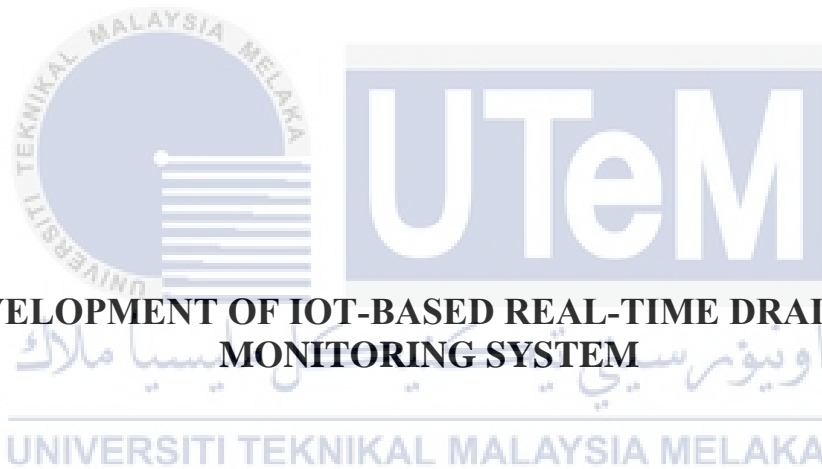




**Faculty of Electrical and Electronic Engineering Technology**



**DEVELOPMENT OF IOT-BASED REAL-TIME DRAINAGE  
MONITORING SYSTEM**

**SHATIISH A/L PANNER SELVAM**

**Bachelor of Electronics Engineering Technology (Telecommunications) with Honours**

**2022**

**DEVELOPMENT OF IOT-BASED REAL-TIME DRAINAGE MONITORING  
SYSTEM**

**SHATIISH A/L PANNER SELVAM**

**A project report submitted  
in partial fulfillment of the requirements for the degree of  
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours**



**Faculty of Electrical and Electronic Engineering Technology**

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MONITORING SYSTEM

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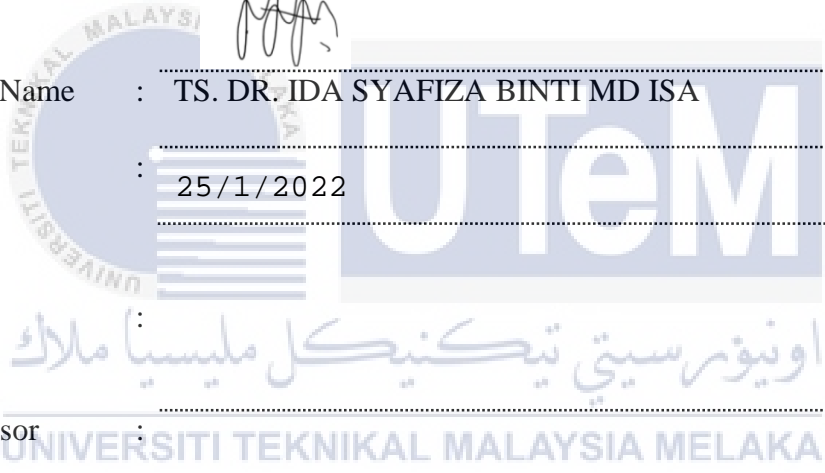
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Name (if any)

Date :

## DEDICATION

*To my beloved mother Mrs.Thuvalarasi a/p Rajoo and my father Panner Selvam a/l Mani, my supportive supervisor Ts. Dr. Ida Syafiza Binti Md Isa, my faithful panels, lecturer of FTKEE, and my friends who strongly supported throughout thick and thin.*



