RESEARCH INNOVATION COMMERCIALISATION & ENTREPRENEURSHIP SHOWCASE

HUMANIZING INNOVATION

COMPUTING & INFORMATICS

DIGITAL CREATIVE & CINEMATIC ARTS

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RICES 2021: COMPUTING & INFORMATICS | DIGITAL CREATIVE & CINEMATIC ARTS

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The publisher hereby records its gratitude to individuals who have helped in one way or another to make this book project a reality.

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FOREWORD

VICE PRESIDENT, RESEARCH AND INDUSTRIAL COLLABORATION AND ENGAGEMENT (RICE)

RICES 2021 with its overarching theme of Humanising Innovation was a huge success and I am extremely pleased with its outcome. This beautiful and meaningful event will not be a success without the dedication, teamwork, creative mind-sets, and hard work by many of us in the Research, Industrial Collaborations and Engagement Division. I am certain that we will be able to continuously and successfully organise this event for many years to come.

I would also like to thank all the committee members for your relentless assistance for this event. The event that marks our DNA to profoundly rethink on ways we can compete in this next-generation, more-human digital world, which is obviously an unclaimed territory. Your contributions are really valuable and precious for the new generations so called the digital natives.

With the help of your hand, we have had a strong 129 participations from various institutions, local and overseas. Personally, I believe this is a big movement to keep pushing and promoting digital, visionary innovation.

To all participants, believe in the creative vibes in you. Continue to churn out new inventions and innovations, let RICES rise to its purpose in providing the stage for the researchers and innovators to freely express your ideas.

Prof. Ir. Dr. Hairul Azhar Bin Abdul Rashid
Vice President
Research and Industrial Collaboration and Engagement
Multimedia University

FOREWORD

CHAIRPERSON OF RICES 2021

On behalf of the Committee, it is my pleasure to welcome you to the 5th Research Innovation, Commercialisation and Entrepreneurship Showcase 2021 (RICES 2021) held virtually on 16 November 2021. RICES provides a platform for the participants to showcase their latest inventions, innovations, and R&D commercialisation achievements. It also provides the opportunity for the participants to receive feedback and develop new partnerships with existing and new collaborators and investors. We are pleased to present the proceedings of the exhibition as its published record.

There are two categories of showcase under RICES 2021 - Research Project Showcase and Social Innovation Project Showcase. Despite the challenging COVID-19 pandemic situations, we received 129 submissions from different countries, representing a slight increase compared to the submissions under these two categories for RICES 2020.

This event is the result of the hard work of many people. We want to express our appreciation to the members of the Organising Committee and the external reviewers for their efforts in evaluating the submissions. We also thank our event sponsor, Keenon Robotics and Prof. Fabian Kung (FOE, MMU), for sharing their robots with us for the opening ceremony. The event would not be possible without the excellent inventions contributed by the participants. We thank all the inventors for their contributions and participation in RICES 2021!

We hope this event will further inspire technological innovations that will benefit humanity.

Prof. Ir. Dr. Lim Heng Siong
CHAIRPERSON of RICES 2021
Deputy Director, Research Management Centre
Multimedia University

FOREWORD

HEAD OF MMU PRESS

I am delighted to write this foreword, not only because Research Innovation, Commercialisation and Entrepreneurship Showcase 2021 (RICES 2021) has been successfully documented in this special edition, but also because the quality of the research papers, various inventions, innovations, and R&D commercialisation achievements are of a high standard. Congratulations to all the participants, and may RICES become the platform for you to achieve greater heights in the future.

It is our utmost hope that MMU Press mission will be an internationally recognised academic press. Its spirit is to connect Multimedia University (MMU) with the larger communities and institutions through innovative and inspiring writings. I believe this book can help researchers, academics, students, and industry players to further develop a shared vision and understanding of the digital world and what it offers. Kevin Colleran, one of Facebook's earliest employees who spoke about staying true to his entrepreneurial spirit says, "If you can't imagine a world different from the one you see today; you will never be able to build a better one."

I would like to humbly thank various people who made MMU Press publications a success especially in its RICES 2021 publications. All these achievements are made possible due to strong commitment by all, especially the Coordinator of Special Publication – Dr. Tan Yi Fei, chief editors, editorial team members and the project leaders, who have contributed to the publication of RICES 2021. The engagement, dedication, commitment, and effort dedicated to this book are indeed beyond words. Thank you and let's make MMU Press be the beacon of knowledge.

Assoc. Prof. Dr. Tan Siow Hooi
Deputy Director, Research Management Centre (Head of MMU Press)
Multimedia University

COMPUTING & INFORMATICS

A MACHINE LEARNING APPROACH TO IDENTIFY PURCHASING PATTERNS FOR ONLINE PURCHASERS

Ong Jing Tan and Lew Sook Ling (✉)
Multimedia University, 75450 Ayer Keroh, Melaka, Malaysia

Abstract

This research enables online shop sellers to use the machine learning model to predict the customer purchasing patterns. The predicted purchasing pattern can help the sellers to better understand consumer buying behaviours.

High cost in promotion and advertising [1]

Unpredictable consumer buying behaviours [2]

Time consuming in customer analysis [3]

Objectives

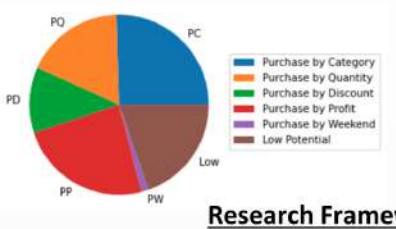
- To develop a generic purchase framework for online purchasers
- To compare the performance of different methods of prediction
- To propose a suitable purchasing framework and prediction method

Learning Algorithms

- Decision Tree
- Support Vector Machine
- Naïve Bayes
- Multilayer Perceptron
- Random Forest
- Logistic Regression

Methods

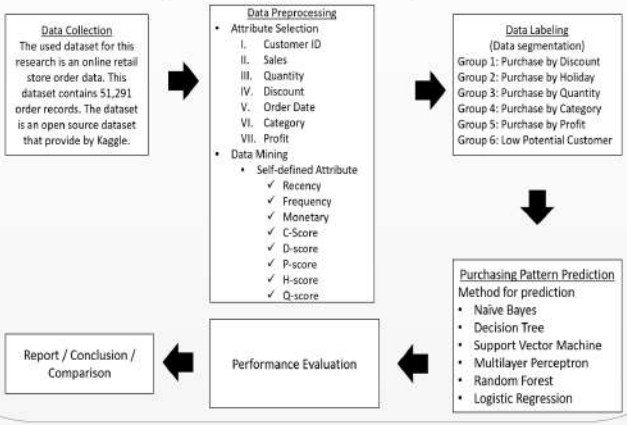
Customer Segmentation



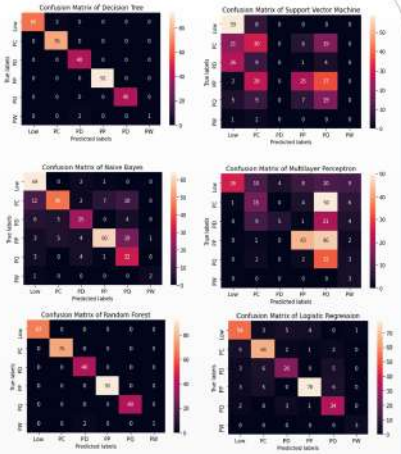
Purchasing Patterns

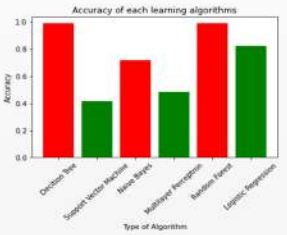
- Purchase by discount
- Purchase by profit
- Purchase by weekend/ holiday
- Purchase by category
- Purchase by quantity
- Low potential customer

Research Framework



Results





Conclusion

The most suitable machine learning algorithm to predict the online customer purchasing data is Random Forest and Decision Tree.

Discussions

- Classify the customer more accurate
- Apply the business strategy more efficient on different patterns of customer
- Reduce the cost on promotion or advertisement

Achievements

- Copyright
- B. Sc. IT – Ong Jing Tan [Talent Development]
- Ong J. T., & Lew S. L. (2021). A Machine Learning Approach to Identify Purchasing Patterns for Online Purchasers [Degree thesis, Multimedia University Malaysia, Melaka, Malaysia]
- Ong J. T., & Lew S. L. (2021). A Machine Learning Approach to Identify Purchasing Patterns for Online Purchasers. IEEE. [In review]

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[1] Choudhury, A. M., & Nur, K. (2019). A Machine Learning Approach to Identify Potential Customer Based on Purchase Behavior. In 2019 International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST) (pp. 242-247). IEEE.
[2] Qiu, J., Lin, Z., & Li, Y. (2015). Predicting Customer Purchase Behavior in the e-Commerce Context. Electronic Commerce Research, 427-452.
[3] Press, G. (2016, March 23). Cleaning Big Data: Most Time-Consuming, Least Enjoyable Data Science Task, Survey Says. Retrieved from Forbes: https://www.forbes.com/sites/gilpress/2016/03/23/data-preparation-most-time-consuming-least-enjoyable-data-science-task-survey-says/?sh=6363d8a6f637

A SEAMLESS MOBILITY FOR VEHICLE TO VEHICLE COMMUNICATION

TS. DR. SITI FATIMAH ABDUL RAZAK, TS. SUMENDRA YOGARAYAN,
PROF. MADYA. TS. DR. AFIZAN AZMAN AND TS. MOHD. FIKRI AZLI ABDULLAH

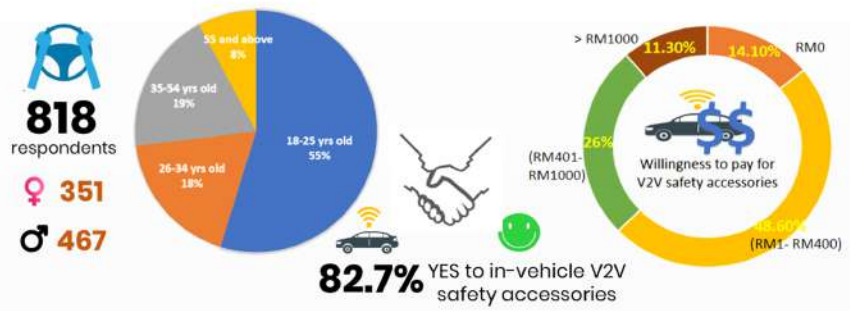
ABSTRACT

One of the important objectives of Intelligent Transportation System (ITS) is to increase the safety of driver by exchanging information between vehicles. Using wireless communication technologies, vehicles can communicate via in-vehicle devices that continuously share safety, mobility and environmental information. This information enables vehicle to be connected to other vehicles or infrastructures. These connected vehicles can alert drivers of potential hazards, take over vehicle operations when needed or even manage networks of autonomous vehicles in near future. Hence, the focus of this project is to design a framework that tackles the time delay, which occurs when vehicles are communicating. The impact of this innovation is to provide a platform for vehicles connectivity.

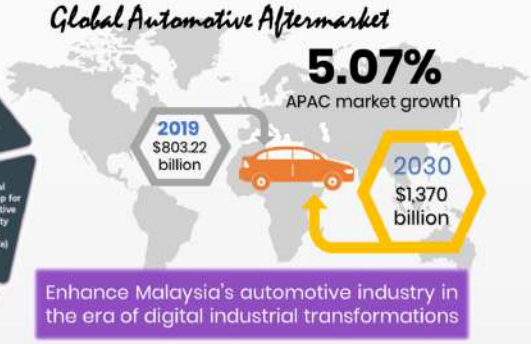
PROBLEM STATEMENT

- Increase number of vehicles on the road
- Increase in age of vehicles
- Increase number of vehicle accidents

METHODOLOGY



IMPACT



PROSPECTS

Grab · MARii · PROTON · TM Research & Development · BOSCH · APTIV · Delphi Technologies · DENSO Crafting the Core

SPECIAL HIGHLIGHTS

GRANT FRGS/1/2019

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6 GOLD AWARD

Publication 3 PUBLISHED INDEXED JOURNAL

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CICC · Connected Car Services · TM Group

Hindusthan
College of Arts & Science
An Autonomous College - Affiliated to Bharathiar University
Approved by AICTE and Govt. of Tamilnadu
Accredited by NAAC-An ISO Certified Institution

Acoustic Fire Extinguisher

Project Leader

Dr.S.Sasikala
Head Department
Of
Cs with CS

Team Members

Ms.E.Kavipriya ,
Mr.R.Jayakumar,
K.Gowtham kumar,
B.Ashwin.

A Brief Description of the project:

Our project name is Acoustic Fire Extinguisher . Already there are multiple technology for extinguishing purpose , but most of them requires water and other products. But we are going to use sound as a basic tool to extinguish fire.

Devices used in project:

- Our device consist of ARDUINO UNO as a microcontroller which control the entire program.
- Fire sensor to detect the fire.
- Ultra sonic sensor to detect the objects nearby.
- Also it consist some Motors and Relays for further moments.
- Woofer is fixed inside to produce sound.

Description of Projects:

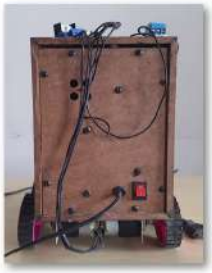
The basic aim of our Fire extinguisher is to extinguish the fire with the help of sound wave. It helps the fire fighter to fight the fire at early stage easily. Fire can be extinguished by the bass wave to extinguish the fire of all types of flames.

Community Name

Department of Computer Science with Cognitive Systems

Photos:






TM Group

AIR POLLUTANT INDEX (API) FORECASTING IN MALAYSIA: DATA FLATTENING WITH MACHINE LEARNING

Yee Jian Chew, Shih Yin Ooi, Ying Han Pang & Kok-Seng Wong

INTRODUCTION

World Health Organisation (WHO) have reported that the mortality caused by air pollution were recorded at an approximate seven million people every year.

API is one of the most common metrics used to assess the daily air quality level in Malaysia. Proliferation of technology have inaugurated the application of machine learning to improve the traditional air pollution prediction.

CAUSED OF AIR POLLUTION

IMPACTS OF AIR POLLUTION

OBJECTIVE

To devise an API prediction model which can be used to **predict the next-day API index** by observing its historical API indexes.

To unearth the dynamic information from a number of historical API indexes by observing their temporal changes.

DATA FLATTENING ALGORITHM

Note: The value 51, 51, ..., 42 is referring to the current API value recorded.

	Time				
Date	00:00	01:00	...	23:00	Class
20/07/2017	51	51	...	42	Good
21/07/2017	41	41	...	55	Good
22/07/2017	56	56	...	52	Moderate

Original Records (w=1)

Algorithm 1. Data Flattening Algorithm

Input:
D, an API dataset with d records.
Window size, w.
Output: temporalized records.
Procedure:
1. **for** $i = 1$ to $i = d–w+1$ **do**
2. **merge** row i to $i+w$-1
3. **endfor**

	Time									
Date	00:00[1]	01:00[1]	...[1]	23:00[1]	Class[1]	00:00[2]	01:00[2]	...[2]	23:00[2]	Class[2]
20/07/2017	51	51	...	42	Good	41	41	...	55	Good
21/07/2017	41	41	...	55	Good	56	56	...	52	Moderate

Temporalized Records (w=2)

DATASET

11 datasets of Hourly API values from 2017 to 2019 across 7 states in Malaysia are extracted from the Malaysia's Open Data Portal.

EXPERIMENTAL RESULTS

Summary of the results for 11 datasets across 10 observing time-step, from w=1 to w=10 of 11 machine learning classifier including (1) J48 decision tree, (2) random forest, (3) Elman network, (4) decision stump, (5) logistic model trees, (6) random tree, (7) reptree, (8) hidden Markov model, (9) hoeffding tree, (10) support vector machines, and (11) naïve Bayes.

Dataset	Performance Variables	Machine Learning Techniques										
		1	2	3	4	5	6	7	8	9	10	11
Larkin	Best window size	8	1	1	1	5	2	9	1	1	2	1
	Classification Accuracy (%)	98.7	**99.1***	98.5	97.5	98.9	98.0	98.6	43.1	97.6	98.4	97.5
Pasir Gudang	**Best window size**	**5**	**2**	**1**	**1**	**2**	**1**	**3**	**1**	**1**	**1**	**1**
	Classification Accuracy (%)	**99.1**	**99.4***	**99.3**	**98.2**	**99.3**	**98.3**	**98.4**	**51.1**	**97.4**	**99.3**	**97.4**
Kota Tinggi	Best window size	1	3	1	6	9	3	2	1	1	1	1
	Classification Accuracy (%)	98.7	99.3	**99.7***	95.9	98.7	98.2	98.1	72.9	96.3	99.0	96.3
Segamat	**Best window size**	**2**	**2**	**1**	**1**	**1**	**3**	**6**	**1**	**1**	**1**	**1**
	Classification Accuracy (%)	**98.1**	**98.9**	**99.2***	**97.7**	**98.9**	**97.9**	**98.3**	**52.9**	**96.0**	**98.7**	**96.0**
Kulim	Best window size	1	1	1	4	8	4	5	1	1	1	1
	Classification Accuracy (%)	98.6	**99.3***	98.6	96.9	97.9	98.4	98.1	53.1	96.1	97.7	96.0
Batu Muda	**Best window size**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
	Classification Accuracy (%)	**99.8***	**99.6**	**99.4**	**99.4**	**99.6**	**99.4**	**99.1**	**66.5**	**98.3**	**99.8***	**98.2**
Cheras	Best window size,	2	2	1	10	3	1	3	1	1	1	1
	Classification Accuracy (%)	97.0	97.4	**98.9***	97.1	98.5	96.3	96.8	62.8	96.3	97.7	96.3
Kota Terengganu	**Best window size**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**
	Classification Accuracy (%)	**98.7**	**99.4***	**98.5**	**97.5**	**98.7**	**98.5**	**98.1**	**53.4**	**96.6**	**98.3**	**96.5**
Kuching	Best window size	2	2	1	1	2	1	4	1	1	1	1
	Classification Accuracy (%)	98.4	**98.8***	97.6	96.8	97.8	97.6	97.5	72.7	90.3	97.3	90.3
Kota Kinabalu	**Best window size**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**
	Classification Accuracy (%)	**97.5**	**98.2**	**95.3**	**95.5**	**98.8***	**97.8**	**97.3**	**73.5**	**93.6**	**97.1**	**92.9**
Minden	Best window size	4	1	1	2	1	2	9	1	1	1	1
	Classification Accuracy (%)	97.7	98.9	98.5	96.5	**99.0***	97.4	97.1	28.5	98.9	98.1	98.7

CONCLUSION

The proposed method will allow vulnerable individuals to plan and prepare their daily activities in advanced by utilising the forecasted API. For example, if the next day predicted API exceeds the normal values, sensitive individuals will be able to prepare a mask ahead of

PUBLICATION

Wong, K. S., Chew, Y. J., Ooi, S. Y., & Pang, Y. H. (2021). Toward forecasting future day air pollutant index in Malaysia. The Journal of Supercomputing, 77(5), 4813-4830.

