) images using an image processing method called image super resolution. The SR image reconstruction is useful where in most cases such as medical imaging, satellite imaging, and video applications multiple frames of the same scene can be obtained. The availability of several LR photos taken from the same scene is the fundamental presumption for enhancing the spatial resolution in SR approaches.

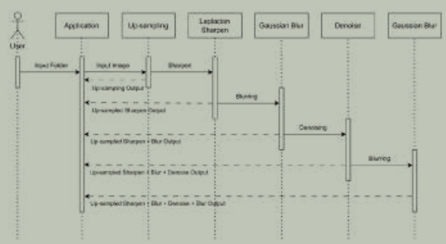
OBJECTIVES

1. To improve the image by fixing or removing artifacts generated by the model.
2. Perfecting post-processed image to be better quality compared to its ground truth (HR).

METHODOLOGY



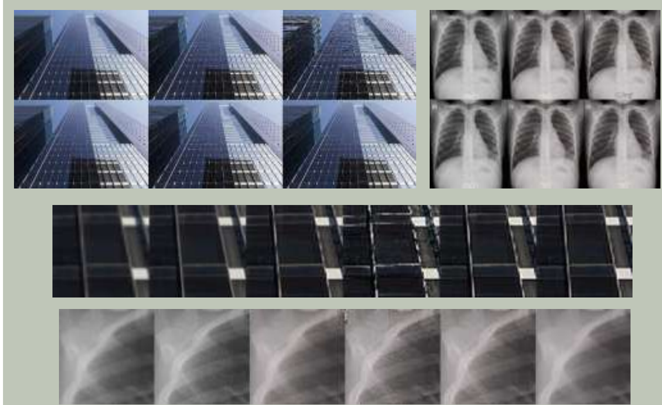
The System Architecture of Neighbour Embedding



UML Sequence Diagram

RESULT AND DISCUSSION

- The performance test is carried out in this experiment to evaluate the metric value based on image quality. Below shows example output.



- Ideal value of VIF is None, but the higher the better.
- SSIM is 1 in terms of quality reconstruction.
- PSNR is between 30 and 50dB.
- MSE is 0. Which is closer to the upsampling model system.

CONCLUSION

All objectives has been achieved. The techniques which is Laplacian Sharpen, Gaussian Blur, and Non-Local Means Denoise successfully applied to improve the quality of the image. Based on the metric assessment used, MSE, PSNR, SSIM, and VIF, shows that the image can be used in any kind of situations. Though, some images didn't achieve the metric assessment, it still produced a better quality compared to its ground truth.

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SW40106 SCIENTIFIC PROJECT II

UMS UNIVERSITI MALAYSIA SABAH

PEMODELAN INTERPOLASI LENGKUNG BEZIER NISBAH KABUR TERHADAP PURATA SUHU DI KOTA KINABALU, SABAH

MOHAMAD SHAFIQ IRWAN BIN ROSMADI & ROZAIMI BIN ZAKARIA

MATHEMATICS VISUALIZATION RESEARCH GROUP (MathViz), MATHEMATICS COMPUTER GRAPHICS PROGRAMME, FACULTY OF SCIENCE AND NATURAL RESOURCES, UNIVERSITI MALAYSIA SABAH

mohamad_shafiq_bs20@iluv.ums.edu.my & rozaimi@ums.edu.my

MCG

ABSTRAK

Kajian ini membincangkan tentang pemodelan interpolasi lengkung Bezier nisbah kabur terhadap purata suhu. Pemodelan ini adalah gabungan pemodelan geometri dengan teori set kabur bagi menyelesaikan masalah ketakpastian data. Ketakpastian data dapat ditakrifkan dengan menggunakan teori asas set kabur, iaitu konsep nombor kabur. Nombor kabur juga digunakan untuk mendapatkan titik data kabur. Seterusnya, proses pengkaburan yang melibatkan operasi potonga-alfa untuk mengurangkan nilai selang di antara titik data kabur dan titik data rangup purata suhu. Malah, proses penyahkaburan dijalankan selepas operasi potongan-alfa untuk mendapatkan titik data kabur rangup. Selain itu, pencarian ralat di antara titik data nyahkabur dan titik data rangup telah dilakukan bagi menguji dan memastikan kebolehpercayaan terhadap model yang dibina. Ralat diperoleh dengan perbandingan antara model penyahkaburan purata suhu dan model rangup purata suhu. Nilai ralat yang kecil atau kurang daripada 0.1 menujukkan model interpolasi lengkung Bezier nisbah kabur adalah dapat digunakan dalam pemodelan purata suhu.

PENGENALAN

Profesor L. A. Zadeh memperkenalkan konsep set kabur sebagai pengembangan dari konsep set klasik pada tahun 1965. Teori ini diakui mampu mengatasi masalah ketidakpastian yang ada dalam data. Ketidakpastian merupakan sifat yang terdapat pada nilai-nilai matematik dalam konteks set kabur. Untuk mengatasi masalah pemodelan data yang melibatkan ketidakpastian, teori set kabur dan konsep nombor kabur digunakan untuk membentuk set data kabur.Interpolasi lengkung Bezier dengan nisbah kabur dibangun melalui model tertentu dengan menggunakan titik kawalan rangup, dan lengkung Bezier nisbah merupakan sebahagian daripada lengkung yang terhasil. Proses pengkaburan dilakukan melalui operasi potongan alfa, sementara proses penyahkaburan dilaksanakan untuk mendapatkan model kabur yang lebih sesuai. Contoh aplikasi dalam model ini dapat dijelaskan dengan menerapkan data purata suhu di Kota Kinabalu, Sabah, ke dalam model tersebut.Akhir sekali, ralat dicari bagi menentukan keberkesanan model rangup dan model nyahkabur yang dibangunkan.

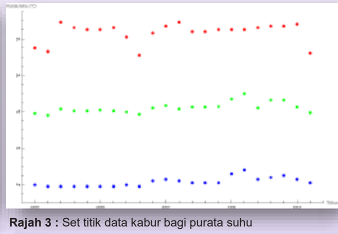
OBJEKTIF

I. Membangunkan model kabur,pengkaburan dan model penyahkaburan menggunakan kaedah interpolasi lengkung Bezier nisbah kabur.

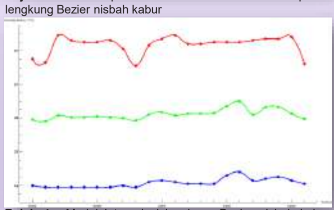
II. Mengaplikasikan model interpolasi lengkung Bezier nisbah kabur dalam memodelkan purata suhu di Kota Kinabalu Sabah.

KEPUTUSAN DAN PERBINCANGAN

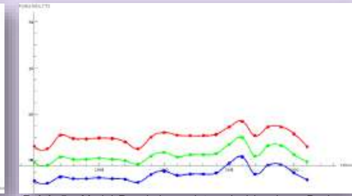
Rajah 2 : Data purata suhu dalam bentuk interpolasi lengkung Bezier nisbah kabur



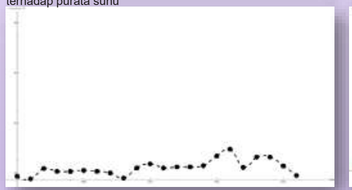
Rajah 3 : Set titik data kabur bagi purata suhu



Rajah 4 : Model Interpolasi lengkung Bezier nisbah kabur terhadap purata suhu



Rajah 5 : Model Pengkaburan interpolasi lengkung Bezier nisbah kabur terhadap purata suhu



Rajah 6 : Model penyahkaburan terhadap purata suhu dengan interpolasi lengkung Bezier nisbah kabur

Rajah 7 : Perbandingan antara model rangup dan model penyahkaburan

Dalam kajian ini, model interpolasi lengkung Bezier nisbah kabur (ILBNK) digunakan untuk memodelkan data purata suhu yang tidak pasti. Proses pentakrifan, pengkaburan dan penyahkaburan data yang tidak pasti dinyatakan dalam kajian ini. Ralat yang dihasilkan antara titik data penyahkaburan dan titik data rangup, iaitu 0.00000981165. Purata ralat ini boleh diterima kerana kurang daripada 10%. Ia menunjukkan bahawa model ILBNK boleh digunakan dalam taburan hujan. Oleh itu, kajian ini terbukti boleh dipercayai.

METODOLOGI

Teori Set Kabur

- x merupakan unsur set semester & A subset kepada X
- $\overleftrightarrow{A}$ mewakili set A.

$$\mu_A(x) = \begin{cases} 1 & jika\ x \notin A \quad (keahlian\ penuh) \\ 0 < c < 1 & jika\ x \in A\ (bukan\ keahlian\ penuh) \\ 0 & jika\ x \in A \quad (bukan\ keahlian) \end{cases}$$

- c mewakili nilai keahlian

Titik Data/Kawalan Kabur

- $\mu_A(P_i) = \langle \mu_A(P_i^{\leftarrow}), \mu_A(P_i), \mu_A(P_i^{\rightarrow}) \rangle$
- $x = P_i$
- $\mu_A(P_i^{\leftarrow})$ =nilai keahlian kiri
- $\mu_A(P_i^{\rightarrow})$ = nilai keahlian kanan

Potongan Alfa Segitiga Nombor Kabur

- $a^\alpha = (d-a)\alpha + a$
- $c^\alpha = -(c-d)\alpha + c$
- $\overleftarrow{A}_\alpha \to [a^\alpha, c^\alpha] = [(d-a)\alpha + a, -(c-d)\alpha + c]$

$\vec{A} = (a, d, c)$ = segitiga nombor kabur

$\overleftarrow{A}_\alpha$= operasi potongan-alfa

Interpolasi Lengkung Bezier Nisbah Kabur

- Andaikan $\overleftrightarrow{P}_i, \overleftrightarrow{D}_i \in R, i = 0,1,\dots,n,$ menjadi satu set titik data kabur dan terbitan kabur yang diberikan nilai pada t. Kemudian, interpolasi lengkung Bezier kubik nisbah kabur melengkung jika $\alpha = \beta = 3$ ialah ditakrifkan sebagai

$$\overleftrightarrow{R}(t) = \frac{\overleftrightarrow{F}_0(t)\overleftrightarrow{P}_i + \overleftrightarrow{F}_1(t)v_i\overleftrightarrow{Q}_i + \overleftrightarrow{F}_2(t)w_i\overleftrightarrow{S}_i + \overleftrightarrow{F}_3(t)\overleftrightarrow{P}_{i+1}}{\overleftrightarrow{F}_0(t) + \overleftrightarrow{F}_1(t)v_i + \overleftrightarrow{F}_2(t)_i w_i + \overleftrightarrow{F}_3(t)}$$

dengan fungsi campuran kabur yang diberikan oleh

$\overleftrightarrow{F}_0(t) = (1-t)^2(1+(2-\alpha)t) = (1-t)^3$

$\overleftrightarrow{F}_1(t) = \alpha(1-t)^2 t = 3t(1-t)^2$

$\overleftrightarrow{F}_2(t) = \beta t^2(1-t) = 3t^2(1-t)$

$\overleftrightarrow{F}_3(t) = t^2\big(1+(2-\beta)(1-t)\big) = t^3$

iaitu v_i dan w_i ialah nilai pemberat dan

$$\overleftrightarrow{Q}_i = \frac{\overleftrightarrow{D}_i}{3v_i} + \overleftrightarrow{P}_i$$

$$\overleftrightarrow{S}_i = \overleftrightarrow{P}_{i+1} - \frac{\overleftrightarrow{D}_{i+1}}{3w_i}$$

$\overleftrightarrow{D}_i$ dan $\overleftrightarrow{D}_{i+1}$= vector tangen $\overleftrightarrow{P}_i$ dan $\overleftrightarrow{P}_{i+1}$.

Tangen vektor ini ditakrifkan sebagai berikut. Untuk lengkung terbuka

$\overleftrightarrow{D}_0 = 2(\overleftrightarrow{P}_1 - \overleftrightarrow{P}_0) - \frac{\overleftrightarrow{P}_2 - \overleftrightarrow{P}_0}{2},$

$\overleftrightarrow{D}_n = 2(\overleftrightarrow{P}_n - \overleftrightarrow{P}_{n-1}) - \frac{\overleftrightarrow{P}_n - \overleftrightarrow{P}_{n-2}}{2},$

$\overleftrightarrow{D}_i = \overleftrightarrow{a}_i(\overleftrightarrow{P}_i - \overleftrightarrow{P}_{i-1}) + (1-\overleftrightarrow{a}_i)(\overleftrightarrow{P}_{i+1} - \overleftrightarrow{P}_i)$ iaitu

$$\overleftrightarrow{a}_i = \frac{\|\overleftrightarrow{P}_{i+1} - \overleftrightarrow{P}_i\|}{\|\overleftrightarrow{P}_{i+1} - \overleftrightarrow{P}_i\| + \|\overleftrightarrow{P}_i - \overleftrightarrow{P}_{i-1}\|}, i = 0,1,\dots,n$$

Penyahkaburan Titik Data/Kawalan Kabur

- $\hat{P}_{i_\alpha} = \frac{1}{3}\sum_{i=0}\langle \overleftrightarrow{P}_{i_\alpha}^{\leftarrow} + P_i + \overleftrightarrow{P}_{i_\alpha}^{\rightarrow} \rangle$

Kebolehpercayaan Model Penyahkaburan

- $\frac{\sum_{i=1}^{n} {}^{PS}P_{i_e}}{n}$ dengan
- ${}^{PS}P_{i_e} = \frac{{}^{PS}\hat{P}_i - {}^{PS}P_i}{{}^{PS}P_i}, i = 1,2,\dots,21, \quad n = 22$

Rajah 1 : Proses pemodelan terhadap purata suhu di Kota Kinabalu Sabah dengan menggunakan model interpolasi lengkung Bezier nisbah kabur

KESIMPULAN

Dalam projek ini, model interpolasi lengkung Bézier nisbah kabur digunakan terhadap purata suhu. Pengkaburan (potongan alfa) digunakan untuk mendapatkan lengkung antara titik data rangup dan juga titik data kabur dengan nilai alfa tetap iaitu 0.8. Proses penyahkaburan dijalankan untuk tujuan menyelesaikan titik data kabur dan juga untuk memperoleh titik data kabur yang jelas. Kedua-dua objektif tercapai apabila objektif pertama titik data kabur dan rangup diperolehi selepas pengkaburan (potongan alfa) dan penyahkaburan dijalankan untuk mendapatkan titik data penyahkaburan.Objektif kedua berjaya disebabkan model ILBNK telah diimplementasikan pada purata suhu untuk mengenal pasti keberkesanan model yang dibangun. Sebagai cadangan kajian masa depan, model interpolasi lengkung B-spline nisbah boleh digunakan untuk kajian masa hadapan terhadap ketidakpastian data.

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PENGHARGAAN

Saya ingin mengucapkan terima kasih kepada penyelia saya iaitu Dr. Rozaimi Zakaria kerana telah membimbing dan menyokong saya sepanjang tempoh projek tahun akhir saya. Selain itu, saya ingin mengucapkan terima kasih kepada keluarga dan rakan-rakan saya yang menyokong mental saya semasa projek tahun akhir saya. Tanpa bantuan mereka, kajian ini tidak mungkin dapat dilaksanakan.

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SW40106 PROJEK SAINTIFIK II -- PROGRAM MATEMATIK GRAFIK BERKOMPUTER

UMS KAMPUS RAHMAH

Transformasi Ke Arah UNIVERSITI INDUSTRI 4.0

Assessment of Air Quality Index in Kota Kinabalu Using Fuzzy Inference System

Muhammad Aidil Firdaus[1] &
Dr. Suzelawati Zenian[2]
Universiti Malaysia Sabah, Malaysia
[1] muhammad_aidil_bs20@iluv.ums.edu.my,
[2] suzela@ums.edu.my

Abstract

This study undertakes a thorough examination of air quality conditions in Kota Kinabalu. The first phase involves the precise measurement and analysis of key air quality parameters such as particulate matter, Carbon Monoxide, Nitrogen Dioxide readings across the city. This meticulous investigation serves as the foundation for comprehending the current state of air quality and the levels of pollutants present in the specified region. The subsequent phase concentrates on crafting a specialized Fuzzy Inference System (FIS) tailored for air quality assessment. This intricate process includes defining precise membership functions, establishing linguistic rules, and configuring the inference system to generate an interpretable Air Quality Index (AQI) based on the collected data. The expected outcomes of this research hold the promise of providing valuable insights into the air quality dynamics of Kota Kinabalu, offering a robust framework for future assessments, and potentially guiding interventions to enhance environmental quality in the region.

