



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF SECURITY SYSTEM BY USING
MOTION SENSOR POWERED BY RADIO FREQUENCY
(RF) ENERGY HARVESTING**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

by

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**Tajuk: DEVELOPMENT OF SECURITY SYSTEM BY USING MOTION
SENSOR POWERED BY RADIO FREQUENCY (RF) ENERGY HARVESTING**

Sesi Pengajian: 2019

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of (Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

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ABSTARCT

Motion sensor is used to detect any presence of movement in order to detect crime. One of the objectives in this project is to develop the security system by using motion sensor powered by the RF energy harvesting. The development and implementation of security system is presented for the Bachelor Degree Final Year Project. This project is introducing a current and latest update technology in the world which is RF energy harvesting. RF energy harvesting is an alternative to power up the operations of motion sensor, by converting the RF energy to DC power. RF energy is obtaining from ambient surrounding which transmitted by billions of radio transmitter and telecommunications medium around the globe such as wireless internet, mobile phone, base station, broadcasting station, WiFi and a Radio Frequency transmitter. RF energy is an alternative of energy which can last for a long time as long as Radio Frequency signal is present in the surrounding. PIC microcontroller is used in this project as it is easier to program the coding and a low power sensor. This project gives benefit to community needs as it improves the quality of security in the house for a long time operation without any hesitation to change batteries frequently and it can improve to cut down on electrical bills since motion sensor is operated by the RF signal.

ABSTRAK

Gerakan sensor digunakan untuk mengesan sebarang kehadiran pergerakan dalam mengesan jenayah. Salah satu objektif untuk projek ini adalah untuk membangunkan sekuriti system menggunakan gerakan sensor yang diberi kuasa oleh RF penuaian tenaga. Pembangunan dan implementasi daripada projek ini akan dibentangkan dalam Projek Tahun Akhir Sarjana Muda. Projek ini memperkenalkan teknologi terbaru dalam dunia iaitu RF penuaian tenaga. RF penuaian tenaga adalah alternatif untuk memberi kuasa kepada cahaya automatic gerakan sensor dengan menukarkan isyarat RF kepada kuasa DC. Tenaga RF didapati daripada ambient sekeliling yang dihantar daripada billions transmitter radio dan telekomunikasi perantaraan seluruh dunia seperti internet tanpa wayar, telefon bimbit, stesen pangkalan, stesen penyiaran, WiFi dan Radio frekuensi transmitter. Tenaga RF adalah alternatif tenaga yang tahan lama pada jangka masa yang panjang selagi kehadiran Radio Frekuensi itu wujud di persekitaran. PIC mikropengawal digunakan di dalam projek ini kerana mudah untuk membuat pengekodan dan mampu untuk operasikan sensor PIR. Projek ini beri kebaikan kepada keperluan komuniti kerana ia menambah baik kualiti sekuriti di rumah untuk jangka masa panjang tanpa ragu-ragu untuk menukar batteri selalu dan ia juga menambah baik dengan mengurangkan bil elektrik setelah gerakan sensor beroperasi menggunakan isyarat RF.

DEDICATION

Special dedicate to my parents,

Zamzam Bin Hj Kassim and Halimah Binti Hj Mamat,

for support and raising me become who I am today.

To my beloved Supervisor and friends,

For give support and helping me in order to finish this thesis.

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TABLE OF CONTENTS

PAGE	
TABLE OF CONTENTS	viii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF APPENDICES	xvii
LIST OF SYMBOLS	xviii
LIST OF ABBREVIATIONS	xix
CHAPTER 1 INTRODUCTION	
1.1 Background	1
1.2 Problem Statement	4
1.3 Objectives	4
1.4 Scope	5
1.5 Summary	6
CHAPTER 2 LITERATURE REVIEW	1
2.1 Overview	7
2.2 Previous Systems and Existing Technologies for Motion Sensor	7
2.3 Matrix table related previous researches regarding the Motion Sensor	14
2.4 Previous Systems and Existing Technologies for RF Energy Harvesting	17
2.5 Matrix table related previous researches regarding the RF E-H	25
2.6 Previous System and Existing Technologies for GSM	30

2.7	Matrix Table related previous researches regarding the GSM.	33
2.8	Comparison between Types of Motion Sensors	36
2.9	Comparison between Types of Renewable Technologies	39
2.10	Comparison of GSM with other Technology	40
2.11	Electronic Hardware	42
2.11.1	Overview	42
2.11.2	Microcontroller	43
2.11.3	PIC 18F4550 Microcontroller	44
2.12	PIR sensor	45
2.13	Lifetime Power Energy Harvesting Development Kit	43
2.14	3.7V LiPO Battery	46
2.15	Charging Board	47
2.16	GSM Mobile Phone	48
2.17	Relay	49
CHAPTER 3 METHODOLOGY		50
3.1	Overview	50
3.2	Gantt Chart PSM 1 and PSM 2	51
3.3	Flowchart of the project	53
	3.3.1 Flowchart for overall project	54
	3.3.1 Flowchart of Radio Frequency Energy Harvesting	55
	3.3.3 Flowchart of Motion Sensor	56
3.4	Explanation methodology of the process	57

