EMERGING TECHNOLOGIES FOR DIGITAL INFRASTRUCTURE DEVELOPMENT

Editors:
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Emerging Technologies for Digital Infrastructure Development

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FOREWORD

This book contains a collection of chapters related to emerging technologies for socio-economic and secure infrastructure development in computer science and systems perspectives. This book is intended for those seeking advanced knowledge to conduct research and/or development.

There were 16 informative and scientifically proven chapters in this book, covering both areas of socio-economic and secure infrastructure development. Each article holds specific knowledge, with empirical analysis and scientifically proven for readers' better understanding and replication. These articles focused on areas such as system performance, tracking and monitoring, analytics, internet of things (IoT) environment, and web applications for the emerging technologies scope, while areas focused on system security are such as sentiment analysis, cyber security, intrusion detection, privacy and fake/deepfake handling.

Hopefully, this book will be the source of reference to recent emerging technologies implementation and advancement in catering to socio-economic and software security horizons.

Thank you.

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PREFACE

Social and economic factors have a growing impact on our lifestyle. These factors provide the basis for our decisions in choosing healthcare, education, shopping, and other key choices of our life. The advancement in various technologies like the Internet of Things (IoT), Artificial intelligence, Data Analytics and Machine Learning has made it possible to measure and positively impact these socio-economic factors. In this competitive world, companies must identify trends and make projections to estimate the future direction of their business. In addition, businesses need to incorporate various technologies to gauge their customer buying behaviour and overall opinions on the products and services. Customer buying behaviour is determined by capturing the customer's involvement in purchase decisions before buying a product or service through various technological platforms, including search engines, social media posts, and a variety of other tools.

Similarly, sentiment analysis is among the critical approaches that businesses must employ to detect and quantify attitudes, opinions and emotions among various customer segments. However, the significant influence of technology on these socio-economic factors has escalated several serious concerns. Among those concerns, the digital divide and the security issues are the biggest challenges to overcome. The digital divide is primarily caused by insufficient technological access, lack of digital skills and cost of the underlying infrastructure. Moreover, knowledge and comprehension of the underpinning security technologies and their application to safeguard these systems are critical. Furthermore, understanding the key issues pertinent to using security technologies and the legal framework within which the security technologies are used is of utmost importance. Investigating the use of emerging technologies for socio-economic and secure infrastructure development will not only support technological sustainability but will also significantly affect the future development trends.

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CHAPTER 1

Determinants of Impulse Purchase Behaviours on e-Commerce Websites

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Abstract: This work investigates the various types and aspects of the determinants that cause impulse purchase behaviour within the context of e-commerce websites. It delves into finding the factors that trigger impulse purchase behaviour for consumers of both male and female gender within the age brackets of earning potential. The findings of this review highlight the factors that need to be in place before a purchase behaviour from a consumer can be observed. These determinants above of impulse purchase behaviour can generally be categorised into internal and external components, which are analysed in this work.

Keywords: Consumer, e-Commerce, e-Retailer, Purchase behaviour, Triggers of online purchase.

INTRODUCTION

Just as outdated products are removed from the shelves to make place for the latest ones, the cohort of the latest generation to enter the consumer market are those who fall under the umbrella of Generation Z [1]. To be more specific, these are individuals born between the years of 1995 and early 2010s. They are often considered "digital natives" as they are the first generation to have grown up surrounded by such an extensive degree of digital communication [2]. As pointed out in a study [3], Generation Z constitutes about 32% of the global population at the time of this writing and is deemed to impact consumer sales in global proportions significantly.

Studies have found that Generation Z is among the cohort of generations who spend at least 11 hours a day liking and sharing digital content across all their devices. As a result, the chances of being exposed to digital advertisements while

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checking various social media platforms of their choice at least five times a day are very high [4]. This is why Generation Z consumers are referred to as being more aware and informed than previous youth generations. Consequently, traditional marketing messages struggle with consumer avoidance [5], as this population segment knows how to pick up brands that blatantly advertise just for sales.

Since traditional advertisement messaging is disregarded by Generation Z consumers, who represent 32% of the global population, it becomes essential to find out more about the determinants of impulse purchase behaviours in e-commerce websites for this consumer group. Although Generation Z consumers have been in the limelight of this chapter so far, a recent development in the global arena in 2019 has necessitated identifying the determinants of online impulse purchase behaviours for other generation cohorts like the Millennials, Gen-X, and Gen-Y. This global development that has shaken the way entire business processes work and disrupted supply chains of various industries is none other than the global pandemic caused by the novel coronavirus.

Just as its predecessors had done in the past, this pandemic has essentially brought the world to a complete standstill to curb the spread of the deadly virus. In other words, regardless of age, sex, or location, most consumers have been confined within the vicinity of their own homes. As customers cannot visit physical sites, businesses in all industries have had to shift their focus and rely heavily on the online retail wing of their existing businesses. This had the effect of consumers meeting most, if not all, of their shopping needs online.

As Fig. (**1**) illustrates, the purchase amount among consumers doubled in 2020 compared to only a year ago. This increase can only be thought to remain at this level or even increase in the near future. Although the world is on its way to a recovery phase due to the invention of vaccines, most consumers have been shopping online almost exclusively for the past year. It is only natural to expect them to become accustomed enough to continue to shop online whenever possible in the foreseeable future. As a result, there has never been a better time to identify the factors influencing consumers to show impulse purchase behaviour online.

INTERNAL DETERMINANTS OF A PURCHASE DECISION

Although the effects of the global pandemic combined with the disregard of marketing messages by Generation Z pose a unique set of challenges for selling online, attempts to sell goods and services to consumers are nothing new. One form of consumer behaviour that has existed since the dawn of commerce and is of particular interest for dealing with consumers who have become desensitised to

marketing efforts is that of impulse purchase. The reasons for a consumer to purchase out of impulse are described below.

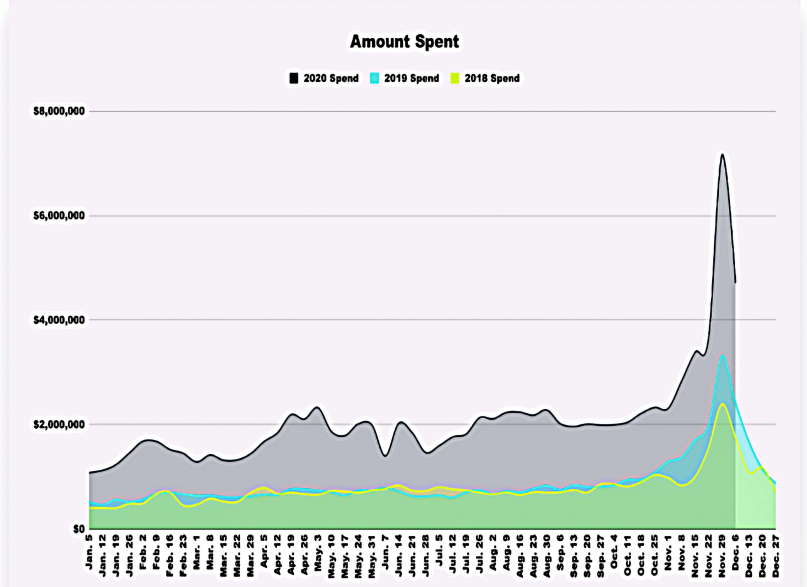

Fig. (1). Drastic 2020 increase in online spending [6].

Trait and Related Determinants

According to [7], several individual traits and self-identification may act as internal sources of impulse buying. Unsurprisingly, psychological impulses strongly influenced impulse buying [8]. Research has shown that people who achieve high scores on tests that measure impulsivity traits are more likely to participate in impulse purchases [9].

Three specific sub-traits within impulsivity stand out when dealing with impulse purchases. First is the sub-trait of *sensation-seeking* behaviour, which directly impacts impulse buying. Sensation-seeking, variety-seeking, novelty-seeking, and similar traits are reported as contributing to impulse buying [5].

Secondly, a tendency to buy things impulsively reflects a deeply rooted longing to act *spontaneously* within the context of consumption. This is what turns into an urge or motivation for actual impulse buying [5]. Impulse purchase tendencies seem easier to observe and detect than other traits.

Finally, *buyer-specific beliefs* are about own perceptions, and the lack tends to cause impulse purchase decisions [10]. Impulse generally occurs when a product

CHAPTER 2

Issuer Credit Rating Performance Report Using Sentiment Analysis

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Abstract: Indonesian Credit Rating Agency (CRA) is currently on its way to becoming the early mover of digital transformation. CRA controls macroeconomics and has a significant impact on many industries across the world. However, there are always those that can exploit it through asymmetric information and human interaction. A solution to reduce human interaction and enhancement is to build Natural Language Processing (NLP) sentiment analysis models and then display the results using an interactive dashboard story. Objectives are created for the aim of the project to be able to conduct a feasibility study, develop a model based on a press release dataset, conduct model evaluation, and display the results on an interactive dashboard. The research aims to utilise press release documents with NLP sentiment analysis to produce prescriptive analysis with interactive visualisation as the final output. Press release files are processed by using several Machine Learning (ML) algorithms such as Support Vector Machine (SVM), Multinomial Naive Bayes (MultinomialNB), Logistic Regression (LR), and Multi-Layer Perceptron Artificial Neural Network (MLP-Ann). This research will be carried out under Dynamic Systems Development (DSDM) and Knowledge Discovery Database (KDD). This will allow the researchers to achieve all objectives, permit models to perform very well, and let the output get displayed on a dashboard as a storyboard.

Keywords: Credit Rating Agency (CRA), Natural Language Processing (NLP), Press Release, Sentiment Analysis.

INTRODUCTION

Credit Rating Agencies (CRA) are institutions or organisations responsible for investigating companies' business activities, economic conditions and sectors. The analysis and demonstration from the company regarding the credit rating institution can justify deciding whether the company shares integrity and soundness from its activity. This was based on what [1] stated on the CRA

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assessment on securities, and what [2] mentioned about the rating agency being affected by the financial and leverage ratio of the company to determine the rating score.

CRA has significant control over the financial market as it involves many parts of the world in determining the rating. On the other hand [3], has not only determined the impact of credit rating on the capital structure of a particular company but has also divided the factors impacting the decision as Internal and External factors. Additionally, the assumption in [4] states that CRA negatively influences the economic sector as it picks a side on the issuer rating. CRA could favour the new issuer with a higher rating; downgrades or upgrades of the issuer occur more often when it has many rivals. This situation has resulted in the asymmetric information exploitation theory by [2], also known as the 'lemon effect'. Subsequently, this led to a statement by [5] regarding the need for performance enhancement to avoid misclassification and invalid information from being generated.

One lead CRA from Indonesia is being concealed as company 'ABC' and is currently struggling to digitalise the infrastructure. In addition to that, the CRA did not even have a prescription and interactive visualisation to support data-driven decision-making. Therefore, this research aims to provide CRA ABC from Indonesia with an interactive performance analysis dashboard visualisation generated from the model that utilises the NLP sentiment analysis technique to calculate a value based on the CRA press release indicating each of the company ABC's issuer. A reusable press release is being proposed to bring a new perspective in establishing a future rating based on past events of the client.

Technology inclusion in the business must be carried out as [6] mentions that digitalisation can help increase productivity, lower overall costs, and reduce human interaction, possibly resulting in the lemon effect or disjunction in the rating process. The whole research sequence will start from data collection until an evaluation using Software Development Life Cycle (SDLC) along with data mining methodology is done. Furthermore, classification modelling combined with the sentiment analysis technique will be carried out to predict the score of each issuer's press release.

MATERIALS AND METHODS

This research focuses on prescriptive analysis based on content from client press releases. The data is primary (in a PDF format) from the company, indicating that content selection must be made. Fig. (**1**) shows what a press release looks like. 408 press releases from 57 bank issuers will be based on the last five years' performance. The primary function will rely on the sentiment analysis technique

to calculate the score of the content, based on a range from -1 to 1, indicating the negative or positive meaning behind the sentiment.