Introduction

Air pollution is a pressing environmental concern, encompassing both indoor and outdoor contamination by chemical, physical, or biological agents that alter the natural characteristics of the atmosphere. Recognized as a significant social issue, environmental challenges related to pollution and resource depletion have gained prominence. Health problems attributed to air pollution, including climatic pollution, water contamination, climate change, ozone depletion, and hazardous waste management, are increasingly acknowledged. The detrimental effects of air pollution on human health, both acute and severe, are well-documented. With the escalation of economic development, globalization, and rising energy demands, substantial emissions and waste contribute to severe air pollution, compromising the essential need for clean air for life on Earth. Notably, vulnerable populations, especially young children, face heightened risks of diseases such as asthma and bronchitis due to exposure to traffic-related air pollution. This research aims to predict air quality using the fuzzy inference system concept, employing MATLAB software and considering variables such as particulate matter, nitrogen dioxide, sulphur dioxide, ozone, and carbon monoxide. The study emphasizes the importance of meteorological data, specifically temperature, to ensure a comprehensive and accurate understanding of the Air Quality Index in the selected region of Sabah.

Objectives

Air Quality Parameter Analysis:

- Measure and analyze key air quality parameters, including particulate matter (PM), Carbon Monoxide (CO), Nitrogen Dioxide (NO2), and temperature readings across Kota Kinabalu.
- Establish a comprehensive understanding of the current air quality conditions and levels of pollutants in the specified region.

Fuzzy Inference System Development:

- Design and develop a fuzzy inference system tailored for air quality assessment.
- Define precise membership functions, establish linguistic rules, and configure the system to generate an interpretable Air Quality Index (AQI) based on collected data.

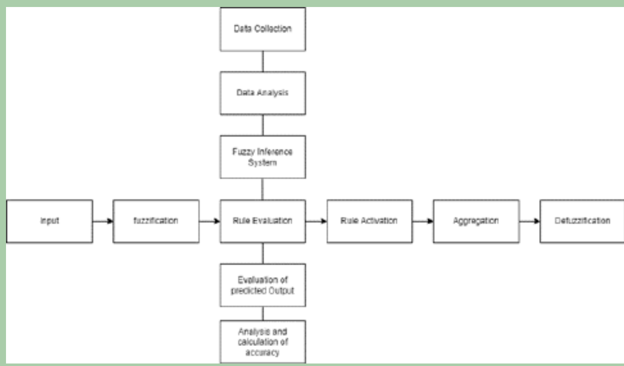
Conclusion

The system was designed to be clear and useful for non-experts. Our research shows that fuzzy logic is effective in predicting air quality. We evaluated the system's accuracy using metrics like Mean Absolute Error and Root Mean Squared Error, which indicate good performance. Visual tools like scatter plots and time-series graphs helped us understand how well the system predicted air quality. Our approach makes it easier for decision-makers to use the system in environmental management. Overall, this study contributes to using fuzzy logic for practical air quality predictions.

Acknowledgement

I'd like to thank my supervisor, Dr. Suzelawati, for her direction and help during the duration of my dissertation. In addition, I'd want to thank my family and friends for their help with my final project. This research would not have been achievable without their help.

Methodology

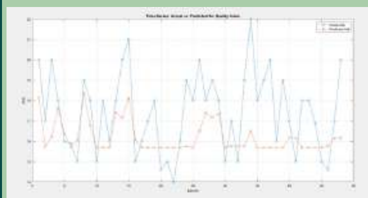


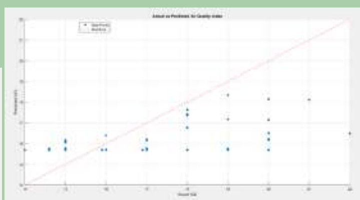
Result and Discussion

The bar function creates bars for both actual and predicted AQI values. The x-axis represents months ('xticks' and 'xticklabels' set the month labels), and the y-axis represents AQI values. Titles, labels, legends, and grid lines are added for clarity.

The scatter plot used to show the relationship between the actual AQI values (actualAQI) and the predicted AQI values (outputData). The ideal line helps visualize how close the predictions are to the actual values. The scatter function creates a scatter plot with filled markers.

The time-series plot that displays the trend of actual AQI values (actualAQI) and predicted AQI values (outputData) over time (months). The plot function creates lines connecting data points for both actual and predicted AQI values.





MAE	1.6785
RMSE	2.0960
Correlation Coefficient	0.4799

The low MAE and RMSE values suggest that the fuzzy inference system has strong predictive accuracy. However, the moderate correlation coefficient indicates a positive but not very strong linear connection between input parameters and AQI. This could mean that other non-linear factors play a role in the relationship. In summary, the fuzzy inference system shows promising accuracy with low MAE and RMSE values. Still, the moderate correlation suggests the need for further analysis and potential refinement of the model to capture more nuances in the connection between input parameters and AQI.

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PEMULIHAN DAN PENAMBAHBAIKAN KUALITI IMEJ PERGERAKAN KABUR MENGGUNAKAN TEKNIK LUCY RICHARDSON DAN UNSHARP MASKING

Muhammad Izzdham bin Abdul Waihp & Abdullah Bade
Mathematics Visualization Research Group (MathViz), Program Matematik Grafik Berkomputer,
Fakulti Sains dan Sumber Alam, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah.
muhammad_izzdham_bs20@iluv.ums.edu.my, abb@ums.edu.my

ABSTRAK

Fotografi menghadapi cabaran pergerakan melalui teknologi pengkomputeran fotografi algoritma Richardson Penelitian menunjukkan peningkatan meskipun memuaskan Cadangan penelitian seterusnya termasuk penambahba metodologi penyemakan kuantitatif menjanjikan pemulihan pergerakan dengan peningkatan melalui penelitian

PENGENALAN

pemprosesan penapisan penyaringan mainkan peranan penting Pengkomputeran fotografi memungkinkan persaingan dengan kamera membawa percitraan Augmented Meskipun pergerakan memiliki pemulihan diperlukan kejelasan Teknologi pemulihan berbasis algoritma persamaan pembezaan berkembang menandakan penelitian meningkatkan teknologi modern

OBJEKTIF

1. Memulihkan tunggal mempunyai dengan pergerakan menggunakan metode Richardson
2. Mengurangkan kehingaran terhadap tunggal dipulihkan daripada pergerakan

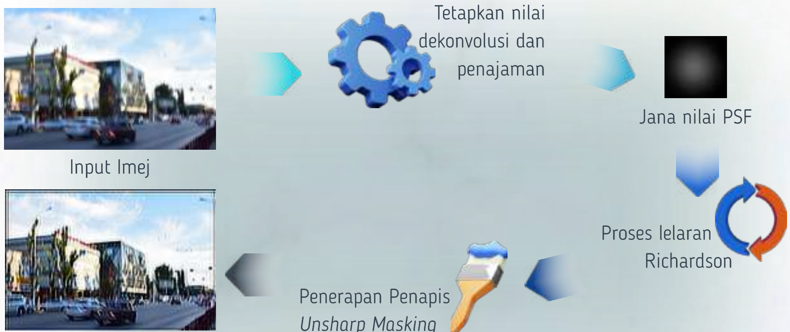
KESIMPULAN

memuaskan memerlukan penambahbaikan khususnya pergerakan ingkatkan perincian Pengujian menggunakan menunjukkan memberi sumbangan pengembangan pemulihan pemahaman pergerakan pengkomputeran fotografi

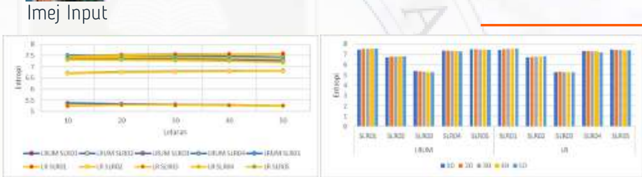
PENGHARGAAN

penyelia Abdullah pensyarah keluarga memberikan dorongan motivasi sepanjang perjalanan

METODOLOGI

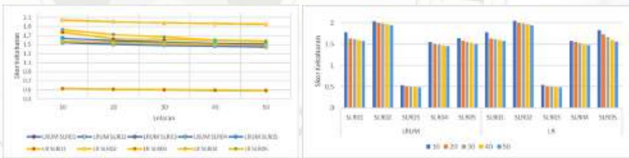


HASIL KAJIAN & PERBINCANGAN



Rajah 1 Perbandingan Nilai Purata Entropi Bagi Setiap Dataset

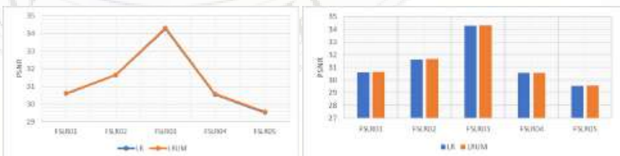
- Entropi Tinggi, Perincian Imej Banyak



Rajah 2 Perbandingan Nilai Purata Skor Kekaburan Bagi Setiap Dataset

- Skor Kekaburan Rendah, Tahap Kekaburan Pada Imej Rendah

NR



Rajah 3 Perbandingan Nilai Purata PSNR Bagi Setiap Dataset

- PSNR Tinggi, Kehingaran Rendah Pada

Rajah 4 Perbandingan Nilai Purata SSIM Bagi Setiap Dataset

- SSIM Dekat Dengan 1, Kesepadanan Struktur Lebih Tinggi dengan Imej Asal

FR

RUJUKAN

PENYULITAN DAN PENYAHSULITAN IMEJ SKALA KELABU BERDEFINISI TINGGI DENGAN MENGGUNAKAN PETA TENT DAN PETA HENON

Noveica Needles & Arif Mandangan
Mathematics Visualization Research Group (MathViz) | Mathematics Computer Graphics Programme
Faculty of Science and Natural Resources, Universiti Malaysia Sabah
Email: noveica_needles_bs20@iluv.ums.edu.my

Abstrak

Kajian ini memfokuskan sistem penyulitan dan penyahsulitan imej skala berdefinisi tinggi menggunakan peta Tent dan peta Henon. Peta Tent dan peta Henon adalah peta *chaotic* secara dinamik diskret yang sensitif terhadap keadaan awalan dan parameter. Hasil analisis menunjukkan bahawa kaedah yang dicadangkan mempunyai tahap kecekapan dalam penyulitan dan penyahsulitan imej skala kelabu berdefinisi tinggi.

Pengenalan

Penyulitan imej adalah teknik untuk menukarkan imej biasa kepada imej sifer, manakala penyahsulitan imej adalah teknik imej sifer kepada imej yang boleh difahami. Kriteria imej yang digunakan adalah imej berdefinisi tinggi (HD) iaitu imej digital dengan resolusi yang tinggi dan perincian yang jelas. Peta Tent dan peta Henon adalah sistem *chaotic* diskret dengan tingkah laku yang sangat kompleks untuk mengubah piksel imej dengan sewajarnya agar kelihatan secara rawak.

Objektif

Imej HD mempunyai nilai piksel yang banyak. Akibatnya, masa pelaksanaan penyulitan dan penyahsulitan imej menjadi lama. Matlamat kajian ini adalah meningkatkan tahap kecekapan dari segi masa pelaksanaan.

1. Untuk membangunkan algoritma penyulitan dan penyahsulitan imej skala kelabu dengan menggabungkan peta *chaotic* Tent dan peta *chaotic* Henon.
2. Untuk menguji kebolehlaksanaan algoritma penyulitan dan penyahsulitan imej yang telah dibangunkan terhadap imej skala kelabu berdefinisi tinggi.
3. Untuk menguji tahap kecekapan dari segi masa pelaksanaan proses penyulitan dan penyahsulitan imej sekala kelabu berdefinisi tinggi dengan menggunakan algoritma yang telah dibangunkan.

Sumbangan

1. Membantu dalam kajian yang menggunakan imej berdefinisi tinggi sebagai kriteria utama imej.
2. Menyumbang dari segi kecekapan masa pelaksanaan.

Penghargaan

Saya mengucapkan terima kasih kepada Dr. Arif Mandangan yang banyak memberi tunjuk ajar. Terima kasih juga kepada keluarga saya yang selalu memberikan sokongan serta rakan- rakan yang membantu saya sehingga kajian ini selesai.

Rujukan

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Lawnik, M., Moysis, L., & Volos, C. (2022). Chaos-Based Cryptography: Text Encryption Using Image Algorithms. *Electronics (Switzerland), 11*(19).

Metodologi

Peta *Chaotic* Tent

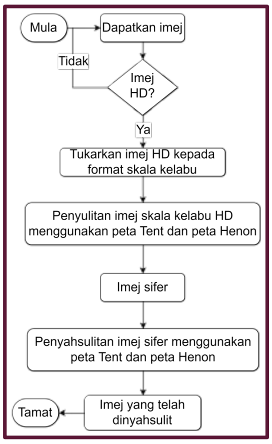
$$x_{n+1} = \begin{cases} \frac{b}{2}x_n, & jika\ x_n < 0.5 \\ \frac{b}{2}(1-x_n) & jika\ x_n \geq 0.5 \end{cases} \quad (1)$$

Peta *Chaotic* Tent

$$x_{n+1} = 1 - a(x_n)^2 + y_n \quad (2)$$

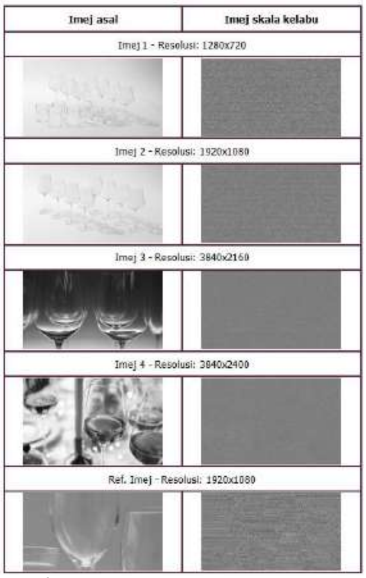
$$y_n = bx_{n-1} \quad (3)$$

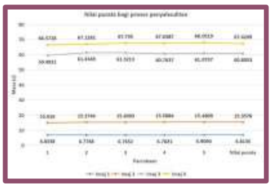
$$x_{n+1} = 1 - a(x_n)^2 + bx_{n-1} \quad (4)$$

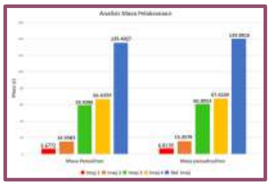


Keputusan dan Perbincangan

Masa pelaksanaan bagi proses penyulitan dan penyahsulitan akan dicatat sebanyak lima kali percubaan bagi mendapatkan pengiraan nilai purata.







Terdapat jurang masa yang amat signifikan semasa proses penyulitan dan penyahsulitan dilaksanakan menggunakan dua sistem yang berbeza, yang mana sistem yang dicadangkan mempunyai masa pelaksanaan yang lebih efektif berbanding sistem yang sedia ada.

Kesimpulan

Kajian ini mencadangkan sistem dengan konsep penyulitan dan penyahsulitan imej skala kelabu berdefinisi tinggi. Oleh itu, sistem penyulitan dan penyahsulitan imej skala kelabu telah dibangun menggunakan peta Tent dan peta Henon. Sistem ini memfokuskan kepada imej dengan definisi yang tinggi dengan batasan piksel imej iaitu minimum 1280x720. Sistem ini juga menunjukkan tahap kecekapan dari segi masa pelaksanaan adalah lebih baik berbanding kajian lepas.

SW40106 SCIENTIFIC PROJECT II
MATEMATIK DENGAN GRAFIK BERKOMPUTER

PEMODELAN LENGKUNG *B-SPLINE* KABUR TERHADAP PURATA SUHU DI TAWAU, SABAH

NUR FATIN NABILAH BINTI MANSUR[1] & DR. ROZAIMI ZAKARIA[2]
Fakulti Sains dan Sumber Alam, Universiti Malaysia Sabah,
88440, Kota Kinabalu, Sabah, Malaysia.
[1]nabilahmansur01@gmail.com, [2]rozaimi@ums.edu.my

ABSTRAK

Kajian ini melibatkan pemodelan geometri dan teori set kabur untuk mengatasi ketakpastian data. Pemodelan geometri dan teori set kabur telah dikembangkan dan diguna dengan meluasnya dalam pelbagai cabang matematik, termasuk juga sains dan kejuruteraan. Dalam konteks ini, nombor kabur digunakan bagi membina takrif titik kawalan kabur untuk perkembangan lengkung kabur dalam pemodelan geometri. Kajian ini membuktikan peranan penting teori set kabur dan logik kabur dalam membina lengkung *B-Spline* kabur, yang diuji pada data purata suhu di Tawau, Sabah. Hasilnya menunjukkan bahawa model ini berkesan menangani ketidakpastian data, dengan ralat kurang daripada 10% berbanding model lengkung *B-Spline* rangup.