## ABSTRACT

Nowadays, technologies are rapidly advancing in this world, including the type of monitoring system used. In addition, the evolution of the Internet of Things (IoT) has made people's life more convenient and practical where it supports everyone to be connected to any things, and anywhere, via the Internet. It has been reported that the current drainage system in most of the countries is still using manpower which may expose them to many hazards and accidents. Therefore, monitoring the status of the drainage from time to time is very crucial to avoid accidents to happen. Several researchers have focused on developing drainage monitoring systems, however, most of the system are using GSM module to send the monitored data to the control room which introduced latency. Therefore, the purpose of this work is to develop an IoT-based Real-Time Drainage Monitoring System to monitor the drainage system. In this work, the proposed system is designed to detect the depth of the water, the level of gas concentration at the drainage area, and the flow rate of the water flow in the drain using a laser sensor, gas sensor, and flow meter sensor, respectively. Besides, the system is also equipped with a GPS module to locate the location of the monitored area. For monitoring purposes, the system is integrated with the Blynk server application where all of the monitored data including the depth of the water, gas concentration, and the flow rate of water in the drain will be stored in the cloud server via WiFi connection. In addition, a notification will be sent out to the in-charge person if any of the sensors exceed the threshold value. The proposed system has been tested and the results show that the system has high reliability and measured and the actual reading has high accuracy with a margin error of 3%.

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## **ABSTRAK**

Pada masa kini, teknologi berkembang pesat di dunia ini, termasuk jenis sistem pemantauan yang digunakan. Di samping itu, evolusi Internet of Things (IoT) telah menjadikan kehidupan orang lebih mudah dan praktikal di mana ia menyokong semua orang untuk dihubungkan dengan apa sahaja, dan di mana sahaja, melalui Internet. Telah dilaporkan bahawa sistem saluran semasa di kebanyakan negara masih menggunakan tenaga kerja yang dapat mendedahkannya kepada banyak bahaya dan kemalangan. Oleh itu, memantau status saluran dari semasa ke semasa sangat penting untuk mengelakkan kemalangan berlaku. Beberapa penyelidik telah meneliti diri pada pengembangan sistem pemantauan saluran, namun, sebagian besar sistem memiliki beberapa kesalahan seperti penerapan gsm dalam sistem yang memberikan data lambat yang akan mempengaruhi pengiriman data waktu nyata ke ruang kontrol masing-masing. Oleh itu, tujuan kerja ini adalah untuk mengembangkan Sistem Pemantauan Saluran Masa Nyata berasaskan IoT untuk memantau sistem saluran. Dalam ini, sistem yang dicadangkan dirancang untuk mengesan kedalaman air, tingkat kepekatan gas di kawasan saluran, dan kelajuan aliran air di longkang menggunakan sensor laser, sensor gas, dan sensor meter aliran, masing-masing. Selain itu, sistem ini juga dilengkapi dengan modul GPS untuk mencari lokasi kawasan yang dipantau. Untuk tujuan pemantauan, sistem ini disatukan dengan aplikasi pelayan Blynk di mana semua data yang dipantau termasuk kedalaman air, kepekatan gas, dan laju aliran air di longkang akan disimpan di internet melalui sambungan WiFi. Sebagai tambahan, pemberitahuan notifikasi akan dihantar kepada orang yang bertanggungjawab sekiranya ada sensor yang melebihi nilai ambang. Sistem yang dicadangkan telah diuji dan hasilnya menunjukkan bahawa sistem ini mempunyai kebolehpercayaan yang tinggi dan tepat dengan kesalahan margin 3%.

اوتیور سیتی تکنیکل ملیسیا ملاک

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## TABLE OF CONTENTS

	<b>PAGE</b>
<b>DECLARATION</b>	
<b>APPROVAL</b>	
<b>DEDICATIONS</b>	
<b>ABSTRACT</b>	<b>i</b>
<b>ABSTRAK</b>	<b>ii</b>
<b>ACKNOWLEDGEMENTS</b>	<b>iii</b>
<b>TABLE OF CONTENTS</b>	<b>ivv</b>
<b>LIST OF TABLES</b>	<b>vi</b>
<b>LIST OF FIGURES</b>	<b>viii</b>
<b>LIST OF SYMBOLS</b>	<b>x</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xixi</b>
<b>LIST OF APPENDICES</b>	<b>xiii</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Background	1
1.2 Problem Statement	2
1.3 Project Objective	2
1.4 Scope of Project	3
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>4</b>
2.1 Introduction	4
2.2 Concept of IOT	4
2.3 Previous research Projects	7
2.3.1 IoT based Sewage Monitoring System	7
2.3.2 IoT-Enabled Inner Drainage Monitoring System Applying Water Flow Sensor	8
2.3.3 For Human Safety, Smart City Solutions on Drainage, Unused Wells, and Garbage Alerting Systems	9
2.3.4 Autonomous Anti-Clogging Sewerage System using IoT	11
2.3.5 Human Safety System in Drainage, Unused Well and Garbage Alerting System for Smart City	13
2.3.6 Smart Drainage Monitoring System Using IoT	13
2.3.7 Underground Drainage Monitoring system using IOT	15
2.3.8 IoT based Sewage Monitoring and Alert System using Raspberry PI	16
2.3.9 IoT and Zig Bee Smart Drainage System	17
2.3.10 Under Ground Drainage Monitoring System Using IoT	18