3.5	Block Diagram	59
3.5.1	Block Diagram of the Overall Process	60
3.5.2	Block Diagram of RF Energy Harvesting	60
3.5.3	Block Diagram of Motion Sensor Automatic Bulb	60
3.5.4	Block Diagram of Motion Sensor Based on GSM Mobile	60
3.6	Conclusion	61

CHAPTER 4 RESULT AND DISCUSSION

4.1	Introduction	62
4.2	Software Implementation of RF Energy Harvesting	63
4.3	Hardware Implementation of RF Energy Harvesting	64
4.4	Result and Analysis Performance of RF Energy Harvesting	66
4.4.1	Amount of received signal by using different types of antenna	67
4.4.2	Discharging and Charging the LiPO battery by using RF Received Signal	69
4.4.3	Performance of RF Received Signal in LOS and NLOS	73
4.4.3	Application of Radio Frequency Received Signal in load (LED)	74
4.5	Schematic Implementation on Motion Sensor for Automatic Light Bulb	76
4.6	Hardware Implementation on Motion Sensor for Automatic Light Bulb	77
4.7	Program Code of Motion Sensor for Automatic Light Bulb	78
4.8	Result on Motion Sensor for Automatic Light Bulb	81
4.9	Analysis Performance of Motion Sensor for Automatic Light Bulb	82
4.10	Hardware Implementation Motion Sensor based on GSM Mobile Phone	85

4.11	Result on Motion sensor based on GSM Mobile Phone	86
4.12	Analysis Performance on Motion Sensor based on GSM Mobile Phone	87
4.13	Discussion	89
4.14	Limitation	91

CHAPTER 5 CONCLUSION AND FUTURE WORKS

5.1	Introduction	92
5.2	Conclusion	93
5.3	Future Recommendation	93

REFERENCES 94

APPENDIX 99

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1:	Comparison criteria of several sensors.	37
Table 2.2:	Comparison of energy harvesting sources	39
Table 2.3:	Comparison between telecommunication technology	40
Table 2.4 :	Features of PIC18F4550 Microcontroller	43
Table 2.5:	Comparison between 8051, AVR and PIC microcontroller	44
Table 2.5:	Description item inside the kit	43
Table 3.2.1:	Project Plans for Bachelor Degree Project PSM 1	51
Table 3.2.2:	Project Plans for Bachelor Degree Project PSM 2	52
Table 4.1:	Value of Radio Frequency transmitted Vs Voltage and Current	63
Table 4.2:	Distance between RF energy harvesting circuit with Radio Frequency Transmitter and voltage of the received signal	67
Table 4.3:	Discharging the LiPO battery using Load	70
Table 4.4:	Charging the LiPO battery using RF received signal	72
Table 4.5:	Received RF Signal in LOS and NLOS	73
Table 4.6:	Motion Sensor Detection Range	83
Table 4.7:	Motion Sensor Detection Range	87
Table 4.8:	Duration of the Mobile Network Services to Send a Call	88

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1:	PIR sensor module enclosed by Fresnel lens	8
Figure 2.2:	Block diagram of hardware implementation setup	10
Figure 2.3:	shows proposed system architecture	11
Figure 2.4:	PIR motion sensor operation	12
Figure 2.5	shows the location of the PIR sensor, door sensor and the web camera	13
Figure 2.6:	Block diagram of an RF power harvesting system	17
Figure 2.7:	EH-WSN test setup	20
Figure 2.8:	Block diagram of RF energy harvesting device	21
Figure 2.9:	Network architecture of RF powered cognitive radio networks	23
Figure 2.10:	Prototype device with area measurement in downtown Tokyo	24
Figure 2.11:	Block diagram of the project proposed	32
Figure 2.12:	Range evolution to the transmission frequency	41
Figure 2.13:	Pin Diagram of PIC18F4550	42
Figure 2.14:	Illustration PIC 18F4550 microcontroller	42
Figure 2.15:	PIR sensor	45
Figure 2.16:	Pin definition and variable resistor	45
Figure 2.17:	Lifetime Power® Energy Harvesting Development Kit	46
Figure 2.18:	Rechargeable LIPO 3.7 V Battery	47
Figure 2.19:	Charging Board	47