CREDIT PROFILE

Corporate Rating *idBBB+/Stable*

Rated Issues
-

Rating Period
August 10, 2017 – August 1, 2018

Rating History
-

FINANCIAL HIGHLIGHTS

As of/for the year ended	Jun-2017 (Unaudited)	Dec-2016 (Audited)	Dec-2015 (Audited)	Dec-2014 (Audited)
Total assets [IDR bn]	4,335.8	4,255.9	1,974.4	2,135.9
Total equity [IDR bn]	1,093.8	1,067.9	210.5	205.5
Total gross loans [IDR bn]	2,566.1	2,426.0	1,251.8	1,216.9
Total cust. deposits [IDR bn]	2,912.9	2,728.1	1,648.6	1,789.8
Net interest revenue [IDR bn]	100.3	156.2	91.8	78.1
Net income [IDR bn]	25.7	39.2	5.5	3.0
NIR/average earning assets [%]	*5.0	5.4	4.7	4.0
Operating expense/income [%]	83.0	82.2	97.5	97.8
ROAA [%]	*1.2	1.3	0.3	0.1
NPL (3-5)/gross loans [%]	1.1	1.3	3.0	4.2
Loan loss reserve/NPL (3-5) [%]	61.9	45.6	49.7	12.7
Risk weighted CAR [%]	32.1	34.9	14.4	14.2
Gross loans/total deposits [%]	88.1	88.9	75.9	68.0
USD exchange rate [USD/IDR]	13,328	13,473	13,785	12,385

*Annualized
The above ratios have been computed based on information from the company and published accounts. Wh ere applicable, some items have been reclassified according to PEFINDO's definitions.

PEFINDO assigns "idBBB+" rating to PT Bank Ganesha Tbk

PEFINDO has assigned its **"idBBB+"** rating to PT Bank Ganesha Tbk (Bank Ganesha). The outlook for the corporate rating is **"stable"**.

An obligor rated idBBB has an adequate capacity to meet its long-term financial commitments relative to that of other Indonesian obligors. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments.

The Plus (+) sign indicates that the rating is relatively strong within the respective rating category.

The rating reflects the Bank's strong capitalization, growth potential from its captive market, and adequate liquidity. However, the rating is constrained by its below average market position, high operating expenses, and exposure to concentration risk.

The rating may be raised if Bank Ganesha significantly strengthens its business position, profitability profile and funding structure on a consistent basis, while maintaining its strong capitalization. The rating may be lowered if there is a material decline in its asset quality or profitability profiles.

Bank Ganesha engages in commercial banking, with main focus on corporate lending. As of June 30, 2017, the Bank's largest shareholders were PT Equity Development Investment Tbk (29.9%), UOB Kay Hian Pte Ltd (12.4%), PT Bintang Tunggal Gemilang (10.0%), and BNP Paribas Wealth Management Singapore (8.1%). The remaining shares were owned by other shareholders and public at below 5% each. It has 12 offices, 24 self-owned ATMs connected with ATM Bersama network, and 319 employees.

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Fig. (1). Press Release Sample.

The data will be in CSV format when transformed manually in Excel from a PDF file. The features in the data include the bank name, date, and sentiment. Raw data will be processed and scored in the NLP model using the TextBlob library (Python-based) after the visualisation is generated using Tableau software. The other four classification algorithms will utilise different libraries of Scikit Learn and Natural Language Toolkit (NLTK) as the base library to conduct the analysis modelling.

Python has emerged as the pioneer of NLP-related modelling, thanks to its vast active community and a massive variety of libraries catering to specific issues, as stated in [7]. It has been mentioned that even though Python is the most powerful and dynamic, it has simple implementations supported by widely popular libraries such as NLTK, pandas, and Sklearn [8]. The procedure will be executed based on a modified Dynamic Systems Development Methodology (DSDM) combined with Knowledge Discovery Database (KDD) to assess the data mining.

LITERATURE REVIEW

NLP is widely used and is currently the most desirable system in some digital-based companies. This is because the companies need extra resources/information from a third-party perspective, also referred to as soft information [9]. The term soft information originates from financially based companies that use non-

CHAPTER 3

Recommendations for Implementing an IoT-Based Inventory Tracking and Monitoring System

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Abstract: Inventory management is vital in the industry because it allows manufacturers and wholesalers to efficiently store and manage information in the warehouse. Warehouse management provides the facility to control functions such as storing newly shipped products in available locations and tracking inventory information and product distribution for shipping. These complex processes in the warehouse management system require manufacturers and wholesalers to ensure that the warehouse operation is running smoothly and efficiently. The use of the Internet of Things (IoT) for automating industrial and household processes has been increasing rapidly in the last few years. This research focuses on IoT for tracking and monitoring inventory, providing an automated and efficient system for manufacturers and wholesalers. A comprehensive discussion has been conducted on IoT application layers and recommended sensors for inventory tracking and monitoring systems. This research also emphasizes applying IoT in inventory, logistics, and warehousing operations. Researchers have proposed an IoT-based system specifically designed to cater to the shortcomings of the existing inventory management systems.

Keywords: Internet of Things (IoT), Inventory Management, Inventory Tracking and Monitoring, Warehouse Management.

INTRODUCTION

Nowadays, many advanced technologies or systems assist manufacturers in managing inventory products, such as arranging inventory on the shelves or recording inventory information in the warehouses. However, only some of these systems provide holistic visibility of complete inventory information being stored in the warehouse. It is among the critical issues almost every warehouse faces, as manufacturers need an accurate system to track this information. Consequently, manufacturers need to put a lot of effort and time into recording inventory and finding the available space to load new inventory inside the available shelves [1].

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In this research, the authors have emphasised proposing a new advanced inventory system to assist manufacturers in managing inventory information effectively and efficiently. In addition, this system is proposed to contain some unique functionalities to keep track of real-time inventory information in the warehouse. The proposed system is an IoT-based system that consists of sensor devices to identify the inventory information in the inventory store. The inventory information will be displayed on the LCD screen, allowing users to show the recorded inventory on a webpage in real-time. Therefore, users would obtain the latest and updated inventory information easily rather than inspecting and recording each inventory container one by one.

PROBLEM STATEMENT

According to research conducted by Peerless Research Group in 2014, it was analysed that 47% of respondents increased their labour productivity in the range of 10% to 24% after implementing an inventory management system, whereas 16% of respondents received a 25% improvement in labour productivity in their industry. As per the Bureau of Labor Statistics, the turnover rate among warehouse employees is 36%. Furthermore, the logistics industry provides approximately 270,000 jobs annually in the world. Therefore, providing adequate training and skilled labour is always challenging, as specified in the above statistics [2].

Several problems associated with industrial warehouses affect the inventory tracking and monitoring processes directly. A flawed warehouse management process may contribute to many issues, including a substantial profit decrease. It will require the company to have higher expenses in managing and controlling its inventory [3].

If procurement managers cannot control inventory wisely, they cannot ascertain the inventory status to handle customers' needs [4]. Hence, in the worst-case scenario, they will need more inventory to meet their customer needs as they cannot capture the exact inventory status in the warehouse. With an efficient and well-organized inventory management system, manufacturers can keep track of stock and transactions in a warehouse [5].

Most companies need complete visibility of their inventory information. They will have a massive issue of purchasing goods at the wrong time; thus, it will increase unnecessary expenses in the warehouse [6]. Furthermore, it may slow down the warehouse operation process because it needs the manufacturers to put a lot of effort and time into looking for the particular goods, then shipping them out or replenishing the lack of inventory in the warehouse. On the other hand, these problems may decrease the company’s profits due to lost sales and higher

inventory expenses. The procurement manager does not have complete visibility on which inventory they should purchase [1]. Besides, manufacturers waste significant time searching for available slots and arranging these incoming inventories on placement [7]. Apart from that, one of the common problems in every organisation is having an excessive inventory in the warehouse and being unable to ship it quickly. Thus, the company can keep on losing money by purchasing unnecessary products.

Inventory management has strategic importance for any industry or factory as it needs financial and human resources to record, update, and maintain stock-related data like level, location, status, *etc.* One of the current industry's significant challenges is inaccurate and inconsistent inventory information that might lead to running out of stock or carrying too much stock, eventually incurring high expenses [6]. Based on research conducted in 2016, most industry players face issues due to their ineffective capacity framework and racking arrangement that significantly impact manufacturers' insufficient space to receive more stock [8]. Therefore, it is tough to determine which inventory store can keep the freshly arrived inventory within due time.

USE OF IOT IN INVENTORY TRACKING AND MONITORING

IoT is widely used in healthcare, transportation, home automation, and industrial systems. It is used to communicate and share information via the Internet to conduct tracing inventory, smart reorganisation, real-time monitoring, security, and process control. Using IoT, machines, sensors, and people can connect via the Internet at any given time and place where the infrastructure is available [9].

IoT-based inventory tracking and monitoring systems will significantly help the inventory management business. Using the latest technology trends, an IoT-based inventory management system can utilise data analytics, cloud computing, mobile devices, etc. This can be done to solve the existing issues as well as address the limitations of the current inventory tracking systems.

IOT APPLICATION LAYERS

IoT application layers consist of the sensor, communication, support, and application layers.

Sensor Layer

The lowest layer is called the sensor layer or smart device layer, which consists of smart devices integrated with sensors. Sensors connect with smart devices to process and provide real-time information. Sensors not only measure and detect

CHAPTER 4

Incorporate Artificial Intelligence into the Fitness Field to Curb Diabetes in Malaysia: Current and Future

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Abstract: With the rapid technological change, most people are living an unhealthy lifestyle and consuming processed food. Additionally, most people spend time on their mobile phones instead of working on other activities such as exercise. Beginners should have at least 2 to 3 days of working out per week, and the intermediate should have 3 to 4 days of strength training. A set of stretching exercises is required after each workout. Approximately 3.9 million people aged 18 and above are diagnosed with diabetes in Malaysia. This means that 1 in 5 adults will be diagnosed with diabetes. The prevalence rate has increased from 13.4% in 2015 to 18.3% in 2019. Some of the main factors that can cause a person to acquire diabetes are obesity and consuming excessive amounts of food with high sugar levels. The two types of diabetes are type 1 diabetes and type 2 diabetes. Type 1 diabetes results in the body not producing insulin, whereas type 2 diabetes causes the body to not respond to insulin even though it produces insulin.

Keywords: Artificial Intelligent, Diabetes, Exercise, Fitness, Live-Stream, Obesity.

INTRODUCTION

According to the Health line article [1], beginners should have at least 2 to 3 days of working out per week, and the intermediate should have 3 to 4 days of strength training. A set of stretching exercises is required after each workout.

Malaysia has a higher ranking in obesity among other Asian countries [2]. Within nine years since 2006, the obesity rate has increased from 11.6% to 17.5% in Malaysia. According to the World Health Organization WHO (2019) investigation, 64% of males and 65% of females in Malaysia are overweight or

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obese, putting them (mainly those aged 18 and above) in danger of becoming diabetes patients. Moreover, half of the people that fall under this category do not even know they are diagnosed with diabetes [3].

In 2018, Cilisos and Fitness First collaborated and researched why Malaysia had the highest number of obese citizens among all the Asian countries. A total of 3,779 respondents were in the survey from states all around Malaysia: Selangor (40.2%), Kuala Lumpur (25.6%), Penang (7.5%), Sarawak (5.2%), and Johor (4.2%). Almost half of the respondents were 21-29 years old. Expectedly, most people preferred to take the elevator over using the stairs. 33.3% of the respondents said their limit was three flights of stairs [2]. Most people who work in offices spend the entire time sitting during the workday, thus leading to physical and mental health issues [4].

Furthermore, approximately 3.9 million people aged 18 and above are diagnosed with diabetes in Malaysia. This means that 1 in 5 people will be diagnosed with diabetes. The prevalence rate has increased from 13.4% in 2015 to 18.3% in 2019 [5]. Some of the main factors that can cause a person to acquire diabetes are obesity and consuming excessive amounts of food with high sugar levels [6]. The two types of diabetes are type 1 diabetes and type 2 diabetes. Type 1 diabetes results in the body not producing insulin, whereas type 2 diabetes causes the body to not respond to insulin even though it produces insulin [7].