PENGENALAN

Profesor Lofti A. Zadeh telah memperkenalkan set kabur dalam kajiannya pada tahun 1965, yang mana kajiannya telah mentakrifkan data ketakpastian dengan konsep nombor kabur. Ketakpastian merupakan sifat yang ada pada suatu nilai matematik kabur. Namun, pembinaan model ketakpastian lengkung menjadi suatu masalah oleh kerana faktor ketakpastian. Dengan mengambil kira faktor ketakpastian tersebut, teori set kabur dan konsep nombor kabur akan digunakan bagi membentuk set data kabur. Hal ini demikian kerana teori set kabur memberikan fleksibiliti yang diperlukan untuk mentakrifkan ketakpastian. Oleh itu, lengkung *B-Spline* kabur yang dibina menerusi model tertentu dengan titik kawalan rangup dan lengkung splin adalah sebahagian daripada lengkung yang dibentuk. Kemudian, proses pengkaburan melalui operasi potongan-alfa dan proses penyahkaburan dilaksanakan bagi mendapatkan lengkung B-Spline kabur. Contoh aplikasi dalam model ini dapat dibincangkan dengan mengaplikasikan data purata suhu di Tawau, Sabah terhadap lengkung B-Spline kabur. Seterusnya, ralat pula ditentukan bagi menguji keberkesanan model rangup dan model nyahkabur yang dibangunkan.

OBJEKTIF

- Membangunkan model kabur, pengkaburan dan model penyahkaburan bagi lengkung *B-Spline* kabur dengan menggunakan teori set kabur.
- Mengaplikasikan model lengkung *B-Spline* kabur dalam memodelkan purata suhu di Tawau, Sabah.

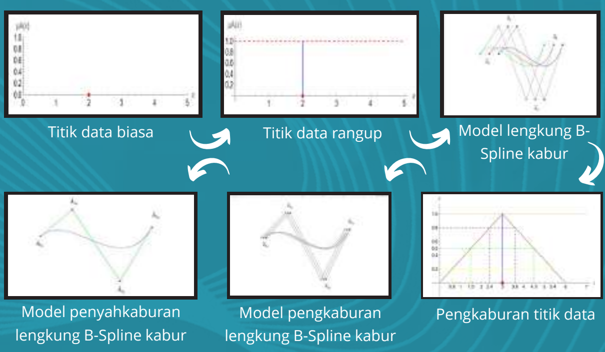
KAEDAH KAJIAN

Teori Set Kabur:
Fungsi keahlian mencirikan gred keahlian bagi setiap unsur ***A*** dalam ***X*** yang ditakrifkan sebagai:

$$\mu_A(x) = \begin{cases} 1 & \text{jika } x \in A \text{ (keahlian penuh)} \\ c \in (0,1) & \text{jika } \tilde{x} \in A \text{ (keahlian separuh)} \\ 0 & \text{jika } x \notin A \text{ (bukan keahlian)} \end{cases}$$

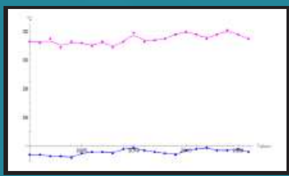
Segi tiga Nombor Kabur:
Segi tiga nombor kabur adalah salah satu jenis nombor kabur yang dapat ditakrifkan sebagai:

$$\mu_A(x) = \begin{cases} \dfrac{x-a_1}{a_2-a_1} & \text{jika } a_1 \le x \le a_2 \\ \dfrac{a_3-x}{a_3-a_2} & \text{jika } a_2 \le x \le a_3 \\ 0 & \text{Sebaliknya} \end{cases}$$

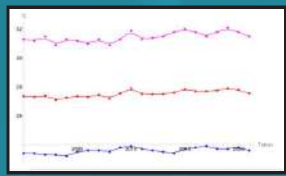


Rajah 1: Carta alir pemodelan lengkung *B-Spline* kabur dengan menggunakan data kabur

HASIL KAJIAN & PERBINCANGAN

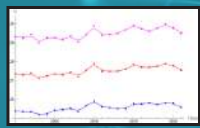


Rajah 2: Data Purata Suhu dalam bentuk lengkung *B-Spline* Kabur

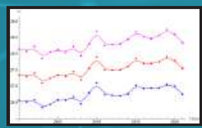


Rajah 3: Lengkung *B-Spline* Kabur terhadap data purata suhu

Rajah 4

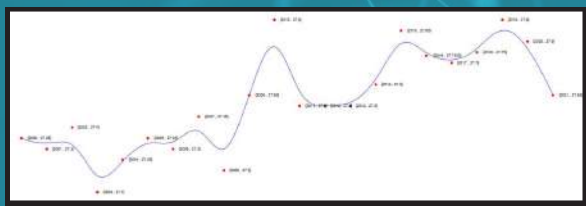


Rajah 5

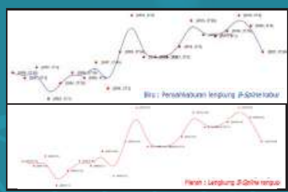


Rajah 6

Dengan mengaplikasikan konsep segi tiga nombor kabur, **Rajah 4, Rajah 5** dan **Rajah 6** menunjukkan pengkaburan lengkung *B-Spline* kabur menggunakan nilai alfa **0.2, 0.5 dan 0.8** untuk memodelkan data purata suhu.



Rajah 7: Model Penyahkaburan Lengkung *B-Spline* Kabur dengan nilai alfa 0.8



Rajah 8: Perbandingan lengkung *B-Spline* rangup dan lengkung nyahkabur

Berdasarkan perbandingan lengkung di Rajah 7, model ini mempunyai purata ralat 0.00000218794. Dengan ini, pemodelan lengkung *B-Spline* kabur terhadap data purata suhu telah menunjukkan model ini boleh digunakan kerana nilai-nilai tersebut adalah dalam julat yang boleh diterima iaitu kurang daripada 0.1.

KESIMPULAN

Dalam kajian ini, gabungan pemodelan geometri dengan konsep nombor kabur dikaji untuk menghasilkan model geometri kabur. Model ini digunakan dalam menangani masalah data ketidakpastian. Proses pengkaburan dan penyahkaburan dilaksanakan bagi model *B-spline* kabur. Nilai ralat yang sangat kecil diperoleh, menunjukkan bahawa model lengkung *B-spline* kabur dapat digunakan dalam ketakpastian purata suhu.

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PENGHARGAAN

Setinggi-tinggi penghargaan dan ucapan terima kasih kepada penyelia saya, Dr. Rozaimi Zakaria atas bimbingan beliau dalam melaksanakan projek tahun akhir ini. Kejayaan menyiapkan projek ini adalah hasil daripada dorongan, bimbingan dan motivasi yang diberikan oleh semua pihak yang terlibat secara langsung mahupun tidak langsung sepanjang proses penyelesaian projek tahun akhir saya ini.

RAMALAN TABURAN HUJAN DI KUDAT BERDASARKAN LOGIK KABUR

NUR IZZAHWANI BINTI MARTANG & DR. SUZELAWATI ZENIAN

Fakulti Sains dan Sumber Alam, Universiti Malaysia Sabah,
88999, Kota Kinabalu, Sabah, Malaysia.

ABSTRAK

Hujan memainkan peranan yang sangat penting dalam menyokong pelbagai aktiviti manusia seperti pertanian, pembangunan, pengurusan sumber air dan perikanan. Walau bagaimanapun, hujan adalah kejadian semula jadi yang terus berubah disebabkan oleh pelbagai faktor iklim yang mempengaruhinya. Satu cara untuk menjangka perubahan taburan hujan yang mungkin berlaku dengan lebih awal adalah dengan mewujudkan sistem yang boleh meramal hujan. Logik kabur merupakan salah satu kaedah yang boleh digunakan dalam sistem ramalan untuk mengetahui faktor yang mempengaruhi taburan hujan pada masa dan tempat tertentu. Dalam sistem ini, satu kaedah logik kabur yang telah digunakan ialah kaedah Mamdani dengan dua parameter sokongan iaitu suhu dan kelajuan angin. Dalam penyelidikan ini, set data yang digunakan adalah bagi tahun 2020 dan 2021 dan telah menghasilkan peratusan ketepatan sebanyak 71.48% bagi tahun 2020 dan 67.86% bagi tahun 2021.

PENYATAAN MASALAH

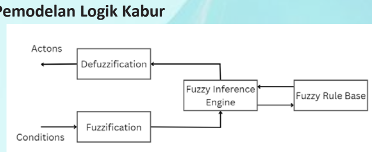
Corak cuaca yang tidak menentu sepanjang tahun di Kudat mewujudkan cabaran yang serius dalam pengurusan bencana dan perancangan sumber yang berkesan terutama semasa monsun barat daya (Mei hingga September), monsun timur laut (November hingga Mac), dan monsun peralihan (pertengahan Mac hingga pertengahan Mei, dan September hingga Oktober), Fenomena seperti hujan lebat, kekurangan hujan dan awan menyebabkan hujan lebat, banjir, dan kemarau.

OBJEKTIF

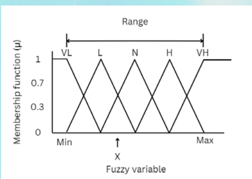
1) Untuk meramal jumlah taburan hujan di Kudat bagi tahun 2020 dan 2021 menggunakan kaedah logik kabur berdasarkan dua pembolehubah iklim iaitu suhu dan kelajuan angin.
2) Untuk membangunkan model ramalan hujan yang boleh digunakan dalam pelbagai bidang seperti pertanian, pengurusan sumber air, dan pengurangan risiko bencana.

KAEDAH KAJIAN

Pemodelan Logik Kabur



Rajah 1: *Fuzzy Base System*



Rajah 2: Pemboleh ubah Kabur

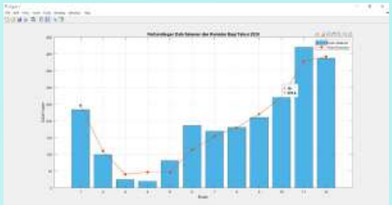
Fungsi keahlian yang sepadan diperoleh daripada fungsi keahlian segi tiga dengan had bawah p, had atas q, dan nilai m di antara p dan q.

$$\mu_A(x) = \begin{cases} 0x \leq p \\ \dfrac{x-p}{m-p} < x \leq m \\ 1x \geq q \end{cases}$$

Pemboleh ubah kabur X dan fungsi keahlian yang ada, $\mu \rightarrow [0,1]$. Set kabur didefinisikan sebagai:

$$\mu A(x) \geq 0, vx \in X$$

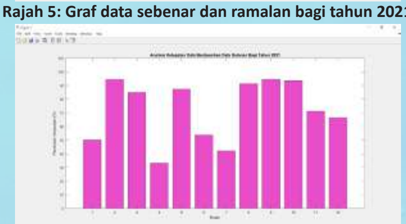
KEPUTUSAN DAN PERBINCANGAN



Rajah 3: Graf data sebenar dan ramalan bagi tahun 2020

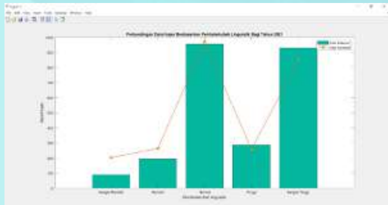
Rajah 4: Graf peratusan ketepatan bagi tahun 2020

Rajah 5: Graf data sebenar dan ramalan bagi tahun 2021

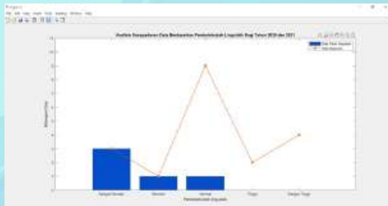


Rajah 6: Graf peratusan ketepatan bagi tahun 2020

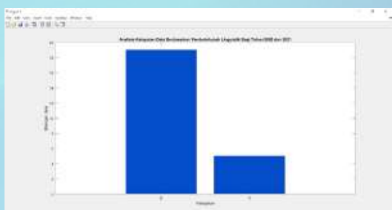
Rajah 7: Graf data sebenar dan ramalan bagi tahun 2020 berdasarkan pembolehubah linguistik



Rajah 8: Graf data sebenar dan ramalan bagi tahun 2021 berdasarkan pemboleh ubah linguistik



Rajah 9: Graf kesepadanan data bagi tahun 2020 dan 2021



Rajah 10: Graf ketepatan ramalan berdasarkan pemboleh ubah linguistik bagi tahun 2020 dan 2021

$$Peratusan\ Ketepatan = \frac{19}{24} \times 100\% = 79.17\%$$

Dengan menggunakan kaedah logik kabur untuk meramal hujan, hasil analisis menunjukkan keberkesanan ramalan boleh dicapai dengan ketepatan 79.17%. Hal ini menunjukkan keberkesanan dan kesesuaian kaedah dalam menghasilkan ramalan yang lebih tepat dan relevan dalam konteks hujan.

Jadual 1: Nilai peratusan ketepatan berdasarkan jumlah taburan hujan bulanan bagi tahun 2020 dan 2021

Tahun	RMSE	Ketepatan (%)
2020	28.57	71.48
2021	32.14	67.86

Berdasarkan Jadual 1, ketepatan bagi seluruh data bagi tahun 2020 dan 2021 menunjukkan tahun 2020 mempunyai nilai peratusan yang lebih tinggi berbanding dengan tahun 2021. Hal ini menunjukkan data ramalan bagi tahun 2020 lebih tepat berbanding data 2021.

KESIMPULAN

Secara keseluruhan, kajian ini adalah untuk mendapatkan ramalan taburan hujan bulanan di Kudat bagi tahun 2020 dan 2021 menggunakan perisian Matlab berdasarkan sistem logik kabur kaedah Mamdani. Sistem logik kabur berdasarkan Kaedah Mamdani ini sesuai dalam memodelkan ramalan taburan hujan di Kudat kerana parameter fungsi keahlian memberikan julat yang tepat hampir bagi setiap data.

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PENGHARGAAN

Penghargaan dan terima kasih kepada ibu bapa saya, penyelia saya, pensyarah, dan rakan-rakan yang telah membantu saya dalam projek ini. Seterusmya, saya ingin mengucapkan ribuan terima kasih kepada mereka yang terlibat secara langsung atau tidak langsung dalam proses menyiapkan projek tahun akhir saya.

SW40106 KAJIAN TAHUN AKHIR II
PROGRAM MATEMATIK DENGAN GRAFIK BERKOMPUTER

UMS UNIVERSITI MALAYSIA SABAH

PENGGUNAAN MODEL PENGATURCARAAN LINEAR DALAM PENJADUALAN TUGAS JURURAWAT DI WAD RAWATAN RAPI NEONATAL (NICU) HOSPITAL KENINGAU

Nurhanani Nadzirah & Asdalifah Talibe
Mathematics Visualization Research Group (MathViz)
Matematik dengan Grafik Berkomputer
Fakulti Sains dan Sumber Alam Universiti Malaysia Sabah
Email: nurhananinadzirah@yahoo.com & asdalifah@ums.edu.my

ABSTRAK

Kajian ini dijalankan bertujuan mengoptimumkan penjadualan kitaran 12 jururawat NICU, Hospital Keningau selama 28 hari. Data diperoleh melalui temu ramah dan model dibina berdasarkan peraturan yang ditetapkan oleh pihak hospital. Namun, penjadualan yang disediakan secara manual telah melanggar beberapa kekangan. Melalui perisian LINGO dan Excel, penjadualan yang optimum menggunakan pendekatan model pengaturcaraan linear berjaya dicapai dengan memenuhi kesemua kekangan terlibat yang membolehkan setiap jururawat hanya bertugas 20 hari sebulan. Kajian ini telah menghasilkan susunan jadual yang cekap dan memberikan jururawat kawalan yang lebih baik terhadap jadual tugas mereka.

PENGENALAN

Hospital Keningau menghadapi masalah kekurangan tenaga kerja jururawat kerana peningkatan jumlah pesakit di hospital tersebut melebihi jumlah jururawat yang tersedia. NICU terutamanya terkesan kerana mereka perlu memantau bayi-bayi kritikal yang baru lahir sepanjang 24 jam sehari. Walau bagaimanapun, penyusunan jadual yang masih menggunakan kaedah manual menyebabkan pengagihan hari dan syif bertugas kepada jururawat adalah tidak cekap dan tidak seimbang. Oleh itu, kajian akan dijalankan untuk membangunkan jadual 28 hari yang optimum melalui pendekatan pengaturcaraan linear.

OBJEKTIF KAJIAN

Objektif kajian ini adalah untuk:

1. Membina model pengaturcaraan linear untuk menyelesaikan masalah penjadualan jururawat di NICU, Hospital Keningau berdasarkan peraturan pihak hospital.
2. Membina jadual kitaran menggunakan Excel berpandukan hasil pengoptimuman model pengaturcaraan linear yang diperoleh melalui LINGO.