GRANTS

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AIR QUALITY MONITORING TOOL FOR PASSENGER VEHICLES

TS. DR. SITI FATIMAH ABDUL RAZAK, TS. SUMENDRA YOGARAYAN, MUHAMMAD NIZAMMUDIN AZLAN
TS. MOHD. FIKRI AZLI ABDULLAH AND PROF. MADYA. TS. DR. AFIZAN AZMAN

INTRODUCTION

Many people spend more than an hour a day in an enclosed vehicle. However, they pay very little attention to the vehicle's air quality.

90 percent human spend their time in vehicle, it is not surprising that factors contributing to poor air quality are receiving significant attention from researchers, government officials and the general public

Internet of Things (IoT) is a networking device capable of collecting and exchanging data to communicate and engage with integrated sensors, controllers, and wireless connectivity

Lack of technology available to the public to provide a monitoring tool for users in the vehicle context

Polluted air harms human health and contributes to environmental changes such as global warming and weather fluctuations.

People cannot trace or monitor the air quality their vehicle emits and also the air quality in the vehicle itself

The problem is closely related to the vehicle, which is the most significant source of pollutants.

One of the major health environmental issue is air quality.

PROPOSED WORK

Minimise exposure to potential adverse health effects

Real time awareness of air quality levels

Support environmental compliance and reporting

ENVIRONMENTAL IMPACT

Awareness of the contaminated air enables the driver to take precautionary steps.

Greater sustainability and lower energy costs.

Optimizing the number of communicating objects with single tool.

SPECIAL HIGHLIGHTS

Intellectual Property
Copyright Affirmed TTO/IP/CR/2021-008

Funding
MMU IR Fund, Grant No MMUI/210026

Competition
INNOCOM 2020 Silver Award

Publication
Journal of Southwest Jiaotong University Quartile 2

Competition
VIC 2021 Gold, Merit and Special Award

COMMERCIALISATION POTENTIAL

Collaborators

Prospects

Passenger Vehicles

Commercial Vehicles

Acknowledgement. This research was carried out within the framework of Connected Car Research Group. The research is supported by Multimedia University Internal Research Fund, Grant No MMUI/210026.

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An Autonomous College - Affiliated to Bharathiar University
Approved by AICTE and Govt. of Tamilnadu
Accredited by NAAC-An ISO Certified Institution

An IOT System Incorporated with LOF and SGBMO-ANN Machine Learning for CVD monitoring and Methods

Project Leader

Ms.P.Deepika
Assistant Professor,
PG & Research
Department of
Computer Science

Team Members

Dr.S.Sasikala ,
Ms.S.Saranya,
Ms.D.Priyadharshini,
Mr.D.Joshua Shalom.

A Brief Description of the project:

We propose a project with the title " An IOT Incorporated with LOF and SGBMO-ANN Machine Learning For CVD Monitoring and Methods". This project helps to predict the occurrences of CVD using real time data which collected using different sensors.

Description of Projects:

Provide the alert for risk in CVD using the data. The machine learning algorithms and Artificial Neural Network is used for predicting heart diseases. Four different sensors are used to collect the factors and passed to cloud. The analysis results are sent through the mobile.

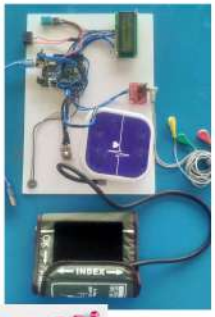
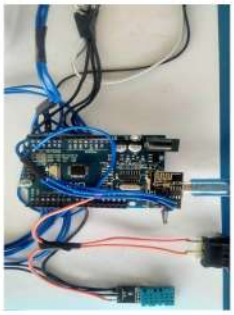
Devices used in project:

- Our device consist of **ARDUINO UNO** as a microcontroller which control the entire program.
- **Blood pressure sensor** to detect the Blood pressure .
- **Electrocardiography (ECG) sensor** to detect the to check your heart's rhythm and electrical activity..
- **Temperature sensor** to detect the temperature.
- **Heart beat sensor** to detect the heart beat level.

Community Name

PG & Research Department of Computer Science
Hindusthan College of Arts and Science
Coimbatore

Photos:

CUSTOMER CHURN PREDICTION FOR TELECOMMUNICATION INDUSTRY : A MALAYSIAN CASE STUDY

Nurulhuda Mustafa, Lew Sook Ling(✉) and Siti Fatimah Abdul Razak
Multimedia University, 75450 Ayer Keroh, Melaka, Malaysia

INTRODUCTION

- Many companies concerned about customer churn, especially in the telecommunications industry [1].
- Churning occurs when a customer switches services [2].
- A rise of 5% in customer satisfaction is followed by a 95% increase in sales [3].
- Net Promoter Score (NPS) dataset used to assess helpdesk and staff assistance →customer rating is based on the solved problem ticket [4].

OBJECTIVES

- Investigate customer churn framework in telecommunication industry
- Predict future customer churn using machine learning algorithms
- Propose customer churn framework in Malaysian telecommunication industry
- Evaluate propose customer churn framework in Malaysian telecommunication industry

METHODOLOGY

- 7776 records of Malaysian telecommunications dataset
  - MTD Sept 2019 & MTD Sept 2020
  - 30 fields
- Out of 38 variables
  - 24 selected
  - including promoter, passive & distractor (NPS Score Scale)
- Used 6 machine learning algorithms
  - Logistic Regression (LR), Linear Discriminant Analysis (LDA), K-Nearest Neighbours Classifier (KNN), Classification and Regression Trees (CART), Gaussian Naive Bayes (NB) & Support Vector Machine (SVM)

RESEARCH MODEL

Figure 1 : A conceptual framework for prediction of potential churner.

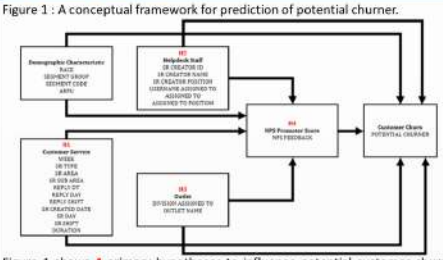


Figure 1 shows **4** primary hypotheses to influence potential customer churn and the mediation effects of NPS feedback that indirectly affects potential customer churn.

DISCUSSIONS

Customer Service

- High or low NPS score rating measures helpdesk staff resolving each problem raised by customer
- Dedicated and polite staff will be needed to resolve customer problems

Retention Programme

- Retention marketing is important from the final three phases of the customer lifecycle (before, during and after) →Contracts do not guarantee long-term customers
- Relationships are difficult to create and maintain → Provider need to focus on customer journeys for long-lasting subscriptions

RESULTS

Machine Learning Algorithms Comparison

Algorithms Name	MTD Sept 2019			MTD Sept 2020		
	Mean	Std	Accuracy Score	Mean	Std	Accuracy Score
Logistic Regression (LR)	0.42	0.01	41%	0.44	0.01	45%
Linear Discriminant Analysis (LDA)	0.41	0.02	42%	0.47	0.02	45%
K-Nearest Neighbours Classifier (KNN)	0.98	0.01	98%	0.98	0.01	97%
Classification and Regression Trees (CART)	0.98	0.01	98%	0.98	0.01	98%
Gaussian Naive Bayes (NB)	0.41	0.01	41%	0.44	0.02	44%
Support Vector Machine (SVM)	0.98	0.01	98%	0.96	0.01	98%

The results in the above table show that Classification and Regression Trees (CART) has the highest estimated accuracy score of **0.98** or **98%**.

Mediation Analysis

X: Independent Variable
M: NPS Feedback
Y: Potential Churner

X	X and M (p-value)	X and Y (p-value)	X, M and Y (p-value) Sobel Test	Significant Relationship X and Y via M
WEEK	0.5365	0.7852	0.5365	No
SR TYPE*	0.0001	0.0024	0.0001	Yes
SR AREA	0.6196	0.7088	0.6195	No
REPLY DT	0.5634	0.8215	0.5634	No
REPLY DAY	0.4331	0.4755	0.4331	No
REPLY SHIFT*	0.0001	0.0138	0.0001	Yes
SR CREATED DATE	0.7494	0.8044	0.7494	No
SR DAY	0.7311	0.7859	0.7311	No
SR SHIFT	0.4008	0.2146	0.4008	No
DURATION*	0.0001	0.0001	0.0001	Yes
SR CREATOR ID*	0.0009	0.0653	0.0009	Yes
SR CREATOR NAME	0.5596	0.1048	0.5596	No
SR CREATOR POSITION	0.7382	0.7535	0.7382	No
USERNAME ASSIGNED TO*	0.0002	0.0292	0.0002	Yes
ASSIGNED TO	0.1727	0.0206	0.1727	No
ASSIGNED TO POSITION	0.9376	0.4814	0.9376	No
DIVISION ASSIGNED TO	0.9622	0.6390	0.9622	No
OUTLET NAME	0.6197	0.5280	0.6197	No

Note: * p-value (< .05)

The NPS Feedback rating change partially mediates the following variables' effects on the probability of customer churn on **SR TYPE**, **REPLY SHIFT**, **DURATION**, **SR CREATOR ID** and **USERNAME ASSIGNED TO** have a significant relationship with potential churn customer.

Hypotheses Results

Hypothesis	Description	Decision
H1a	WEEK is positively associated with the customer churn probability	Not Supported
H1b	SR TYPE is positively associated with the customer churn probability	Supported
H1c	SR AREA is positively associated with the customer churn probability	Not Supported
H1d	REPLY DT are positively associated with the customer churn probability	Not Supported
H1e	REPLY DAY are positively associated with the customer churn probability	Not Supported
H1f	REPLY SHIFT is positively associated with the customer churn probability	Supported
H1g	SR CREATED DATE is positively associated with the customer churn probability	Not Supported
H1h	SR DAY are positively associated with the customer churn probability	Not Supported
H1i	SR SHIFT is positively associated with the customer churn probability	Not Supported
H1j	DURATION is positively associated with the customer churn probability	Supported
H2a	SR CREATOR ID is positively associated with the customer churn probability	Supported
H2b	SR CREATOR NAME is positively associated with the customer churn probability	Not Supported
H2c	SR CREATOR POSITION is positively associated with the customer churn probability	Not Supported
H2d	USERNAME ASSIGNED TO are positively associated with the customer churn probability	Supported
H2e	ASSIGNED TO are positively associated with the customer churn probability	Not Supported
H2f	ASSIGNED TO POSITION are positively associated with the customer churn probability	Not Supported
H3a	DIVISION ASSIGNED TO are positively associated with the customer churn probability	Not Supported
H3b	OUTLET NAME is positively associated with the customer churn probability	Not Supported
H4	A lower NPS feedback rating is considered more potential churner than a customer with a higher NPS feedback rating	Supported

The test of hypothesis reveals that **H1b** =SR Type (Service Request Type), **H1f** = REPLY SHIFT (Respond Day Shift), **H1j** = DURATION (Respond Time Duration) ,**H2d**=USERNAME ASSIGNED (Officer in Charge Username) and **H2g** = ASSIGNED TO (Officer in charge name) have a significant impact on the probability of churn

CONCLUSIONS

Low NPS Score	• immediate helpdesk response serves to meet customer needs and determine employee ability to satisfy customers.
6 Machine Learning algorithms	• CART has the highest accuracy rates (98%) for predicting potential customer churn.
NPS Feedback Rating	• appears to be a partial mediator between some churn determinants and customer churn from the findings.
Proposed Framework	• helps providers identify potential churn customers and offering win-back programmes to targeted churning customers.
Recommendation	• focuses on NPS rating together with provided feedback for a better finding and analysis.

ACHIEVEMENTS

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DriveSAFE: DRIVER PROFILER USING MACHINE LEARNING AND SMARTPHONES

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FOE, Multimedia University

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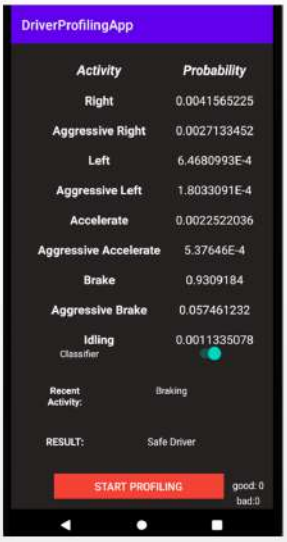
Ts. Dr. Ng Hu
FCI, Multimedia University

OVERVIEW

Driver behaviour strongly influences road safety and is currently the main contributor to traffic fatalities. **We propose a machine-learning-based system that harnesses smartphone sensors to classify driving events and score driver's performance.**

The system consists of an app that classifies the driving events using a trained machine learning model, and an algorithm that classifies driver behaviour. **This system can accurately classify driving events performed such as safe and aggressive turns, acceleration, braking, and idling.**



RESULTS

Real-world experiments were carried out to determine the functionality and effectiveness of the app. The average detection accuracy of the system in various scenarios is close to 94%.

Driving Events	Accuracy	Driver Profiler
Right-turns	22/25 ≈ 88%	Safe Driver
Left-turns	20/25 = 80%	Safe Driver
Aggressive Right	21/25 ≈ 84%	Aggressive Driver
Aggressive Left	24/25 = 96%	Aggressive Driver
Accelerate	18/25 ≈ 72%	Safe Driver
Brake	21/25 ≈ 84%	Safe Driver
Aggressive Accelerate	22/25 ≈ 88%	Aggressive Driver
Aggressive Brake	19/25 ≈ 76%	Aggressive Driver
Idling	23/25 ≈ 92%	Safe Driver
Average	**94%**	

KEY FEATURES

Scalable – App can be distributed via app stores
Cost-effective – No external sensor devices required
Flexible – Improved efficiency with short turnaround time

FEATURE FUSION OF 2.5D FACE RECOGNITION USING EXTREME LEARNING MACHINE

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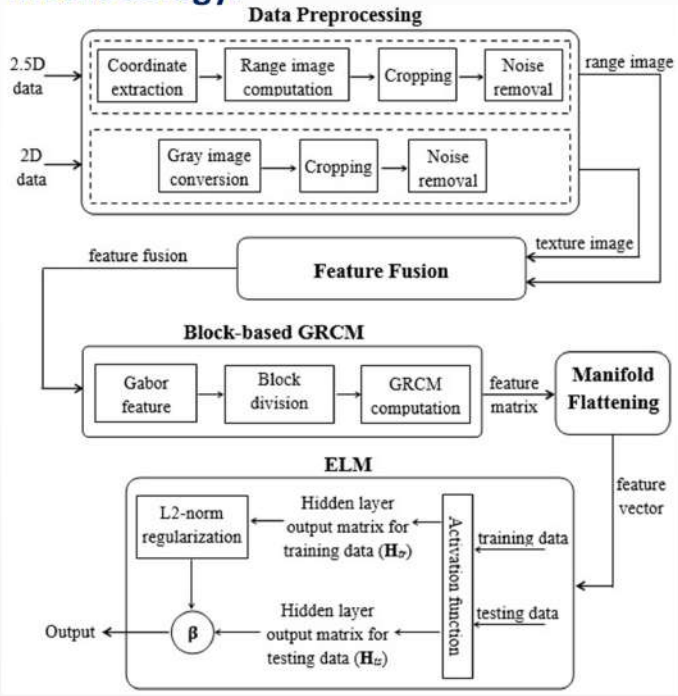
Faculty of Information Science and Technology, Multimedia University

A variant of 3D face recognition known as 2.5D face recognition has emerged as an appealing biometric solution. Extreme Learning Machine, a machine learning classifier, is proposed to enhance the recognition performance. Since the fused features are able to offer more discriminative characteristics, various feature fusions are examined for the proposed method.

Objective:

- To employ feature fusion approaches to enhance the performance of 2.5D face recognition.
- To propose the Extreme Learning Machine (ELM) in 2.5D face recognition to boost the recognition rate.

Methodology:



Comparison of Face Recognitions:

	2D Face Recognition	2.5D Face Recognition	3D Face Recognition
Representation	Texture image	Range image	3D facial model
View in 3D	Not applicable	Single frontal view	Full view
Point coordinate	x and y	x, y and z	x, y and z
Captured device	Digital camera	3D scanner	multi-view stereo system
Processing cost	Cheap	Medium	Expensive
Limitation	Affected by illumination, expression and pose changes	Affected by expression and pose changes	Affected by expression and pose changes
Sample of Image			

Experimental Result:

	Recognition rate (%)				
	2000	4000	6000	8000	10000
Range image	95.92	97.05	97.59	97.88	97.83
Texture image	95.28	96.44	96.88	96.08	96.13
Fusion concatenation	97.34	98.67	98.82	99.21	**99.36**
Fusion averaging	94.00	96.46	97.19	97.49	97.59
Fusion weighted averaging	95.23	97.15	97.69	97.83	97.93
Fusion automatic weighted averaging	95.42	97.44	97.88	98.08	98.13
Fusion PCA	95.03	97.17	97.69	97.97	97.98
Maximum fusion	85.88	90.55	91.44	92.52	92.91
Minimum fusion	88.68	92.18	92.77	93.16	93.60
Max – min fusion	95.87	96.05	96.59	96.58	97.29
Inner fusion	96.51	98.13	98.62	98.77	**98.92**

Conclusion:

This research presents a fusion-based approach by implementing the machine learning technique in the 2.5D face recognition. Experimental results shows the fusion concatenation and inner fusion are the two best feature fusions for the proposed 2.5D face recognition.