CURRENT SITUATION OF DIABETES CARE IN MALAYSIA

To diminish the case, the Malaysian government introduced the '*Enhanced Primary Health Care (EnPHC)* project in July 2017. The project aims to raise awareness/exposure regarding chronic diseases. Approximately 20 health clinics are located in the Johor and Selangor area. The project requires the citizens to register at the clinic so the track of the population is recorded in the database [3]. However, not all the states in Malaysia have the *ENPHC* health care clinic implemented, such as Negeri Sembilan. Therefore, a fitness monitoring system will be developed to raise awareness of fitness for diabetes.

Countries worldwide have been experiencing the COVID-19 pandemic since the beginning of the year 2020. People need to practice social distancing to prevent the spread of COVID-19 (coronavirus). Actions such as sneezing, coughing, or even close contact can result in a healthy person being infected [8]. Due to the pandemic, fitness centres are forced to close until further notice. Hence, a growing number of e-fitness have come into the market. Examples include following workouts from online conference software like Microsoft Teams and Zoom (Lufkin, 2020). The system will develop a recorded workout video and a live workout session to ensure users can exercise from within their homes. This will

be done so that individuals will only struggle and practice exercises if they visit physical fitness centres. Nevertheless, this is still the start of the project research, and the result may vary depending on the functional and non-functional considerations.

Technologies Used in Current Diabetes Care

With the rapid advancement of technology, it is no surprise that it is being used in the diabetic field. There are two main categories: insulin administered by a syringe, pen, or pump and blood glucose monitoring assessed by a meter or continuous glucose monitor. UtilizinUtilisinginge and pen is the safest method for people with diabetes to test the glycemic target [9]. An insulin pen allows the user to administer insulin to the body. The two types of pens are disposable pens and reusable pens. A disposable pen has a prefilled insulin cartridge. This means that once the diabetes patient has finished up the insulin from the disposable pen, the whole pen unit is rendered useless and can be disposed of. On the other hand, a reusable pen has a replaceable insulin cartridge. This means that even if the diabetic patient uses insulin, it is possible to replace the cartridge with a new one.

For hygiene purposes, once the replaceable insulin tube is finished, the patient should discard the needle and replace it with a new disposable one. This allows for more prolonged insulin pen usage and improves the patient's health [10]. The hardware, devices, and software not only manage the blood glucose level but also improve the diabetic's quality of life. This is helpful as patients have to be cautious due to their weaker immune systems [9]. Recently, the technology used regarding diabetes has transformed into a hybrid device that allows the user to monitor glucose and provide insulin simultaneously. At the same time, medical-related devices and software will be tracking them along with allocating diabetes self-management support for better accuracy detection. Additionally, there are more complex and smarter devices that can help further improve the lives of diabetics [9]. For example, the smart insulin pen, a combination of the vial and syringe, can record the dose usage and timing with the push-button injection, ultimately saving the diabetic patient much time.

Problems and Solutions: Why do we have diabetes?

Diabetes always appears in our lives for some reason.

Lack of Exercise and Unhealthy Lifestyles

To avoid getting diagnostic diabetes, exercise and consuming a balanced diet are key factors. However, most people are busy with their hectic lifestyles, causing them to depend on fast/processed food which is unhealthy and increases the

CHAPTER 5

An RSA-based Secure E-hailing Application

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Abstract: E-hailing and taxi services play a vital role in the transportation industry. It inadvertently also provides opportunities for malicious hackers to hack into e-hailing applications to gain private user information. With the increase in data breaches, there is a need for an encryption technique to increase the security level and assure the safety of users' data. This study proposed SafeCar, a secure e-hailing application using the RSA algorithm. SafeCar is developed using ASP.NET language. Testing has been done to evaluate the security, input validation, and user satisfaction. The testing results showed that 50% had a very good security level, another 50% with a good security level, 100% user satisfaction, and 67% had very good input validation, with another 33% resulting in good input validation.

Keywords: e-hailing, Encryption, RSA, Security.

INTRODUCTION

Reconnaissance, or recon, is the first and most crucial step for penetration testing or security research. Limited or inaccurate data would lead to the wrong direction in later phases of attack, such as scanning or gaining access, hence the saying, "time spent on reconnaissance is seldom wasted". Reconnaissance is not only for cyber security researchers; privacy-focused users often gather their personal information, also known as a digital footprint, to see if it is exposed to the public. Moreover, they can occasionally check if websites like Haveibeenpwned have breached their accounts. In short, reconnaissance is getting more attention and is easily accessible as online activities have started to become more active. Some initial information gathered in the reconnaissance stage is breached credentials and digital footprints. Breached credentials, especially those not encrypted or hashed, are shortcuts for attackers and the biggest threat to account owners. This is because further reconnaissance and enumeration will not be needed anymore to gain unauthorised access to their accounts. However, in most cases, additional

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information is required to launch an attack successfully. This is where digital footprint recon comes into place. Looking for traces of an individual or organisation left online allows for a broader range of attacks to be launched. For example, gaining information like the working location or friends of the target on social networks allows social engineering to be undertaken. Specific exploits can be launched if the attacker gains mobile device information of the target by searching which platform (Twitter for iOS or Twitter for Android) the target used to send out tweets on Twitter. These are just some examples of how little pieces of information can be gathered to widen the attacking choices of the attacker and the risk exposed to every internet user. Thus, having a tool to automatically collect both digital footprint and breached credentials from several sources would provide convenience to professionals and novice users.

The developer proposed the tool mentioned above that allows users to gather digital footprints from Facebook and Twitter, as well as breach the status of target users with both CLI and GUI.

MATERIALS AND METHODS

Materials required for the project include programming language and libraries used to develop the proposed solution. Python is the chosen programming language, as it is easy to learn and implement and has extensive libraries, including the ones needed for this tool, as shown in Table **1**.

Table 1. Libraries and their purposes.

Library	Purpose
Requests, Beautifulsoup	Scrape information from Facebook and breach checking the website
Tweepy	Work with Twitter API to gather Twitter data
Xlsxwriter	Export gathered data to an Excel file
Argparse	Configure commands and parameters used in CLI
Tkinter	Develop GUI

INFORMATION GATHERING METHODS

Three commonly used methods to gather data from websites are web scraping, API, and browser automation.

Web scraping is also known as web harvesting or data mining. It is a technique to gather desired data by sending HTTP requests, sanitising received HTTP responses, and extracting essential data.

API is known as Application Programming Interface. It is the same as web scraping because both retrieve website data by sending HTTP requests. The difference is that APIs return fetched data in a well-formatted way, usually in JSON or XML format. In contrast, web scraping requires an extra step to sanitise or parse HTTP response to remove unwanted HTML elements, leaving only the desired data [1].

Surveys such as that conducted by [2] on one retail store, TS Stores, showed that out-of-stock issues have caused between 8% and 22% of expected sales of promotional products to be lost. Two of the branches managed by Kim Soon Lee suffered from lost sales amounted to about US $75,000. Previous studies have reported that out-of-stock products can affect a customer's satisfaction with the retailer [3]. If consumers are dissatisfied with a hypermarket, they may be prone to switch their regular store to another. Therefore, hypermarkets may lose their loyal customers and sales opportunities.

Browser automation is used to automate browser activities, such as filling out a form, entering data in a textbox, clicking buttons on a webpage, and so on [2]. The same technique can be used to scrape data from websites. Instead of users who are controlling the browser, the bot or script is the one that automates the predefined user actions on the browser.

However, only **Web scraping and API** are used to gather data as browser automation gathers data significantly slower yet makes no significant difference in the comprehensiveness of data.

Web scraping guarantees the speed of information gathering without compromising much on the comprehensiveness of data. Since it is prone to webpage or HTML structure changes, API can be used to balance out such a risk. On the other hand, web scraping can cover the downside of API's rate limit.

Therefore, both techniques are used to complement each other. Web scraping is used to extract breach status and Facebook data, whereas API is used to extract Twitter data.

SOFTWARE DEVELOPMENT METHODOLOGY

The spiral model was chosen as the software methodology to develop the proposed system. It is a risk-driven iterative development method that loops through four major phases in every cycle: planning, risk analysis, development and testing, and evaluation, as shown in Fig. (**1**).

CHAPTER 6

Digital Divide in Primary Schools

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Abstract: The gap in the use of the Internet and computers in society is classified as the level-two digital divide. Research papers from 61 popular journals published between 2005 to 2018 were examined to carry out a Systematic Literature Review (SLR). In addition, renowned organisations' research publications from 2010 to 2018 were used. The adoption of technology, the type of use, the frequency of use, and the effectiveness of use were the main areas of level-two Digital Divide research. This use is further affected by the accessibility determinants of Affordability, Gender, Age, Education Level, Race, and Digital Skills. None of the research used the accessibility determinants as a moderator between availability and use.

Keywords: Accessibility, Adoption, Affordability, Digital Divide, Digital Skills, ICT Use, SLR.

INTRODUCTION

The COVID-19 pandemic has forced many educational institutions worldwide to conduct their teaching and learning online during the yearlong lockdown. This fueled the Digital Divide issue in society, particularly in developing countries among students. The Digital divide is a moving target [1] from Level One, where the availability of Information Communication Technology (ICT) infrastructure is a primary concern [2], to Level Two, which is the *Use* of ICT, to Level Three, which is the *Appropriate-use* of ICT [3]. This Systematic Literature Review (SLR) research delves into the Level-Two Digital Divide using educational technology, computers, and the Internet, which is a part of an unpublished doctoral thesis [4].

In the early days of ICT diffusion, several studies defined the digital divide regarding availability and accessibility only [5 - 8]. Later the use or adoption of ICT received the attention of researchers [9] in developed nations. As the availability issue has been vastly reduced, fixed terrestrial high-speed broadband

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at speeds of 25 Mbps/3 Mbps is available for 92.3 per cent of Americans [10] However, the usage issue isn't solved still, and a few researchers view the use as the second-level digital divide [11]. These studies predominantly examine the hours, days, and weeks of computers and Internet usage, taking everyday activities, such as web browsing, social networking, watching videos, listening to music, playing games, checking or sending an email, and uploading or downloading applications into consideration. Without usage, the aims of ICT are unachievable. The Digital Future Report finds that 77 per cent of Americans use the Internet daily, and 17 per cent use it at least once a week [12]. Others measure use by bandwidth usage. Hilbert, in his research, suggested improving "the intensity of usage" [13] by traffic flow per time unit and admitted the absence of internationally recognised measures on effective ICT usage.

ITU [14] has a similar measure of ICT use. For a computer, the measurement consists of nine activities ranging from simple copying or moving a file or folder to an advanced activity of writing a program using a programming language. Twenty-nine Internet activities are used, ranging from getting information about goods or services to online banking. Many of these activities have become partly routine for many users in their daily lives. As Giddens says, human actors maintain stocks of knowledge to perform day-to-day social activities [15].

Similarly, when ICT activities are perceived to be less complicated, and by monitoring how others use them, human actors can follow the same. For example, the WhatsApp messenger application allows short messages, pictures, and videos to be exchanged using Internet-enabled smartphones. Actors in their interaction may routinely observe how other actors use the messenger with few touches and swipes on the smartphone screen to communicate.

Observability, the level of complexity, and the relative advantage in communication lead to the diffusion of the technology [16]. With this in mind, browsing the Internet to read news, watching streaming videos, searching the web for information, and many other primary activities may be accomplished by actors with the existing stock of knowledge, reflexively monitoring the conduct of others but may be incapable of explaining the relative advantage.

Intention to use is a measure of the strength of one's intention to perform a behaviour [17, 18]. According to Ajzen, intention involves belief, target, situation, and time [19]. For instance, a teacher intends to use PowerPoint slides to teach science today. However, Giddens argues that the terms 'intentions', 'motivation', and 'reasons' have different connotations and should be used carefully. Researchers agree that intention and motivation have different meanings. When the behaviour in question is intended, the actor can rationalise the behaviour with

discursive consciousness or practical consciousness, but the unintended behaviour is merely a reactive response [20]. Thus, we can conclude that the ICT activities by actors are intended actions like watching an online streaming video or sending a message using WhatsApp. These actions will not happen without having an intention.