METODOLOGI

Rajah 1: Carta alir proses pembinaan model

Model pengaturcaraan linear untuk penjadualan jururawat di NICU, Hospital Keningau adalah seperti di bawah:

Meminimumkan $z=\sum_{i=1}^{m}\sum_{j=1}^{n}(M_{i,j}+E_{i,j}+N_{i,j})$ (1)

Subjek kepada:

$\sum_{i=1}^{m} M_{i,j}+E_{i,j}+N_{i,j} \geq 20$ (2)

$\sum_{i=1}^{m} M_{i,j}+E_{i,j}+N_{i,j} \leq 22$ (3)

$\sum_{i=1}^{m} M_{i,j} \geq 6$ (4)

$\sum_{i=1}^{m} E_{i,j} \geq 6$ (5)

$\sum_{i=1}^{m} N_{i,j} \geq 8$ (6)

$\sum_{i=1}^{m}\sum_{j=1}^{n}(M_{i,j}+E_{i,j}+N_{i,j}+F_{i,j}+X_{i,j})=1$ (7)

$\sum_{j=1}^{n} M_{i,j} \geq 1$ (8)

$\sum_{j=1}^{n} E_{i,j} \geq 1$ (9)

$\sum_{j=1}^{n} N_{i,j} \geq 2$ (10)

$\sum_{j=1}^{n} M_{i,j} \leq 5$ (11)

dengan $M_{i,j}, E_{i,j}, N_{i,j}, F_{i,j}, X_{i,j} \in \{0,1\}$, $i=1,2,\dots,m$ dan $j=1,2,\dots,n$

Tatatanda
i = Indeks hari ($i \in m=28$)
j = Indeks jururawat ($j \in n=12$)

Pemboleh ubah
M = Syif pagi
E = Syif petang
N = Syif malam
F = Rehat malam
X = Cuti rehat
Z = Jumlah hari bertugas

$\sum_{j=1}^{n} E_{i,j} \leq 4$ (12)

$\sum_{j=1}^{n} N_{i,j} \leq 4$ (13)

$M_{i,j}+M_{i+1,j}+M_{i+2,j} \leq 2$ (14)

$E_{i,j}+E_{i+1,j}+E_{i+2,j} \leq 2$ (15)

$N_{i,j}+N_{i+1,j}-(F_{i+1,j}+F_{i+2,j}) \leq 1$ (16)

$N_{i,j}+M_{i+1,j}+E_{i+1,j} \leq 1$ (17)

$F_{i,j}+F_{i+1,j}+M_{i+1,j}+E_{i+1,j}+N_{i+1,j} \leq 1$ (18)

$X_{i,j}+X_{i+1,j}+X_{i+2,j}+X_{i+3,j}+X_{i+4,j}+X_{i+5,j}+X_{i+6,j}=1$ (19)

$X_{i,j}+M_{i+1,j}+E_{i+1,j}+N_{i+1,j}+X_{i+2,j} \leq 2$ (20)

HASIL & PERBINCANGAN

Jadual 1: Jadual syif bertugas jururawat menggunakan kaedah manual.

Hari	Jururawat												Jumlah Jururawat Bertugas per Syif				
	1	2	3	4	5	6	7	8	9	10	11	12	M	E	N	F	X
1	M	E	M	N	X	M	X	F	E	E	F	N	3	3	2	2	2
2	M	E	N	F	N	X	E	X	N	M	M	F	3	2	3	2	2
3	M	M	N	X	N	E	M	N	F	M	M	E	5	2	3	1	1
4	N	M	F	E	F	M	M	N	X	E	M	E	4	3	2	2	1
5	N	N	X	E	X	M	X	F	E	M	X	M	3	2	2	1	4
6	F	N	M	E	M	E	N	E	M	X	N	X	3	3	3	1	2
7	X	F	M	M	M	N	N	E	E	X	N	E	3	3	3	1	2
8	E	X	E	N	E	N	F	M	M	N	F	M	3	3	3	2	1
9	M	E	M	N	M	F	X	E	N	N	X	E	3	3	3	1	2
10	M	E	E	F	N	X	E	X	N	F	E	N	1	4	3	2	2
11	M	M	E	E	N	E	E	N	F	X	M	N	3	4	3	1	1
12	M	N	X	E	F	E	M	N	X	E	N	F	2	3	3	2	2
13	M	N	N	E	M	M	M	F	E	M	N	E	5	3	3	1	0
14	X	F	N	X	E	N	N	E	M	E	F	M	2	3	3	2	2
15	N	E	F	M	X	N	N	M	E	M	E	X	3	3	3	1	2
16	N	M	X	N	E	F	F	M	E	M	E	E	3	4	2	2	1
17	F	E	M	N	N	X	E	M	M	N	X	E	3	3	3	1	2
18	E	N	M	F	N	M	X	M	N	N	E	M	4	2	4	1	1
19	M	N	E	X	F	E	M	X	N	F	M	N	3	2	3	2	2
20	M	F	E	E	X	M	E	N	F	X	N	N	2	3	3	2	2
21	E	X	N	M	E	M	M	N	X	E	N	F	3	3	3	1	2
22	X	M	N	E	M	E	N	F	E	M	F	X	3	3	2	2	2
23	M	E	F	M	E	N	N	M	E	N	X	M	4	3	3	1	1
24	N	M	X	E	M	N	F	E	M	N	E	E	3	4	3	1	1
25	N	N	M	M	E	F	X	X	N	F	M	M	4	1	3	2	2
26	F	N	E	E	N	X	M	M	N	X	M	E	3	3	3	1	2
27	X	F	E	X	N	E	M	N	F	E	N	M	2	3	3	2	2
28	E	X	M	N	F	E	E	N	X	M	N	N	2	3	4	1	2
Jumlah Syif Pagi per Jururawat	11	6	8	5	6	7	8	7	5	8	7	7	Nota:				
Jumlah Syif Petang per Jururawat	4	7	7	10	6	8	6	5	8	6	5	9	M = Pagi			F = Rehat Malam	
Jumlah Syif Malam per Jururawat	6	8	6	6	8	6	6	8	7	6	8	6	E = Petang			X = Cuti	
Jumlah Hari Bertugas	21	21	21	21	20	21	20	20	20	20	20	22	N = Malam				
Jumlah Rehat Malam per Jururawat	3	4	3	3	4	3	3	4	4	3	4	3					
Jumlah Cuti per Jururawat	4	3	4	4	4	4	5	4	4	5	4	3					

Jadual 2: Jadual syif bertugas jururawat menggunakan model pengaturcaraan linear.

Hari	Jururawat												Jumlah Jururawat Bertugas per Syif				
	1	2	3	4	5	6	7	8	9	10	11	12	M	E	N	F	X
1	X	N	E	X	N	M	E	E	N	M	E	N	2	4	4	0	2
2	E	F	N	M	F	N	M	E	N	N	M	F	3	2	4	3	0
3	E	X	N	E	X	N	E	N	F	N	M	X	1	3	4	1	3
4	M	M	F	M	M	F	N	N	X	F	N	E	4	1	3	3	1
5	N	E	X	N	E	X	N	F	M	X	N	E	1	3	4	1	3
6	N	M	M	N	E	M	F	X	E	M	F	M	5	2	2	2	1
7	F	N	E	F	N	M	X	M	E	M	X	N	3	2	3	2	2
8	X	N	E	X	N	E	M	E	N	E	M	N	2	4	4	0	2
9	M	F	N	M	F	N	M	M	N	N	E	F	4	1	4	3	0
10	E	X	N	M	X	N	E	N	F	N	E	X	1	3	4	1	3
11	M	E	F	E	E	F	N	N	X	F	N	M	2	3	3	3	1
12	N	E	X	N	M	X	N	F	M	X	N	E	2	2	4	1	3
13	N	M	E	N	E	E	F	X	M	E	F	M	3	4	2	2	1
14	F	N	M	F	N	M	X	M	E	M	X	N	4	1	3	2	2
15	X	N	E	X	N	M	M	E	N	E	M	N	3	3	4	0	2
16	E	F	N	E	F	N	E	M	N	N	M	F	2	3	4	3	0
17	E	X	N	E	X	N	M	N	F	N	E	X	1	3	4	1	3
18	M	M	F	M	M	F	N	N	X	F	N	E	4	1	3	3	1
19	N	E	X	N	E	X	N	F	M	X	N	M	2	2	4	1	3
20	N	E	M	N	M	E	F	X	M	E	F	M	4	3	2	2	1
21	F	N	E	F	N	E	X	E	E	M	X	N	1	4	3	2	2
22	X	N	M	X	N	M	E	M	N	E	E	N	3	3	4	0	2
23	M	F	N	E	F	N	M	E	N	N	M	F	3	2	4	3	0
24	E	X	N	M	X	N	E	N	F	N	E	X	1	3	4	1	3
25	M	M	F	E	M	F	N	N	X	F	N	E	3	2	3	3	1
26	N	M	X	N	M	X	N	F	E	X	N	E	2	2	4	1	3
27	N	E	M	N	E	E	F	X	M	E	F	M	3	4	2	2	1
28	F	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	2	3	2	2
Jumlah Syif Pagi per Jururawat	6	6	6	6	6	6	6	6	6	6	6	6	Nota:				
Jumlah Syif Petang per Jururawat	6	6	6	6	6	6	6	6	6	6	6	6	M = Pagi			F = Rehat Malam	
Jumlah Syif Malam per Jururawat	8	8	8	8	8	8	8	8	8	8	8	8	E = Petang			X = Cuti	
Jumlah Hari Bertugas	20	20	20	20	20	20	20	20	20	20	20	20	N = Malam				
Jumlah Rehat Malam per Jururawat	4	4	4	4	4	4	4	4	4	4	4	4					
Jumlah Cuti per Jururawat	4	4	4	4	4	4	4	4	4	4	4	4					

Jadual 1 dan 2 menunjukkan pola syif bertugas, rehat malam dan cuti untuk 12 orang jururawat yang dibina masing-masing berdasarkan kaedah manual dan pengoptimuman dari model pengaturcaraan linear. Jadual baharu telah memenuhi kesemua 12 kekangan yang ditetapkan mengikut peraturan pihak hospital. Perbandingan kedua-dua jadual dapat dilihat pada Jadual 3.

Jadual 3: Perbandingan jadual yang dibuat secara manual dan melalui model pengaturcaraan linear.

[illegible]

KESIMPULAN

Pada akhir kajian, kedua-dua objektif tercapai. Model pengaturcaraan linear berjaya dibangunkan untuk penjadualan jururawat di NICU, Hospital Keningau dengan mengambil kira semua peraturan dan batasan yang dikenakan oleh pihak hospital. Setelah mengoptimumkan model menggunakan LINGO, jadual kitaran 28 hari telah dihasilkan menggunakan Excel dan boleh dipaparkan melalui VBA. Pendekatan model ini boleh diperluaskan ke unit-unit lain di seluruh hospital bagi menyediakan penyelesaian menyeluruh untuk penjadualan jururawat.

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PENGHARGAAN

Setinggi-tinggi penghargaan kepada penyelia, pensyarah, keluarga dan rakan-rakan yang banyak membantu menyiapkan penyelidikan ini. Tidak lupa kepada pihak Hospital Keningau yang sudi berkongsi maklumat penyusunan jadual di hospital tersebut.

Pemodelan Interpolasi Lengkung Splin-B Kubik Kabur Terhadap Data Harga Emas dalam Ringgit Malaysia pada Tahun 2018 Sehingga Tahun 2022

Nurul Azeah Watie Binti Mohd Ali, Rozaimi Bin Zakaria
nurul_azeah_bs20@iluv.ums.edu.my, rozaimi@ums.edu.my
Fakulti Sains dan Sumber Alam, ,Universiti Malaysia Sabah

ABSTRAK

membincangkan tentang pembinaan pemodelan interpolasi lengkung menggabungkan pemodelan geometri dengan menyelesaikan masalah ketakpastian Pendekatan melibatkan proses pengkaburan proses penyahkaburan digunakan menyelesaikan masalah ketakpastian wujud didalam dalam ringgit Malaysia diambil Model pengkaburan merangkumi rangup mempunyai ketakpastian menyel saikan masalah tersebut proses penyahkaburan dijalankan terhadap model pengkaburan menghasilkan model nyahkabur bernilai tunggal Kebolehpercayaan model dibina dengan mencari wujud

OBJEKTIF

Pemodelan interpolasi lengkung adalah matlamat objektif dicapai adalah

- Membangunkan lengkung model pengkaburan model penyahkaburan interpolasi lengkung menggunakan
- gaplikasikan model interpolasi lengkung terhadap Malaysia

KAEDAH KAJIAN

Teor Set Kabur

- Mentakrifkan ketakpastian data melalui pendekatan nombor kabur.
- Diwakili dengan nilai keahlian

$$\mu_A(x) = \begin{cases} 1 \;\; jika\ x \in A\ (keahlian\ penuh) \\ c \in (0,1) \;\; jika\ x\ \tilde{\in} A\ (bukan\ keahlian\ penuh) \\ o \;\; jika\ x \notin A\ (bukan\ keahlian) \end{cases}$$

Teori Set Kabur

- Perwakilan matematik dalam bentuk geometri.
- Fungsi Interpolasi Splin-B Kubik:

$$\tilde{B}_\alpha(t) = \sum_{i=0}^{d} D_i N_{i,d}(t)$$

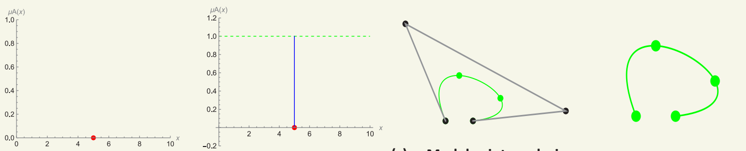
PERNYATAAN MASALAH

dalam mengandungi ketidakpastian disebabkan berlaku semasa proses pengumpulan termasuklah kesilapan manusia kerosakan pengukur

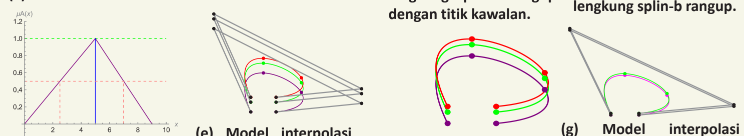
PENGHARGAAN

Terima terhingga kepada penyelia Rozaimi bimbingan sepanjang menyiapkan projek sangat menghargai segala sokongan kerjasama diberikan sepanjang penyelidikan

Carta Alir Pemodelan Lengkung Splin-B Kubik Kabur

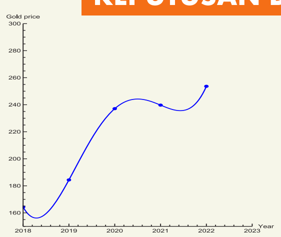


(a) Titik data
(b) Titik data rangup
(c) Model interpolasi lengkung splin-B rangup dengan titik kawalan.
(d) Model interpolasi lengkung splin-b rangup.

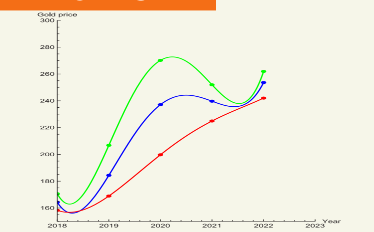


(e)Pengkaburan dalam bentuk segitiga nombor kabur
(e) Model interpolasi lengkung splin-B pengkaburan dengan titik kawalan.
(f) Model interpolasi lengkung splin-B kubik pengkaburan.
(g) Model interpolasi lengkung splin-B nyahkabur dengan titik kawalan.

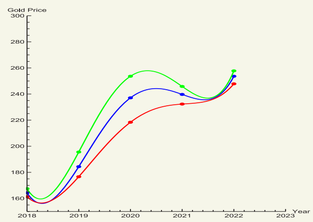
KEPUTUSAN DAN PERBINCANGAN



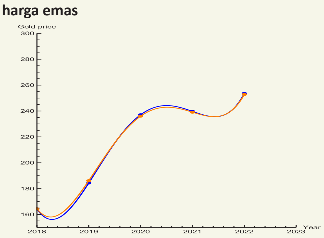
Interpolasi lengkung splin-B kubik rangup data harga emas



Interpolasi lengkung splin-B kubik kabur terhadap data harga emas



Model interpolasi lengkung splin-B kubik pengkaburan terhadap data harga emas dengan nilai alfa=0.5



Model interpolasi lengkung splin-B kubik nyahkabur terhadap data harga emas.

KESIMPULAN

Model lengkung terhadap Berjaya dibangunkan dengan gabungan pemodelan geometri diperoleh adalah lingkungan diterima 00002296 kurang daripada

RUJUKAN

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UNDERWATER IMAGE ENHANCEMENT VIA COLOR CHANNELS COMPENSATION, MULTI-SCALE RETINEX WITH COLOR RESTORATION AND IMPROVED ADAPTIVE GAMMA CORRECTION WITH WEIGHTING DISTRIBUTION

Sally Pan Hui Qi & Abdullah Bade
Mathematics Visualization Research Group (MathViz)
Mathematics with Computer Graphics Programme
Faculty of Science and Natural Resources
Universiti Malaysia Sabah
sally_pan_bs20@iluv.ums.edu.my & abb@ums.edu.my

UMS UNIVERSITI MALAYSIA SABAH

MCG

ABSTRACT

Underwater image plays a crucial role in providing critical insights into the underwater environment. However, underwater images are often of degraded quality due to the properties of water that influenced the propagation of light. Thus, this paper proposed an underwater image enhancement system that implements a sequence of algorithms including Color Channels Compensation, Multi-Scale Retinex with Color Restoration, and Improved Adaptive Gamma Correction with Weighting Distribution.