2.3.11 Drainage Monitoring System with Smart Sensors	19	
2.3.12 In Real-Time Applications Using IoT, a Smart Sewage Alert System for Workers	20	
2.3.13 ESP 8266 Node MCU Based Weather Monitoring System	21	
2.3.14 IoT Based Underground Drainage Monitoring System	22	
2.3.15 Drainage Overflow Monitoring System using IoT (DOMS)	23	
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	<b>25</b>
3.1	Introduction	25
3.2	Design of the system	25
3.3	Hardware Implementation	26
3.3.1	Node MCU Lua V3 ESP 8266 WiFi	26
3.3.2	MQ5 LPG Natural Gas Sensor	28
3.3.3	GY-NEO6MV2 Flight Control GPS Module	29
3.3.4	TOF10120 range sensor	30
3.3.5	Water Flow Sensor	31
3.4	Software Implementation	32
3.4.1	Arduino IDE	32
3.4.2	Blynk application	33
3.5	Project work Flow Chart	35
<b>CHAPTER 4</b>	<b>RESULTS AND DISCUSSIONS</b>	<b>37</b>
4.1	Introduction	37
4.2	Software Results	37
4.2.1	MQ-5 Gas Sensor	39
4.2.2	TOF10120 range sensor	40
4.2.3	Water flow sensor	41
4.2.4	Flight Control GPS Module sensor	42
4.3	Hardware Development	44
4.3.1	MQ-5 Gas Sensor	44
4.3.2	TOF10120 range sensor	45
4.3.3	Water flow sensor	46
4.4	Project Prototype	47
4.5	Analysis Results	48
4.5.1	MQ-5 Gas Sensor	48
4.5.2	TOF 10120 Range sensor	51
4.5.3	TOF Water flow sensor	53
4.5.4	Flight Control GPS Module sensor	56
<b>CHAPTER 5</b>	<b>CONCLUSION AND RECOMMENDATIONS</b>	<b>57</b>
5.1	Introduction	57
5.2	Conclusion	57
5.3	Recommendation	58
<b>REFERENCES</b>	<b>59</b>	
<b>APPENDICES</b>	<b>61</b>	

## LIST OF TABLES

TABLE	TITLE	PAGE
Table 2. 1	Elements of IoT	5
Table 2. 2	Sensor values were obtained in a stable level condition	10
Table 2. 3	Specification of LPG sensor	13
Table 4. 1	MQ-5 Gas Sensor Output	50
Table 4. 2	Height of water TOF sensor vs Measurement value	52
Table 4. 3	Water flow rate vs the digital output	55



## LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2. 1	IoT based smart applications (Kinza Shafique and Bilal A. Khawaja)	6
Figure 2. 2	IoT offers a cutting-edge technology. (Kinza Shafique and Bilal A. Khawaja).	7
Figure 2. 3	Block diagram depicting Methodology	8
Figure 2. 4	Underground Drainage Monitoring System Block Diagram	9
Figure 2. 5	Block Diagram of the System	10
Figure 2. 6	Block diagram of the complete system is made up of a number of different components.	12
Figure 2. 7	Node MCU Block Diagram	14
Figure 2. 8	Block representation of Server connection	15
Figure 2. 9	Block diagram for the suggested system	16
Figure 2. 10	The system's block diagram	17
Figure 2. 11	Implementation circuit in real-time	17
Figure 2. 12	Architecture diagram of the system	18
Figure 2. 13	Block Diagram of Drainage monitoring module	19
Figure 2. 14	The Proposed Model's Block Diagram	20
Figure 2. 15	Circuit diagram of the input and output block	21
Figure 2. 16	The Overall System Connection Diagram	22
Figure 2. 17	Block Diagram Used in Monitoring system	23
Figure 2. 18	Proposed system architecture	24
Figure 3. 1	Block diagram	26
Figure 3. 2	Pins of Node MCU	27
Figure 3. 3	Node MCU ESP8266	28