Not only for teaching and learning, but education technology is also used as an information search tool, used for school administration, and collaboration with parents [21]. Reinhart examined five types of technology, from basic computer skills to higher-order computer skills, used in classrooms by K-12 teachers in the US. His research deals with whether the teachers use low or high-order technology and the effect of socio-economic factors on the usage [11].

Human actors intentionally or unintentionally change the technology in practice in the course of repeated use and when the knowledge to use increases. In Orlikowski's perspective, repeated practice explains the structuration of technology and use [22]. She illustrates how Americans use tax software to file their returns in her study.

When people routinely use tax preparation software, they draw on its inscribed properties and embedded information content, their experiences with technology, and the understanding of their rights and obligations as taxpayers to enact a set of reporting rules and resources with the software.

METHODOLOGY

This research used evidence-based SLR [23] instead of randomly selecting the journal papers and reports. The research papers published in 61 journals and conference proceedings from 2005 to 2018 were reviewed. A total of 100 journal papers were selected. Of this, 30 percent was from Asia, 22 percent from North America, 15 percent from Europe, 5 from Africa, 3 percent from South America, and 1 percent from Middle Eastern countries where the Digital Divide research was centred. 24 percent of the research delved into the global Digital Divide.

In addition to the above, 25 regional and international organisations reports published from 2010 to 2018 were also reviewed. Finally, 86 reports were used for this research. The significant contribution of the reports came from the Malaysia Communications and Multimedia Commission (MCMC), International Telecommunication Union (ITU), Organization for Economic Co-operation and Development (OECD), National Telecommunications and Information Administration (NTIA), and Global Information Technology Report (GITR).

CHAPTER 7

Intrusion Detection System for the Internet of Medical Things (IoMT)

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Abstract: In this paper, the authors proposed the design of an Intrusion Detection System (IDS) that can be used in the healthcare sector to increase cybersecurity. This sector is facing high cyber threats. Similar IDS systems will be reviewed in the following pages, followed by the justifications of why the authors decided to design the IDS to be Signature-based. The experimental results showed that the developed IDS could successfully capture the network traffic, record the logs and show an informative alarm screen with a few other options within the dashboard to assist the user in handling the situation and assure the hospital network security.

Keywords: Healthcare IoT, HIDS, Hospital Security, Intrusion Detection System (IDS), Internet of Medical Things (IoMT), NIDS.

INTRODUCTION

Recently, technology has been playing a significant role in improving medical devices. Many medical devices are smart, meaning they are computer-related and connected to a database or more in the hospital network. The benefits are increasing, as well as the risk or fear of cyber-attacks. IoMT, The Internet of Medical Things, is a term for all smart medical devices and programs linked to a healthcare centre's network. In other words, IoMT is a medical device that can connect to a network to start communication and data transmission between smart devices. "Healthcare IoT" is considered another description of IoMT [1]. Since the IoMT is advancing so fast to provide more comfort to the patients and to make the hospital's staff work efficiently, the need to ensure the privacy and security of all the sensitive data are increasing symmetrically.

Many sectors respond to IoT technology very fast, unlike the healthcare sector. However, the Internet of Medical Things (IoMT) is now getting ready to move to

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the next level in keeping people safe and guaranteeing better medical services whilst reducing healthcare costs. Allied Market Research came out with a report predicting that the IoMT market will reach around $137 billion globally by 2020. It is worth mentioning that about 3.9 million smart medical devices are connected and monitor many areas of a patient's body [2].

Statistics, according to the Herjavec Group, which provides a special report from cybersecurity venture editors, show that there are more than 93% of healthcare groups faced a cybersecurity breach and data leakage within the years from 2017 to 2020. Moreover, the healthcare organisations that have experienced cyber-attacks over five times in three years are actually above 57% of the healthcare sector [3]. Regarding the IoMT insecurity, the CISO of Northwell Health, one of the nation's largest healthcare systems, Kathy Hughes, said that the IoMT devices have small operating systems and the security features and functions are bolt-ons rather than built-in, which makes those devices suspectable for cyber-crimes and threats. Real cases and difficult situations happened recently. A medical centre in California, US, lately shut down due to a ransomware attack that infected the clinics so harshly.

Additionally, (ENT) a hearing centre located at Battle Creek, Mich., collapsed and closed its doors for good since the database was hacked and the data was permanently erased. In some cases, recovering and dealing with post-attack troubles is challenging to get operations back to normal [4]. The usage of IoT devices, in general, is rapidly increasing, causing cybersecurity threats to grow alongside it.

Fig. (**1**) shows the increase in the IoT market globally from 2017 to the upcoming five years. Aside from that, ransomware attacks against healthcare sectors are expected to increase x5 in 2021, according to the cybersecurity ventures report [5].

To maximise data protection, healthcare IT specialists need to understand the cyber threats they are dealing with. Apart from the fact that the cyber-attack can cause financial consequences, it also might put the patient's life on the line. This is possible if the medical device's function is interrupted. Implementing an Intrusion Detection System (IDS) will assist the team in putting an end to many vulnerabilities.

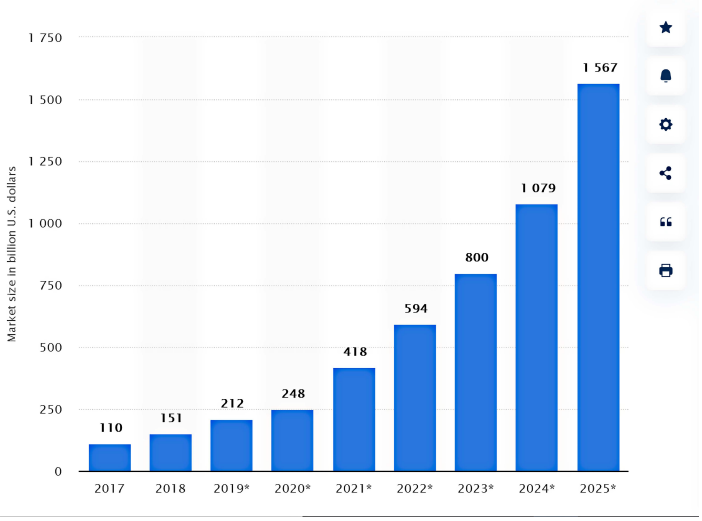

Fig. (1). Market size of the IoT [5].

REVIEW OF IDS SYSTEMS

In this section, a few similar systems will be studied with brief explanations about the features and limitations of each one of them. This step will provide a strong base for a better understanding of the challenges' nature related to developing this project.

Snort

Snort is considered the leading industry in IDS tools and systems. It is a well-known product from Cisco, and there are versions to be installed on both Windows and Linux operating systems. Snort allows the user to run the system in three different modes, as shown in Fig. (**2**):

- Sniffer mode
- Packet logger
- Intrusion detection

One benefit is that Cisco Systems support it since it is one of Cisco's products. However, it has its disadvantages as well, which include the difficulty of updating the rules you set in the system as it needs to be done manually and the fact that it requires so many configurations to setup Snort, which makes it slightly complicated to use if the person has no experience with such tools [6].

CHAPTER 8

Cyber Security State of Industrial Internet of Things (IIoT)

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Abstract: Cybersecurity is a critical component of technology and must be considered during the early stages of the development of any system. Cyber security issues and challenges faced by IIoT are discussed in this paper. The first section of this paper focuses on Industrial Control System (ICS) environments where IIoT are deployed to understand the nature of business and technology companies with IIoT networks, followed by a comparison to understand the difference between Operational Technology (OT) and Information Technology (IT) networks and how both can be used to serve the need of business requirements. This paper evaluates the state of cyber security in industrial networks and IIoT and the safety and privacy concerns found in the literature. Solutions and improvement techniques introduced to cyber security functions mainly focus on prevention, detection, and response. Moreover, IoT organisational and operational security and cyber threat intelligence are also discussed. Finally, an approach is presented on how to conduct a security assessment on IIoT environments safely.

Keywords: Countermeasures, Cyber security, IIoT, Industrial control system (ICS), Operational technology, Vulnerability.

INTRODUCTION

IoT provides a layer of intelligence on top of physical machines and devices by connecting them to share resources. The idea of connecting things could be as simple as automating tasks, such as opening a garage door, or more complex, like controlling the entire business operation of a factory. The number of devices in 2020 connected to the internet is estimated to be 20 billion ("Gartner Says 8.4 billion Connected 'Things' Will Be in Use in 2017, Up 31 Percent From 2016)

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[1]. This report focuses on the state of security in the industrial internet of things and the underlying infrastructure that controls them.

The adoption of the industrial internet of things enables industries to integrate physical systems and IT applications to facilitate and orchestrate entire production lines to reduce human manual intervention. The difference between conventional IoT devices and industrial IoT is in the environment where they are deployed and the application's target. Conventional IoT devices usually target consumers, while IIoT targets the industrial sectors. Furthermore, Industrial IoT is used in critical environments, making reliability and safety their highest priority.

In terms of security, TrendMicro zero-day initiative team conducted intensive research in two years (2015-2016) to assess the state of ICS security. The research revealed 250 zero-day vulnerabilities that could be used to attack critical infrastructure [2]. Moreover, it is believed that the state of ICS security is insecure. Only one company was able to discover serious security problems and the average time required to patch vulnerabilities. Fig. (**1**) shows the number of days needed by each vendor affected in the research to patch vulnerabilities.

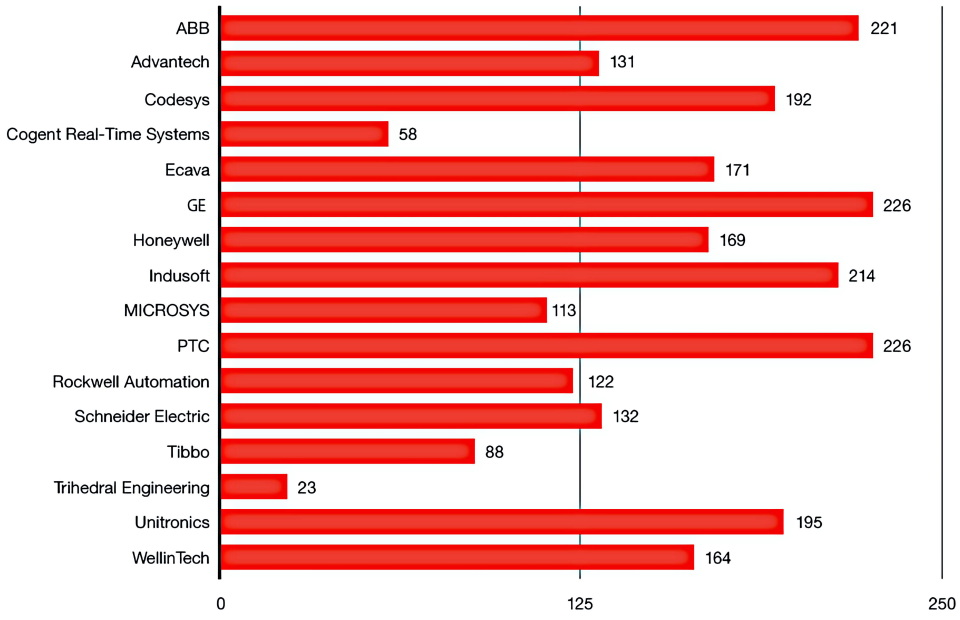

Fig. (1). Average patch time by Vendors [2].

According to the national vulnerability database (NVD) maintained by NIST, 2020 does not have any fewer vulnerabilities than previous years, as there are 365

new ones. Most of the published vulnerabilities can be exploited remotely. The servility of the published vulnerabilities is shown in Fig. (**2**).

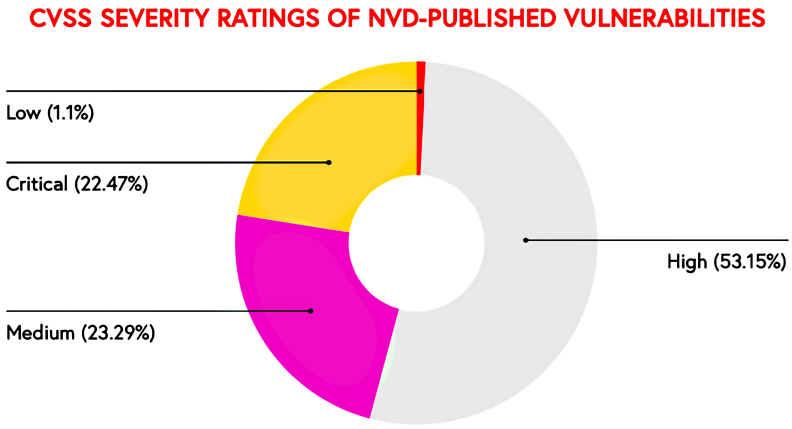

Fig. (2). 2020 vulnerability severity [3].