FUNFIT: MOBILE EXERGAMING WITH HUMAN ACTIVITY RECOGNITION USING DEEP SPATIAL-TEMPORAL ANALYSIS

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Faculty of Information Science and Technology, Multimedia University, Melaka, Malaysia.

Introduction

In the present-day world, health is the greatest wealth that man can possess. Eating a balanced diet, regular exercising, and getting enough sleep is the key to a healthy lifestyle. However, the lockdown, home confinement and social distancing due to COVID-19 have changed physical activity and sedentary habits due to the prolonged stays at home. Moreover, most individuals find exercise boring. Hence, to make exercise more fun and compelling, a mobile game application, called ***FunFit***, that requires coordination skills for visual and physical movement is proposed. In ***FunFit***, a deep learning-based human activity recognition (HAR) system is embedded to identify the individual's actions based on his/her body part movements. This motion-based game could become part of the solution against sedentary lifestyle and even obesity. This research project is to design an efficient smartphone-based HAR system based on one-dimensional (1D) inertial signals as mode of interaction with the game.

Problem Statement

Problem 1: The lack of physical activities among people is increasing globally. According to a survey conducted concerning global trends on insufficient physical activities, **27.5% of individuals** who are older than 18 years old are **physically inactive**. Sedentary lifestyles can be detrimental to one's health and lead to chronic diseases such as hypertension, stroke, heart attack, high blood pressure, and diabetes. Lack of time and energy, lack of sports facilities and equipment, loss of interest and motivation are the few primary reasons for abandoning exercising.

Problem 2: Popular HAR approaches can be categorised as handcrafted feature-based (HCF) and deep learning (DL) methods. HCF methods **require hardcore pre-processing** and **manual feature engineering** to extract crucial features from input signals before classifying them using traditional machine learning classifiers. Moreover, most HCF methods **do not capture spatial-temporal features efficiently**. On the contrary, DL methods can extract significant underlying features automatically from input signals and classify them. However, most DL methods **do not retain a longer effective history** which is crucial to motion signals as it provides rich information.

Objectives

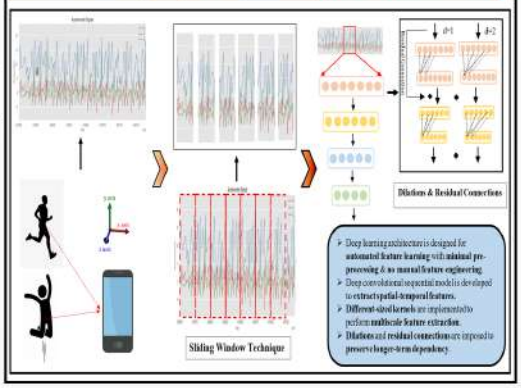
- To develop a mobile exergaming application: ***FunFit*** - the research has focused on positive outcome: helping people that usually have a sedentary lifestyle move towards a physically more active lifestyle.
- To design a deep convolutional sequence HAR model that requires minimal pre-processing and no manual feature extraction to efficiently identify gamers' body movements as mode of interaction with ***FunFit***.
- To equip the proposed HAR model with dilated convolutions and residual connections for longer-term dependency modelling to effectively recognize human activities.

Key Features of FunFit

- Embedded with the proposed deep HAR model with high activity recognition accuracy and fast inference time
- Makes exercise more fun and accessible
- Able to invite friends and family to play
- Challenge others in a game
- Check workout history
- Share the high scores with others

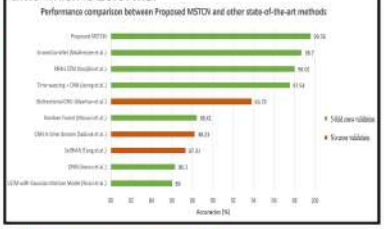
Methodology → Multiscale Temporal Convolutional Network (MSTCN)

Data Collection → Signal Pre-processing → Model Construction



Results

The proposed deep learning HAR model was evaluated on **UniMiB-SHAR dataset** using **5-fold cross-validation protocol**. The results proved that the proposed MSTCN dominates the existing state-of-the-art methods by achieving an average accuracy of **99.58%**. Furthermore, the proposed MSTCN also had a relatively fast **inference time** which is **23.67ms**.



Conclusion

In conclusion, ***FunFit*** will break the stigma towards exercising and allure more individuals to be **physically active**. The proposed deep learning HAR model was evaluated using a 5-fold cross-validation protocol and the empirical results showed that the proposed model could achieve an average accuracy of **99.58%** on the UniMiB-SHAR dataset and outperformed other state-of-the-art methods.

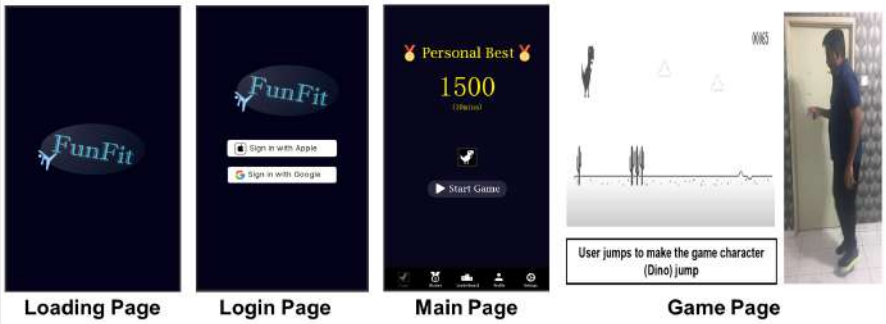
Commercialisation Potential

A survey concerning the new state of online gaming conducted in 2020 states that a plethora of gamers, regardless of age and gender, still prefer **mobile phones as their primary gaming** device globally, and each year, the gap between the preference for mobile phones and other devices widens. Moreover, the report also revealed that **almost 32%** of gamers spend more than seven hours playing games every week. Thus, ***FunFit*** has commercialisation potential as it is an exciting interactive mobile exergaming application. Moreover, anyone with a smartphone can play this game anywhere and at any time.

Research Achievements

- ✓ This project is funded by Fundamental Research Grant Scheme (FRGS)
- ✓ Published extended abstract titled "Subject Independent Human Activity Recognition using Multiscale Temporal Convolutional Network" in DIFCON 2021
- ✓ Submitted journal titled "MSTCN: A multiscale temporal convolutional network for user-independent human activity recognition" to F1000 journal (Scopus Q1)
- ✓ Talent development: a PhD candidate with specialization in machine learning/ artificial intelligence

FunFit Application



Loading Page **Login Page** **Main Page** **Game Page**

HUMAN AGE ESTIMATION USING GAIT AND FACE MODALITIES

Timilehin B. Aderinola • Assoc Prof. Ts. Dr Tee Connie • Prof. Ts. Dr Ong Thian Song
Faculty of Information Science and Technology, Multimedia University

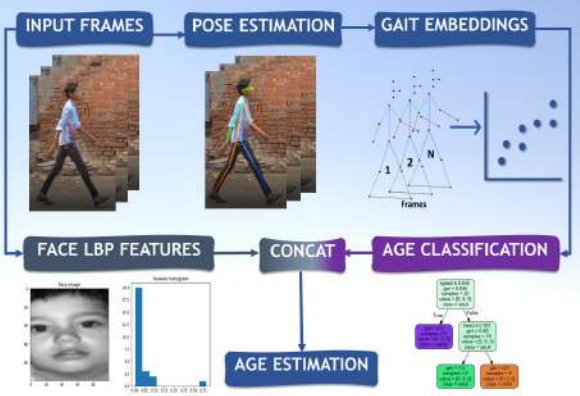
1) INTRODUCTION

- Automatic age estimation involves labelling humans with precise age/age group based on physical attributes, e.g., gait and face [1].
- Useful in surveillance, law enforcement, HCI and access control, e.g., preventing minors from purchasing alcohol.
- Face image quality affects performance, but gait can make up for these limitations [2], [3].

2) OBJECTIVES

- To develop a framework for human detection and automatic gait feature extraction in video sequences;
- To use hierarchical-based learning for age estimation using a fusion of human facial and gait features;
- To perform systematic evaluation on the proposed age estimation approach.

3) METHODOLOGY



4) PRELIMINARY RESULTS

5) DISCUSSION/CONCLUSION

- Two preliminary experiments:
  - Experiment A – without age group.
    – MAE of 8.9 years was achieved;
  - Experiment B – with age group.
    – MAE of 5.6 years was achieved.
- There was better performance in experiment B, with MAE lowered to 5.6 years.
- Fusing gait and face features can improve the performance of age estimation.

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IMPROVING TRAFFIC FLOW PREDICTION IN SMART CITY APPLICATIONS

Hatem Fahd Al-Selwi , Azlan Bin Abd.Aziz, Fazly Salleh Abas, Azwan Bin Mahmud , Nur Asyiqin Amir Hamzah

INTRODUCTION

In recent years, with the rapid growth in the number of vehicles, the road infrastructure capacity and resources cannot keep up with the rapid increase in demand in smart city applications. Therefore, Traffic flow prediction helps in alleviating traffic congestion as well as in some connected vehicles applications such as resources allocation [1]. However, most of the existing models do not consider external factors such as weather data and this makes them unrealistic [2]. In this project , we demonstrate in our model how weather data can improve the prediction accuracy and efficiency ,and hence, enhances the performance of the proposed model .

RESEARCH OBJECTIVES

1. To study the correlation between traffic flow data and weather data using PeMS dataset and weather information.
2. To demonstrate that combining weather data with traffic data could improve prediction accuracy.

METHODOLOGY

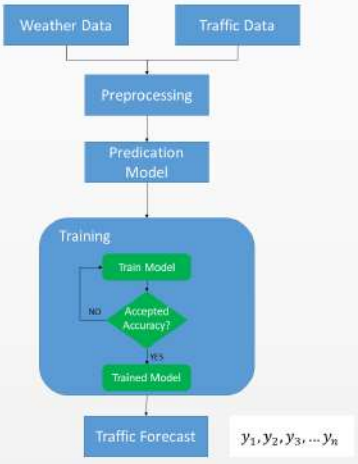

Figure 1: Diagram of the system

In this research, to study the impact of weather data on traffic flow prediction we used three prediction models and compared their performance with and without weather data.

SIMULATION RESULTS

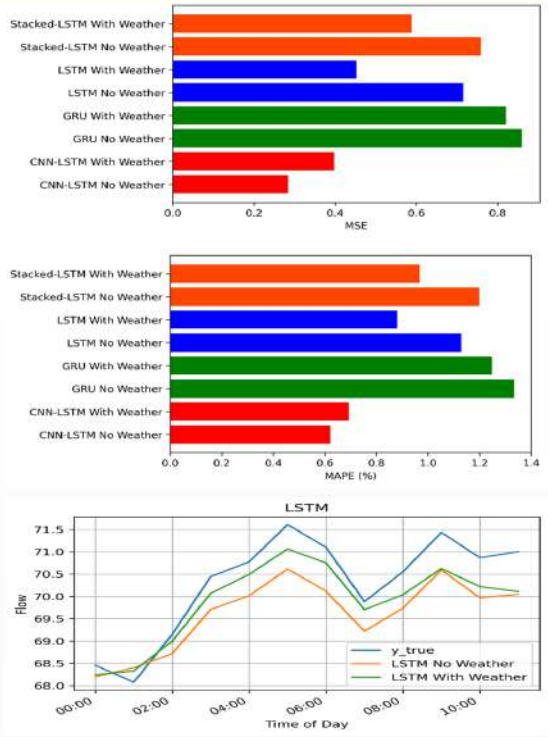

Figure 2: Models accuracy.

CONCLUSION

In this project, we studied the impact of weather data on traffic prediction. The experiment results showed that the model accuracy increases if weather data is combined with the traffic data. This increase in the accuracy is due to the correlation between weather conditions and traffic flow. In this project, work has been done for data processing to prepare the weather data to be used with traffic data, where every data point in weather data requires corresponding values in traffic data.

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ACKNOWLEDGMENT

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IoT Smart Parking Guidance Using WKNN Algorithm

Huzaifah Abdulrahim, Assoc. Prof. Dr. Md Shohel Sayeed & Dr. Siti Fatimah Abdul Razak

Abstract 01

Go'N Park is an smart parking system that utilizes indoor positioning using Wi-Fi RSSI fingerprinting and Weighted K Nearest Neighbors algorithm with real-time navigation to estimate user location with high accuracy along with an IoT approach for parking detection is developed. The system uses sensors technology to detect the availability of a parking spot in real-time and send the information to an IoT cloud and display it to the user through an app over the internet, wherefrom the user can get routed/navigated to their desired parking spot. This approach can make use of existing technologies and infrastructure for localization that can make it cost efficient, in addition it can potentially reduce parking time.

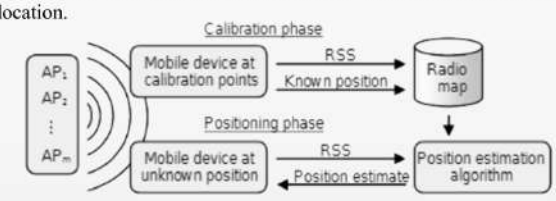
02 Proposed System

As mentioned in the abstract the proposed system uses WKNN algorithm for user location estimation, which is discussed in this section:

A. User Localization Using Wi-Fi RSS and WKNN

User localization and guidance with Wi-Fi finger-printing is done in two phases, online phase or also known as positioning phase and an offline phase also known as calibration.

- **Calibration Phase:** RSS values are measured and recorded in dBm from Wi-Fi APs/Extenders at certain reference points and associate each value with its coordinates(x, y), then it is pined on the area floor map to create a radio map and the average of several recorded samples is stored in the database of the area, which is done in the first part of the calibration phase.
- **Online Phase:** A RSS value of an unknown location is measured and compared to the previously recorded values in the radio map to find the best match using WKNN algorithm to estimate users location, by finding k indices from the radio map that has the nearest RSS values using Euclidean Distance to the reference point given a vector measured at the unknown location.



B. Discussion and Testing:

The implementation of the system involves several stages, from uploading the area floor plan, points of interest (POIs) and Wi-Fi RSS recording.The system was tested in three different locations with three different scenarios, I.e., (i) using GPS for navigation, (ii) using WKNN with the building Wi-Fi for navigation, and (iii) using Maximum a Posteriori (MAP) instead of WKNN for navigation, and then adding Pix-Link portable extenders for better Wi-Fi coverage in all areas, by taking the average error rate of ten different points in each location.

Results 04

I. Using GPS for Navigation: Using GPS showed an average error rate of 3.55 meters.

II. Using Pre-Installed Wi-Fi RSS with WKNN: In this scenario the average error rate got reduce by around 35% averaging 2.3 meters.

III. Using Wi-Fi Extenders with WKNN: As on the previous scenario building pre-installed Wi-Fi coverage was low, adding the extenders made a noticeable increase in accuracy reducing average error rate to 1.5 meters

IV. Using Wi-Fi Extenders with MAP: WKNN results were more accurate than MAP as it averaged an error rate of 2.2 meters.

05

Fig.1 Overall System Diagram.

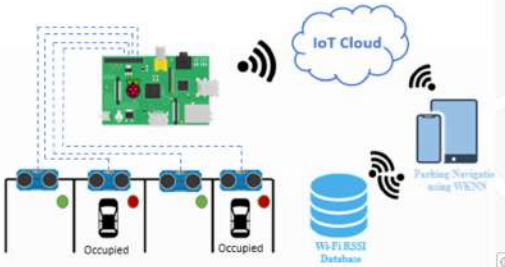


Fig.2 User Navigation

Fig.3 Wi-Fi Fingerprinting

Key Features 06

- Real time parking detection.
- Real time parking slots and sensors monitoring over the Internet.
- User localization and guidance is done in real-time with high accuracy.
- Green innovation, less parking time therefore reducing CO2 emission.

Conclusion 07

This research examined the use of the WKNN algorithm in the parking system. It also presents that the implementation and utilization of indoor positioning approaches can improve parking navigation reliability by up to 60% compared to the other techniques. Leading to a more convenient parking experience and help reduce parking time, enhances the quality of life, especially in urban cities, reduces fuel consumption from cruising around parking areas or buildings, and reduces wasted time and CO_2 emission by vehicles for a more green environment.

IOT-BASED CUSTOMER FLOW MONITORING SYSTEM

TS. DR. SITI FATIMAH ABDUL RAZAK, KHOO HAN MENG, TS. SUMENDRA YOGARAYAN,
TS. MOHD. FIKRI AZLI ABDULLAH AND PROF. MADYA. TS. DR. AFIZAN AZMAN

INTRODUCTION

01 Customer monitoring systems are extremely popular since they are primarily utilized for safety, security, and business.

02 Due to the current SOP procedure, the entry and exit of customer in premises are required to be monitored.

03 An implementation of IoT technologies would lead to a more reliable solution for customer monitoring in premises.

1 Most tools for people counting sensor are expensive.

2 The paper record might be difficult to be referred by the manager.

3 Decrease the sales performance of the company and reduce their productivity.

4 A worker needs to manually count the number of customers going in and out of the business premise.

PROPOSED WORK

Premises

Customer Entry-Exit Point (Limit to 10)

Cloud

Data Collection of Customer Entry-Exit

Administrator

Visual Representation

SIGNIFICANCE

Customers can be flagged when the premise has reached a certain customer limit number, in compliance with COVID 19 regulations

Provides personalised crowd insights for a business premise

Helps businesses to monitor the number of customers entering and leaving their premise.