Figure 3. 4 Pins of MQ-5 Gas Sensor	28
Figure 3. 5 MQ-5 Gas Sensor	29
Figure 3. 6 GY-NEO6MV2 Flight Control GPS Module	29
Figure 3. 7 Pins TOF10120	30
Figure 3. 8 TOF10120 Module	31
Figure 3. 9 Flow rate sensor	32
Figure 3. 10 Arduino IDE Software	33
Figure 3. 11 Blynk Application	34
Figure 3. 12 Flowchart of final year project implementation	35
Figure 4. 1 Database page for Blynk	38
Figure 4. 2 The MQ-5 sensor's hardware source code	39
Figure 4. 3 The TOF sensor's hardware source code	40
Figure 4. 4 The Water flow sensor's hardware source code	41
Figure 4. 5 Flight Control GPS Module sensor and WIFI source code	42
Figure 4. 6 Flight Control GPS Schematic	42
Figure 4. 7 Schematic diagram of Drainage monitoring system	43
Figure 4. 8 Connection diagram for MQ-5 Gas Sensor	44
Figure 4. 9 Connection diagram for TOF10120 range sensor	45
Figure 4. 10 Connection diagram for Water flow sensor	46
Figure 4. 11 Construction of Real-Time Drainage Monitoring System	47
Figure 4. 12 Gas sensor value when in open space	48
Figure 4. 13 Gas sensor value when in contact with methane gas	49
Figure 4. 14 MQ-5 Gas Sensor Graph Output	50
Figure 4. 15 TOF10120 sensor value when low water level	51
Figure 4. 16 TOF10120 sensor value when high water level	51

Figure 4. 17 Height of water TOF sensor vs Measurement graph output	53
Figure 4. 18 Water flow sensor value when water flow is blocked	53
Figure 4. 19 Water flow sensor value when water flow open	54
Figure 4. 21 GY-NEO6MV2 Flight Control GPS Module	56



## LIST OF SYMBOLS

1. % - Percentage
2. ° - Degree
3. ‘ - Prime
4. “ - Double Prime





## LIST OF ABBREVIATIONS

API - Application Programming Interface  
CMOS - Complementary metal-oxide semiconductor  
CO - Carbon Monoxide  
CPU - Central processing unit  
CRs - Cognitive Radio  
DHT - Digital Temperature and Humidity  
DOMS - Drainage Overflow Monitoring system  
DSP - Digital signal processing  
GND - Ground  
GPS - Global position system  
GSM - Global System for Mobile  
HTTP - Hypertext Transfer Protocol  
IDE - Integrated Development Environment  
IOT - Internet of Things  
LCD - Liquid Crystal Display  
LUA - High-Level Programming Language  
MCU - Micro controller Unit  
NET - Network Enterprise server  
NETPI - Network Analyser  
NFV - Network Function Virtualization  
PIC - Peripheral Interface Controller  
PPM – Parts Per Million  
RF - Radio frequency  
RFID - Radio-frequency identification  
SD-WSN - Software Defined Wireless sensor network  
SPAD - Single Photon Avalanche Diodes  
SPI - Serial Peripheral Interface  
TCP/IP - Transmission Control Protocol/ Internet Protocol  
TOF - Time-of-Flight  
UART - Universal Asynchronous receiver-transmitter  
VCC - Voltage Common collector  
VNC - Virtual network computing

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A:	Gantt Chart 1 of PSM 1	61
Appendix B:	Gantt Chart 2 of PSM 2	62