The US ICS-CERT team also published 139 advisories for hardening the security of ICS [3].

Industrial Control System Environment

The architecture of any control system is divided into three primary levels: field level, control level, and production control level. The field level consists of sensors and actuators. Sensors either control the actuators or send data for storage and processing. The control level is placed at a higher field level. It receives data from sensors and sends commands to actuators. The interaction between devices controlled on this level uses intelligent language to define the rules and decision-making parameters. A programmable logic controller is an excellent example of a control-level device. Devices at the production control level control all the lower levels of devices and provide a high overview of the entire production process. Human Machine Interface is an example of a production control system. The production control level is where IT systems are interfaced with OT networks [4].

IoT in Electrical Sector

The electrical sector was one of the first industries to embrace the internet of things to build smart power grids. IoT will act as a layer of connected devices built on the power grid network.

The definition of the smart grid is derived from the fact that the distributed IoT devices across the power grid network send the gathered data to an IT system for

CHAPTER 9

Machine Learning for Browser Privacy

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Abstract: Online privacy is an Internet user's control of how much personal information is shared with a third party. Unfortunately, some third parties, such as data brokers, collect user data without permission to resell the data to other parties. Browser tracking allows each Internet user to be uniquely identified, and in-depth user profiles are built. Browser fingerprinting is one of the most effective methods of browser tracking. It uniquely identifies each user through their devices' configuration, even for users using the same device models. Using Virtual Private Networks, the Tor browser and specific browser extensions as a countermeasure against browser fingerprinting are not widespread, so it often results in a compromised user experience. Researchers have proposed various classification machine learning approaches to improve browser privacy; some focus on recognising and blocking advertisements and website scripts that track users. In contrast, others identify potential vulnerabilities in browser security configurations. There is a need for more research in machine learning, especially natural language processing, to enhance browser privacy.

Keywords: Browser Fingerprinting, Machine Learning, Online Privacy, User Interest Profiling.

INTRODUCTION

With the increased time spent on the Internet, user data is of great interest to marketers and advertisers. Browser tracking uniquely identifies each user and collects data regarding their browsing activities. The massive amount of collected user data leads to highly sophisticated and effective machine learning models that classify users into market segmentation for targeted marketing purposes. This paper examines the current research in browser tracking, and the machine learning approaches on user data, as well as the research in the countermeasures through privacy-enhancing technology (PET) and machine learning approaches.

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ONLINE PRIVACY

Privacy is a human right that controls how much access other individuals have over themselves. As humans are social beings, privacy, as part of social communication, has evolutionary roots in personal and social boundaries [1]. However, online privacy is an evolutionary mismatch, as online communication is very different from its face-to-face counterpart, and people are much less concerned about privacy in an online setting. This phenomenon is known as the privacy paradox.

On the other hand, some researchers, such as [2] and [3], explain that online privacy is a form of social contract or power-responsibility equilibrium, where people are less concerned about online privacy if they believe that the government, online businesses, and firms will honour their end to the contract by ensuring that the users' data is handled safely. This social contract can lead to mutual benefits. In fact, by disclosing information such as personal preferences, customers can save money through highly customised product recommendation systems [4]. However, customers will start withholding personal information if an online business uses such information to price discriminate.

DATA BROKER

Both approaches to online privacy, whether explained from the perspective of evolution or social contract, assume that disclosure of personal information is a consensual process. Data brokers are private companies that collect personal information from social networks and browsing history [5]. These companies operate covertly and exchange this information with other data brokers and governments.

By applying machine learning to such data, invaluable information such as a user's preferences and other behavioural patterns are obtained. Not only is such information highly sought by marketers, but governments often hire data brokers. As governments and large corporates benefit immensely from such arrangements, there are almost no consequences to the practice of making immense profits from selling someone's data without their permission.

While the reason for banking, financing parties, or law enforcement to purchase the services of data brokers can be for more benign reasons, such as fraud detection, some clients (such as politicians) use such information to influence the general public for personal gains [6]. Each click, like, and post is collected and aggregated to build a highly detailed profile so each person can be labelled and categorised. Naturally, such services not only attract a wide variety of clients but also attract other crime syndicates. Although one would think that data brokers

would hold deeply onto their resources, data breaches happen, leading to financial fraud, identity theft, and other scams [5].

Unfortunately, because these companies operate covertly, many people are unaware of their existence. They are not held accountable for data breaches where there was not even a social contract or any consensus in the first place. Victims of such cases end up financially devastated and are often left with little to no assistance while these private companies continue to make a profit.

CURRENT RESEARCH IN BROWSER FINGERPRINTING

In web browsing, third parties infer the browsing habits of first parties (Internet users) over time. Some third parties are necessary, such as essential and optimisation third parties, who collect such information to improve user experience [7]. Others, such as malware third parties, redirect third parties and tracking third parties, are responsible for viruses, redirects, and embedded tracking.

Targeted online advertising evolved from simple ad banners. Today, many online advertisements are personalised according to the users' interests, which is made possible by collecting and analysing a user's browsing activities and habits. IP addresses, cookies, and browser fingerprinting are used to identify an Internet user uniquely. An IP address is assigned for each device connected to the Internet [8]. While a device's IP address may change over time, it was found that IP addresses are often retained and reused, which could lead to long-term tracking. Online advertisers often overlook IP address tracking, although it is difficult for Internet users to modify their IP address.

On the other hand, browser fingerprinting is more commonly used and discussed. Browser fingerprinting is a process where information about a device, such as the hardware and browser configuration, is collected *via* a web browser. In more advanced fingerprinting, attributes are collected from browser features, such as canvas and webGL, which also provides information about the device's graphics [2].

A similar but rarer technique used is the AudioContext, where audio signals are collected instead. Browser extensions are also used in browser fingerprinting [9]. The type and nature of extensions that are installed can often reveal information such as age group, religion, politics, ethnicity, health, and sexual orientation, through techniques such as inference attacks. Said attacks occur when the extensions' textual descriptions are analysed using natural language processing (NLP). Even minor details, such as font metrics and battery status, can be used against an Internet user's interest [10]. Although different Internet users may

CHAPTER 10

ARP Spoofing in Launching Man-in-the-Middle Attack

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Abstract: Man-in-the-Middle (MITM) attack is a typical eavesdropping cyberattack. The attacker can launch a MITM attack whenever the attacker and victims are on the same network. Here is a scenario: A MITM attacker connects to Subway's Wi-Fi and waits for the victim to connect to the Subway Wi-Fi. Eventually, Victim A walks in and connects to Subway's Wi-Fi. Once Victim A gets connected and is on the same network as the attacker, the attacker can launch an attack to intercept the network traffic of Victim A. Therefore, everyone on the same network connection with the attacker can be the target of a MITM attack. In this paper, the MITM attack will be introduced. The attacker can spy on the victim, steal sensitive credentials, disrupt communications, or even corrupt the data through the said attack. To discover how the MITM attack works, this paper explains it based on the ARP Spoofing attack, which exploits the ARP protocol to send out forged ARP responses. ARP Spoofing attack is one of the MITM attacks. This paper emphasises the MITM attack phases, different types of MITM attacks, ARP Spoofing attacks, and how ARP works. The demonstration of steps for launching an ARP Spoofing attack and the tools involved, like Nmap, Arpspoof, and Wireshark, are also included.

Keywords: Arpsoof, ARP Spoofing, Information Security, Man-in-The-Middle, Nmap, Wireshark.

INTRODUCTION

With the development of network technology, the demand for the Internet has become indispensable. Due to that, whoever uses the internet, increases their chance of being a victim of the MITM attack. This chapter is sorted into sections. The first section introduces the MITM attack, including the attack phases and the seven types of MITM attacks. The second section explores the ARP; explains how ARP and the ARP Spoofing attack work. The third section introduces the tools for launching an ARP Spoofing attack involving Nmap, Arpspoof, and Wireshark.

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The fourth section contains the demonstration steps for launching the ARP spoofing attack. The fifth section includes reviewing the MITM attack. Lastly, the sixth section concludes with some countermeasures regarding the MITM attack.

MITM ATTACK

The MITM attack is an unauthorised cyberattack where the unauthorised attacker secretly eavesdrops and intercepts the traffic or communication between two parties by impersonating one of the parties without alerting the victim [1]. During a MITM attack, the attacker will be placed between the user and the web application (Fig. **1**).

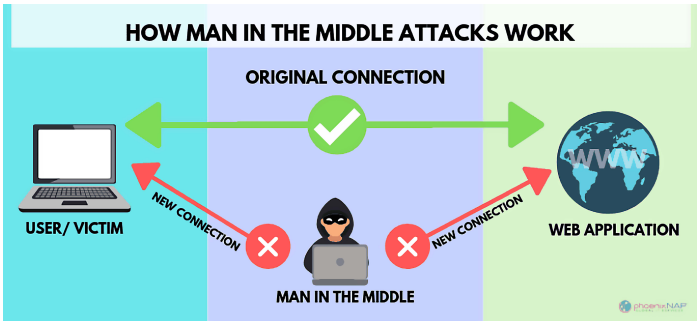

Fig. (1). MITM Attack Concept [2].

The goal of the MITM attack is either observe or manipulate network traffic. The attacker can obtain a lot of information, such as network traffic, login credentials, and other sensitive information, through the attack. In extreme cases, the attacker may alter the communication between two parties to reach specific objectives. After obtaining the data and information, the attacker may use it for their purposes or sell it, usually through the dark web.

MITM Attack Phases

Based on the problem stated above, Hypermarket Stock Monitoring System using IoT Automation can determine the products left on the shelf in real-time. Once the quantity of a product drops to a certain level set earlier, it will automatically notice the hypermarket staff. The team can view the product information, location, and quantity left via the system. The hypermarket can gain several benefits by implementing this stock monitoring system using IoT. Firstly, the products arranged on the market floor will be more organised as the system guides the restocking process. The system can determine which product should get restocked first; hence the on-shelf availability is significantly increased.

Type of MITM Attacks

There are seven types of MITM attacks with different functions, as shown in Table **1**.

Table 1. Seven Types of MITM Attacks and Functions [1 - 3].

MITM Attacks	Functions
IP Spoofing	Attackers imitate the IP address of the application to trick victims into accessing the URL connected to the fake site.
DNS Spoofing	Attackers spoof the DNS by tampering with websites' address records within the DNS server and thus redirect the victims to access the site.
HTTPS Spoofing	Attackers spoof the victims' browsers and pretend it is a secure website by passing forged certificates to the victims' browsers. The victims will see 'HTTPS' in the URL instead of 'HTTP', and the browser will be redirected to an insecure website.
SSL Hijacking	Attackers send phoney authentication keys for the user and web application during a TCP handshake. It appears as a secure site, 'HTTPS', but the attackers monitor the whole session.
Email Hijacking	Attackers spoof the email address and send their instructions to the victim. Attackers usually target the email of financial institutions and banks and then redirect victims to respond or send money to the spoofed email.
Wi-Fi Eavesdropping	Attackers create a fake Wi-Fi access point by setting up a public Wi-Fi connection. Once the victims connect to the Wi-Fi, the attacker can gain access to their network traffic.
Stealing browser cookies	Attackers hijack the victims' browser cookies and gain access to the victim's private information through the victims' browsing history.

ARP

Address Resolution Protocol (ARP) is a protocol that resolves IP addresses to machine Media Access Control (MAC) addresses. It converts 32-bit IPv4 addresses to 48-bit MAC addresses and vice versa.