Businesses can plan their marketing strategies based on the insights

ENVIRONMENTAL IMPACT

Provides easier customer monitoring for staff on duty

Allow managers to keep track of the flow of customers

Managers will be aware of current in-premise's occupancy level and limit the next people coming in to maintain social distance

COMMERCIALISATION POTENTIAL

COMMERCIALISATION POTENTIAL

01 **Intellectual Property (IP)**

Written copyright application for submission to TTO

02 **Publication**

Written journal paper to IJIM is in review

Acknowledgment. We gratefully acknowledge the use of service and facilities of the Connected Car Services Research Group, Centre of Intelligent Cloud Computing at Multimedia University.

OIL PALM FFB COUNTING USING YOLO DARKNET

Lim Teng Gen and Lew Sook Ling (✉)
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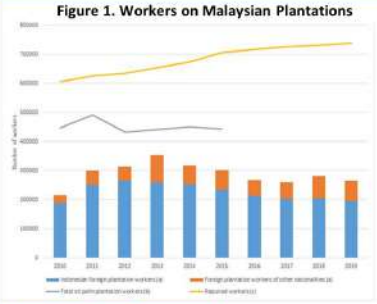
Background of Study

Figure 1. Workers on Malaysian Plantations



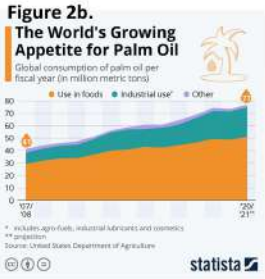
Oil palm fruit is called Fresh Fruit Bunch (FFB). Generally, there are two colours of FFB, which are red FFB and black FFB.

Malaysia faced workforce shortage even before pre-covid era (2010-2019) [1]. It is clear that in every year, demand for worker in oil palm plantation exceed at almost twice of the supply.

Figure 1 shows 80% to 85% of the workers are foreigners, but in year 2021, due to covid restriction, overseas hiring was halted as the number of foreigner workers decrease. Therefore plantations struggle to maintain output capacity with workforce shortage [1]. **Therefore new management technology is needed to better utilise the existing labour force.**

Figure 2a.

Figure 2b.



Malaysia and Indonesia control the global production of palm oil by 84% and the global demand for it will continue to rise by prediction as shown by Figures 2a and 2b [2]. The high and wide usage of palm oil had sparked a demand for palm oil in the global market. Hence a large amount of palm oil had been planted in Malaysia to fulfil and cater to the demand [3]. With this, **labour force are increased tremendously for plantation management such as security for theft prevention such as current and future rounds of yield forecasting that is focused on this project.**

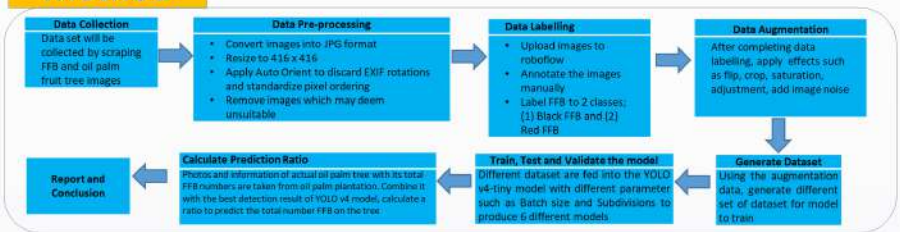
Objectives

- To have fast counting on the quantity of FFB on oil palm tree from an image
- To detect and count both red and black FFB for yield prediction
- To ensure reliability of counting results

Justification of Study

- Long standing issue for labour shortage, worsen due to covid restrictions, limited hiring for new foreign workers[1], with high demand for oil palm, need a better system for oil palm fruit management[4].
- Traditional method of counting FFB is slow, must count the FFB one-by-one for each tree. Does not have efficiency and effectiveness.
- Can reduce labour force, reduce effort for owner to manage and predict their harvest

Method



Results

Original image | **Model i300 detection result**

Original image | **Model i300 detection result**

Benefits

- Reduce human error
- Increase labour efficiency
- Reliable data source which can be verified
- Able to detect both red and black FFB

Achievements

- Copyright
- B. Sc. IT – Lim Teng Gen [Talent Development]
- Lim T. G., & Lew S. L. (2021). Oil Palm Counting System [Degree thesis, Multimedia University Malaysia, Melaka, Malaysia]
- Lim T. G., & Lew S. L. (2021). Oil Palm FFB Counting using YOLO Darknet. IEEE. [In review]
- Industrial collaboration

Commercialization Potential

- Very High, due to ongoing shortage of labour force, human error and reliability; a better solution is needed to tackle these issues
- Able to detect both red and black FFB means it is able to forecast and predict the harvest round for this season and the next season

Conclusion

- Developed a fully working system which end-user can upload an image and have fast counting on the quantity of the FFB in the image
- The developed system can predict the total number of FFB on the oil palm tree with acceptable accuracy
- The developed system can ensure reliability by reproducing result that can be validated and cross checked later

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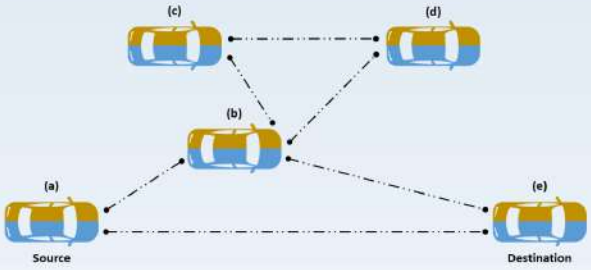
[3] Abdullah, R., & Wahid, M. B. (2010). World Palm Oil Supply, Demand, Price and Prospects: Focus on Malaysian and Indonesian Palm Oil Industry. Malaysian Palm Oil Board Press, Malaysia.
[4] Idayu, I., & Supriyanto, E. (2014). Oil Palm Plantations Management Effects on Productivity Fresh Fruit Bunch (FFB). APCBEE Procedia, 8, 282-286.

PERFORMANCE ENHANCEMENT OF ROUTING PROTOCOL FOR QUALITY OF SERVICE SUPPORT IN VEHICULAR AD HOC NETWORKS (VANETS)

TS. MR. SUMENDRA YOGARAYAN, TS. DR. SITI FATIMAH ABDUL RAZAK AND PROF. MADYA. TS. DR. AFIZAN AZMAN

WHAT IS IT?

Vehicular Ad Hoc Networks, (VANETs), is an ad hoc network where the vehicle acts as a node for a specific need or situation.



WHY DOES IT MATTER?

VANETs leverages to a wide range of possibilities, such as dynamic route scheduling, prevention of vehicle collisions, real-time traffic condition monitoring, blind-spot detection and other applications.

WHAT IS THE CURRENT PROBLEM?

- Lack of VANET-specific characteristics settings for data transmission.
- Lack of performance deliberation that requires the cooperation of each node

HOW DOES IT WORK?

The project concentrates on VANET routing and performance through testbed deployment. Routing classification in VANET comprises proactive, reactive and hybrid routing. These routing protocols may require performance testing to identify the appropriate protocol. As an outcome, the project developed a testbed considering suitable routing protocols with traffic differentiation and scheduling of performance support in VANETs.

WHAT IS THE SIGNIFICANCE?

The recent push of National Automotive Policy (NAP) 2020 aims to transform the Malaysia Automotive Industry towards Connected Mobility Ecosystem (CME) by 2030. The policy ensures that Malaysia would support developing regulations, especially in automated, autonomous, and connected vehicles. As such, this project could considerably be part of the applicability of Vehicle to Everything (V2X) moving closer to reality.

SUMMARY

As transportation gets even complex, the necessity of examining VANET testbed-based results can distinguish better performance compared to a VANET simulation-based.

SPECIAL HIGHLIGHTS

1 Silver Award	1 Bronze Award	1 Q2 Journal	2 Q3 Journal	1 Q3 Conference

Acknowledgement. This research was carried out within the framework of Connected Car Research Group. The research is supported by Multimedia University Graduate Research Scheme, Grant No MMUI/190005.02 and a portion of this research was supported by Fundamental Research Grant Scheme, Grant No MMUE/190034.

PRESENTATION ATTACK DETECTION FOR FINGER VEIN RECOGNITION

NURUL NABIHAH ASHARI, TS ONG, TEE CONNIE, HT JACKSON, YF LEONG

ABSTRACT

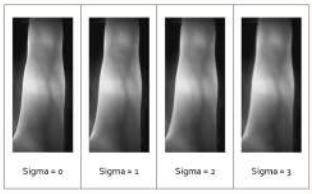
- In the recent years, finger vein biometrics has been gaining traction commercially
- Presentation attacks is one where the attacker uses fake finger vein pattern to spoof the finger vein sensor
- In this research, a multi-scale histogram of oriented gradients representation is proposed for presentation attack detection (PAD) with minimal pre-processing step
- The results are evaluated with a benchmark dataset and compared with the other PAD methods that returns promising results

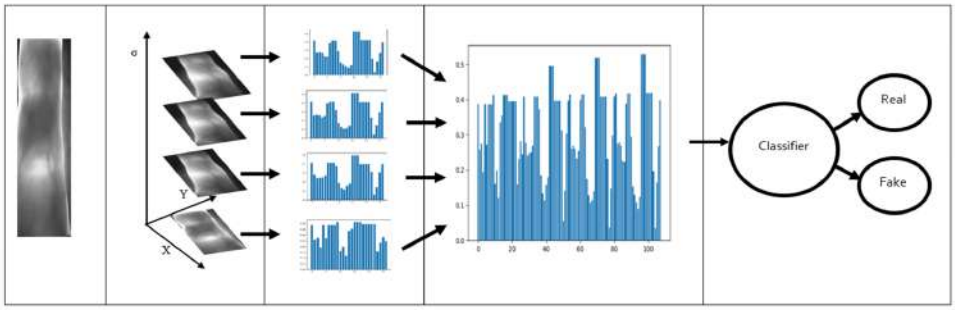
OBJECTIVE

- To design a method to detect presentation attacks of finger vein
- To evaluate the proposed method by using the standard benchmark SCUT-FVD dataset

METHODOLOGY

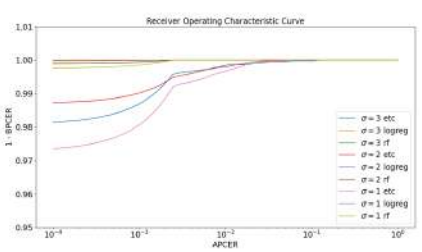
- Images under different scale are generated using Gaussian technique
  - $L(\sigma, I) = I * G(\sigma)$ where I is the image and $G(\sigma)$ symbolizes the Gaussian kernel with variance σ
- Histogram of Oriented Gradient is a texture-based descriptor that provide representation of an image using the distribution of local intensity gradients
  - Divide the image into uniformly spaced cells, calculate magnitude and directions for each cells, and combine all feature vectors
- The histogram features are then fed to classifier to determine whether the image is real or fake

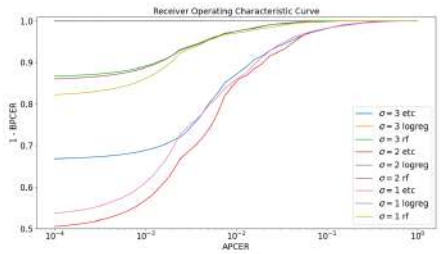




RESULT

Average Classification Error Rate (ACER) (%)		
Methods	Full	Cropped
TV-LBP	0	0
FSER	18.47	43.61
HDWT	5.69	46.30
DDWT	1.60	41.06
FSER-DWT	2.13	30.02
HOG	6.75	10.16
MHOG	0.014	1.50





CONCLUSION

The proposed method returns a promising result of 0.014% ACER and ranks the second best among other methods aforementioned.

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- J. Kolberg, M. Gomez-Barrero, S. Venkatesh, R. Ramachandra, and C. Busch, "Presentation Attack Detection for Finger Recognition," *Advances in Computer Vision and Pattern Recognition*, Springer, 2020, pp. 435–463.
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PROGNOSTIC REPORTING SYSTEM FOR HORMONE RECEPTOR TESTING IN BREAST CARCINOMA PATIENTS

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Introduction

2020 Breast cancer facts

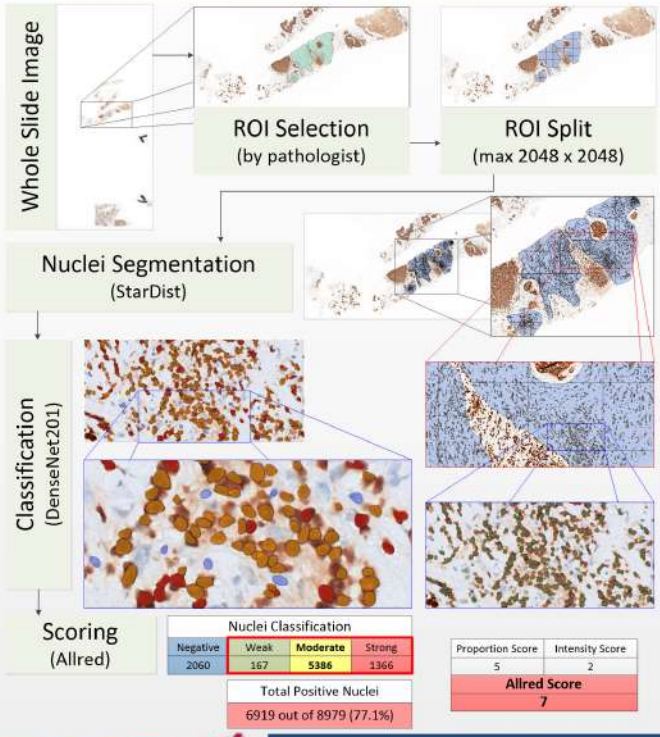
- 8,418 cases with 3,503 deaths
- Second deadliest after lung cancer
- 48% are diagnosed late
- 5-year survival rate is higher if diagnosed early

Early diagnosis survival rate:

Stage I: 88%
Stage II: 81%
Stage III: 60%
Stage IV: 23%

- **Breast cancer evaluation**: crucial step is by testing tumor tissue from biopsy/surgery, for its estrogen receptor (**ER**), progesterone receptor (**PR**) and/or human epidermal growth factor receptor (**HER2**)
- **Current practice**: Regardless its stage, treatment strategies are manual determination of ER, PR and HER2 status by the pathologists (exhaustive and time-consuming)

Methodology



Special Highlights

- A prognostic reporting system prototype of hormone receptor status for breast cancer, with automated scoring of ER, PR and HER2 expression status from WSI
- High commercialization potential can be used by researchers and pathologists worldwide
- Part of Research Excellence Consortium (KKP) of MMU-UKM-IMU Artificial Intelligence for Digital Pathology (AI4DP)

Results

Segmentation

~400,000 nuclei detected on 10 WSIs within 4 hours (0.04s per nucleus)

Classification

~400,000 nuclei classified into four classes (negative, weak, moderate, strong) within 17 hours (0.16s per nucleus)

Scoring

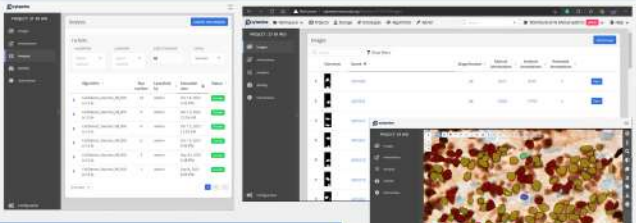
Less than 1s per WSI

WSI	Automated	Manual
1	**7**	**7**
2	6	7
3	**3**	**3**
4	**3**	**3**
5	**2**	**2**
6	**8**	**8**
7	3	0
8	**7**	**7**
9	4	3
10	2	0

Key Features

- Automatic scoring of ER, PR and HER2 markers for breast cancer evaluation and treatment
- Whole-slide images for more inclusive and accurate prognosis
- Can help solve the good health and well-being sustainable development goals

Web User Interface (Cytomine)



In Collaboration With

IsDB Islamic Development Bank
PUSAT PERUBATAN UNIVERSITI MALAYA
TM Group

REAL TIME DISTORTION CLASSIFICATION AND RANKING IN LAPAROSCOPIC VIDEOS

Project Leader: Prof. Ir. Dr. Hezerul Abdul Karim
Researchers: Dr. Nouar AlDahoul, Eng. Mhd Adel Momo
Faculty of Engineering (FOE)

INTRODUCTION

- Laparoscopic videos are tools used by surgeons to insert narrow tubes into the abdomen without making large incisions in the skin.
- Automatic detection and identification of distortions are significant to enhance the quality of laparoscopic videos to avoid errors during surgery.
- The video quality assessment includes two stages: classification of distortions affecting the video frames to identify their types and ranking of distortions to estimate the intensity levels.

PROBLEM STATEMENT

- The videos captured by a camera are prone to various distortions such as noise, smoke, uneven illumination, defocus blur, and motion blur with various levels of severity, which have impact on visual quality.
- The most challenging part of laparoscopic videos dataset is the availability of multiple types and levels of distortions in the same video. This is formulated as a problem of multi-label distortion classification and ranking.

Figure 1. Few frames from the laparoscopic video dataset

SOLUTION DESCRIPTION

- A state-of-the-art deep learning model called vision transformer was used to extract informative features by transferring learning and representation from the domain of natural images to the domain of laparoscopic videos.
- Six parallel multilayer perceptron (MLP) classifiers were added and attached to vision transformer for distortion classification and ranking.