# CHAPTER 1

## INTRODUCTION

### 1.1 Background

The Internet of Things (IoT) is a combination of sensors, software, and other technologies embedded in objects that connect and exchange data with other devices over the internet. A study in [1] said that by applying intelligence in everyday objects, they turned into smart devices and can be controlled from anywhere in the world. Many IoT-based systems has been developed for monitoring purposes which include home automation system, remote health monitoring system and emergency notifications for medical and healthcare systems, agriculture monitoring system that can control the water pump anywhere and environmental monitoring. However, it has been reported that, currently, the drainage system in most of the countries is still using manpower for cleaning and managing purposes [1]. Hence, the workers are exposed to hazardous gaseous around the drainage area which may lead to underground workers' death. Therefore, monitoring the real-time condition of the drainage system is very crucial to avoid any accident. In this work, an IoT-based real-time drainage monitoring system has been developed using an Arduino microcontroller with the aim to monitor the depth of the water, the gas concentration, and flow rate of the water in the drainage system. The real-time monitored data will be sent to the cloud via WiFi using the Blynk application. Also, the proposed system is equipped with a GPS module to locate the location of the monitored drainage area and a notification message will be sent out to the in-charge person when an emergency is detected i.e. sensor detected value that exceeds the threshold.

## 1.2 Problem Statement

A flood is a disaster caused due to a clogged drainage system [2]. Recently, it has been reported that the flash flood that happened in Kuala Lumpur, is due to the poor service maintenance of the drains and irrigation canals. The poor service maintenance of the drains and irrigation canals has resulted in the exposure of toxic gases due to the decomposition of organic household or industrial waste. In addition, the flash flood also leads to a rise in mosquitoes, a foul odor, etc. Therefore, the development of a smart drainage monitoring system is important to prevent flooding. Many researchers have focused on developing the drainage monitoring system. However through the previous research, certain disadvantages can be found which require human interaction at times to obtain the results from the system, data recorded is not in real-time, and limited sensors. Therefore the proposed project overcomes the disadvantages of the existed project and will be a reliable device to assist the challenged workers.

## 1.3 Project Objective

The objectives of this work are as follows:

- a) To develop an IoT-based real-time drainage monitoring system, to monitor the depth of the water, the level of gas concentration, and the flow rate of the water for blockage detection in the drain using Arduino.
- b) To develop a data logging system to record real-time monitored data for monitoring purposes.
- c) To evaluate the performance of the developed prototype in terms of its reliability and accuracy compared to the measured value.

## 1.4 Scope of Project

The scope of the projects prioritizes the detection of the water flow rate, the depth of water level, and the presence of gas concentration through using a portable device that can produce real-time data using the presence of IoT. The proposed system is targeted to be used as one of the smart cities applications where wireless internet connection is unlimited. Since the project is focusing on flow rate, using water flow sensors helps to calculate the volume of water flowing through the system.

The project also focuses on monitoring the gas concentration value in parts per million(ppm) at the drainage environment therefore a Gas Sensor is MQ-5 sensor is also added to the system for monitoring purposes. Since the MQ-5 gas sensor has a high sensitivity to Methane, Propane is a suitable sensor for the current environment. The TOF10120 sensor is a range module camera system that measures the round trip traveled by the light produced to determine the distance between the camera and the subject for each point of the image with time-flight techniques. Through the laser sensor, the data being recorded is the height water level. A GPS is added to this project so that it gives flexibility for the respective authority to detect the location of the system. Each GPS satellite sends a signal to the GPS receiver. The satellites transmit the same time at which the signals are sent. All the information mentioned above is sent to the Blynk server application through wifi for recording purposes in real-time. The data recorded from the server is being recorded every 5 minutes interval time and tabulated to get an average reading.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

In this part chapter, thorough literature research has been conducted based on the previous works to better understand the research problem being studied. A detailed discussion has been done and analyzed on the relationships of each work obtained from various authors that are relevant to this project.

#### 2.2 Concept of IOT

According to the IoT agenda, Kevin Ashton of Procter & Gamble created the term "Internet of Things.". Through his founding of radio frequency identification (RFID) where this would allow computed to manage a person's belongings. Back then the minimum goal of IoT is the installation of short-range mobile transceivers into a variety of common items and to provide new forms of communication between humans and machines. A study has been conducted to support this claim by [1] to introduce the Internet of Things (IoT) as a wide cultural phenomenon. Their paper also recommends two techniques for developing new business models based on IoT and concludes with a discussion of how far the future of IoT can be anticipated. The elements of IoT can be represented in Table 1.1 below.