MITM Attack Phases

Based on the problem stated above, Hypermarket Stock Monitoring System using IoT Automation can determine the products left on the shelf in real-time. Once the quantity of a product drops to a certain level set earlier, it will automatically notice the hypermarket staff. The team can view the product information, location and quantity left via the system. The hypermarket can gain several benefits by implementing this stock monitoring system using IoT. The products arranged on the market floor will be more organised as the system guides the restocking proc-

CHAPTER 11

Elderly Monitoring Using the Internet of Things (IoT)

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Abstract: As people get older and their bodies weaken, they become more prone to illnesses and injuries. This paper reviews several research papers that discuss implementing a monitoring system that monitors the elderly. This research aims to improve the healthcare and safety of elderly people alone at home by implementing a monitoring system based on IoT technology in Malaysia. This paper also discusses how stratified sampling methods and surveys can help identify elderly peoples' preferences and improve the monitoring system. The system proposed in this research uses real-time pulse and temperature monitoring, real-time fall detection monitoring, a cloud database, and a mobile application that could help reduce the effort and worry of taking care of the elderly. The findings of this research will help to improve the lives of elderly people that prefer staying in their own homes and will hopefully reduce the effort needed to take care of them. Future system improvements will include blood pressure and respiration rate monitoring, allowing more accurate monitoring of their health.

Keywords: Elderly, Health and Safety, Internet of Things (IoT), Monitoring System.

INTRODUCTION

As people get older, they go through physiological changes. This affects their appearance and causes a decline in their health [1]. Human bodies get weaker as they age, making them more susceptible to health disorders. This can result in them losing their balance while standing or walking, making them more prone to falling and injury. A monitoring system is a system that is designed to monitor the health of elderly people. With the latest IoT technology, it is possible to monitor their health from anywhere in the world if there is a network connection.

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PROBLEM STATEMENT

The population of elderly people in Malaysia has been increasing over the years. The total population of them has increased from 2.106 million (6.5%) in 2018 to 2.184 million (6.7%) in 2019 [2]. It is projected that by 2030, 15% of Malaysia's population will comprise elderly people above 60 [3]. Due to this, especially for those who live alone at home, it is imperative to develop a monitoring system for them in case of any emergencies.

AIM AND OBJECTIVES

The research aims to improve the healthcare and safety of elderly people alone at home by implementing a monitoring system based on IoT technology in Malaysia.

OBJECTIVES

- To implement an IoT-based monitoring system for elderly people to monitor their health at home.
- To implement a system that detects fire and determines whether the elderly resident has fallen anywhere at home.
- To implement a system that automatically contacts emergency services and close relatives of the elderly resident in case of an emergency.

RESEARCH QUESTIONS

- How IoT-based monitoring systems for elderly people can be implemented to monitor their health at home.
- How the system will detect fire and whether the elderly resident has fallen anywhere at home.
- How the system can automatically contact emergency services and close relatives of the elderly resident in case of emergency.

LITERATURE REVIEW

This section of the research paper reviews past research related to the proposed topic. This is done to gain a better understanding of existing research related to the topic of the proposal. The domains that have been identified and will be reviewed are:

Internet of Things (IoT)

The Internet of Things (IoT) is a network of connected devices such as sensors, network devices, vehicles, *etc.* This network allows these devices to interact and

"talk" to each other without human interaction [4]. IoT has allowed a lot of processes, such as sensing, interacting, and communicating between different devices, to be automated. The devices acquire data from sensors and then decide what to do next based on the system's logic [5]. IoT aims to link things together no matter the time, place, device, or person using any ideal network or service [6].

Monitoring System using IoT

According to [7], an IoT monitoring system allows elderly people to be monitored from their homes. The elderly person can wear wearable sensors that monitor vital signs, which allows continuous tracking of the patient's health. A wireless sensor is placed in the elderly person's home to create a wireless sensor network that can transmit real-time data that doctors can access. According to [1], a monitoring sensor that uses IoT, an accelerometer, will be able to detect if an elderly person has fallen by measuring the gravitational acceleration of the accelerometer. The data from the accelerometer will be evaluated and then transferred to an IoT platform to be monitored. Reference [8] stated that an IoT monitoring system consists of sensors that monitor vital signs and detect falls. In the context of this research, this is the definition of a monitoring system.

Elderly in Malaysia

Reference [9] stated that elderly people in Malaysia refer to people who are 60 years old and above. Reference [10] also supports this statement, saying that the elderly in Malaysia are defined as people 60 years and over. Fifteen percent of the population of Malaysia is expected to be 60 or more by the year 2030. Most elderly people prefer staying at home to moving to a care facility. This is because staying home allows them to maintain independence and feel comfortable and secure in a familiar environment.

Elderly Monitoring System at Home Using IoT Technology in Malaysia

An elderly monitoring system at home using IoT Technology in Malaysia means that this system will combine the use of IoT sensors to create a monitoring system to monitor elderly people in Malaysia that stay at home. The elderly person staying alone at home will wear wearable sensors that monitor vital signs, and the data will be acquired and sent to medical professionals and relatives for monitoring.

Similar Systems

This section will compare similar systems primarily focused on IoT elderly monitoring systems.

CHAPTER 12

IoT-Based Medical Ecosystem

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Abstract: The Internet of Things (IoT) is an evolving technology in the emerging digital transformation domain. The healthcare system is also growing, using IoT to improve human life and save more lives. With the assistance of IoT technology, physicians can easily monitor patients' health conditions in real-time. A cardiac pacemaker is a medical device connected to the IoT environment to improve the efficiency of healthcare. However, low-quality IoT design will bring disadvantages, such as cyber-attacks. Every process of building IoT medical devices should evaluate the product before launching it to the market. Manufacturers or hospitals should organise their critical infrastructure orderly to protect confidential data. The data should achieve the confidentiality, integrity, and availability of the CIA triad, which is the foundation of information security. This paper aims to study the vulnerabilities of IoT medical devices, the methods of possible attacks from hackers, and organisational and operational security to address cyber security in the healthcare industry. Moreover, it proposes a framework for the IoT medical ecosystem between the patient and the hospital to improve the existing IoT medical ecosystem.

Keywords: Attack Vectors, Cyberattack, IoT Medical Ecosystem, IoT, Security Framework.

INTRODUCTION

According to ReportLinker [1], the healthcare IoT market is expected to be $534.3 billion by 2025. The technological revolution causes the Internet of Things (IoT) to advance. One of the solutions to create a smart healthcare model is using IoT as the backbone, connecting the countless online connections to become an integrated system running in real-time. Data collection from IoT devices is meaningful insights to healthcare doctors, physicians, and patients because they can more efficiently track the patient's condition. The patient also understands their daily health condition to balance their lifestyle. IoT devices require embedd-

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ed software to communicate with hardware and human interaction. Creating IoT applications is convenient as it can read the data coming from devices. Even though IoT healthcare brings many benefits to our lifestyles, many challenges still exist.

The data security and the management of IoT devices are the concern of the healthcare executives and Information Technology (IT) team. For example, a pacemaker is a medical device that connects with the Internet, Bluetooth, and cellular to communicate with other devices and places, such as a home monitoring device and smartphone. IoT medical devices assist doctors or physicians in monitoring patients' heart conditions. The cardiac pacemaker has five years of battery life and implants inside the left of the human chest. The cardiac pacemaker will send the information about the patient's heart to the home monitoring device or smartphone. The monitoring device or smartphone aggregates the data and sends it to the hospital system. The hospital system will show the patient's data by providing an analysis for the doctor or physician to determine and plan the upcoming treatment or expected outcome for the patient. The solution is to prevent the patient from having irregular heartbeats, vascular diseases, cardiac arrhythmias, or heart failure. IoT devices are integrated with many devices to form a systematic management system. However, there is an unnoticed issue regarding security vulnerabilities at the application layer; the IoT device can be compromised by unauthorised access. The impact of the security issue will threaten human lives. Washington [2] mentioned that Muddy Water published the vulnerability of cardiac devices and caused the former St. Jude Medical shares to decrease by more than 8%.

BACKGROUND OF ABBOT AND THE IOT MEDICAL

According to Abbott [1], the global medical device company Abbott Laboratories combined with St. Jude Medical in January 2017. The company is an American multinational medical device in health care and supports 160 countries [3]. The company acquired innovative technology to create better equipment to help people in need and bring advanced technology into the healthcare platform.

Fig. (**1**) shows the IoT medical ecosystem from Abbott. One of the IoT medical products of Abbott is the implantable cardiac device. This pacemaker operates for slow heart rhythms, electric shock for the heart, and pacing to terminate dangerously fast heart rhythms. The cardiac pacemaker is inserted under the skin of the upper chest area. The " leads" wires connected to the pacemaker are put in the heart [4]. This cardiac pacemaker technology saves many patients from slow heartbeat (bradycardia) and fast heartbeat (tachycardia) and coordinates the treatment for heart failure. Radio frequency-enabled (RF) technology applies to a

cardiac pacemaker. The pacemaker sends the signal to the transmitter with wireless communication. According to International Organization for Standardization (ISO) [5] indicates that the pacemaker applies 401 to 406 MHz frequency on the electromagnetic compatibility (EMC) standard, ISO 14117:2019 [6]. The transmitter is the home monitor transmitter and receives the RF signals from the cardiac devices. The data is stored in the device for reading. Typically, the transmitter is used at the patient's home. Both IoT medical devices require connecting with the patient's home network to communicate with each other. The network connection needs to be able to reach the Merlin.net Patient Care Network, thus, the patient's data is able to be sent to the physician to monitor and analyse the data. The pacemaker programmer is the external desktop computer used to adjust the cardiac pacemaker, and it is a crucial tool for the doctor. This is because it is essential to download the patient's data stored on the cardiac pacemaker and edit the setting in the pacemaker if necessary. Adjusting the pacemaker programmer can help avoid additional surgery for the patient. The back end of the Merlin.net Patient Care Network (PCN) is the system connected to the web server and the database. Therefore, the physician or doctor can access the server to view the analysis data of the patient. The IoT medical ecosystem server ensures the safety of the patients without the need for additional surgery. This considerably reduces the patients' on-site visits to doctors compared to the past.

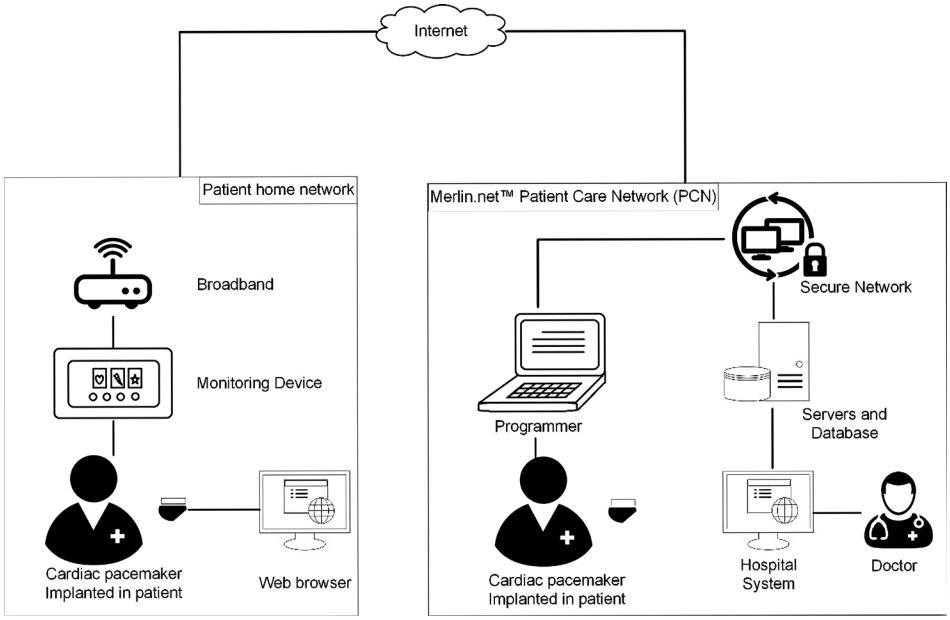

Fig. (1). IoT medical ecosystem from Abbott.