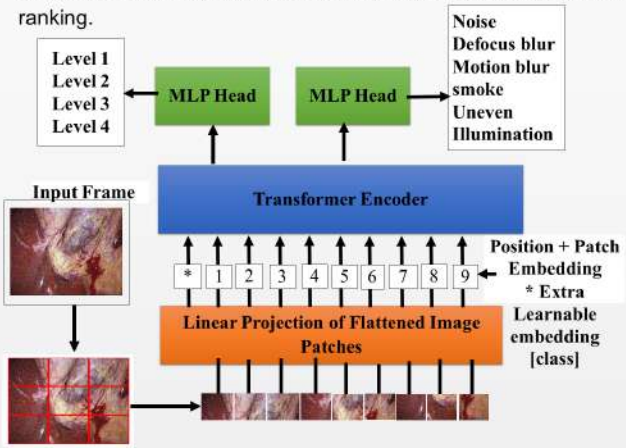


Figure 2. The vision transformer architecture for distortion classification and ranking

FEATURED RESULTS

Table 1. comparison between the proposed solution and baseline methods

Method	F1-score (Single + Multi Distortions) %	F1-score (Single-Distortion) %	Accuracy %
Vision transformer (Proposed)	**97.5**	**94.7**	**91.5**
ResNet50-LSTM (baseline)	94.2	89.3	85.0
Decision Fusion ResNet50+4 SVMs (baseline)	94.9	94.7	83.0
VGG16+many FM + FC (baseline)	94.1	93.3	81.5
VGG16 + 5 FC (baseline)	93.3	90.7	78.0
Baseline	91.5	88.0	76.5
Baseline	85.4	98.7	58.0
Baseline	83.2	89.3	57.0

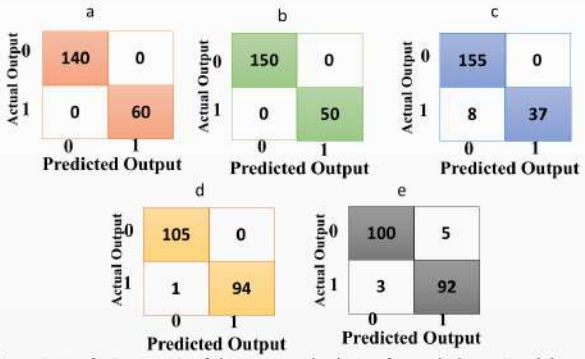


Figure 3. Confusion matrix of the proposed solution for each distortion: (a) AWGN noise, (b) defocus blur, (c) motion blur, (d) smoke, and (e) uneven illumination.

COMMERCIALIZATION POTENTIAL

- An accurate (F1 score of **97.5 %**), robust, and fast (**20 FPS**) solution for distortion classification and ranking.
- It is a significant component in automatic video enhancement system.
- The proposed solution can help surgeon to avoid errors during laparoscopic surgery.
- The proposed solution can reduce time required for troubleshooting to do changes to the technical equipment that cause distortions.

Special Highlight

- First prize in ICIP20 challenge (challenge winner)
- 2 copyrights
- Presentations: 1 MECON conference
- Publications: 3 Q1 journal papers (one published and two under review)

PUBLICATIONS

1) N. Aldahoul, H. A. Karim, M. J. T. Tan and J. L. Fermin, "Transfer Learning and Decision Fusion for Real Time Distortion Classification in Laparoscopic Videos," in IEEE Access, vol. 9, pp. 115006-115018, 2021, doi: 10.1109/ACCESS.2021.3105454.
2) AlDahoul N, Abdul Karim H, Ba Wazir AS et al. Spatio-temporal deep learning model for distortion classification in laparoscopic video [version 1; peer review: awaiting peer review]. F1000Research 2021, 10:1010 (https://doi.org/10.12688/f1000research.72980.1)

RFCNN MASKED FACE RECOGNITION

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Abstract

Masked face recognition embarks the interest among the researchers to find a better solution for face recognition applications, especially in the Covid-19 pandemic lately. In this research, a new masked face recognition method known as Random Forest Convolutional Neural Network (RFCNN) is introduced.

Objective

This method combine with the Random Forest algorithm in Convolution Neural Network to pre-train the masked face features. RFCNN is designed to assist in extracting more informative data and preventing overfitting problem.

Proposed Solution

Example of Masked Face Image

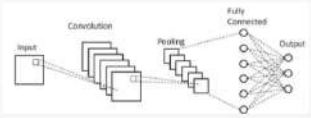
A — Masked Facial Image

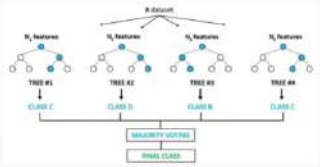
B — Resize, image alignment, and grayscale the image

Normalization

C — Convolutional Neural Network

Using CNN as the feature extraction





D — Classify the name of the image and predict accuracy

Random Forest Classifier

Experimental Results

$TAR = 1 - FRR$ → TAR is the percentage of correct matching. The higher the better.

Comparison with Other State-of-the-art Methods.

Techniques	TAR (Accuracy)
CNN+MLP (Hariri, 2021)	91.3%
MTCNN+SVM (Ejaz & Islam, 2019)	98.5%
ResNet-50 (Mandal et al., 2021)	89.3%
KNN+Facenet (Fatema et al., 2021)	99.1%
RFCNN	**99.9%**

The Comparison of Different Parameter Settings.

Experiments	Datasets	Activation function	Random State	Trees	TAR (Accuracy)
Experiment 1	RMFD	relu	42	5	0.9403
				10	0.9933
				15	0.9943
Experiment 2	RMFD	sigmoid	42	5	0.9449
				10	0.9929
				15	0.9943
Experiment 3	LFW	relu	42	5	0.9443
				10	0.9972
				15	0.9996
Experiment 4	LFW	sigmoid	42	5	0.9478
				10	0.9979
				15	0.9998

ROF - A Framework to Auto Generate Requirements Specification

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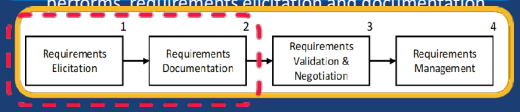
INTRODUCTION

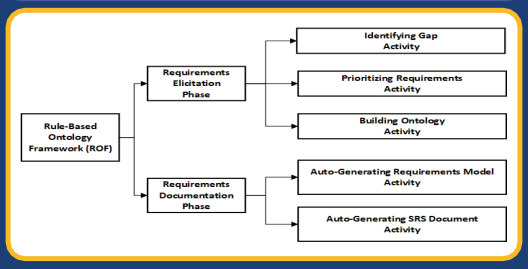
Background Problems:

- **60 percent of all errors** in system development happen during Requirements Engineering
- **Existing elicitation method doesn't give enough guidance** that could clearly guide the stakeholders and developers to specify requirements
  - **Much time and effort** are needed to build requirements document based on both technical and business perspectives
  - There is a **lack of integrated framework** which performs requirements elicitation and documentation



Requirements Engineering Process

This research proposes A framework, namely **Rule-Based Ontology Framework (ROF)** for auto- generating requirements specification



ROF Taxonomy

- The ROF includes **Requirements Elicitation and Requirements Documentation phase.**
- Final output of ROF is **Requirements Model** in BPMN notation and **SRS document** in ISO/IEC/IEEE 29148:2018 template

ROF Specification

No	Type	Language	SoGware	Tools
1.	Database	SQL	MySQL	MySQL Workbench 6.3 CE PHP My Admin
2.	Programming Code	PHP, JAVA	XAMPP 7.2.7 Jdk 1.8.0_101	Netbeans IDE 8.2
3.	Web Server	Apache 2.0 Handler	XAMPP 7.2.7	Notepad++
4.	Ontology	Definition Language (DL)	DL Query 1.1.0	Protégé 4.1

ROF is implemented in **two applications:**

- Lecturer Workload Management Application (LWM)
- Student Payment Management Application (SPM)

ROF IMPLEMENTATION

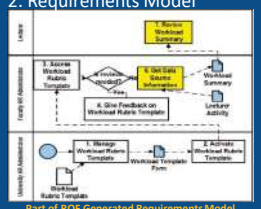
No	Criteria	Manually Built Approach	By Using ROF
1	Elicitation	No detail guidelines	Provide detail guideline (Gap Identification Method)
2	Prioritization Requirements	Manually without involved users application	Using Kano's Model
3	Business and system enhancement	Not aligned	Aligned
4	Requirements model	Do not use any specific notation	BPMN Notation
5	SRS	Do not use any specific template	ISO/IEC/IEEE 29148:2018
6	Requirements Changes	Update manually, Need much time and effort	Re-generate requirements document, reduce time and effort
7	Variety of tools	Non-integrated	Integrated Framework

ROF Outputs:

1. Requirements Ontology (RO)

Sample of Requirements Ontology Instance

2. Requirements Model



Part of ROF Generated Requirements Model

3. SRS Document

Part of ROF Generated SRS Document

Evaluation Result

Performance Measurement	Result
Validating Prototype	100% Passed
Measuring Effectiveness	Reduce element and requirement errors
Measuring Efficiency	(Saving of 70-80% or more time)

ROF Contribution

- This work proposes a rule-based ontology framework, **ROF, for auto-generating requirements specification** consists of:
  - Requirements Elicitation with **Requirements Ontology** as the output
  - Requirements Documentation which auto-generate **Requirements model (BPMN) and SRS Document (ISO/IEC/IEEE 29148:2018)**
- Performance measurements result proves that ROF improves **effectiveness and efficiency of building requirements document**
- Finally, ROF provides an integrated framework for stakeholders and developers, so that they **minimize the risk of requirements errors and improve the creation of requirements documentation** resulting in **project cost efficiency.**

SLEEPCON: SLEEPING POSTURE RECOGNITION MODEL USING CONVOLUTIONAL NEURAL NETWORK

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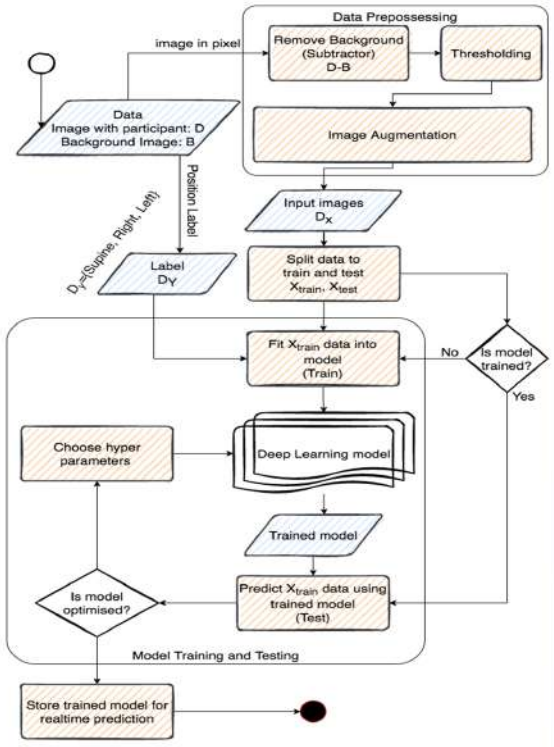
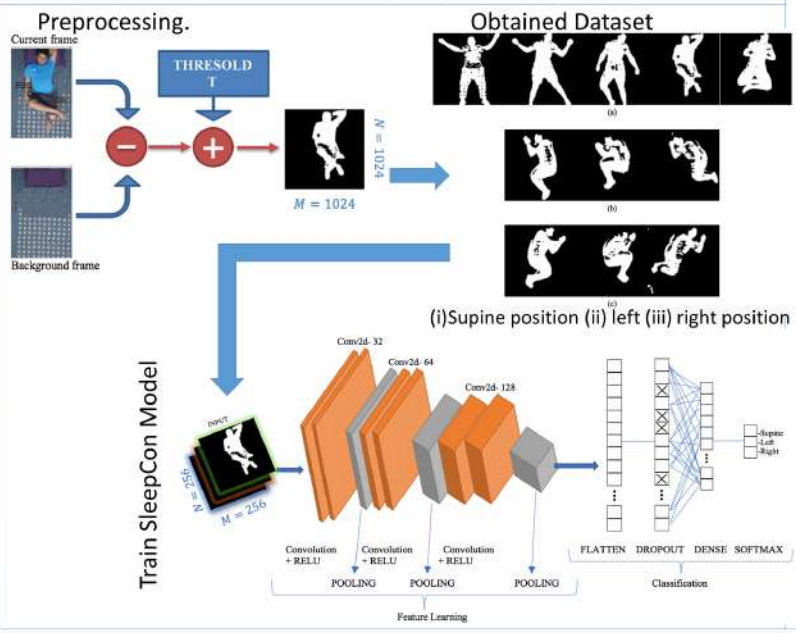
Abstract

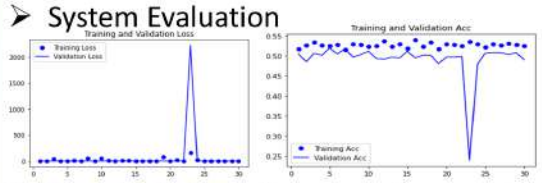
Sleep is a natural activity, which is essential for life and physical well-being. Sleep quality affects human health and standard of living. Meanwhile, sleep posture is associated with sleep quality (W.H. Lee et al., 2017). This paper addresses the Deep Learning based analysis of sleeping position on the bed. The result of this analysis is classification of the position into one of three categories: supine, left and right.
The goal of the study is to develop a model that can be used to perform this sleeping posture classification on binary image input particularly from camera or pressure sensor. In particular, such analysis is needed to classify the patient's body motor function.

Methodology

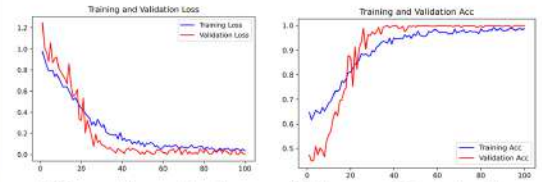




System Evaluation



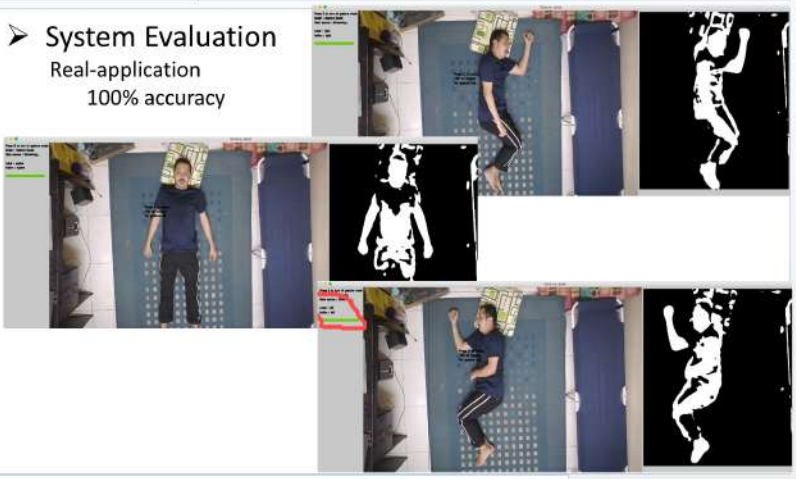
Training and evaluation performance for 2 person dataset



200 epoch required around 12hours of training time, maximum accuracy obtained 99.59% for 6 person dataset

System Evaluation

Real-application
100% accuracy



Conclusion

The Effective CNN model for recognizing sleeping posture is developed. The system will work with any input image data obtained from camera or pressure sensor. This work also contains own set of datasets which will be open for other researcher for further study.

Acknowledgements

We would like to thank RMC,MMU for the IRFund to conduct the study on sleeping posture. Project SAP ID: MMUI/210024.

SmartHealthCard: Blockchain & Tourism Post COVID-19

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Research Questions

- How to design a framework for a fast and secure digital COVID-19 credentials exchange that is compliant with data protection regulations for border crossing or traveling?
- How to securely create, store, and retrieve a user's digital COVID-19 credentials during the credential's issuing and verification process?

Abstract

As the pandemic COVID-19 illness spreads at an unprecedented rate throughout the world, both major and small economic sectors are experiencing the effects of government-imposed limitations and regulations such as social distances, movement control orders, and more. During the pandemic's length, the tourism industry is one of the most affected economic sectors.

As vaccines become more widely available, each government is working to develop a system that can generate a digital vaccine certificate and PCR lab test result to verify that a person is fully vaccinated or has a negative PCR test result in order to allow them to enter business premises, travel, cross state borders, and a variety of other activities. Each country will be able to reclaim its business activities, which have been harmed for several years. However, the use of centralised systems in the development of the digital COVID-19 pass system results in a number of issues and limitations, including the system's high sensitivity to failures, slow and inefficient information exchange, and vulnerability in data security and privacy protection for users.

As a result, the goal of this project is to offer a new digital COVID-19 pass that uses the "SmartHealthCard" blockchain-based system solution. SmartHealthCard is a decentralised application (dApp) that replaces the old, centralised approach by encrypting and hashing user data and safely storing it in a distributed database. Privacy preservation, GDPR compliance, self-sovereignty, KYC compliance, and data integrity are additional capabilities of this project.

This initiative has the potential to benefit the user, the healthcare professional, the service provider, and the government. The suggested platform enables quick validation of tamper-proof COVID-19 tests/vaccines, aiding in COVID-19 transmission control while respecting the user's right to privacy. In principle, a secure COVID-19 credential would serve as evidence that someone has been vaccinated against COVID-19, recovered from COVID-19 or tested negative for COVID-19 PCR test. Thus, this facilitates a safe, unrestricted travel while also removing a person from most government controls. Lastly, this secure COVID-19 certificate may aid public authorities in limiting access to vital or sensitive institutions such as airports, schools, hospitals, and other public places.

Proposed Solution

Figure 1: SmartHealthCard dApp Logo.