INTRODUCTION

Underwater images are essential for exploring and understanding the underwater environment, serving various applications like underwater archeology and marine life recognition [1]. However, underwater images are often of degraded quality as light propagates differently in water [2]. In the underwater environment, lights with longer wavelengths are more absorbed, causing a color cast in underwater images, often appear in bluish or greenish tones. On the other hand, the scattering effect caused by water molecules and suspended particles leads to color distortion and low-contrast in underwater image. This phenomenon not only causes objects that appear colorful on the surface to appear dull and monochromatic underwater, but also decreases the difference of intensity between the object and the background.

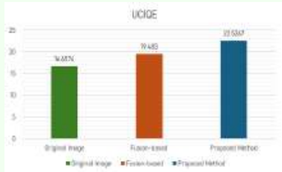
OBJECTIVES

- To apply color channels compensation that is used to minimize the effect color cast in underwater images.
- To correct color distortion on the underwater image by implementing Multi-Scale Retinex with Color Restoration (MSRCR).
- To apply Improved Adaptive Gamma Correction with Weighting Distribution (IAGCWD) that is used to boost the contrast of underwater images.

RESULTS AND DISCUSSION

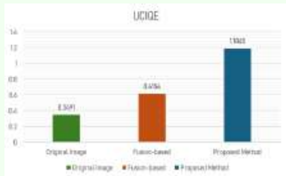
High PCQI value indicate high contrast

Average PCQI value for the original image is 0.6389 while the output of Fusion-based method is 0.7172. The output of the proposed method achieved the highest average PCQI value which is 0.8098 (increased 26.7491%).



High UCIQE value indicate high color accuracy

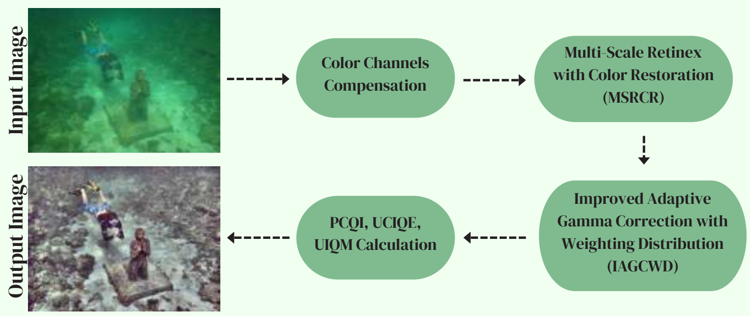
Average UCIQE value for the original image is 16.5674. The results of Fusion-based method obtained an average UCIQE value of 19.4830 while the final results have the highest average UCIQE value which is 22.5267 (increased 35.97%).



High UIQM value indicate high quality

Average UIQM value for the original images is 0.3491 while the Fusion-based method is 0.6156. The final outputs achieved highest average UIQM value which is 1.1865 (increased 118.64%).

METHODOLOGY



CONCLUSION

The proposed method shows a good performance on underwater image enhancement as the final result of the proposed method has higher color accuracy and contrast. This can be supported by evaluating the proposed algorithm using a series of image quality assessments. However, the proposed method has two shortcomings. The first drawback is the time-consuming nature of the proposed system. The proposed system utilizes multiple image processing techniques which requires a significant processing time to obtain the final results. Besides, the MSRCR process increases the computation time as the number of Gaussian kernels increases. Furthermore, this system has limited enhancement capabilities where all three-color channels are highly attenuated.

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to my supervisor, Assoc. Prof. Dr. Abdullah Bade. His unwavering guidance and assistance have been instrumental in navigating the complex processes of my final year project. Besides, I would like to thank my family and friends who have provided me spiritual support throughout this project. This study would not be a success without their assistance and support.

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SW40106 SCIENTIFIC PROJECT II
PROGRAM OF MATHEMATICS WITH COMPUTER GRAPHICS

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IMPROVED MULTILEVEL MODULARITY OPTIMIZATION METHOD FOR CATCHMENT CLASSIFICATION

SEK JEN NEE[1,3,4] & SITI AISYAH BINTI TUMIRAN[2,3,5]

[1]Mathematics Visualization Research Group (MathViz), [2]Mathematics Computer Graphics Programme,
[3]Faculty of Science and Natural Resources, University Malaysia Sabah
Email: [4]sek_jen_bs20@iluv.ums.edu.my & [5]sitiaisyah.tumiran@ums.edu.my

ABSTRACT

This study aims to enhance the Multilevel Modularity Optimization (MMO) method, specifically the Multilevel Modularity Density Optimization (MMDO) method, by replacing the modularity function (Q value) with modularity density function (D value). The MMDO method will be evaluated by classifying catchments with three different network sizes, that are, the entire network station (218), a small network size of 100 random realizations, and a small network size of 9 drainage division regions in Australia. This study also investigates the relationship between catchment characteristics and flow characteristics in selected 10 large communities using the MMDO method, as well as the relationship between distance and correlation using the catchment classification obtained in Australia.

PROBLEM STATEMENT

The MMO method, proposed by Blondel *et al.* (2008), which measures network partitioning into densely connected communities. However, the Q value, modularity function, measurement has found to have limitation, scale resolution limit problem. The MMDO method is the improved method to overcome the limitation by replacing the Q value with D value, the modularity density function, to provide a reliable catchment classification framework.

OBJECTIVES

I. Improve the MMO method using modularity density function for catchment classification.
II. Evaluate the superiority of the improved MMO method by classifying catchments with three different scenarios of network sizes.
III. Investigate the relationship between catchment characteristics and flow characteristics, as well as the distance-correlation relationship, based on the communities identified using the improved method.

RESEARCH METHODOLOGY

Modularity Function Formula:

$$A_{ij} = \begin{cases} 1 & if\ there's\ link\ between\ i\ and\ j, \\ 0 & otherwise \end{cases}$$

$$Q = A_{ij} - \frac{k_i k_j}{2m}$$

where,
A_{ij} is the Adjacency matrix,
k_i and k_j are the degree of the vertex, and
m is the total number of links in the network.

Modularity Density Function Formula:

$$D = \sum_i \left(\frac{2l_i}{n_i} - \frac{l_i^{ext}}{n_i} \right)$$

where,
n_i serves as the number of nodes in subgraph i,
l_i serves as the number of internal links in subgraph i,
l_i^{ext} serves as the number of external links in subgraph i.

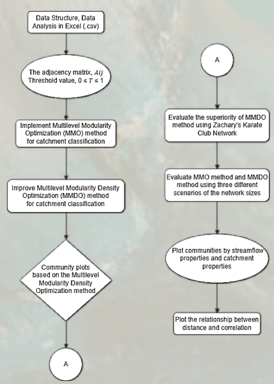

Figure 1: Flow Chart for Methodological Procedures.

RESULTS AND DISCUSSION

Zachary's Karate Club Network Benchmark

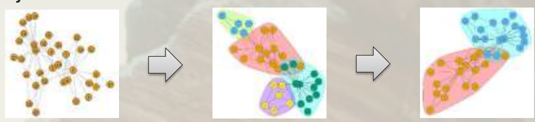

Figure 2: Outcomes of Zachary's Karate Club Network (left), after applied MMO method (middle) and after applied MMDO method (right).

Superiority of MMDO method

Figure 3: Community detected using MMO method (left) and MMDO method (right).

	Number of Stations Changed	
Regions	**MMO**	**MMDO**
Carpentaria Coast (CC)- 13 stations	4	1
Lake Eyre Basin (LEB)- 5 stations	0	0
Murray Darling Basin (MDB)- 75 stations	14	11
Northeast Coast (NEC)- 42 stations	10	6
Southeast Coast (NSW)- 16 stations	3	0
Southeast Coast (VIC)- 27 stations	11	3
Southwest Coast (SWC)- 11 stations	7	0
Tasmania (TAS)- 12 stations	4	0
Tanami Timor Sea Coast (TTS)- 12 stations	4	0
Total of number station changed	57	21

Table 1: Number of stations changed using both methods according to the 9 drainage divisions.

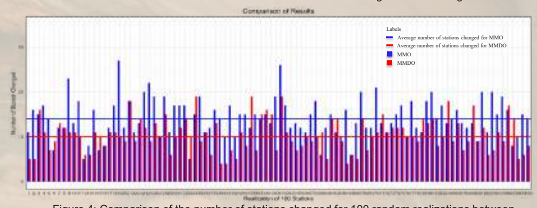

Figure 4: Comparison of the number of stations changed for 100 random realizations between both methods.

Catchment Relationship using MMDO method

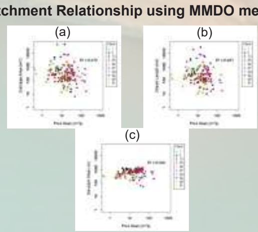

Figure 5: Relationship between station against flow mean for 10 largest communities.

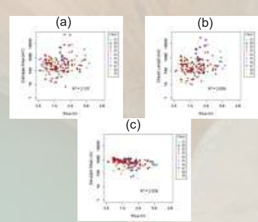

Figure 6: Relationship between station against flow CV for 10 largest communities.

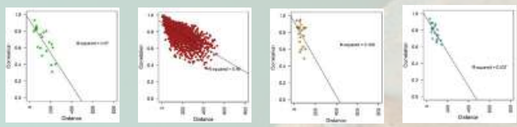

Figure 7: Distance-correlation relationship for large communities in Australia.

CONCLUSION

The MMDO method is a new approach to the MMO method, which was introduced to improve its vulnerability to scale resolution limit problems. The method maximizes a modularity density function to determine the optimal network split. The MMDO method was applied to 218 Australian network stations for catchment classification, addressing three scenarios: entire network stations, 100 random realizations, and 9 drainage division regions. Results showed the MMDO method outperformed the MMO method in most scenarios.

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ACKNOWLEDGEMENT

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SW40106 FINAL YEAR PROJECT II
MATHEMATICS WITH COMPUTER GRAPHICS PROGRAMME

Vehicle License Plate Number Recognition (VLPNR) Under Challenging Condition

Sia Ping Hui[1,3] & Rechard Lee[2,4]
[1] Program of Mathematics with Computer Graphics, [2] Mathematics Visualization Research Group (MathVis), Faculty Of Science And Natural Resources, Universiti Malaysia Sabah
[4] sia_ping_bs20@iluv.ums.edu.my, [5] rechard@ums.edu.my

Abstract

Vehicle license plate number recognition systems encounter significant hurdles, particularly in adverse weather conditions like fog, rain, and snow. These conditions pose a threat by reducing visibility and distorting captured images. This project aim to utilize a combination of object detection and optical character recognition to identify license plate numbers in adverse scenarios. The proposed model employs YOLO-NAS for object detection and EasyOCR for optical character recognition. After three iterations, the proposed model demonstrated impressive results: 98.57% accuracy in recognizing license plates under normal conditions, 89.52% accuracy under obscured conditions, and 93.78% accuracy under hazy conditions. These outcomes affirm the validity and comparable performance of the proposed method when compared to existing approaches.

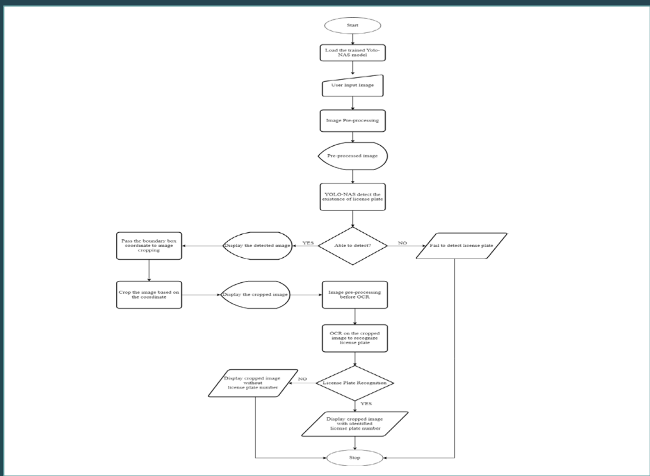
Introduction

Vehicle License Plate Recognition (VLPR) is a pivotal technology with applications in traffic management, law enforcement, and security. The process involves image capture, preprocessing, feature extraction, and the integration of pattern recognition algorithms and machine learning models. VLPR system often combines object detection and optical character recognition (OCR) to automate the identification of license plates. Object detection locates and isolates license plates within images or video streams, while OCR extracts alphanumeric characters, enabling the system to convert visual data into machine-readable text. VLPR systems face challenges in adverse conditions, impacting visibility. Adverse weather, low lighting, and hardware limitations hinder accurate license plate recognition.

Objectives

1. To design a vehicle license plate recognition model using object detection and optical recognition
2. To recognize and identify the vehicle license plate number under challenging conditions using the model.

Methodology



Result & Discussion

Results

Dataset	Accuracy %
Normal	98.57
Obscured	89.52
Hazy	93.78

Compared to Existing

Detection success	
Model	**Success %**
YOLO+SNN+MTL	99.2
Proposed model	100.0

Recognition under normal conditions	
Model	**Accuracy (%)**
Model 1	98.1
Model 2	99.8
Proposed model	98.52

Recognition under challenging conditions	
Model	**Accuracy (%)**
Model 1	95.95
Model 2	88.80
Proposed model	91.65

Conclusion

The Vehicle License Plate Recognition (VLPR) project aimed to enhance the accuracy of license plate recognition under challenging conditions. The project had successfully achieved its two objectives. Due to the lack of dataset in testing, the results of the proposed model could not prove the model is certainly better than existing model. However, using the current dataset in testing the proposed VLPR model performed on-par with existing methods and exhibited superior performance in specific conditions.

Acknowledgement

I express my gratitude to my supervisor, Mr. Rechard Lee, for his mentorship, feedback and unwavering support throughout the project. I am also deeply thankful to my examiner, Associate Professor Dr. Abdullah Bade, for his invaluable guidance and insightful suggestions.

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MATHEMATICS VISUALIZATION RESEARCH GROUP (MathViz)

APPLICATION OF FUZZY ANALYTIC HIERARCHY PROCESS IN RENTAL HOUSE PREFERENCES AMONG UNDERGRADUATES IN FACULTY OF SCIENCE AND NATURAL RESOURCES, UNIVERSITI MALAYSIA SABAH

SITI AYUNI BINTI RIFLI | ASDALIFAH BINTI TALIBE

siti_ayuni_bs20@iluv.ums.edu.my | asdalifah@ums.edu.my

MATHEMATICS WITH COMPUTER GRAPHICS PROGRAMME

FACULTY OF SCIENCE AND NATURAL RESOURCES, UNIVERSITI MALAYSIA SABAH

ABSTRACT

Rental house is one of the factors that university students must consider when residing off-campus. Each person has their own set of preferences when it comes to rental housing criteria. This survey-based research focuses on exploring the rental housing preferences of students in the Faculty of Science and Natural Resources (FSSA) at Universiti Malaysia Sabah (UMS). The aim of study is to evaluate the criteria preferences of rental house among the undergraduate students of FSSA in UMS using Fuzzy Analytic Hierarchy Process (FAHP). For data analysis, this study utilized two distinct systems: Microsoft Excel and the FuzzyAHP Calculator, a system designed for FAHP calculations using the Python programming language. The findings are FSSA students has highest priority on rental house location, followed by the overall cost, facilities, then the environment.

INTRODUCTION

Rental housing especially in Kota Kinabalu had expanded well and continued to grow until now. Given the limitations in providing student dormitories, university students rely on local rental housing markets surrounding the campus to meet their housing needs. Homeowners may have limited knowledge of students' overall preference for rental house. Thus, this issue poses a significant challenge in the housing market, leading to dissatisfaction for both homeowners and students. This problem needs to be addressed so there are initiative that can be done to educate homeowners about rental house preferences of students.

OBJECTIVES

The objectives of this study are:

1. To demonstrate the application of FAHP for rental house preference among the FSSA undergraduates; and
2. To identify the order of priority for all criteria in the selection process of rental house among FSSA undergraduates.

METHODOLOGY

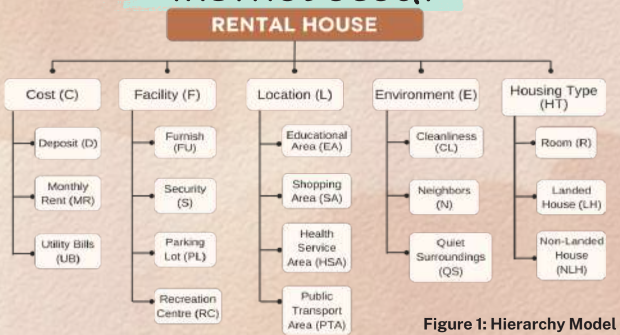

Figure 1: Hierarchy Model

1. Fuzzy Pairwise Comparison Matrix

$$\tilde{A}^k = \begin{bmatrix} \tilde{d}^k_{1,1} & \tilde{d}^k_{1,2} & \dots & \tilde{d}^k_{1,j} \\ \tilde{d}^k_{2,1} & \dots & \dots & \tilde{d}^k_{2,j} \\ \dots & & & \dots \\ \tilde{d}^k_{i,1} & \tilde{d}^k_{i,2} & \dots & \tilde{d}^k_{i,j} \end{bmatrix}$$

where $i, j = 1, 2, \dots$

2. Averaging Preferences of Multiple Decision Makers

$$\tilde{d}_{ij} = (l_{ij}, m_{ij}, u_{ij})$$

$$\tilde{d}_{ij} = (\text{average}(l^k_{ij}, m^k_{ij}, u^k_{ij}))$$

3. Fuzzy Geometric Mean Values

$$\tilde{r}_i = \left(\prod_{j=1}^{n} \tilde{d}_{ij}\right)^{\frac{1}{n}}, \qquad i = 1, 2, \dots, n.$$

4. Fuzzy Weight and Defuzzification

$$\tilde{w}_i = \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \dots \oplus \tilde{r}_n)^{-1}$$

$$\tilde{w}_i = (lw_i, mw_i, uw_i)$$

$$M_i = \frac{lw_i + mw_i + uw_i}{3}$$

5. Relative Weight

$$N_i = \frac{M_i}{\sum_{i=1}^{n} M_i}$$

6. Consistency

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

$$CR = \frac{CI}{RI}$$

All the formula was fully utilized in Microsoft Excel and FuzzyAHP Calculator system.