CHAPTER 13

Active Learning-based Mobile Learning System for Students of Asia Pacific University

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Abstract: In recent years, mobile technology has become increasingly more available and advanced, especially in education. Mobile learning technology allows individuals to have online distance learning in COVID-19 by transforming traditional Learning from online Learning to mobile Learning. The implementation of mobile Learning in higher education is essential because it allows students and tutors to stay connected and allows students to access online materials for active Learning at any time. Therefore, this research proposes a mobile learning system integrated with active learning practices for Asia Pacific University students in the learning process. This will give students more positive outcomes such as better academic performances and achievements, increased motivation and attention in studies, increased learning satisfaction in students, and training them to be active learners. This research is conducted using the Quantitative method to the selected participations, and the outcome of this research could contribute to the entire education field in promoting active learning practices to improve academic performance and also provide other researchers with an insight into exploring the mobile learning system into higher education.

Keywords: Active Learning, E-Learning, Learning Management Systems, Mobile Learning, Passive Learning.

INTRODUCTION

Active Learning is a form of learning [1] where students are actively involved in the class, thus obtaining opportunities to develop and explore significant aspects of the courses by being one of the active learning group members or individuals [2]. In this digital era, with the growth and availability of technology, many students prefer online Learning and obtaining online resources [3].

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A problem with online Learning is that the online resources need to be more accurate, and thus they cannot be fully trusted. Therefore, it will be better if students can use a platform that offers opportunities to communicate and discuss any confusion on tasks, assignments, or homework with tutors and friends. The university is generally considered more stressful compared to high- and primary-schools due to the more competitive environment [4]. Active Learning can lower anxiety in students in the learning process based on how it is implemented [5]. Its limitation is that other practices may lead to greater anxiety than active learning practices, which have not been explored [6]. Moreover, mobile technology can play a beneficial role in promoting academic learning [7]. A study says that the implementation of mobile Learning into Higher Education led to a positive effect on the performances and achievements of students [8]. According to [9], the interactivity of mobile apps can result in more favourable outcomes, as mobile interaction can increase motivation and attention in students. Therefore, it is highly recommended to implement a mobile system integrated with the active learning method into Higher Education [10]. However, the hardware available has limitations as students need to use a high specification of mobile phone to enjoy the benefits of this learning method [10, 11]. According to [10], another limitation is data collection, educational information is chosen as the only one of the centres for the study, but the range of collecting data is comprehensive. Therefore, the rate of accurate data collected could have been higher. Asia Pacific University students are chosen as the target of this research to ensure that students can experience mobile-learning integrated with active Learning. In this paper, a mobile-learning system integrated with the active learning method will be proposed to promote the active learning experience so that all the students can benefit from it. Students can use the system to learn extra knowledge which will not be covered in the course materials, such as streaming the curated videos. However, tutors can make online quizzes for students to assess their knowledge. Integrating these active learning methods into the mobile learning system can increase theoretical knowledge and skill scores from using the system.

The rest of the paper is organised as follows. Section 2 will look into works that have been done along with arguments and limitations similar to the proposed ideas. Section 3 will further explain the need for the study by analysing and studying the problem of passive Learning. Section 4 presents the research's aim and the objectives to achieve the aims. Section 5 simplifies the research paper into individual research questions and answers to the research objectives. Section 6 elaborates on the significance of the research towards the field of the study. Section 7 suggests the most suitable methodology to be carried out in the research. Section 8 provides an overview of the proposed system and illustrates the use case and flowchart diagrams for better understanding. Section 9 concludes

the research and raises issues for future research and improvements that could be made.

BACKGROUND

Since the current paper adopts the active learning method in the mobile learning system for Asia Pacific University students, some previous works are briefly reviewed in the Active Learning method and mobile learning.

Active Learning

Active Learning is a form of learning achieved through establishing high engagement between students and tutors rather than keeping a passive learning environment. A previous study by [12] recommended that the learning process should implement the effective learning method concept. According to the findings, it has improved student academic performance, fostered skills development, and increased student satisfaction in the learning process. Its limitation is that the research focuses only on students who use technological equipment to produce skills and knowledge and understand fields to participate in activity lessons [13]. Another study by [5] has stated that students enjoy "doing something" and that a hands-on approach to problem-solving resulted in students understanding better and having reduced anxiety levels. According to the findings, the anxiety level was reduced in students doing group work to solve a problem. Anxiety levels can also be decreased when students who understand the concept explain it to others. Its limitation is focused on the evaluation of situations that are common in active learning courses. Individuals have unique anxiety levels; some consistently have light anxiety levels, whereas others have severe anxiety. Another study by [14] has pointed out that active learning strategies are implemented to promote student engagement, which significantly impacts student learning. According to the findings, implementing active Learning effectively increased students' understanding from 40% to 60% compared to passive learning methods. Its limitation is that the research was done using a poll by the authors, with the involvement of faculty and staff in both the design and teaching of online courses about student engagement [15].

Mobile Learning

Mobile learning is an advanced type of E-learning, which has evolved from distance learning to e-learning, with no time and place limits [16]. Mobile learning enables and improves the ability of learners to access internet information through mobile devices with wireless technology [17]. A previous study by [8] has pointed out that mobile learning can be used in developing a distant-learning system to create extensive communication despite the physical

CHAPTER 14

Analytics on Airline Customer Satisfaction Factors

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Abstract: Dissatisfaction with the services provided causes customer loss and customer churn in airline companies. Analytics conducted in assessing customer satisfaction in airline companies and their analytical methods are reviewed to identify the analysis's strengths, weaknesses, and gaps. Data analytics on assessing customer satisfaction have been conducted on facilities and services provided, price, service quality, reviews of customers, and flight catering. However, this research indicates that only a few in-depth studies consider flight delays as a critical factor influencing customer satisfaction. A flight is considered delayed if it departs or arrives 15 minutes later than the scheduled time. Therefore, in this research, further analytics can be done on the amount of time-of-flight delay in assessing customer satisfaction.

Keywords: Customer satisfaction, Flight delay, Regression analysis, Sentiment analysis.

INTRODUCTION

There has been noticeable customer loss in airline companies due to the dissatisfaction of customers with the services provided [1]. With the pandemic, many airlines are already facing significant losses, so losing their customer base even further is something airlines cannot afford. Decreasing customer loyalty of airline companies affects the business of the airline companies. Customer satisfaction is essential in determining their profitability and sustainable growth. Airline companies have to refine their services to maintain customer loyalty and their competitiveness among competitors. Studies [2] showed that the cost of gaining a new customer is higher than retaining an existing customer. Therefore, it is essential to improve the satisfaction level of the customers in the airline companies to retain the existing customers. Satisfied customers will promote the airline companies to their friends or relatives, which will differentiate the airline's image from its competitors and increase the chance of attracting new customers.

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Therefore, analytics on assessing customer satisfaction are carried out to understand customers' expectations of the services and the facilities provided by the airline companies. It also provides practical insights to airline companies on the critical determinant of customer satisfaction so that they can improve on it to increase their customer satisfaction level.

DATA ANALYTICS ON ASSESSING CUSTOMER SATISFACTION

Many factors influence customer satisfaction in airline companies, including the behaviour of the cabin crew and staff, cleanliness of the aircraft, service quality, and more. Airline companies must pay attention to them because customer satisfaction plays a vital role in developing customer engagement and loyalty [3]. To provide insights to airline companies, analytics have been done on different aspects to assess customer satisfaction, as described below.

Facilities and Services Provided

Most early analytics for assessing customer satisfaction was concerned with the facilities and services provided by the airline companies. The studies conducted by [4] focused on the services used to satisfy the passengers, including pre-flight services, in-flight services, and post-flight services. It showed that in-flight service is the critical determinant of customer satisfaction. The regression analysis has been done on customer relationship management, in-flight services, and cabin environment [5]. Similarly, it also proved that in-flight services significantly affect customer satisfaction. In [6], an analysis was carried out on the facilities provided in the aircraft. It showed that seat comfort, with the highest standardised coefficient of 0.407, is the most dominant factor in customer satisfaction. Therefore, to increase customer satisfaction, airline companies should improve the facilities and the services provided in the aircraft to meet or exceed the expectation of the customers. Customer satisfaction is the appraisal of the customers on the gap between their expectations and experience [7].

Price

In [8], analytics on customer satisfaction in airline companies showed that the price of the flight ticket is a critical factor that affects passenger satisfaction. Recent studies also outlined that price is the most crucial factor influencing customer satisfaction and loyalty to airline companies [9]. It showed that the price variable has the highest estimated values and t-values, as evaluated using the Structural Equation Model (SEM) technique. The flight ticket price is crucial in determining customer satisfaction, especially with the introduction of low-cost carriers, such as AirAsia. If the price is high, the customers will choose other airlines that also provide the same quality of service to them [1].

Besides, price affects customer satisfaction significantly because customers set an expectation of the facilities and services provided by the airline companies based on the price of the flight ticket purchased [10]. Therefore, customers will compare their expectations and experience, rating the airline companies negatively based on the discrepancy between them [11]. When the customers feel that the service does not meet the ticket purchase price, it creates dissatisfaction. Analytics on the price and customer satisfaction helps the airline companies set the price of the flight ticket to be more realistically equivalent to its value, effectively securing customer satisfaction.

Service Quality

Service quality is the ability to meet the needs and requirements of the customers and the extent to which the delivered service matches or exceeds the customers' expectations [12]. In [13], the SERVQUAL model was introduced to measure service quality based on five dimensions: reliability, assurance, tangibles, empathy, and responsiveness. The SERVQUAL model is also known as the RATER model.

According to [14], flight punctuality widely influences customer satisfaction. Airline companies should increase their service quality in terms of reliability by having fewer changes in the flight schedule, increasing customer satisfaction. The study in [6] showed that online flight ticket purchasing affects customer satisfaction the most. Regression analysis was conducted on the service quality in assessing customer satisfaction [15]. The result showed that the customers are most satisfied with the flight ticket reservation system and are least satisfied with the courtesy of the cabin crew. Airline companies must ensure that customers can buy their preferred flight tickets from the online flight booking system and that their personal information is protected. Therefore, the reliability of the service plays a vital role in service quality, which determines the customer satisfaction of airline companies.

In [6], it is mentioned that there is a difference in the need for service quality for the customers of domestic flights and international flights. Service quality in terms of tangibles has to be maintained and improved by the airline companies. Tangibles are the physical facilities, equipment, and personnel [16]. Airline companies must provide in-flight entertainment for long-distance flights so that the customers will not get bored. The traits and quality of the services provided by airline companies affect customer satisfaction and customer loyalty [17]. Airline companies must continuously monitor the service quality and make timely required changes to ensure that high-quality service is provided to satisfy the customers and retain the existing customer base.

CHAPTER 15

A Personalized Recommendation System for Academic Events

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Abstract: Academic events are growing in numbers worldwide annually for researchers to discuss their work. The research on recommendation systems in academic domains has high significance for researchers. The classical approach to the recommender system uses content-based and collaborative filtering that tends to produce poor results. The focus of the study is to determine the factors involving the selection of academic events and create a user-based personalised recommender system for academic events. A survey will be conducted to identify the factors affecting the choice of events. The system will filter the results of the events using a matching matrix by conducting a factor analysis and receiving input to find the most relevant academic events from the database. The study's approach evaluates the result based on the pre-processed data and the similarity measures between a similar user (Top-n) and an active user for events with a higher probability of participation. The weighted average of the neighbour's ratings will be generated for the predictions of the events. The study's outcome will prove that the personalised recommendation system is better than the classical approach in finding the most relevant events. The recommendation system can be optimised in domains.

Keywords: Academic Event, Collaborative Filtering, Factor Analysis, Matching Matrix, Recommender System.

INTRODUCTION

The enormous amount of data in the current information system has been increasing rapidly, resulting in enormous options for users. The problem can be solved using a personalised recommendation system to meet customer needs and demands [1, 2]. The recommendation system is considered a subclass of the information filtering system to reduce the issue of information overload on the Internet [3]. The recommender system can create predictions for the ratings of events that have not been voted for to match the user preference [4, 5]. There are

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three approaches to the design of the recommendation system: collaborative filtering, content-based filtering, and hybrid techniques. The collaborative filtering technique is based on the commonalities of people agreeing in the past, while the content-based filtering is based on similar items that the user has rated. The hybrid system is a combination of both collaborative filtering and content-based filtering. According to Shambour and Lu (2015), popular online companies like Amazon, Netflix, and Last.fm use recommendation systems to service their customers. Netflix provides recommendations based on two filtering techniques: collaborative filtering for previously searched and watched movies of a similar user and content-based filtering for movies with similar characteristics with high ratings.