This project proposes a new Blockchain-based privacy-preserving digital COVID-19 credential platform, SmartHealthCard, for issuing and confirming COVID-19 vaccine and PCR test certificates. Figure 1 depicts the SmartHealthCard dApp logo. SmartHealthCard seeks to stop COVID-19 from spreading while adhering to privacy regulations. For instance, it is compliance with General Data Protection Regulation (GDPR) and Know Your Customer (KYC), as well as preserving user autonomy. The suggested method will be used not only for COVID-19 testing, but also for COVID-19 vaccinations, which are now accessible in several countries. This project is believed to be the foundation for a modern COVID-19 secure vaccination credential, especially for travel, as COVID-19 is a global threat. The following are the key contributions of this project, as well as the proposed solution:

1) *Privacy preservation*: To reserve encrypted user data, including COVID-19 findings, SmartHealthCard uses an off-chain IPFS storage (InterPlanetary File System). Only the IPFS hash is saved on the Blockchain, ensuring that sensitive data is never exposed to those scanning the Blockchain.
2) *General Data Protection Regulation compliance*: SmartHealthCard is a GDPR-compliant because it uses well-known data-protection standards, including JSON Web Tokens (JWT), ERC1056 Lightweight Ethereum Identity, and W3C verifiable credentials (VC), ensuring that users retain in charge over their personal data.
3) *Self-sovereignty*: User is the owner of his/her identities in SmartHealthCard and has total in charge over his/her personal information, as well as the COVID-19 credential that he/she has been granted. Furthermore, SmartHealthCard enables the selective disclosure idea, which allows the user to exchange specific bits of data with specified trustworthy partners.
4) *KYC-compliance*: Because it checks the identification of various users before onboarding them, SmartHealthCard is KYC-Compliant. This could enable more reliable communication and in charge over the information that is gathered throughout a given identity, as well as the collection of genuine data regarding the population's immunity condition in real time. As a result, the suggested strategy would act to be the foundation for real time supervision of the community health condition, as well as the progress of deconfinement and pandemic management.
5) *Integrity*: This project can confirm the genuineness of the digital COVID-19 credentials by comparing the hash value of the information supplied by the users and the one which is already recorded in the Blockchain ledger, because the hash value of the information is recorded immutably in the Blockchain.

SmartHealthCard Main Process

1) Application's Installation, DIDs' Generation, and Issuer and Verifier Registration

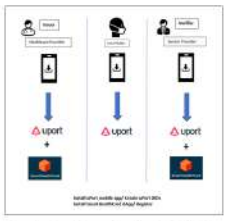

Figure 2: Application's Installation, DIDs' Generation, and Issuer and Verifier Registration.

2) Holder's Logging to SmartHealthCard

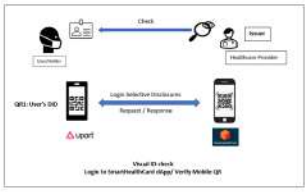

Figure 3: Holder's Logging to SmartHealthCard.

3) COVID-19 Certificates Issuing

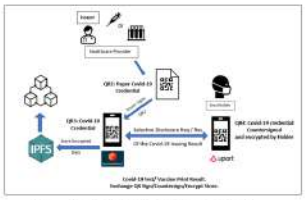

Figure 4: COVID-19 Certificates Issuing.

4) COVID-19 Certificates Verification

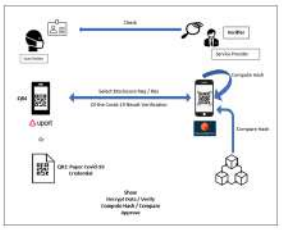

Figure 5: COVID-19 Certificates Verification.

SmartHealthCard Architecture

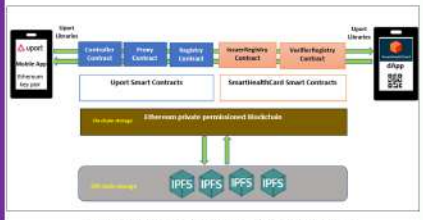

Figure 6: SmartHealthCard Platform's Architecture.

Objectives

- To design a secure framework for personal healthcare information in compliance with data protection regulations.
- To utilise Blockchain technology to securely encrypt personal healthcare information.
- To enable digital COVID-19 credential information exchange to be done in a fast and secure manner.

Commercialisation Values

- This product provides a framework for a futuristic and secure decentralised healthcare information system.
- Due to the decentralised application, this product will be resistant to cyber-security attacks such as Denial-of-Service (DOS) attacks, Man-in-the-Middle (MITM) attacks, and many more which can cause data breaches and severe system failures.
- This product allows the personal healthcare information exchange process to be done faster and efficiently by implementing Blockchain as it uses "smart contracts" automation.
- This product can prevent the exploitation or selling of patient health information as the technology gives patients full control over who can access their health information.
- This product also prevents any information blocking which commonly happens in a centralised healthcare information system.

Screen Designs

Figure 7, 8 and 9 are samples screenshot during COVID-19 credential verification process using uPort mobile app and SmartHealthCard dApp:

Figure 7: The User Scans the QR Code.

Figure 8: The User Needs to Login to Share His/her DID and COVID-19 Credential.

Figure 9: The Credential is Verified and Valid.

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SmartPay: Integration of e-Wallet and Financial Portfolio Analysis

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Introduction

In this modern era, most of the businesses are using technology such as online payment, QR code and online transfer. E-wallet is a virtual and cashless service that can be installed and used as a substitute for physical cash in all of the smart phones, which allows us to do daily payment task, such as paying bills, ordering foods and calling a car. More people are using e-wallet to make payments, because e-wallets provide a lot of convenience especially during the COVID-19 pandemic. The existing e-wallets provide many functions such as QR code pay, transfer and scan. Unfortunately, it does not have the financial portfolio analysis to encourage users to spend wisely.

SmartPay Features

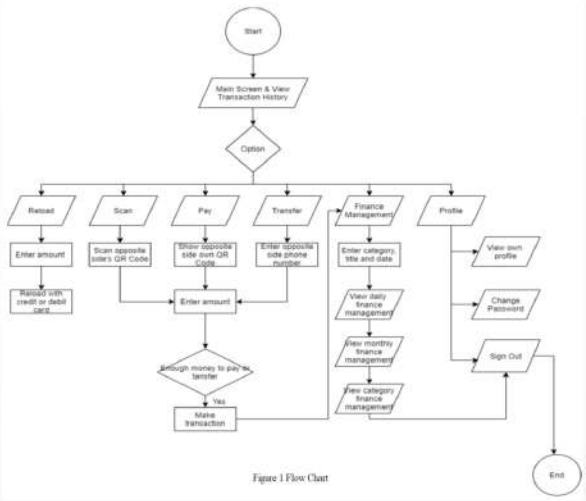

Figure 1 Flow Chart

Conclusion

Overspending remains an issue to a lot of people especially teenagers and undergraduates who obtained their first debit/credit card. This is due to its convenience and hassle-free usage. Consequently, it leads to unnecessary purchases and losing track of spending and in some circumstances, bankruptcy.

In this project, SmartPay aims to encourage cashless payment and at the same time, tracking one's expenses on a daily and monthly basis. Every transaction is recorded and analysed so that user is aware of their spending patterns. Ultimately, a sense of responsibility and financial literacy is instilled in every user.

Research Questions and Objectives

RQ 1 : How to encourage people to be cashless?
RQ 2 : How to encourage people to keep track their expenses?

RO 1 : To develop an e-Wallet which encourages people to be cashless.
RO 2 : To integrate financial analysis module into the e-Wallet framework.

Interface Design

Figure 2 Splash Screen

Figure 3 Home Screen

Figure 4 Daily Finance Management

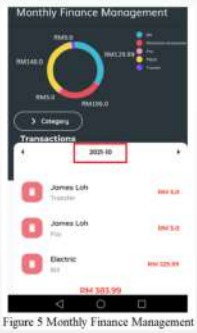

Figure 5 Monthly Finance Management

Figure 6 Category Financial

Commercialisation Values

- SmartPay enables users to make payment and transfer money conveniently and easily.
- E-Wallet becomes even more apparent during and post COVID-19 pandemic.
- SmartPay enables users to trace their every single transactions in a ledger.
- Financial portfolio analysis encourages users to spend wisely to prevent overspending.

Stacked Autoencoder Based Feature Learning with Parallel Particle Swarm Optimization for Community Detection

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Abstract

In this paper, we propose a new stacked autoencoder (SAE) based on feature learning with parallel particle swarm optimization (PSO) to discover communities of complex networks (CNs). PSO uses two objective functions to enhance the performance of finding communities. A distributed and parallel framework is developed to render parallel PSO-based SAE efficient and scalable. The results reveal the effective role of the proposed deep learning with parallel PSO optimization in detecting communities in CNs.

Motivation

Deep learning has demonstrated its effectiveness in a variety of applications including community detection [1]. SAEs are used to extract useful features from CN data that reveal similarity between nodes to provide accurate assignment of similar nodes to the same community. Even though good results were reported in the literature using the deep learning-based community detection methods, two issues remain unsolved satisfactorily. First, The training algorithm of these deep learning methods is oriented on gradient descent optimization, i.e. the backpropagation algorithm; as a result, several shortcomings are encountered, such as local suboptimal solutions, premature convergence and vanishing gradient problem in deep learning, traps in saddle points, a difficulty in deciding a good set of initial parameter settings, and the absence of parallelization implementation that supposedly could expedite computation process . Second, CNs are usually has a high dimensionally representation [5]. This creates a complex neural network architecture and increase the time and space complexities. In addition, in reality the size of the CNs increases considerably. Hence, an efficient technique should be deployed in community detection in large CNs that is essentially a large time/space-consuming problem[2-5].

Objective

- To develop a new SAE based on parallel PSO for learning low dimensional features and performing community detection in CNs.
- To use two objective functions for PSO algorithm to further enhance the performance of the community detection task.
- To develop an efficient distributed and parallel framework to improve the efficiency and scalability of the SAE based on parallel PSO method.

Methodology

In this paper, we introduce a research work that uses SAE based on Parallel PSO (SAE-PPSO) method to extract useful features from CN data that reveal similarity between nodes to provide accurate assignment of similar nodes to the same community. It consists of three main phases.

A. Preprocessing:

In this phase, the CN data is prepared for the feature extraction phase using the following equation:

$$S\emptyset = \frac{2comm\_Neig(vi, vj)}{d(vi) + d(vj)}, S\emptyset \in R^{n \times n},$$

The $comm\_Neig(vi, vj)$ is a set of shared nodes by two adjacent nodes vi and vj; $d(vi)$ and $d(vi)$ are the degrees of nodes i and j, respectively and $d(vi) + d(vj)$ is the total degrees of the two nodes.

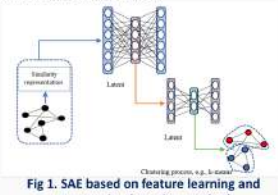

Fig 1. SAE based on feature learning and community detection method

B. Feature extraction

SAE receives the *similarity representation of a given CN* from the preprocessing phase. Each autoencoder layer in the SAE consists of an input layer, a hidden $\boldsymbol{h}$, and an output layer. The decoding layer uses the transpose parameterslayer $\boldsymbol{\theta}_2 = \boldsymbol{\theta}_1^T$ of the decoding layer.

C. Clustering:

In this phase , all similar nodes should belong to a cluster or a community through set operations such as: selecting k-nodes according to the number of clusters and then calculating Euclidean distance between cluster centres and nodes. As a result, similar nodes are grouped into a one cluster.

The proposed SAE-PPSO method is optimized with PSO Algorithm, which involves the following phases:

A. Initialization

Many particles (P_s) are randomly generated. Each particle (P_i) provides a solution in the search space for the optimization problem. Current solution $\boldsymbol{\theta}$, the best local solution P^{best}, and the best global solution g^{best}.

B. Evaluation

$f(\theta, h) = MSE + (1 - Q)$,

$MSE = \frac{1}{n}\sum_{i=0}^{n}(x^i - x^{\wedge i})^2$, $Q = \frac{1}{2m}\sum_{i,j}\left(A_{ij} - \frac{d_i d_j}{2m}\right)\delta_{ij}$,

MSE: loss function of AE model

Q: verifies the quality of community detection.

$f(\theta, h)$ evaluates all suggested solutions by P_s to find the best solution.

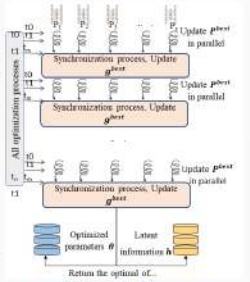

Fig. 2 The structure of the parallel processes of the SAE-PPSO method

C. Update

The particles parameters are updated by $\theta_i^{(t+1)} = \theta_i^{(t)} + V_i^{(t+1)}$, $i \in [1, P_s]$, t iteration,

$V_i^{(t+1)} = wV_i^{(t)} + c1\,r1\left[P_i^{best} - \theta_i^{(t)}\right] + c2r2\left[g^{best} - \theta_i^{(t-1)}\right]$, $i \in [1, P_s]$,

V: PSO velocity, $c1$, $c2$, $r1$, $r2$, w are PSO parameters.

The local best solution of P_i is updated by $P_i^{best} = \theta_{id}^{(t+1)} \mid f\left(\theta_{id}^{(t+1)}\right) = \min_{k=1,2,3\ldots t+1}\left(\{f(\theta_{id}^{k})\}\right)$

The best global solution is updated by $g^{best} = P_i^{best} \mid f\left(P_i^{best}\right) = \min_{i=1,2,3\ldots P_s}\left(\{f\left(P_i^{best}\right)\}\right)$

***Parallelization*:** Each particle P_i and its operations, such as updating P_i velocity V_i and position θ_i, operations of encoder and decoder layers, and the fitness function $f(\theta, h)$, are carried out in parallel (**Fig. 2**).

Results

Experimental setup:

Q and NMI [2] were used to evaluate SAE-PPSO effectiveness, and time is used to evaluate efficiency. 10 datasets [2]; Karate, Dolphin, School6_7, Football, Polbook Ploblogs, Cora, Citeseer and Facebook. 8 comparison methods and two machines were used for the evaluation.

Effectiveness results:

- The average of NMI and Q of ASE-PPSO on all 10 datasets is superior to comparison methods (**Table 1**).
- Friedman test are 1.24e-04 and 1.2e-05 for NMI and Q. So, there is a significant difference of results and the null hypothesis was rejected.
- Nemenyi results show that SAE-PPSO is at the top rank for NMI and Q (**Fig. 3**).
- The performance (NMI and Q) of SAE-PPSO is significantly different from comparison methods.

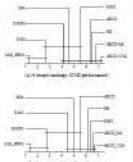

Fig 3. Results from the Nemenyi test

Table 1. Average of NMI and Q performances

Methods	NMI	Q
SPA [2]	0.712	0.398
SAM [2]	0.810	0.423
DANM [2]	0.761	0.510
DAM [2]	0.71	0.471
NG [6]	0.668	0.427
AECD [7]	0.661	0.447
AECD-COA [8]	0.64	0.431
AECD-GA [9]	0.655	0.438
SAE-PPSO	**0.848**	**0.514**

Efficiency results:

- Results in **Figs. 4** and **5.** show the computation time of the parallel implementation of the SAE-PPSO.
- **Fig. 4a** shows that there is no efficiency improvement with parallel on small data
- **Fig. 4b** indicates that the superiority of the parallel SAE_PPSO increases on the use of larger datasets.
- **Fig. 5** shows the computation of the SAE-PPSO is scalable.

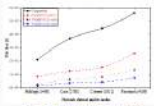

Fig 5. SAE-PPSO with different cores

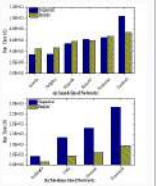

Fig 4. parallel versus sequential of SAE-PPSO

Conclusion and Future work

This research work finds the following:

- The integration of parallel PSO and SAE could lead a search for finding optimal solutions that enhance community detection performance.
- The PSO with multi objective functions directs the optimization to improve the performance of the community detection task.
- The parallel framework is helpful to increase the efficiency and scalability of SAE-PPSO.

Some possible extensions from current work to further improve the community detection:

- To evaluate the robustness of SAE-PPSO in dealing with large incomplete, dynamic, and heterogeneous CNs.
- To investigate other hybrid metaheuristic deep learning methods, e.g., PSO and GA, BP and GA.

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UNSUPERVISED TIME SERIES ANOMALY DETECTION FOR SMART HOME ENERGY CONSUMPTION SYSTEM USING CLUSTERING APPROACH

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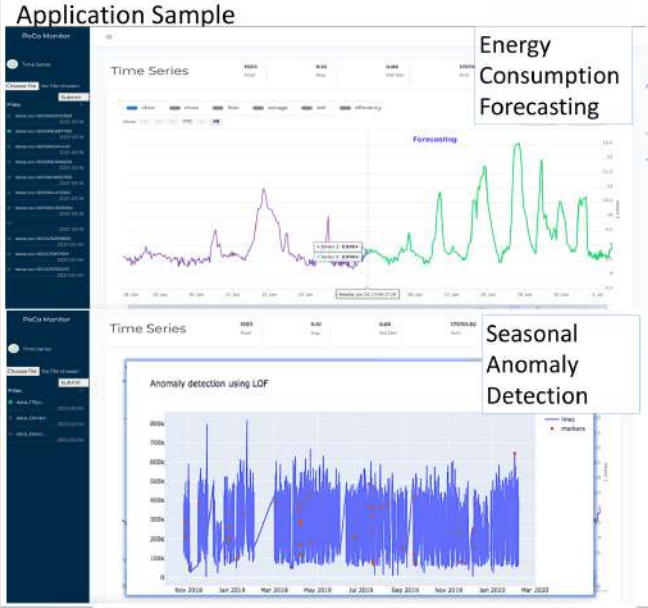
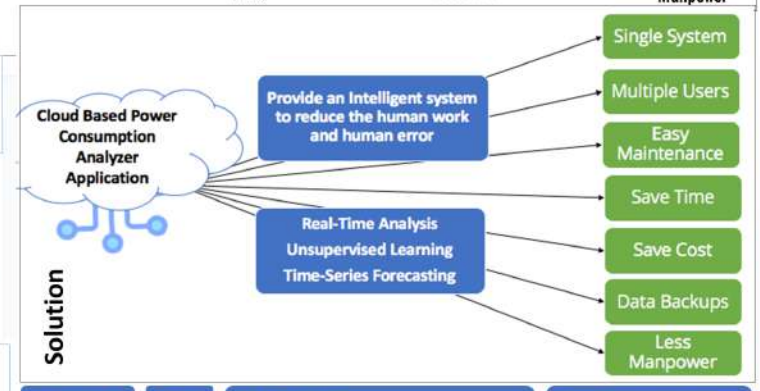
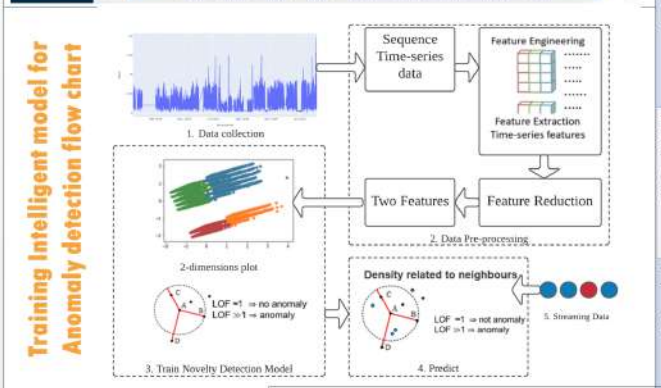
Recent years have seen significant growth in the adoption of smart home devices. It involves a Smart Home System for better visualisation and analysis with time series. However, there are a few challenges faced by the system developers, such as data quality or data anomaly issues. These anomalies can be due to technical or non-technical faults. It is essential to detect the non-technical fault as it might incur economic cost. . The developed system will help detect abnormal data that could eventually benefit any individual using a smart home energy monitoring system, not only for inaccurate data but also for unusual energy usage or energy theft detection. The system also consist of intelligent system to forecast energy consumption in time-series. This System will be helpful to save energy by proving users unusual usage.