RESULT & DISCUSSION

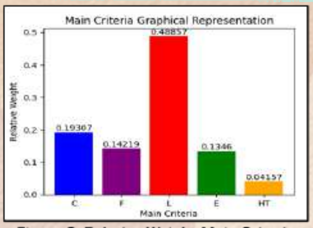

Figure 2: Relative Weight Main Criteria

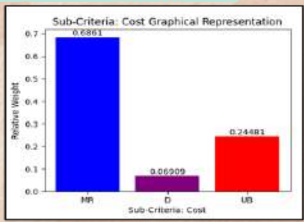

Figure 3: Relative Weight Cost

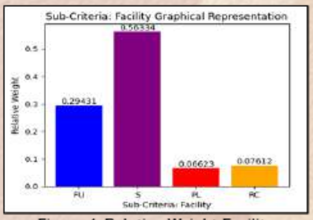

Figure 4: Relative Weight Facility

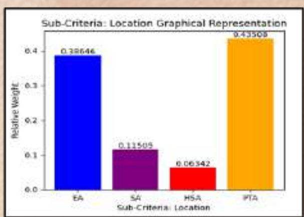

Figure 5: Relative Weight Location

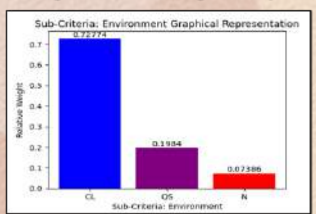

Figure 6: Relative Weight Environment

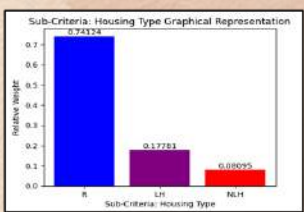

Figure 7: Relative Weight Housing Type

The criteria rank is determined by the bar plot height. Students prioritize rental housing based on location, emphasizing proximity to public transport. Second place is cost where students prioritize most on monthly rent. Next is facility where security is the most preferred amenities and environment criteria where cleanliness is the most prioritized one. Housing type is the least preferred overall but within this category, students prefer rooms.

CONCLUSION

The FAHP methods is utilized in Microsoft Excel and FuzzyAHP Calculator system. Within the system, all required formulas and algorithms is utilized for the computation of overall FAHP steps. The resultant output is extracted from the system for analysis to derive the result. The preference and priorities of FSSA students in all criteria has successfully evaluated through the designed system.

ACKNOWLEDGEMENT

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PENYULITAN DAN PENYAHSULITAN IMEJ BERWARNA MENGGUNAKAN PETA *ARNOLD CAT* & PETA *CHAOTIC* HENON

SITI NURUL HATIKAH MOHAMMAD & ARIF MANDANGAN
FACULTY OF SCIENCE AND NATURAL RESOURCES, UNIVERSITI MALAYSIA SABAH
siti_nurul_hatikah_bs20@iluv.ums.edu.my

ABSTRAK

Kajian ini meneroka aplikasi peta *Chaotic*, khususnya peta *Arnold Cat* dan peta Henon, untuk penyulitan dan penyahsulitan imej berwarna. Peta *Arnold Cat* digunakan kerana kemampuannya untuk membuat permutasi rumit, manakala peta Henon digunakan untuk sifat-sifatnya yang *chaos* dalam menghasilkan urutan *pseudo-random*. Kaedah yang dicadangkan dinilai menggunakan kaedah metrik seperti PSNR, SSIM, MSE, NPCR, dan UACI. Hasil eksperimen menunjukkan keberkesanan skim penyulitan yang dicadangkan dalam menyediakan imej-sifer yang berkualiti dan tahap keselamatan yang tinggi. Kajian ini memberikan pandangan mengenai kecekapan penyahsulitan dan keupayaan untuk memulihkan imej asal dari imej-sifer.

PENGENALAN

Proses penyulitan dan penyahsulitan imej bergantung kepada algoritma penyulitan yang digunakan untuk mendapatkan imej-sifer yang berkualiti. Jika algoritma kriptografi yang digunakan menghasilkan imej-sifer yang kurang berkualiti, maka imej-sifer tersebut akan mudah untuk dipecahkan dan tahap keselamatan imej akan berkurang. Oleh itu, kajian ini dijalankan dengan matlamat untuk meningkatkan tahap kualiti imej-sifer semasa proses penyulitan dan penyahsulitan imej dengan menggunakan gabungan peta chaotic Henon dan peta Arnold Cat, sekali gus meningkatkan rangka kerja keselamatan keseluruhan untuk imej digital dalam pelbagai aplikasi.

OBJEKTIF

Objektif yang perlu dipenuhi dalam projek ini adalah seperti berikut:

- Untuk membangunkan algoritma penyulitan dan penyahsulitan imej melalui penggabungan peta *Arnold Cat* dan peta *Chaotic* Henon.
- Untuk menguji tahap kebolehlaksanaan algoritma yang dibangunkan dalam menyulitkan dan menyahsulitkan imej dengan resolusi persegi.
- Untuk menguji tahap kualiti imej-sifer bagi algoritma penyulitan dan penyahsulitan imej yang telah dibangunkan berbanding algoritma sedia ada.

METODOLOGI

1. Algoritma *Arnold Cat* (*Confusion*)

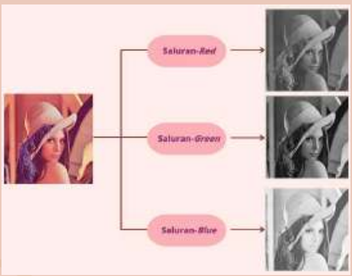
$$\begin{bmatrix} x_n' \\ y_n' \end{bmatrix} = \begin{bmatrix} 1 & p \\ q & pq+1 \end{bmatrix} \begin{bmatrix} x_n \\ y_n \end{bmatrix} \bmod N \qquad (1)$$

2. Algoritma Peta Henon (*Diffusion*)

$$x_{n+1} = 1 - \alpha x^2 + y_n \qquad (2)$$

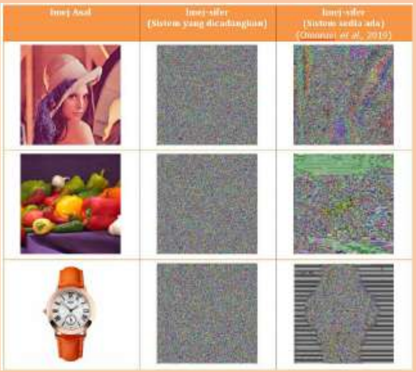
$$y_{n+1} = 1 - \beta x_n \qquad (3)$$

Pisahkan saluran imej



HASIL DAN PERBINCANGAN

Hasil dan perbandingan



Penanda Aras Kualiti Imej

- SSIM
  - Imej-sifer: Rendah dan menghampiri 0 (Mempunyai sedikit atau tiada persamaan)
  - Imej-dinyahsulitkan: Nilai Tinggi dan menghampiri 1 (Kesamaan yang hampir sempurna)
- MSE
  - Imej-sifer: Nilai tinggi dan menghampiri 1
  - Imej-dinyahsulitkan: Nilai rendah dan menghampiri 0 (Kualiti pembinaan semula imej asal)
- PSNR
  - Imej-sifer: Nilai < 10 (Perbezaan yang ketara)
  - Imej-dinyahsulitkan: Nilai antara 30 & 40 (Tiada perbezaan)

Analisis prestasi sistem

PENGHARGAAN

Jutaan ribuan terima kasih kepada penyelia kajian tahun akhir saya kerana banyak memberi tunjuk ajar, bimbingan dan bantuan dalam penghasilan kajian ini dengan jayanya.

KESIMPULAN

Sistem penyulitan dan penyahsulitan imej berwarna berdasarkan kedua-dua peta *Chaotic* ini berjaya dibina. Beberapa ujian dan eksperimen telah dijalankan untuk menilai dan mengukur kualiti imej-sifer yang dihasilkan. Penyulitan dan penyahsulitan imej warna menggunakan kedua-dua peta *Chaotic* ini adalah gabungan teknik yang mampu menghasilkan imej-sifer berkualiti tinggi tanpa penampilan bayang-bayang imej asal. Walau bagaimanapun, kajian ini boleh dilaksanakan dengan menambah teknik lain untuk meningkatkan kecekapan dari segi masa atau menggunakan imej warna dengan pelbagai resolusi sebagai kajian masa depan.

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SW40106 PROJEK SAINTIFIK II
MATHEMATICS WITH COMPUTER GRAPHIC

Transformation towards UNIVERSITY INDUSTRY 4.0
UMS KAMPUS RAHMAH
Eco Campus
Leading Towards Innovative Societies

UMS UNIVERSITI MALAYSIA SABAH

DOUBLE IMAGE ENCRYPTION USING SPROTT B HYPERCHAOTIC MAP

Syahidatul Shafiqah Ramlee & Arif Mandangan
Mathematics Visualization Research Group (MathViz) | Mathematics Computer Graphics Programme
Faculty of Science and Natural Resources, Universiti Malaysia Sabah
Email: syahidatul_shafiqah_bs20@iluv.ums.edu.my

MCG Mathematics Computer Graphics Universiti Malaysia Sabah

ABSTRACT

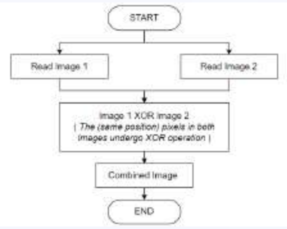
A cryptosystem for image encryption using Sprott B hyperchaotic map is proposed, where double images are encrypted to produce one cipher image. The cryptosystem begins with the process of combining two images and encrypting the combined image using the hyperchaotic map. One cipher image will be produced carrying the information of the two images. The proposed cryptosystem results in a cipher image with excellent quality in terms of noise-like appearance of which the information of the images is concealed. While the cryptosystem satisfies the requirements of producing cipher images with excellent quality, the system also achieves the credibility to decrypt the cipher image restoring the plain image the same to the original.

INTRODUCTION

Image encryption is a method to generate cipher images in attempt to prevent access from unauthorized parties. A cipher image should be generated to be completely unreadable to secure the integrity of the images. The implementation of chaotic maps in image encryption is resulting for a reliable cipher image. There exist types of chaotic maps with chaos characteristic hyper than the ordinary chaos state known as hyperchaotic map, which possesses such an extreme chaos behaviour and more complex compared to the state of ordinary chaotic map.

METHODOLOGY

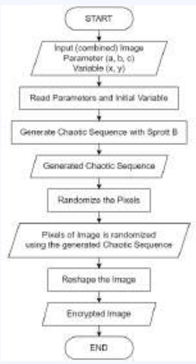
Step 1: Combining Two Images



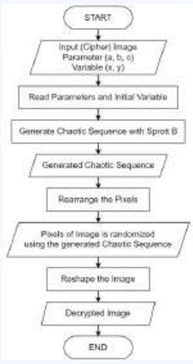
Step 2: Sprott B Hyperchaotic Map (Generate Sequence)

$$f'(x) = ayz$$
$$f'(y) = bx - cy$$
$$f'(z) = d - exy - f(xy)$$

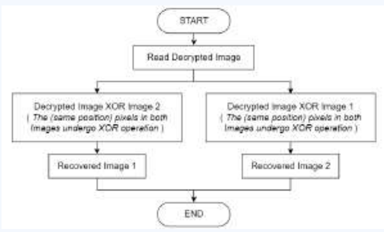
Step 3: Encrypting Image from Step 1



Step 4: Decrypting Cipher Image from Step 3



Step 5: Recovering Plain Images (Separating decrypted image from Step 4)



Objectives

1. To develop a cryptosystem for double images encryption using Sprott B hyperchaotic map.
2. To analyze the quality of the cipher images produced by the proposed cryptosystem by comparing its quality with the quality of cipher images produced by existing method.
3. To analyze the quality degradation of the images after being encrypted, by comparing the original plain images with its output of recovered plain images.

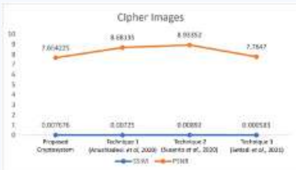
RESULT AND DISCUSSION

Structural Index Similarity Measurement / *Peak Signal to Noise Ratio*

Image 1	Image 2	SSIM		PSNR	
		Cipher Image	Recovered Image	Cipher Image	Recovered Image
Apple	Lena	0.00856	0.95286	7.65498	33.21831
	Barbara	0.00844	0.96315	7.66322	33.44797
	Baboon	0.00887	0.95061	7.66719	33.19455
Lena	Apple	0.00592	0.99134	7.69565	33.36967
	Barbara	0.00683	0.98884	7.66763	33.46223
	Baboon	0.00877	0.98546	7.66149	33.40936
Barbara	Apple	0.00707	0.98963	7.67977	33.16189
	Lena	0.00786	0.98493	7.67220	33.06742
	Baboon	0.00742	0.97959	7.66196	33.01274
Baboon	Apple	0.00659	0.97716	7.66450	33.15353
	Lena	0.00787	0.96730	7.66117	33.08787
	Barbara	0.00843	0.96740	7.66029	33.09649

1. SSIM values for cipher images:
   - ➢ all are small and closer to 0 (has ***little to NO similarity***)
2. SSIM values for recovered images:
   - ➢ all are large and closer to 1 (has ***almost perfect similarity***)
3. PSNR values for cipher images:
   - ➢ all are below 10 (poor quality/ has ***massive difference***)
4. PSNR values for recovered images:
   - ➢ all are in range 30-40 (good quality/ ***little difference***)

PERFORMANCE OF CRYPTOSYSTEM



PSNR has the least value than the other techniques. SSIM is smaller than some.
- ➢ Cipher image is better with better difference.

SSIM has the largest value than the other techniques. PSNR is larger than some.
- ➢ Image recovered better with better similarities.

CONCLUSION

Cryptosystem of encrypting double images using Sprott B hyperchaotic map is developed. The result shows that the cryptosystem produces a cipher image with excellent quality and recovers the plain images the same to the original. Additionally, the cryptosystem performs somewhat better compared to other techniques in terms of producing better cipher image and recovering better plain images.

ACKNOWLEDGEMENT

I would like to sincerely thank my supervisor for all his helpful guidance. I am truly grateful.

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SW40106 SCIENTIFIC PROJECT II
MATHEMATICS WITH COMPUTER GRAPHICS

UMS
UNIVERSITI MALAYSIA SABAH

ANALYSIS OF RAINFALL AND STREAMFLOW TREND AND VARIABILITY IN SABAH

Tam Min Xuan & Siti Aisyah binti Tumiran
Mathematics Visualization Research Group (MathViz), Mathematics Computer Graphics Programme
Faculty of Science and Natural Resources, Universiti Malaysia Sabah
tam_min_bs20@iluv.ums.edu.my & sitiaisyah.tumiran@ums.edu.my

MCG Mathematics Computer Graphics Universiti Malaysia Sabah

ABSTRACT

This study aims to identify and analyse existing relationships between rainfall and streamflow trends while investigating potential influencers impacting streamflow variability. The Mann-Kendall test, Pettitt test, Sen's slope estimator and Pearson correlation coefficient were employed to analyse trends, change points detection, and the relationship of rainfall and streamflow across monthly, seasonal, and annual timeframes. The study's findings indicated that most rainfall monitoring stations did not display statistically significant trends. Conversely, streamflow also did not exhibit statistically significant trends. However, the streamflow trends and change points were found to be inconsistent in all stations. The variations observed in streamflow, despite the absence of significant changes in rainfall, suggested the streamflow was influenced by other variables such as physical elements of the watershed, particularly alterations in Land Use Land Cover (LULC) dynamics. These changes are highly likely to contribute to the observed fluctuations in streamflow. The results of this study can serve as a foundation for further research into the impact of watershed dynamics on variations in hydrological flow.