LITERATURE REVIEW

Academic Events

Academic events are organised for scientific researchers to create opportunities for attendees to share their knowledge and experience in the relevant fields. The academic events are conducted in multiple ways, such as conferences, seminars, workshops, and upskill programs. These events are beneficial for networking [6-8], research collaboration or partnerships [6, 8, 9], job opportunities and career development [6-8], and knowledge transfer [7, 8]. The missed opportunity of going to an unsuitable event will cause time and money wastage. As the students are inexperienced and lack knowledge, they will have trouble selecting the best choice for them according to their current preferences.

The most related tools for academic events are the AllConference, Workshop Finder, and Eventbrite. Functions not found in these tools include user preference and user rating. The user rating is a reliable metric for judging the likes and dislikes of an item [4, 10, 11]. Using linear and ordinal regression, user preference can be converted into a numerical value [11]. These two essential metrics are not found in the tools available for academic events. A recommender system that includes the user rating and contextual information will provide more relevant results for the users. A comparison of the functionality of different tools is provided in Table **1**.

Table 1. Comparison of the functionality of different tools for events.

Function	AllConference	Workshop Finder	Eventbrite
Search by keyword	Yes	No	Yes
User preference	No	No	No
Search by domain	No	Yes	Yes

Function	AllConference	Workshop Finder	Eventbrite
Search by time	Yes	No	No
Search by location	Yes	No	No
User rating	No	No	No
Ranking search result	No	No	Yes
Recommendation for similar event keyword	No	Yes	Yes

Recommender System

The recommender system can solve a vast amount of information by filtering the specific user based on their preference [4, 12]. As the users have different priorities and objectives when choosing academic events, the 2 recommender systems can identify the specific needs and demands of the user. The recommender system can be developed based on a similar user or a list of academic events matching users' context. The recommender system mainly uses three approaches, content-based filtering, collaborative filtering, and hybrid filtering, as shown in Fig. (**1**). The everyday use of recommender systems is found in various sectors like e-commerce, music, hotels, and books [13].

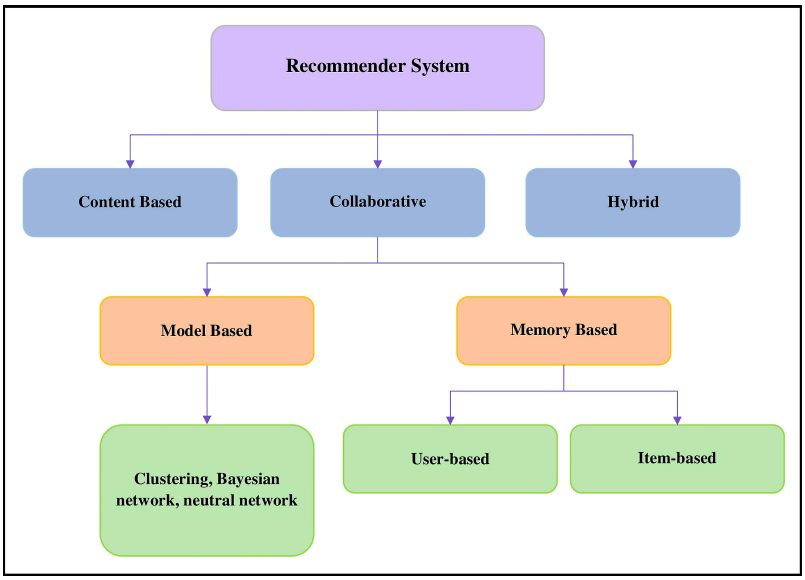

Fig. (1). Different types of recommender systems commonly used.

Content-based filtering is used to make recommendations based on user preferences for product features and characteristics. Collaborative filtering imitates a similar user's request by interest or taste. The disadvantage of using a

CHAPTER 16

e-Health Web Application with Electronic Medical Records (EMR) and Virtual Appointments

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Abstract: Relying on papers to document medical records hinders the United Nations' goal of creating a more sustainable world for future generations. With the excess usage of paper, the world is contributing towards global warming. Medical staff tends to take a long time to pull out a patient's medical record when it can be done in a matter of seconds. Being paperless does not immediately mean it is effective or transparent, as medical providers don't usually share the content of a patient's medical record with the patient itself, let alone a different medical provider. Another issue is the lack of transparency within the healthcare sector. This research focuses on the need for Malaysia to have an e-Health system, preparation and participation towards the e-Health system, and the security of migrating towards the e-Health system.

Keywords: EMR, Healthcare, ICT, Medical Computing, Virtual Appointment.

INTRODUCTION

It is reported that Malaysia is facing a shortage of healthcare workers and providers that has drastically reduced healthcare options for Malaysians over the years [1]. Travelling to appointments on congested roads is also a hassle. TomTom's Traffic Index reveals that drivers in Kuala Lumpur lost seven days and two hours due to traffic in 2019 [2]. Apart from that, there is the issue of overcrowding in hospitals, creating a pressurised situation where it looks like they are inefficient and mismanaged [3]. Malaysia is reported to have a poor track record of transparency in healthcare. An example of this was when a fire erupted in Hospital Sultana Aminah. During the incident, the Ministry of Health could not provide any follow-up information on the cause of damage, loss of records, *etc* [4].

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The current generation lives in an era where information and communication technology (ICT) has become an inevitable force. ICT services and devices have proved to become the present and the future. Be it buying groceries or even a car; you could do all that by browsing through an online platform. Many sectors have matured into accepting that ICT is here to stay and is the tool to move businesses forward. This can be observed by the introduction of Industry 4.0, which focuses on ICT to enhance processes further. The healthcare sector is valued at 11.9 trillion globally [5]. In Malaysia alone, the healthcare sector will be valued at RM127.9 billion by 2027 from RM56.3 billion in 2017 [4]. The healthcare sector is a crucial and lucrative investment option for any country. We have matured in dealing with diseases over time, but diseases have also found ways to adapt and form new variations to challenge us. More research and treatment options are being found, resulting in the masses living longer and being able to deal with more chronic conditions [6]. We have certainly brushed up our capabilities to cure disease, but we still need to improve in keeping track of our medical records, which could be a crucial reference for the future generation. Malaysia's public hospitals and private/public clinics still rely on keeping our medical records in a binder to collect dust; however, this could be changed with the adaptability of EMR. In addition to providing EMR as a preliminary function, the system will also include the capability of running virtual appointments. Due to present challenges such as COVID-19, we are learning to adapt to be present digitally. For example, we rely on virtual communication tools such as Zoom, Google Meet, and Microsoft Teams for several things, such as conducting classes and having meetings. Therefore, it will not be that difficult to use virtual conferencing tools for the healthcare sector.

LITERATURE REVIEW

The literature review looked at the research papers based on the selected domain while investigating similar systems. With the help of published papers, the researchers can gain in-depth knowledge on the selected topics. The medium of collecting data is articles, journals, books, websites, and sources that relate to the domain. It should be done in a professionally documented way, where the research should be able to provide a theoretical base and determine the nature of the study. Apart from acknowledging the work of previous researchers, it can also provide a "landscape overview" for the reader.

Healthcare

The healthcare sector is valued at 11.9 trillion globally [5]. In Malaysia alone, the healthcare sector will be valued at RM127.9 billion by 2027 from RM56.3 billion in 2017 [4]. Medicine has been a lucrative investment for a country to make.

Mediums that may accelerate the growth of the sector are policy, science and technology, regulatory, and social insurance. However, a lack of government coordination and policies will hinder the healthcare sector. The healthcare sector still thrives on being one of the most favoured sectors by analysts and investors [7].

According to a PowerPoint presentation on e-Health by the Ministry of Health, Malaysia is set to become a nation of healthy individuals, focusing primarily on improving the current landscape of the healthcare industry. The current Malaysian healthcare industry is divided into public and private participants. The public is primarily funded by the government, while the private is a profit organisation. The funding sources of the public system are taxes, government funding, individual payments, EPF, and SOSCO. The goal is to provide a wide range of budget services to most domestic and international populations. The private system operates with a fee for the service, where only a segment of the population can afford the service. There are 15 state hospitals, 26 major specialist hospitals, 27 minor specialist hospitals, 10 specialist hospitals, and 66 non-specialist hospitals under Malaysia's public healthcare wing. All this data was gathered through the infographic, as shown in Figs. (**1** and **2**) [8, 9].

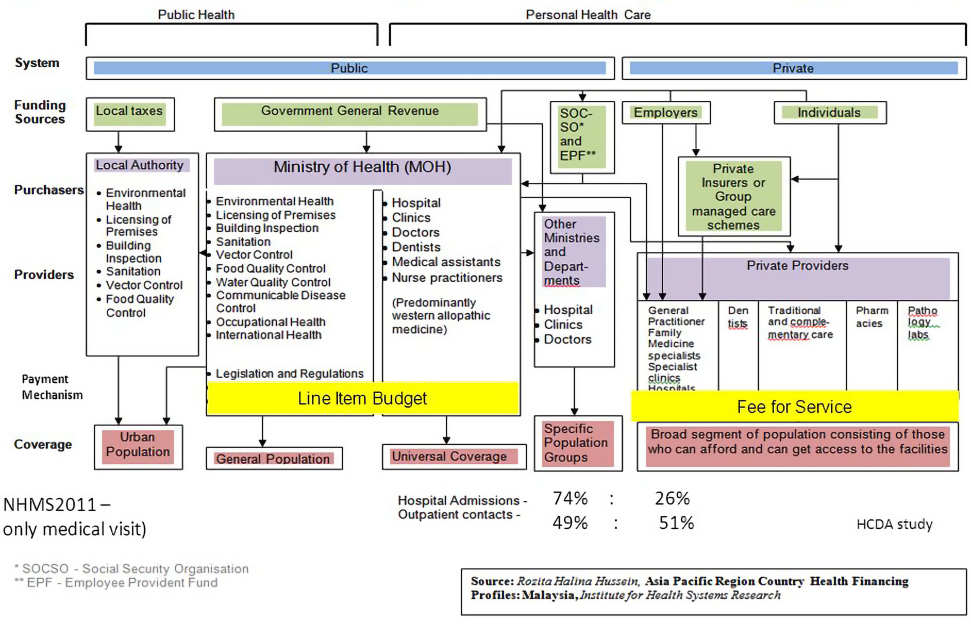

Fig. (1). Malaysia's Current Healthcare System [8].

SUBJECT INDEX

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Prof. Muhammad Ehsan Rana is an associate professor with Ph.D. in software engineering. With a career spanning over 20 years, he has excelled in teaching, research, and academic management. Currently, he serves as an associate professor at the Asia Pacific University of Technology & Innovation (APU), Malaysia. He has authored and co-authored a number of research articles, conference publications, and book chapters, focusing on areas, such as computer architecture, cloud computing, IoT, and blockchain. His expertise and dedication are evident through his involvement as a reviewer for several prestigious indexed journals and his active participation in organizing IEEE and other international conferences. Being an advocate for bridging the gap between academia and industry, Prof. Ehsan has played a crucial role in incorporating industrial collaboration into academic endeavors. Notable collaborations include renowned companies, such as IBM, EMC, Semtech, ARM, Salesforce, CASUGOL, MSTB, MIMOS, among others. Through these collaborations, he has fostered valuable connections and facilitated the integration of real-world industry practices into academic settings.

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Prof. Manoj Jayabalan is a postdoctoral fellow at Liverpool John Moores University, UK, with over 15 years of experience in academia and industry. He holds a Ph.D. in computing from the Asia Pacific University of Technology & Innovation, Malaysia, as well as an MSc in Software Engineering from Staffordshire University, UK, and a B.Eng (Computer Science) from Anna University, India. Manoj is widely recognized for his outstanding contributions in teaching and research. His expertise spans data science, artificial intelligence, machine learning, health informatics, and software engineering, and his work in these areas is highly regarded. He has published over 50 articles in reputable academic journals, conferences, and books, receiving commendation for his research excellence.