Application Sample







	Year 1	Year 2
Utilities	Electricity Subscription *RM500 / Monthly* *RM5000 / Yearly*	Electricity Water **Add On** Sensor Subscription *RM750 / Monthly* *RM7500 / Yearly* Sensor *RM300 / Monthly* *RM3000 / Yearly*
Target Customers	160 (Manufacturing Companies x 20% (Success Rate) = **32**	320 (Manufacturing Companies x 30% (Success Rate) = **96 New Utilities Customers** 32 Existing Utilities Customer Add On - 25% of Total Customers
Total Sales	32 x RM5000 = **RM160,000**	96 x RM7500 = **RM720,000** 32 x RM3000 = **RM96,000** 32 x RM5000 = **RM160,000** **TOTAL= RM976,000**

Related Accepted Research Papers

1. Unsupervised Anomaly Detection for Energy Consumption in Time Series using Clustering Approach, Emerging Science Journal, 2021 (Scopus, Q1)
2. Detecting Abnormal Electricity Usage using Unsupervised Learning Model in Unlabelled Data, International Journal of ADVANCED AND APPLIED SCIENCES, 2021 (WoS/Scopus)
3. Detecting Abnormal Electricity Usage using Gaussian Mixture Model in Unlabelled Data, VLSI, SIGNAL PROCESSING & COMMUNICATIONS – NCVSComs20 , 2020 (Conference)

VEHICLE TYPE RECOGNITION IN NIGHTTIME SCENE

Willy Liew Wen How, Mohd Haris Lye Abdullah (FYP supervisor)

ABSTRACT

- **Intelligent Transportation System (ITS)** has become an often-mentioned topic as it is outlined as one of the pillars to establish smart city concept.
- Vehicle type recognition plays a vital role in Intelligent Transportation System, which aims to **enhance traffic efficiency**, implement **innovative traffic management** and minimize **traffic accident**.

Objectives:
- make analysis, evaluation and comparison of different state-of-the-art vehicle type recognition models
- achieve a tradeoff between detection accuracy and computational speed
- integrate contemporary model architectures to overcome the challenges of vehicle detection in nighttime scene

CHALLENGES

Insufficient illumination due to lower luminance
- deficient in appearance information
- contrast between vehicle and background is not salient

Complex lighting environment
- interference from streetlights, building illumination, reflection of light
- high rate of false vehicle detection

Significant feature loss in traditional CNN architecture
- hard to detect small, blurry or occluded vehicles

Scarcity of public nighttime vehicle dataset
- insufficient training data causes unsatisfactory recognition accuracy


Complex lighting environment


Low luminance & blurry vehicles


Occluded vehicles

METHODOLOGY

Defining Scope
- camera viewpoint
- urban nighttime scene
- vehicle type classes
- vehicle scale size
- vehicle occlusion ratio
- recognizable by human's eyes
- image resolution

Literature Review
- motion-based detection
- vehicle lamp or car face segmentation
- deep neural network to extract features
- scene translation to enhance image features

Dataset
- public dataset: DETRAC, Compcar, BIT
- data preprocessing
- self-labelled images

Building Model
- object detection algorithm: SSD, YOLO, Faster R-CNN
- backbone network: ResNet, MobileNet, DarkNet
- transfer learning

Fine-tuning
- hyperparameter tuning: learning rate scheduler, optimizer, regularizer
- data augmentation techniques
- modifying model architecture: number of layers and convolution operation

Analyzing Result
- convergence of training session - total loss
- evaluate mAP & FPS
- compare results with other established model

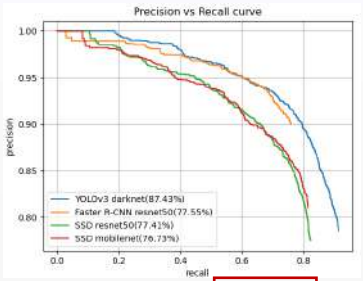
Output
- output prediction test video to evaluate performance of model
- run model on Intel Upsquared maker board (In Progress)

RESULTS

- all objection detection models with respective backbone network were trained with the same dataset with transfer learning with weights from pretrained model
- different cosine decay learning rate schedulers were deployed to ensure the model achieves convergence
- output prediction of trained model with online test video in different scenario

DISCUSSIONS

- metrics used for model performance evaluation:
  1. *Precision-Recall curve*
  2. *mean Average Precision (mAP)*
  3. *Frame per second (FPS)*
- based on the comparison of results, YOLOv3 with darknet achieves the best result in term of detection accuracy and processing speed



Detection Model	SSD		Faster R-CNN	YOLOv3
Backbone Network	Mobilenet	ResNet50	ResNet50	Darknet
Input size	320x320	640x640	640x640	416x416
Processing speed	14.72 fps	5.35 fps	4.16 fps	13.06 fps
mAP	76.73%	77.41%	77.55%	87.43%

CONCLUSION

Vehicle types recognition in nighttime scene has large commercialization potential in traffic flow analysis, automated toll fare collection, road speed enforcement and smart parking management. Future works include running the model on Intel Upsquared maker board and evaluating the performance in more diversed scenario considering different traffic density, illumination intensity and weather condition.

Reference:
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[3] See Jackson Hole, "Jackson Hole Wyoming USA Town Square Live Cam - SeeJH.com." https://www.youtube.com/watch?v=1EiC9bvVGnk.
[4] Virtual Railfan, "La Grange, Kentucky USA - Virtual Railfan LIVE." https://www.youtube.com/watch?v=y7CJNpuiS7g.
[5] KUKU Sound & Film, "ASMR /ハイウェイサウンド、PASSING BY、TRAFFIC、CITY." https://www.youtube.com/watch?v=xEtM11Afhc.

VIDEO ANALYTICS USING DEEP LEARNING FOR HAJJ PILGRIMAGE CROWD MONITORING

Project Leader: Assoc.Prof. Dr. Junaidi Abdullah, Mr. Md Roman Bhuiyan, Dr. Noramiza Hashim & Mr. Fahmid Al Farid
Faculty of Computing & Informatics, Multimedia University, Malaysia.

Research Background

- Hajj is an annual religious **gathering** in Mecca, Saudi Arabia.
- These **large groups of people** move between different religious sites to complete the ritual.
- Managing the **large crowds** is important to prevent crowd disasters.
- This research aims to propose improvements on for hajj pilgrimage. **crowd density classification and crowd behavior analysis**
- In this research we propose a **Fully Convolutional Neural Network** (FCNN) based framework for **crowd movement analysis**

Problem Statements

- Nowadays, it is very important to perform video analysis and monitor **the crowd density of the pilgrims and detect any abnormal movement**. To achieve this, there is a need for state-of-the-art technologies such as deep learning.
- There is a big challenge in analyzing images or videos that involve **movement of large numbers of pilgrims** with **density ranging between 7 to 8 people per square meter.**
- Currently, there is no standard dataset for Hajj scenario.

Research Objectives

1. To build deep learning architecture to effectively capture both the spatial & temporal features for automatic crowd density estimation and abnormal crowd behaviour.
2. To develop a new dataset based on hajj pilgrimages.

Proposed Approach

Objective 1: To build deep learning architecture to effectively capture both the spatial & temporal features, for automatic crowd density estimation and abnormal crowd behavior.

Proposed Approach

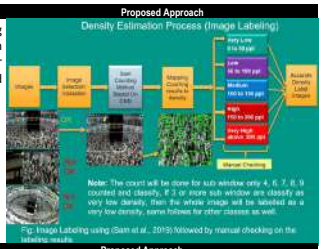


Fig: Image Labeling using (Sam et al., 2019) followed by manual checking on the labeling results

Proposed Approach

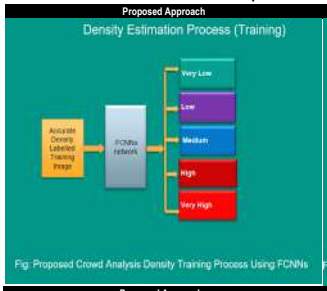


Fig: Proposed Crowd Analysis Density Training Process Using FCNNs

Proposed Approach

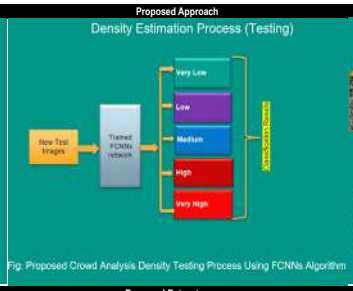


Fig: Proposed Crowd Analysis Density Testing Process Using FCNNs Algorithm

Proposed Approach

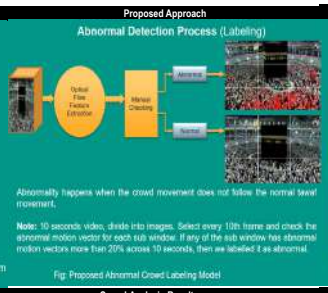


Fig: Proposed Abnormal Crowd Labeling Model

Proposed Approach

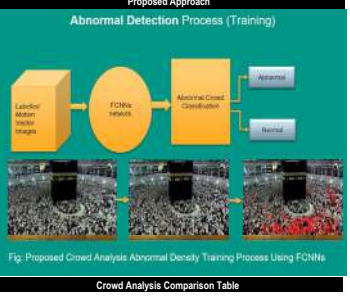


Fig: Proposed Crowd Analysis Abnormal Density Training Process Using FCNNs

Proposed Approach

Objective 2: To Develop a new dataset based on hajj pilgrimages

- The first collection of datasets covering the type of Hajj ritual events **(Tawaf around Kabaa)**.
- The spatial resolutions are **high-resolution (1,280x720) pixels** for images **(HD)** and **(1,280✕720) pixels (HD) for videos**
- Source of Data collection from the **YouTube.**
- For crowd density analysis, we need to classify dataset into **5 classes.** We will collect 30000 thousand images that will contain 5 classes.
- For abnormal and normal video analysis, we need to get **100 videos (10s for each video) dataset**.
- For training data I will use 80% and testing 20% .

Proposed Dataset

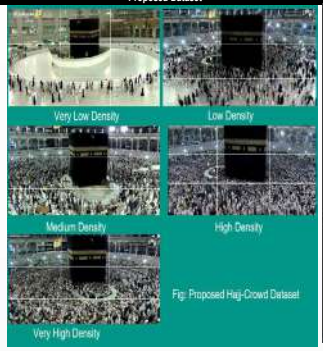


Fig: Proposed Hajj-Crowd Dataset

Crowd Analysis Results

Crowd Analysis Comparison Table

Method Name	Very Low	Low	Medium	High	Very High	Overall Accuracy
ResNet	66.25	80.20	85.50	91.77	90.25	82.79
VGGNet	70.50	77.80	90.45	80.25	94.25	82.65
FCNN (Our Model)	83.50	91.00	97.00	94.50	98.25	94.44

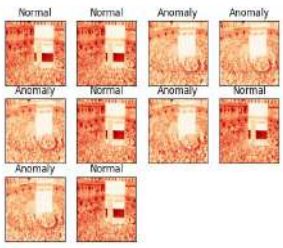
TABLE 1: ACCURACY COMAPRISION FOR CROWD ANALYSIS USING OUR MODEL AND HAJJ-CROWD DATASET-2021.

Crowd Anomaly Detection Comparison Table

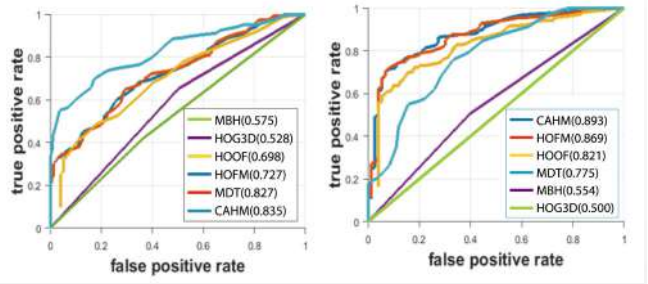
Approach	AUC	ERR%
HOFM (R. V. H. M. Colque, C. A. C. Júnior, and W. R. Schwartz, 2015)	0.806	28.6
HOG3D(A. Kläser, M. Marszalek, and C. Schmid, 2008)	0.5	50.0
MBH(H. Wang, A. Kläser, C. Schmid, and C.-L. Liu, 2013)	0.539	48.7
HOOF (R. Chaudhry, A. Ravichandran, G. Hager, and R. Vidal, 2009)	0.765	26.2
Our Results (CAHM)	0.907	9.0

TABLE 2: ANOMALY DETECTION AUC AND ERR (%) RESULTS OF OUR HAJJ-CROWD VIDEO DATA SET.

Anomaly Classification Results



Anomaly Classification Graphical Results



Conclusion

This research provides a new approach for crowd density estimation using a convolutional neural network. A multi-column structure of high-level feedback processing that addresses the problems in large crowds is the proposed model of the convolutional neural network. The proposed model can recognize moving crowds, which leads to improved performance. We found that crowd analysis prior to crowd has significantly boosted the efficiency of analysis for extremely dense crowd scenarios.

Commercialization Potential

This research has a wide range of applications and has the potential to be commercialized. This study is critical not just for Hajj pilgrims, but also for other forms of gatherings, such as sports, retail malls, and roadways. This study will be commercialized to identify abnormalities in all forms of large crowds. We think that if we can find funding to market our developed solution, it will be a significant contribution to humanity.

Acknowledgements

Multimedia University, Cyberjaya, Malaysia fully supported this research.

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Weapon Detection In Surveillance Videos Using Deep Neural Networks

Research Member: Muhammad Ekmal Eiman Quyyum Bin Mohamad, Mr. Mohd Haris Lye Abdullah

Introduction

- Many cases regarding dangerous weapon is increasing in society such as robbery., mass shooting and terrorism which can jeopardize the safety of people.
- One of the cases in New Zealand involved 49 people were killed in two-anti Muslim terrorist attack.
- Cases in Malaysia such as robbery incident in shopping mall occurred due to lack of security system.
- Therefore, implementation of weapon detection in surveillance camera (CCTV) can improve security level.

Problem Statement

- The current projects for weapon detection using deep neural network is providing less accuracy and poor in detection speed in real-time detection.
- Weapon detection in surveillance videos projects having difficulty to detect object in low resolution using surveillance footage.
- Monitoring the CCTV 24 hours required a lot of manpower and can reduce the security level due to human visual error.
- Many crimes occur is being recorded by CCTV but there is no detection system which can alert the security.

Method & Key Features

The proposed method is using a deep learning architecture such as YOLOv3 to achieve a good performance in accuracy and speed in order to detect a dangerous weapon in real-time application. YOLOv3 will make a prediction that contain dangerous weapon such as knife and pistol inside video frames. The system is optimized by applying these method;

- Adding additional one predicting scale in the network backbone to increase the prediction capability for small object detection.
- Generate custom anchor boxes based on custom dataset.
- Using learning rate schedular to stabilize the training session.

Featured Results

CNN Architecture	Results			
	Mean Average Precision (mAP)	*Frame Rate Per Second (FPS)*	*Batch Size*	*Epoch*
SSD MobileNetV2	64.52%	18.21	8	30
YOLOv3 Darknet-53	89.64%	11.5		
YOLOv3-Tiny Darknet-19	78.23%	27.18		
Improved YOLOv3	90.2%	12.32		

	Database-Sohas_weapon		
	Precision	Recall	F1
Baseline multi-classifier	91.30%	91.03%	91.09%
OVA	92.76%	92.03%	92.29%
OVO VOTE random	93.68%	**93.16%**	93.35%
OVO VOTE weight	93.85%	92.96%	93.35%
OVO WV	93.45%	92.68%	93.01%
OVO LVPC	93.55%	92.55%	93.00%
OVO ND	**93.87%**	93.09%	**93.43%**
OVO PC	93.41%	92.84%	93.07%
OVO PE	93.74%	92.96%	93.29%
DRCW k = 1	91.78%	91.42%	91.51%
DRCW k = 2	91.88%	91.48%	91.56%
DRCW k = 3	92.38%	91.81%	91.99%
DRCW k = 4	92.83%	91.93%	92.26%
Improve YOLOv3	**90.20%**	**85.05%**	**88.02%**

Commercialisation Potential

- Fast and accurate weapon detection surveillance camera for security companies such as RSS Security and Delta Force Security Services.
- This proposed system mainly can be used in any environment which has a higher probability for crime action.
- Our weapon detection system also targets public people to install surveillance camera at their home to improve security.

Conclusion

Weapon detection system is very useful nowadays as it can improve efficiency in the security field as it is one of the solution behind human visual error. The balanced in accuracy and speed during detection in real-time application make our proposed system become reliable in order to maintain the security level as well as to prevent the robbery or any crime action that involves dangerous weapon.