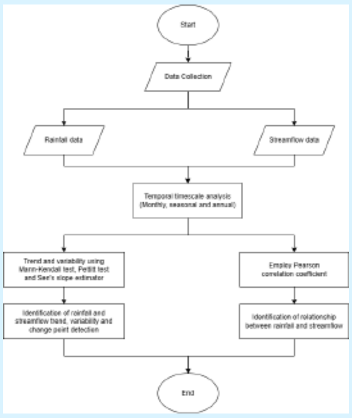
INTRODUCTION

Conducting trend analyses on hydro-meteorological data is crucial in detecting and comprehending rainfall-runoff changes. The identification of alterations in extended hydrometeorological data is essential for the strategic development of forthcoming water resources and flood prevention. Hydrometeorological patterns may be influenced by land-use alterations, river flow variations, or shifts in climate conditions. Rainfall-runoff changes are primarily attributed to climatic changes and anthropogenic activities. One of the climatic factors influencing the temporal patterns of water availability is rainfall, which exhibits significant regional and temporal variability globally.

OBJECTIVES

1) To employ statistical methods, such as the Mann-Kendall test, Pettitt test as well as Sen's slope estimator, to analyse the trend and variability of rainfall and streamflow in Sabah.
2) To assess the trend and variability of rainfall and streamflow annually, monthly, and seasonally in Sabah.
3) To examine the relationship between rainfall and streamflow in Sabah using the Pearson correlation coefficient.

METHODOLOGY



Methodology Flowchart

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RESULTS AND DISCUSSION

Rainfall Analysis

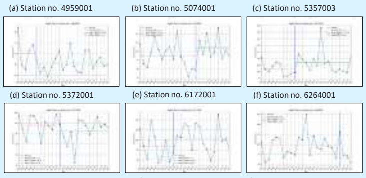
Monthly rainfall trends: summary results of Mann-Kendall test and Z statistics

Month	4959001	5074001	5357003	5372001	6172001	6264001
Jan	0.09	0.14	0.63	-0.70	1.42	-0.40
Feb	-0.86	0	-0.68	-1.12	-1.29	-0.51
Mar	0.16	-1.17	-0.54	-1.05	1.00	-0.30
Apr	0.82	-0.16	-0.26	-0.44	**2.36**	-0.07
May	-0.37	-0.28	1.24	-0.33	-0.49	0.82
Jun	-1.45	1.33	-0.47	1.94	-0.86	-0.02
Jul	-1.28	0.44	0.47	**2.01**	1.56	0.96
Aug	-0.79	0.91	0.58	-1.00	-0.63	-0.70
Sep	0.47	0.56	0.02	0.37	-0.33	0.86
Oct	-0.72	-0.42	-0.65	-0.65	0.02	-0.54
Nov	-0.86	0.21	0.07	1.89	1.52	-1.31
Dec	-0.12	1.33	0.30	-0.70	-0.51	-0.21

The annual and seasonal rainfall patterns: summary results of Mann-Kendall test and Sen's slope estimator

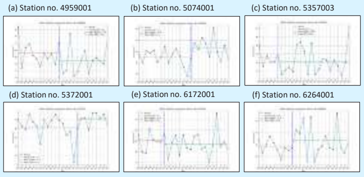
Station No.		Kendall's tau	S-value	P-value	Z-value	Sen's slope estimator
4959001	Annual	-0.023	-7	**0.889**	-0.140	-0.073
	Dry season	-0.012	-183	**0.814**	-0.235	-0.001
	Wet season	-0.009	-96	**0.877**	-0.154	-0.001
5074001	Annual	0.047	14	0.761	0.304	0.109
	Dry season	0.101	1131	0.066	1.836	0.012
	Wet season	-0.221	**-2474**	0	**-4.019**	-0.038
5357003	Annual	0.013	4	**0.944**	0.070	0.110
	Dry season	0.002	24	**0.970**	0.037	0
	Wet season	-0.156	**-1738**	0.005	**-2.823**	-0.028
5372001	Annual	-0.113	-34	0.441	-0.771	**-0.449**
	Dry season	0.034	376	0.542	0.609	0.004
	Wet season	-0.204	**-2284**	0	**-3.710**	-0.033
6172001	Annual	0.067	20	0.657	0.444	**0.411**
	Dry season	0.035	386	0.532	0.626	0.004
	Wet season	-0.178	**-1987**	0.001	**-3.227**	-0.033
6264001	Annual	-0.047	-14	0.761	-0.304	-0.203
	Dry season	0.048	533	0.387	0.864	0.007
	Wet season	-0.186	**-2074**	0.001	**-3.369**	-0.034

(a) Station no. 4959001 (b) Station no. 5074001 (c) Station no. 5357003
(d) Station no. 5372001 (e) Station no. 6172001 (f) Station no. 6264001



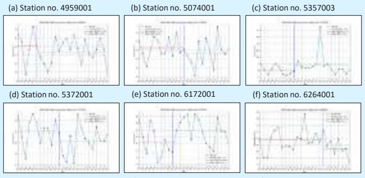
The Pettitt homogeneity test of representative annual rainfall monitoring stations

(a) Station no. 4959001 (b) Station no. 5074001 (c) Station no. 5357003
(d) Station no. 5372001 (e) Station no. 6172001 (f) Station no. 6264001



The Pettitt homogeneity test of representative dry season rainfall monitoring stations

(a) Station no. 4959001 (b) Station no. 5074001 (c) Station no. 5357003
(d) Station no. 5372001 (e) Station no. 6172001 (f) Station no. 6264001



The Pettitt homogeneity test of representative wet season rainfall monitoring stations

Streamflow Analysis

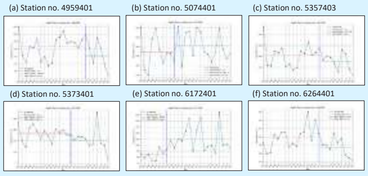
Monthly streamflow trends: summary results of Mann-Kendall test and Z statistics

Month	4959401	5074401	5357403	5373401	6172401	6264401
Jan	0.77	0.47	0.12	-1.03	**2.32**	0.14
Feb	0.42	-1.47	-1.24	**-2.13**	1.94	-0.42
Mar	-0.28	-0.49	-0.68	-1.42	**2.02**	-0.65
Apr	0.72	0.12	-0.21	-1.08	0.63	-0.61
May	0.72	0.49	0.07	-0.33	0.98	0.47
Jun	0	0.82	0.44	0.44	0.75	0.23
Jul	0.72	0.82	-0.35	-0.47	1.64	-0.07
Aug	0.35	**2.52**	-0.96	-0.65	0.12	-0.51
Sep	-1.42	0.96	-1.68	-1.87	0.19	-0.61
Oct	**-2.13**	-1.52	**-2.01**	**-2.17**	-0.37	-1.40
Nov	-0.86	1.61	-0.86	-0.37	1.80	-1.82
Dec	0.30	1.05	0.72	-1.38	0.54	-1.12

The annual and seasonal streamflow patterns: summary results of Mann-Kendall test and Sen's slope estimator

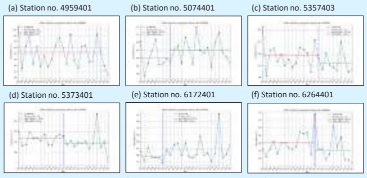
Station No.		Kendall's tau	S-value	P-value	Z-value	Sen's slope estimator
4959401	Annual	-0.100	-30	0.498	-0.677	-2.861
	Dry season	-0.140	**-1562**	0.011	**-2.537**	-0.287
	Wet season	-0.056	-627	0.309	-1.017	-0.144
5074401	Annual	0.033	10	**0.834**	0.210	0.867
	Dry season	-0.003	-36	**0.955**	-0.057	-0.005
	Wet season	-0.143	**-1594**	0.010	**-2.589**	-0.388
5357403	Annual	-0.187	-56	0.199	-1.285	**-32.358**
	Dry season	-0.148	**-1655**	0.007	**-2.688**	-0.644
	Wet season	-0.145	**-1621**	0.008	**-2.633**	-0.819
5373401	Annual	-0.367	-110	0.011	**-2.546**	**-67.802**
	Dry season	-0.083	-926	0.133	-1.504	-0.274
	Wet season	-0.146	**-1628**	0.008	**-2.645**	-0.776
6172401	Annual	0.387	116	0.007	**2.686**	**25.686**
	Dry season	0.092	**1033**	0.093	1.677	0.095
	Wet season	-0.115	**-1282**	0.037	**-2.088**	-0.249
6264401	Annual	-0.150	-45	0.304	-1.028	-3.130
	Dry season	0.012	133	**0.830**	0.215	0.007
	Wet season	-0.233	**-2608**	0	**-4.236**	-0.187

(a) Station no. 4959401 (b) Station no. 5074401 (c) Station no. 5357403
(d) Station no. 5373401 (e) Station no. 6172401 (f) Station no. 6264401



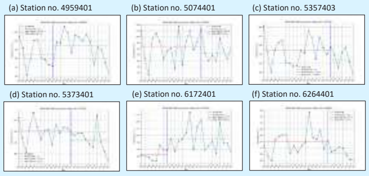
The Pettitt homogeneity test of representative annual streamflow monitoring stations

(a) Station no. 4959401 (b) Station no. 5074401 (c) Station no. 5357403
(d) Station no. 5373401 (e) Station no. 6172401 (f) Station no. 6264401



The Pettitt homogeneity test of representative dry season streamflow monitoring stations

(a) Station no. 4959401 (b) Station no. 5074401 (c) Station no. 5357403
(d) Station no. 5373401 (e) Station no. 6172401 (f) Station no. 6264401



The Pettitt homogeneity test of representative wet season streamflow monitoring stations

CONCLUSION

The research provides a comprehensive statistical analysis of 12 hydrological monitoring stations in Sabah, covering data on rainfall and streamflow. The selection of rainfall and streamflow monitoring stations in Sabah was based on few factors such as their location, the availability and quality of time-series data. The trends of rainfall and streamflow patterns were thoroughly investigated wisely at various timescales including monthly, seasonal, and annual.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to University of Malaysia Sabah for the invaluable support and resources provided throughout the completion of this final year project. Besides that, I extend my heartfelt appreciation to the Department of Irrigation and Drainage Malaysia for their generous contribution of data, which significantly enriched the quality and depth of my research.

SW40106 SCIENTIFIC PROJECT II
MATHEMATICS WITH COMPUTER GRAPHICS

UNIVERSITI MALAYSIA SABAH

AN ENHANCED SQUARE MARKER FOR TRACKING ACCURACY IMPROVEMENT AND OCCLUSION HANDLING IN VIRTUAL TRY ON

Wong Xiu Jian[1,3,4] & Rechard Lee[2,3,5]
[1] Program of Mathematics with Computer Graphics, [2] Mathematics Visualization Research Group (MathVis),
[3] Faculty Of Science And Natural Resources, Universiti Malaysia Sabah
[4] wong_xiu_bs20@iluv.ums.edu.my, [5] rechard@ums.edu.my

Abstract

This project aims to enhance augmented reality (AR) experiences by improving tracking and addressing occlusion issues. Fiducial markers, VuMark was designed to boost tracking in challenging environments. Depth masking was also implemented to conceal occluded parts of virtual objects. The efficiency of these markers was compared through experiments, including lighting tests, marker orientation tests, and a 3D object occlusion test. Results indicate that the proposed marker outperforms the normal marker in tracking efficiency. When applying depth masking, the virtual try-on AR system successfully handles 3D object occlusion, ensuring a precise fit of the 3D watch model to the user's wrist.

Introduction

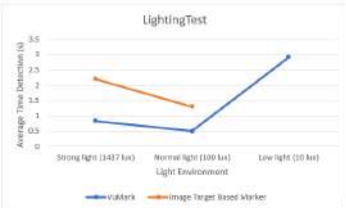
Augmented Reality (AR) is a technology that overlays digital information and graphics onto the real-world environment. With Marker-based AR, virtual content is displayed when the camera recognises certain markers or patterns that have been pre-defined. Markers are often QR codes or black-and-white graphics that the AR application can read. In marker-based AR, while significant strides have been made, challenges persist in the realms of marker and occlusion handling. Addressing these hurdles remains pivotal for the continued advancement of AR development.

Objective

- To design fiducial marker to improve tracking in challenging environments.
- To adapt depth masking to hide the occluded part of virtual object.

Results & Discussion

Lighting



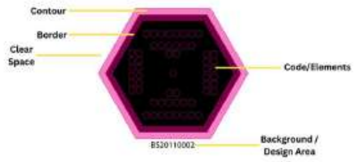
Orientation

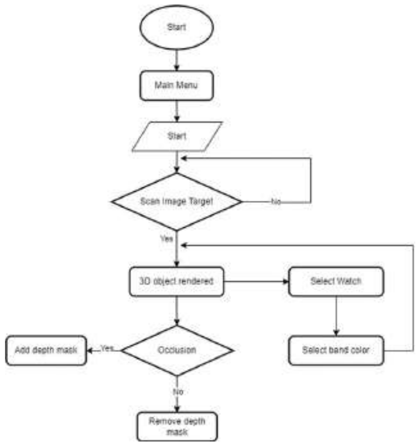
Degree of orientation		Description
VuMark		Marker is detectable at 0 degree.
		Marker is detectable at 90 degree.
Normal Marker		Marker is detectable at 0 degree.
		Marker is undetectable starting from 70 degree.

Occlusion

Depth mask enable	Depth mask disable
	

Methodology





Conclusion

The fiducial marker used in this system improved the tracking accuracy compared to normal existing marker. Depth mask adapted in this system showed a success occlusion handling in virtual try-on system.

References

- Alfakhori
  Occlusion Handling Applications
  Outdoor Scenarios
- Augmented *Presence*
  Teleoperators *Environments,*

Acknowledgement

Grateful for my Final Year Project's success. Thanks to Mr. Rechard Lee, my supervisor, and Associate Professor Dr. Abdullah Bade, my examiner, for guidance and support. Appreciate my parents, lecturers, and friends for their contributions.

UNDERWATER IMAGE QUALITY ENHANCEMENT BY USING CONVOLUTIONAL NEURAL NETWORK BASED ALGORITHM

SW40106 SCIENTIFIC PROJECT II
YAP JIA JUN[1,3,4] & DR ABDULLAH BADE[2,3,5]
[1] Mathematics Computer Graphics Programme, [2] Mathematics Visualization Research Group (MathViz),
[3] Faculty Of Science and Natural Resources, Universiti Malaysia Sabah
[4] yap_jia_bs20@iluv.ums.edu.my, [5] abb@ums.edu.my

ABSTRACT

This paper proposes a new deep learning-based underwater image quality enhancement by combining the image formation model and white balance model to improve the overall quality of underwater images in terms of haze removal, improve contrast and sharpness, and colour balance. Experimental results demonstrate the advantages of the proposed method in improving visual quality by eliminating the influence of underwater environmental factors, removed haze, increased contrast and sharpness, restore and balancing colours. These results are further supported by quantitative metric, indicating improvement of 2.80%, 4.67%, 5.22% and 2.69% in entropy, PCQI, UIQM and UCIQE respectively, as compared to image formation model.

INTRODUCTION

Digital image processing involves manipulating images using computers, with applications spanning from gamma to radio waves. Underwater surveillance faces challenges like low illumination and limited visibility due to light attenuation, absorption, and scattering. Traditional methods struggle to adapt to diverse underwater scenes. This paper proposes a dual Convolutional Neural Network (CNN)-based approach to comprehensively enhance underwater images, aiming to overcome traditional limitations for improved surveillance and exploration.

METHODOLOGY

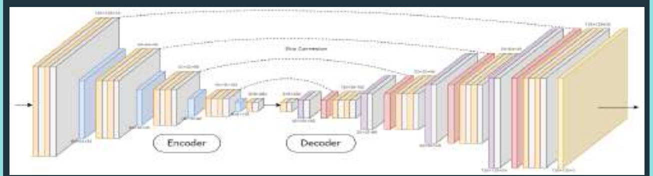


Figure 1. Framework of white balance model

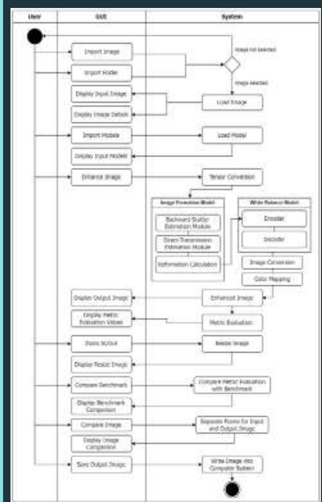


Figure 3. Activity diagram of proposed system.

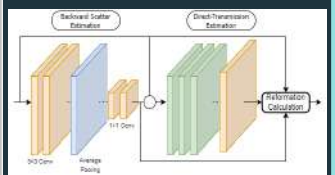


Figure 2. Framework of image formation model

CONCLUSION

- The evaluation result shown that both objectives of this project were achieved by using deep learning-based algorithm.
- The underwater image formation model was implemented to remove haze-like effect in the underwater image.
- The fusion of white balance model and underwater image formation model was developed to further improve the image quality.