Table 2. 1 Elements of IoT

Technological Aspects	Hardware	Wireless devices (such as computers, smartphones, RFID tags, and wireless sensors) are used to connect physical objects to the Internet of Things (IoT) and enable communication across the network.
	Software	Built software applications to input value in a certain groups of customers and utilities for an end to end IoT user applications
	Networking	Different networking technologies allow us connecting from one point to another point through the internet and satellite communication.
	Intergrated manifesto	A cloud-based, integrated platform that allows interaction and easy compatibility between multiple hardware, software, and networking aspects.
	Quality	Operational guidelines require the design of emerging Iot components and ensure their compatibility.
	Data	Data created in real-time by IoT nodes that are constantly broadcasting their properties through the network (for example, a temperature sensor transmitting room temperature).
Physical environment	Human objects	Humans experiencing with the IoT wireless devices such as smartphones, health sensors, etc.
	Objects	Cars, parcels, and animals are examples of physical objects that can interact and share through a network.
	Surrounding environment	Humans and physical space can communicate with one another, such as at a vehicle park with an integrated RFID card reader.
Socio-economic	Customers	Specific IoT applications, such as smart home systems, target individual consumers or companies.

	Department of Organization	The organisations in charged of developing, publishing, and enforcing IoTrelated regulations.
	Associations of companies	Companies that are responsible setting standards and guidelines that facilitate IoT.
	Consumer privacy groups	Protecting customers from security and privacy problems as a result of IoT applications and similar technologies
	Entrepreneurs	Intelectual business person engaging in entrepreneurship and intrapreneurship using IoT.

Based on research done by [2] says that their paper presents the Internet of Things, including statistical and architectural trends, application cases, problems, and future possibilities The author also gives an overview of the developing 5G-IoT framework. Some of the IoT technologies are SD-WSN, NFV, and smart radios are all examples of software-defined wireless sensor networking (CRs). The authors say that IoT offers many business and carrier opportunities. Figures 2.1 and 2.2 below briefly describe the future of IoT.

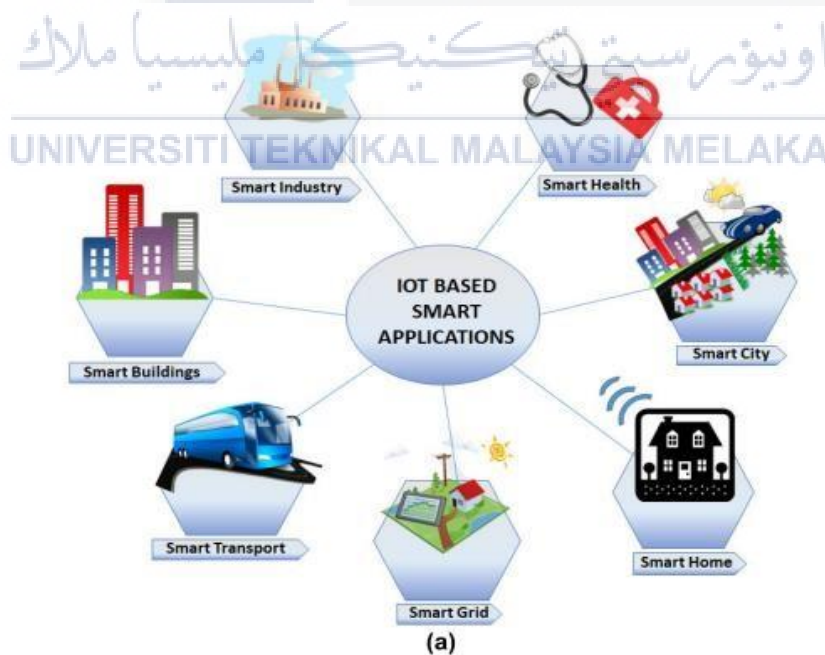


Figure 2. 1 IoT based smart applications (Kinza Shafique and Bilal A. Khawaja)