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DIGITAL CREATIVE & CINEMATIC ARTS

Creative Interpretation as Basis of A Historical Building Reconstruction

>>Fauzan Mustaffa[1], Peter Wood Charles[2], Harold Thwaites[3], Eugene Ch'ng[4], Lim Yan Peng[5]<<

[1 2 5]Multimedia University, Cyberjaya | [3] Sunway University, Petaling Jaya | [4]University of Nottingham, Ningbo, China

ABSTRACTS

This research investigates and examines traces of Melaka Sultanate Bridge preceding to 1511 war; a study that envision to reconstruct the historic bridge that neither in existence nor visually accessible. As such, the study seeks clues based on historical information about the bridge. The study includes investigation on the Sultanate Melaka municipality that put the historic bridge to work. The study involves archival materials especially descriptive clues from historical text written about the same period to the Sultanate era and archival visual almost all of which were produced consecutive to Sultanate period. The researcher cross-references his analysis on archival visuals which includes municipal plans, artist impressions and cartographic materials with narrative text from the ancient Malays, China and Portuguese. The method of the study includes narrative analysis, visual anthropological analysis and design process. The study put forward a set of criteria of the Bridge to be considered in the design process resulting on creation of various options of bridge design. After re-examination and refinement, a three-dimensional interpretative historical reconstruction of the bridge was proposed that best fits the idealism of the study. The study also suggested a perspective in regard to the phenomena at the river mouth facing the Straits of Melaka at that time.

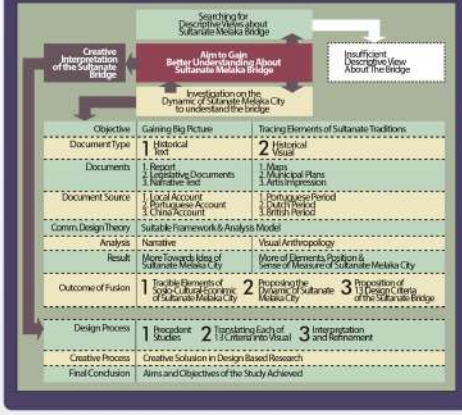
> "There is simply not enough direct descriptive view to reconstruct the Sultanate bridge. Thus, this research took a broader investigation in looking into the dynamics of the Sultanate city; in view of socio-cultural-economic context to understand how the bridge was put to work."

METHODOLOGY

This research is designed as an exploratory research; a research that build its case by collecting, examining, analysing and assembling 'relevant puzzles' into the mix based on the historical information as fundamental reasons; from the leftover tradition of Sultanate Melaka municipality that has a direct or indirect relationship with the bridge. This study is also shaped by its investigative nature in obtaining the big picture of the Melaka Sultanate city in the context of socio-cultural-economic factors and the type of data that has implications on the idea, form, and measure of the bridge.

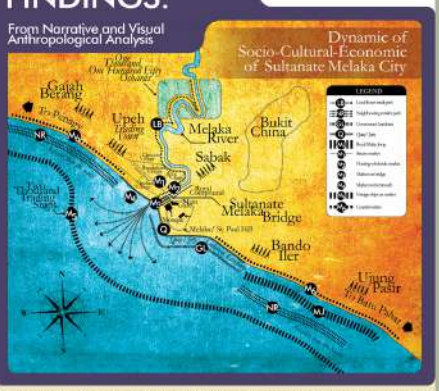
This study involves three types of analysis framework namely; i) Narrative analysis by Czarniawska [1], ii) Visual Anthropological framework by Collier [2] and iii) Design process framework from Victorian Curriculum & Assessment Authority (VCAA)[3].

RESEARCH SYNOPSIS



FINDINGS:

From Narrative and Visual Anthropological Analysis

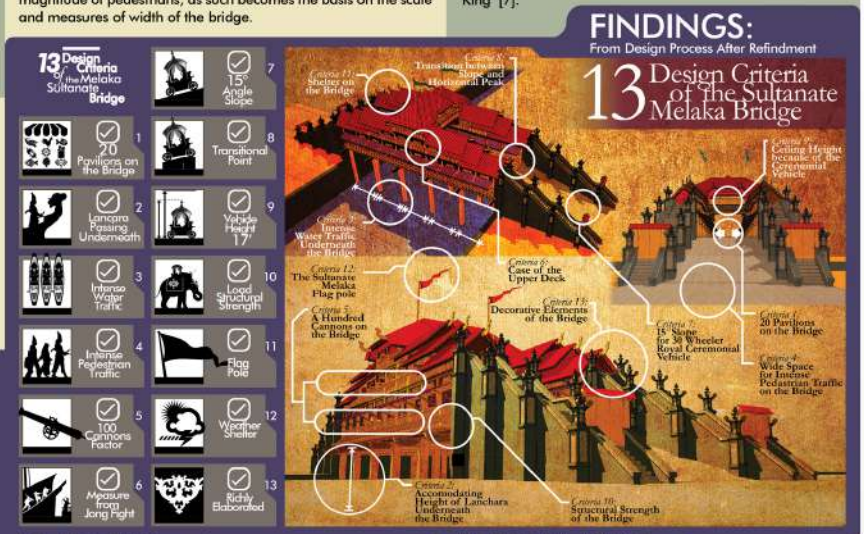


The scale of population in Melaka city during Sultanate era is a major factor to the bridge; with one hundred and ninety thousand inhabitants towards the end of Sultanate era [4]. The intensely populated areas includes Upeh (Tranquerah), Tanjopacer (Ujong Pasir), Iler (Bandar Hilir), and Sabak [5]. The analysis on spread of population and their interaction to six identified markets and other institutions on both sides of the land provides the measure of magnitude of pedestrians; as such becomes the basis on the scale and measures of width of the bridge.

The existence of 20 pavilions on the Sultanate bridge [6] provides strong clues regarding the length and width of the bridge. The culture of Lanchara (small size ship or a large size boat [4]) at the river mouth of Melaka Sultanate period suggested that the bridge deck needed to be elevated to accommodate Lancaras passing through. The case of the intense flow of water vehicles traffic contributed to the proposition of wide gaps between the structural pillars underneath the bridge. The existence of 1150 orchards [7] brought the case of supply and demand of agricultural goods in central Melaka and the trading ships; which required retailers passing through underneath the bridge in reaching to the Straits of Melaka. The fact that the Bridge was made stockade and the analysis of the arrangement of a hundred artilleries described in the 1511 war narrative [8] bringing-up the case of the 'upper deck'. The case of the upper deck of the bridge reinforced by the event of Jong fight in the 1511 war narrative [9]. A thirty wheeler ceremonial detected passing through the bridge in a royal parade suggested that the bridge was not merely a pedestrian bridge; and providing clues regarding the practical angle of the diagonal deck, transition point, and the height of the ceiling. The structural strength of the Sultanate bridge was also understudied in view of Sultans mounted on an elephant especially in royal parades [5]. The study proposes that the flag pole that reported in 1511 war [8] was a permanent feature of the bridge design during the Sultanate period. The blazing sun of Melaka's tropical climate is a significant factor that suggested the roofing factor of the Sultanate bridge. The Bridge was described as 'richly elaborated' [7] and thus, factored to the bridge. The idea of 'royalness' is emphasised in an expression by Pires, that pairing it with a grand mosque was 'ordered' by the Sultans and therefore had to gratify the 'King' [7].

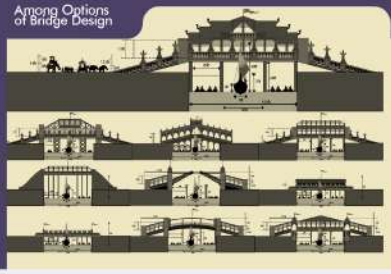
FINDINGS:

From Design Process After Refindment



DESIGN PROCESS

Among Options of Bridge Design



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RIPHEN RESEARCH PROGRAM: DIGITAL FUTURES

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Nilai University - A.P. Dr. Alice Escalante De Cruz; **MSU** - A.P. Dr. Arun Kumar Tarofder; **UTP** - A.P. Dr. Mohd Zuki Yusoff; **IUKL** - Prof. Dr. Noor Saadah Zainal Abidin, Dr. Juliana Rosmidah Jaafar, Mdm Nurul Hazwani Kamarudin, Mdm Noor Hidayu Zakaria; **UNITEN** - Prof. Dr. Salman Yussof; Sera Syarmila Bt. Sameon; **UNIKL** - A.P. Dr. Ahmad Sabry Mohammad, Dr Muhammad Noor Nordin

GOALS & OVERVIEW

A **collaborative research on Digital Futures for resilience and sustainable cities**. Seven projects related to infrastructure and technological methods with advanced community mindsets oriented towards the project goals. Resiliency is one of the most important quality for cities of the future. All cities are confronted with the future impacts of Climate Change, Resource Scarcity, Social Cohesion, Rapid Urbanisation and Digital Inclusion. Achieving resilience to these challenges will require future proofing the city through strategizing now for sustainable solutions and action. Resiliency of the community, economy and environment are the quality properties that need to be achieved and maintained in smart sustainable cities. Focusing resilience in those dimensions is the way forward to future proof urban ecosystem.

Video Pitching

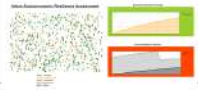
We are owing a better place for our younger and future generation. Imagine how our cities will be in the next 30 to 50 years? **We are thinking ahead for the digital futures by looking into research on smart infrastructure, engineering and social based research for creating resilient cities**.

This video explains some details: ***https://youtu.be/TUFfPvnreGg***

Collaborative projects

Future Proofing Sustainable Cities - Simulation of Urban Quality Management Model

In this project, an Urban Quality Management (UQM) Model will be proposed and simulated to monitor and assess city resilience. Among the key dimensions that influence resilience for Malaysia's cities are the infrastructure, economy, social, health & institution, and environment. Key data from these dimensions will be sourced and input into the model. The targeted data is from the past few years (before and during COVID-19) and predict into the future.



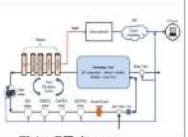
Case Study on Digital Futures: "Future Proofing Smart Waste Management" for Sustainable Cities in Malaysia

In this project, an integrative future-proofing plastic waste management model will be proposed and reviewed from three main cities, Klang valley, Penang and Melaka. Four key aspects of future household waste management were discussed, Data and technology, economy, data, governance, and social aspects. The review of the paper from the 4 aspects will be sourced and input into the model. The data also focuses on the past 2 years only during the COVID-19 pandemic.

UNITEN: IoT-supported Sustainable Smart Building

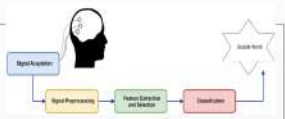
Smart building:
- Use of ICT to monitor building condition and control building systems.
- Aim to optimize building performance.
- Involve installation of sensors and control systems
- Form an IoT network in the building

Energy efficiency: IoT living Lab @UNITEN
- Involves three different building blocks in UNITEN.
- To install IoT system to monitor building environment.
- Analyze building performance data to improve energy efficiency.



Water Efficiency: IoT-based Pool Water Quality Monitoring System
- Aimed for hotel and public swimming pools.
- To install IoT system to monitor pool water quality.
- Analyze water quality data to facilitate pool maintenance with the aim to improve water efficiency.

Water Efficiency: IoT-based Pool Water Quality Monitoring System



Assistive System for Elderly using Brain Computer Interface for Independent Living

Assisted living system based on Brain Computer Interface (BCI) can play a role in enhancing the elderly's living independence. Objective 1: To develop a machine learning technique to translate a mental command to a control command. Objective 2: To implement the machine algorithm for control applications in a real-time environment using a portable processor-based device.

IoT-supported Hydroponic Farming

Nanosensors play an essential role in agriculture. They are used to monitor crop growth and field conditions, plant pest and disease infection and environmental stressors. The utilisation of nanosensors allowed the conversion of some traditional agriculture practices into smart agriculture. Smart agriculture is energy-saving, environmentally friendly, and enhances food security.

Despite considerable advances in nanotechnology in agriculture, there are still many unresolved concerns. One area that requires attention is acquiring knowledge and developing methods for risk assessment of nanomaterials and evaluating the effects on non-target organisms. The evaluation is crucial for nanomaterials risk management programmes. The present study investigated the potential toxicity effects of biosynthesised copper oxide nanoparticles (CuONPs) on *Brassica rapa* subspecies Chinensis (Pak Choy) seedlings.

CuONPs are potential sensor material in public security and environmental applications. Crops like Pak Choy that are widely cultivated in urban areas may be exposed to nano materials via the soil, water, or atmospheric pollution.

AirSense: Smart City with Air Quality Monitoring System

Laser-based sensor for ambient air monitoring is presented and five gases, affecting the air quality, can be quantified. The light sources are selected to measure CO, NO, NO2, N2O and SO2. The footprint of the measurement setup is designed to fit in rack with 4 height units whereas one is holding the optical components and the other one contains the electronics and data processing unit.

Digital Volunteerism as a Platform to Curb Social Isolation Among Youth in Klang Valley

Individuals who are isolated have been reported showing higher levels of illness and mortality as compared with those who are more socially integrated. Youth has been reported to perceive themselves as less valuable, low self-esteem and lack of confidence due to the feeling of being isolated from their own networks. Social isolation is a state of estrangement, in which social connections are limited or absent. This study focus to explore the concept of digital volunteerism among youth to curb the issue of social isolation.

Sustainable Community Engagement (SCE) Through Social Media in Smart City to Develop Green Community Social Responsibility (G-CSR)

To conceptualize SCE using social media from organizational and community points of view. To explore how SGCE can influence green community's behavior in Smart City. To develop a conceptual framework on how SCE using social media and increase community engagement in developing G-CSR. To recommend important principles and matrices of the SCE that will contributes to society and industry.

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Publication:
Afida Jemat, Salman Yussof, Sera Syarmila Sameon, Nur Adriana Alya Rosnizam, "IoT-based System for Real-time Swimming Pool Water Quality Monitoring". Lecture Notes in Computer Science series, Advances in Visual Informatics, Springer-Verlag, 2021. [Accepted]

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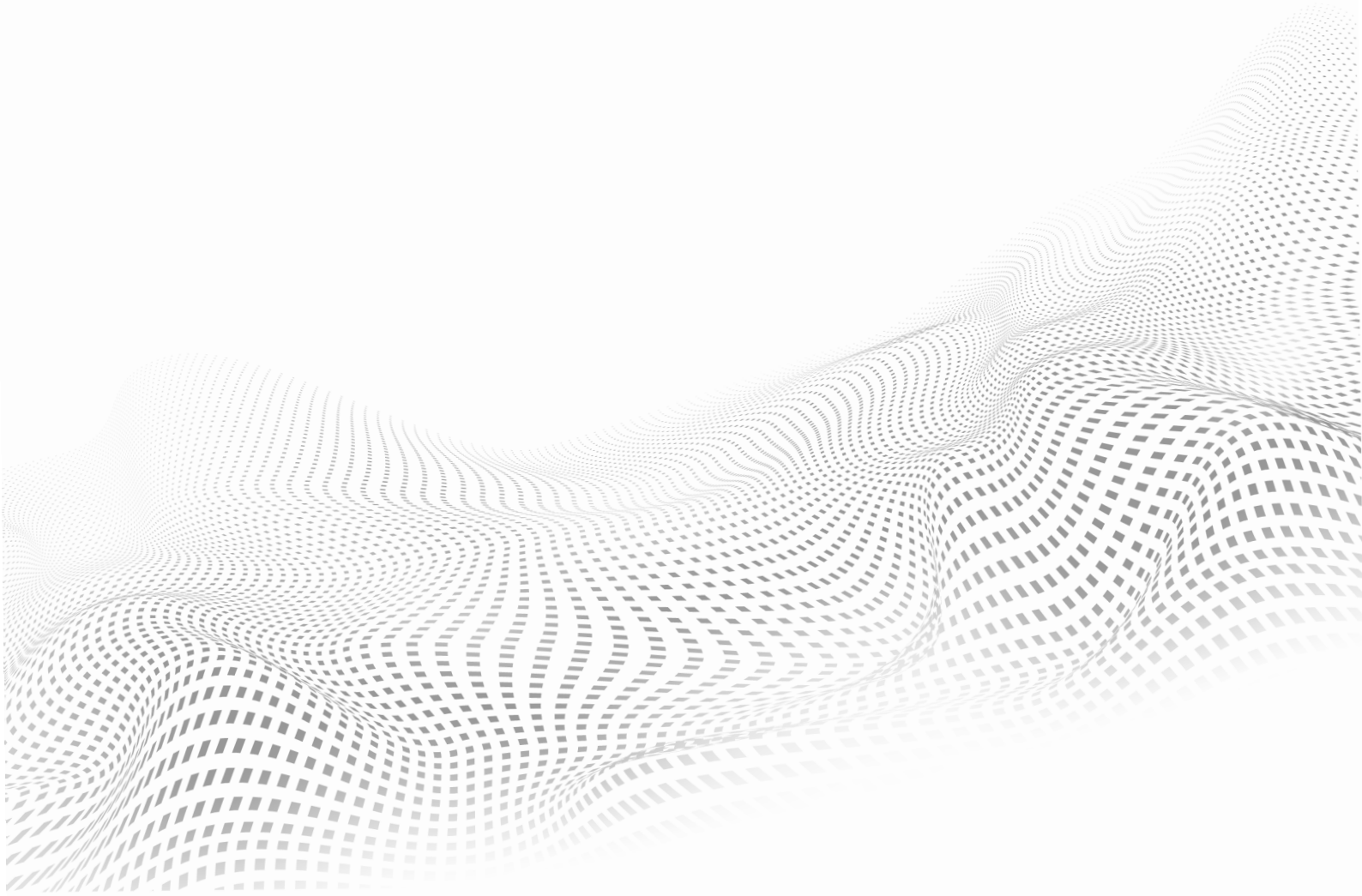

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