REFERENCES

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- Chen, X., Zhang, P., Quan, L., Yi, C., & Lu, C. (2021, January 7). Underwater Image Enhancement based on Deep Learning and Image Formation model. arXiv.org.

OBJECTIVES

- To implement underwater image formation model by removing haze-like effect in the underwater images.
- To develop a fusion of white balance model and underwater image formation model to increase sharpness, contrast and colour balance in the degraded underwater colour images.

RESULT & DISCUSSION

Table 1. Visual Quality Results of Proposed System for Hazy Images

Metrics	SSIM	Entropy
Input	1.0000	6.3342
IF	0.7408	7.3498
Proposed	0.6268	7.5553

Table 2. Summary of SSIM and Entropy of Proposed System for Hazy Images

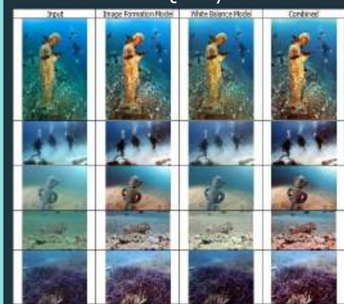


Table 3. Visual Quality Results of Proposed System for Low Contrast and Sharpness Images

Metrics	PCQI	UIQM
Input	1.0543	0.6810
IF	1.3092	1.1306
WB	1.1858	0.9283
Proposed	1.3703	1.1896

Table 4. Summary of PCQI and UIQM of Proposed System for Low Contrast and Sharpness Images

Table 5. Visual Quality Results of Proposed System for Greenish and Bluish Images

Metrics	UCIQE
Input	54.6248
IF	77.2292
WB	73.0024
Proposed	79.3077

Table 6. Summary of UCIQE of Proposed System for Greenish and Bluish Images

ACKNOWLEDGEMENT

I extend my heartfelt thanks to Prof. Madya Dr. Abdullah Bade, my supervisor, for the opportunity to conduct research and for invaluable guidance. Appreciation goes to Mr. Rechard Lee, my examiner, for dedicating time to examine my thesis. Gratitude to all involved, directly or indirectly, in completing this project.

UMS UNIVERSITI MALAYSIA SABAH

MCG Mathematics Computer Graphics Universiti Malaysia Sabah

A COMBINED ANALYTICS HIERACHY PROCESS -GOAL PROGRAMMING MODEL FOR SCHEDULING FIREFIGHTER IN BALAI BOMBA DAN PENYELAMATAN LINTAS LIKAS

Yong Kam Seng & Madam Asdalifah Talibe
Mathematics with Computer Graphics
Faculty Of Science And Natural Resources
Universiti Malaysia Sabah

Abstract

Efficient scheduling of firefighters is paramount to ensuring a prompt and effective emergency response system. Explores the challenges associated with firefighter scheduling and proposes a comprehensive approach to optimize the allocation of personnel, taking into consideration varying skill sets, fatigue management, and operational constraints. This study aims to develop a schedule using the Analytic Hierarchy Process-Goal Programming (AHP-GP) approach. In this scheduling is conducted based on the number of firefighters and shifts in Balai Bomba dan Penyelamatan Lintas Likas. There are 3 squads which have 55 firefighters and the shifts are divided into morning and night shifts. The model was built based on the data obtained from Balai Bomba dan Penyelamatan Lintas Likas. This study presented a combined AHP-GP model that accommodated both hard and soft constraints for a 28 days planning horizon. The proposed model satisfied all the soft constraints. The result obtained from this model gave an optimal solution in the new schedule scheme.

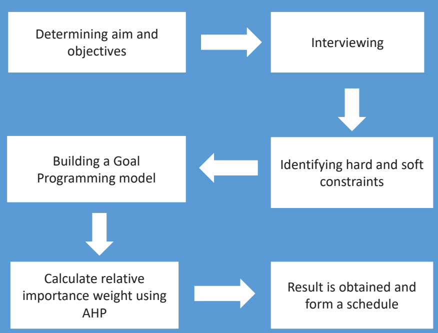
Introduction

Efficient scheduling of firefighters is crucial for prompt emergency response and resource optimization. Current methods often rely on manual processes, leading to challenges in balancing staffing levels, accommodating shift requirements, and ensuring fair workload distribution. This study aims to analyze these scheduling issues comprehensively and propose effective solutions to enhance overall firefighter operations.

Objectives

- To apply the combined Analytic Hierarchy Process and Goal Programming (AHP-GP) model to solve the firefighter scheduling problem.
- To generate a new schedule scheme for firefighter in Balai Bomba dan Penyelamatan Lintas, Likas.

Methodology



Conclusion

In conclusion, this study introduces and validates an innovative scheduling approach, the Analytic Hierarchy Process coupled with Genetic Programming (AHP-GP), for firefighter scheduling in Balai Bomba dan Penyelamatan Lintas, Likas. The AHP-GP model successfully achieves its objectives by optimizing scheduling decisions and generating a new schedule scheme for firefighters.

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Result & Discussion

A zero-one goal programming model is formed based on the hard and soft constraints.

Minimize $z = w_1 \sum_i^n (D1_i^+ + D1_i^-) + w_2 \sum_i^n D2_i^-$

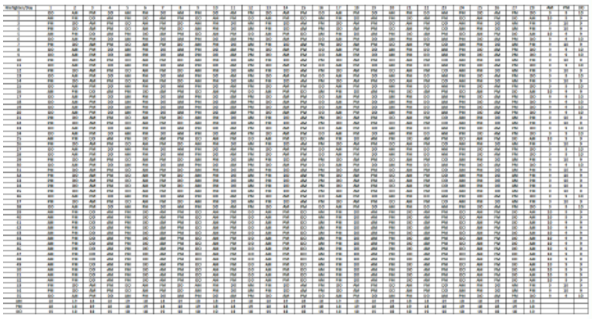
Subject to

$$\sum_{i=1}^{n} X_{i,j} \geq 17, \text{ for } j = 1,2,\ldots 28$$
$$\sum_{i=1}^{n} Y_{i,j} \geq 17, \text{ for } j = 1,2,\ldots 28$$
$$\sum_{i=1}^{n} X_{i,j} \leq 19, \text{ for } j = 1,2,\ldots 28$$
$$\sum_{i=1}^{n} Y_{i,j} \leq 19, \text{ for } j = 1,2,\ldots 28$$
$$X_{i,j} + Y_{i,j} + D_{i,j} = 1$$
$$X_{i,j} + X_{i,j+1} \leq 1$$
$$X_{i,j} + D_{i,j+1} \leq 1$$
$$Y_{i,j} + X_{i,j+1} \leq 1$$
$$Y_{i,j} + Y_{i,j+1} \leq 1$$
$$D_{i,j} + Y_{i,j+1} \leq 1$$
$$X_{i,j} + Y_{i,j+1} + D_{i,j+2} \leq 3$$
$$D_{i,j} + D_{i,j+1} + D_{i,j+2} = 1$$
$$X_{i,j} + X_{i,j+1} + X_{i,j+2} + Y_{i,j} + Y_{i,j+1} + Y_{i,j+2} \leq 2$$
$$\sum_{j=1}^{m} X_{i,j} + Y_{i,j} + D1_i^+ - D1_i^- = 19$$
$$\sum_{j=1}^{m} X_{i,j} - \sum_{j=1}^{m} Y_{i,j} + D2_i^+ - D2_i^- = 1$$

Where

$X_{i,j} = 0 \text{ or } 1, Y_{i,j} = 0 \text{ or } 1, D_{i,j} = 0 \text{ or } 1$

The newly generated schedule illustrates the assignment of firefighters to squads, their respective shifts, and days off over the 4-week planning period.



The AHP-GP model successfully adhered to all hard constraints. Following an assignment, it will precisely replicate the structure of the manual schedule.

Acknowledgement

I express profound gratitude to my supervisor, Madam Asdalifah Talibe, family, friends, and all firefighters who participated in interviews for their invaluable support, guidance, and contributions in my academic journey.

BIOGRAPHY

Professor Dr. Abdullah Bade has achieved significant accomplishments in the field of computer graphics, image processing, and visual computing during his distinguished academic career. He obtained a Bachelor of Science degree in Computer Science in 2000 and a Master of Science Degree in Computer Science with a specialisation in Computer Graphics in 2003 from Universiti Teknologi Malaysia (UTM). In 2008, driven by a curiosity to investigate, he obtained a PhD in Industrial Computing from the Universiti Kebangsaan Malaysia (UKM).

Prof. Abdullah seamlessly transitioned from his academic pursuits to making important contributions in the field of visual computing. Between 2000 and 2010, he held the position of Senior Lecturer in the Faculty of Computing at UTM. During this time, he imparted his expertise and served as a source of inspiration for several students. Currently, he holds the position of Professor in the fields of Computer Graphics, Image Processing, and Visual Computing in the Faculty of Science and Natural Resources, Universiti Malaysia Sabah (UMS).

He has a wide range of research interests in visual computing, which include computer graphics system, image processing methods, computer vision, and computational photography. Prof. Abdullah is a esteem author who has published a significant number of articles in reputable scholarly journals, conference proceedings, books, and technical papers. His study is motivated by a deep need to not only expand the limits of knowledge in his profession, but also to impart his skills and mentor of future generations.

His commitment extends beyond the confines of the classroom. Prof. Abdullah, in his role as a supervisor, fosters an intellectually stimulating atmosphere and offers thorough support. Nine out of 15 of his PhD students, who have already graduated, provide evidence of his inventive leadership. The impact of his influence is evident in the success of 16 out of the 17 Master's students under his supervision. Each of these students is equipped with the skills and knowledge necessary to tackle practical challenges in their respective sector. Moreover, Prof. Abdullah has had a significant impact on both UTM and UMS by overseeing the academic progress of over 100 undergraduate Final Year Project students.

Prof. Abdullah Bade is a dedicated scholar in the fields of computer graphics, image processing, computer vision, and visual computing. His unwavering passion and steadfast commitment to advancing knowledge discovery, teaching, and supervision have made substantial contributions to exceptional characteristics, and he continues to inspire and propel the field of visual computing. Prof. Abdullah is not only an educator, but also a mentor who shapes future leaders in visual computing.

BIOGRAPHY

Dr. Suzelawati Zenian is a Senior Lecturer at UMS where she has served in the Mathematics Computer Graphics Programme, Faculty of Science and Natural Resources since 2006. She earned her PhD in Mathematics from UTM, specializing in Fuzzy Image Processing and obtained her Bachelor Degree of Science (Mathematics), Master of Science (Mathematics) from UKM.

Her expertise is in fuzzy image processing and her research interests include fuzzy theory, control theory, differential equations and mathematical modeling. Throughout her career, she has contributed to the advancement of techniques that apply fuzzy logic to handle uncertainties in image data, enabling more accurate image analysis and interpretation. Her work has significant applications in fields such as medical imaging, remote sensing, and automated systems, where precise data interpretation is crucial.

In addition to her research, she is actively involved in collaborating with other experts in the field to explore innovative approaches in fuzzy image processing. Her contributions are widely recognized, with numerous publications in prestigious journals and presentations at international conferences, establishing her as a respected figure in the field of fuzzy image processing.

Her reputation as an engaging and supportive educator has made her a valued mentor to her students. She fosters a nurturing and inclusive learning environment, inspiring her students to strive for excellence while prioritizing their well-being.

BIOGRAPHY

Ts. Dr. Arif Mandangan is a Senior Lecturer at UMS, where he has served in the Mathematics Computer Graphics Programme, Faculty of Science and Natural Resources since 2008. He earned his PhD in Cryptography from Universiti Sains Malaysia (USM), specializing in Post-Quantum Cryptography (PQC). His research interests span multiple domains, including PQC, data analytics, and numerical analysis, where he focuses on developing efficient computational solutions for complex mathematical and cryptographic challenges.

In the field of cryptography, Dr. Arif's work has notably concentrated on enhancing the efficiency of cryptographic systems, such as the CRYSTALS-KYBER post-quantum key encapsulation mechanism (PQ KEM). Recently, he has also been exploring strategies to optimize the lattice-based cryptosystem, aiming to reduce the size of the public key, an advancement that could significantly impact the field's practical applications.

Beyond cryptography, Dr. Arif is equally passionate about data analytics and numerical analysis, where he leverages mathematical models and computational methods to draw meaningful insights from complex datasets. His work in these areas contributes to advancing techniques that can be applied across industries, from finance to technology.

Dr. Arif is also dedicated to education, both in and outside the classroom. He plays an active role in curriculum development and frequently organizes STEM-focused events, such as Kem Matematik Perdana, to inspire young students. Through his undergraduate and graduate courses, he integrates real-world applications with theoretical knowledge to prepare his students for future challenges in mathematics and cryptography.

A frequent contributor to international conferences, Dr. Arif recently helped organize the first ever MyCRYPTOLOGY Week 2024 and South-East Asia Post Quantum Cryptography Summit 2024 as one of the Program Chairs, enhancing the field's visibility in Malaysia and Southeast Asia. His work has been widely published, and he continues to collaborate with industry experts to push the boundaries of his research. Currently, Dr. Arif is appointed as an Expert Evaluator Panel by CyberSecurity Malaysia for the AKSA MySEAL 2.0 (2023) and AKSA MySEAL 2.1 (2024).

BIOGRAPHY

Dr. Rozaimi Zakaria is a Senior Lecturer at UMS, where he has served in the Mathematics Computer Graphics Programme, Faculty of Science and Natural Resources since 2014. He earned his PhD in Mathematics from Universiti Malaysia Terengganu (UMT), specializing in the field of Fuzzy Geometric Modeling. In his doctoral research, he focused on developing techniques to model uncertainty data through the use of curves and surfaces based on the principles of fuzzy mathematics. This specialized area of study allows him to explore innovative ways to effectively represent and analyze data that contains inherent ambiguity or vagueness, which is often encountered in real-world applications.

Currently, Dr. Rozaimi research is still primarily focused on modeling uncertainty data using various theories and concepts of fuzzy mathematics, with the goal of better defining and understanding uncertainty data. Additionally, he has expanded his research to explore real-world data applications based on his expertise in this field. He has published numerous articles that are closely related to his areas of focus. Furthermore, Dr. Rozaimi is actively seeking research grants to support the expansion and progression of his research endeavors.

In his teaching career, Dr. Rozaimi is actively engaged with various mathematics courses. He shares his knowledge, ideas, and concepts with students, drawing connections to other related courses to demonstrate the importance and relevance of the material being taught. Dr. Rozaimi strives to engage his students by highlighting how the different mathematics subjects are interconnected and how the skills and concepts learned in his courses can be applied in a broader context.

BIOGRAPHY

Asdalifah Talibe is a lecturer in Mathematics Computer Graphics at the Faculty of Science and Natural Resources, UMS. She obtained her Bachelor Degree of Science (Mathematics) in 2006 and her Master of Science (Mathematics) in 2007 both from UKM. Currently, she is pursuing a doctorate in fuzzy geometric modelling at UMS, where she aims to further develop her expertise in mathematical applications.

Her research interests include Mathematical Modelling, particularly in shift scheduling and optimization, as well as Decision Making using the Analytic Hierarchy Process (AHP) and the Fuzzy Analytic Hierarchy Process (FAHP). Her contributions in these areas provide valuable frameworks for operational efficiency and data-driven decision-making, which are essential for complex, real-world applications. Her work has been published in respected journals and conference proceedings, and she is a regular presenter at academic conferences, where she contributes valuable insights to the field.

In teaching, Asdalifah is passionate about making mathematics accessible and engaging for students of all levels. She focuses on Calculus and Optimization, two fundamental areas of mathematics that underpin both theoretical understanding and practical applications. Her approach emphasizes the development of problem-solving skills and the application of mathematical techniques to real-world scenarios, equipping students with tools to tackle complex challenges effectively.

BIOGRAPHY

Ts. Rechard Lee has made substantial contributions in the fields of interactive design for games, computer vision, image processing, UI/UX, and augmented reality. He earned a Bachelor of Science degree in Computer Science from Universiti Putra Malaysia in 2000 and a Master of Science degree in Mathematics with Computer Graphics from Universiti Malaysia Sabah in 2014. He is currently pursuing a doctorate in computer vision and image processing.

From 2010 to 2016, Ts. Rechard Lee obtained several prestigious certifications, including Microsoft Certified Systems Engineer, Microsoft Certified Systems Administrator, Microsoft Certified Technology Specialist, and Huawei Certified Network Associate.

As an educator, he has shared his expertise and served as a mentor, inspiring students in their early career development both before and after graduation. He has supervised the academic progress of over 100 undergraduate students working on their final-year projects.

In addition to his teaching role, Ts. Rechard Lee is a dedicated researcher with diverse interests that encompass image processing, computer vision, interactive design in gamification, and the application of augmented reality in STEM education for early childhood. He has published articles in reputable scholarly journals and conference proceedings and has received gold and special awards at international innovation competitions.

Passionate about teaching and knowledge sharing, Ts. Rechard is committed to inspiring and equipping future-proof graduates for their careers.

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