Figure 2.20: GSM 2G Mobile Phone	48
Figure 2.21: Relay	49
Figure 3.1: Block diagram of overall project	59
Figure 3.2: Block diagram of RF Energy Harvesting	60
Figure 3.3 shows the block diagram Motion Sensor Automatic Bulb	60
Figure 3.4: Block diagram of second stage security system	61
Figure 4.1: Simulation Result of Radio Frequency Energy Harvesting	62
Figure 4.2: Hardware Development on Radio Frequency Energy Harvesting with directional antenna	64
Figure 4.3: Hardware Development on Radio Frequency Energy Harvesting with Omni directional antenna	64
Figure 4.4: Hardware Development on Radio Frequency E-H without antenna	65
Figure 4.5: Radio Frequency Transmitter by Powercast	65
Figure 4.6: Graph of Distance between RF energy harvesting circuit with the Radio Frequency Transmitter (cm) and voltage of received signal (V).	68
Figure 4.7: The Charging board emitted bright light	70
Figure 4.8: Graph of discharging the LiPO battery by using Load(V)	71
Figure 4.9: Graph of duration of LiPO battery to charge (minutes) by using RF Received Signal (V)	73
Figure 4.10: RF Energy Harvesting Circuit with Load (LED)	75
Figure 4.11: Schematic Design of Motion Sensor for Automatic Light Bulb by using Fritzing	76
Figure 4.12: Hardware Development on Motion Sensor for Automatic Light Bulb	77
Figure 4.13: Start page of the MICROCHIP software.	78

Figure 4.14: Choose debug Program which is the PICkit3	78
Figure 4.15: Source Code of the program	79
Figure 4.16: Program success built	80
Figure 4.17: The bulb lights up when motion presence in the outdoor area (prototype)	81
Figure 4.18: The bulb not light up when motion absence in the outdoor area(prototype)	81
Figure 4.19: Setup Project of Motion Sensor for Automatic Light Bulb	82
Figure 4.20: Project Set Up for Detection Range of Motion Sensor	83
Figure 4.21: Delay duration of the motion sensor.	84
Figure 4.22: Duration of the Automatic Bulb Motion Sensor will light up	84
Figure 4.23: Motion sensor connected with the key speed dial of the GSM Mobile.	85
Figure 4.24: GSM mobile phone sending an alarm call to user after door triggered based on Prototype	86
Figure 4.25: Delay of the Sensor for GSM Mobile	88

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Example Appendix	99

LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
l	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

PCA	Principal Component Analysis
RF	Radio Frequency
BSC	Base Station
SWIPT	Simultaneous Wireless Information and Power Transfer
WPT	Wireless Power Transfer
PIR	Passive Infrared
EH	Energy Harvesting
GSM	Global Communication Mobile
LiPO	Lithium Polymer Battery
2G	Second Generation

CHAPTER 1

INTRODUCTION

This chapter will provide brief explanation of the Motion Sensor that powered by RF Energy Harvesting. Besides, it also covers the background, problem statement, objective, scope, project significance and summary.

1.1 Background

Motion sensor is a type of home security to detect crime. According to the article published by “World Of Buzz”, Malaysia’s ranks number one in South East Asia and number 15 in worldwide for highest crime rate. This issue is serious as some of the crime activity turns up to rape or sexual abuse that will affect the mental and physical health of the victim. According to “Star Online” on May 2017, there is a rape and robbery incident occur in Bandar Kinrara. Unluckily, the two suspects who doing this crime activity success to disappear and the police still cannot identify the suspects. This is due to lack of security technology. Thus, PIR motion sensor is one of the essential weapons for home or building security. Besides, motion sensor is a user friendly technology as it affordable in price and low power consumption.

A little, ease and inexpensive remote sensor hub is essential for omnipresent detecting. In any case, the requirement for as often as possible supplanting its battery has dependably been an issue, which has restricted its utilization of (Wireless Sensor Networks) WSNs. Energy harvesting is one of the strategic ways used to resolve of this

issue. There are several type of energy harvestings in the market, the common energy harvesting known as solar. However, solar power emphatically depends on the presence of sunlight and so difficult to scavenge energy during the night time or in darkness surrounding as the supply amount of the harvested energy rely on the weather. Thus, in favor of to trigger the sensor node during the night time, it is compulsory to be implemented with the rechargeable or backup batteries. These rechargeable or backup batteries need an extra recharging circuits which are normally costly.

In context of energy harvesting, the most ideal technique is to use permanently and long lasting working or activation from the sources of energy. Thus, we decide on using an ambient RF field as an energy source to power up the wireless sensor hub. Latest technology is the development of RF to DC converter to power up low power electrical or electronics devices. This latest technology is first stage develop by the USA scientist and engineers who realize to conserve energy. The utilization of this energy as a main of power supply will not just lessen the battery substitution cost, yet in addition empower a long-lasting activity in WSNs.

Every year, there are more 120.000 new base transceiver stations or base transceiver station around the globe. This number of growths of the wireless networking outcomes in a way to boosts of the Radio Frequency (RF) power in the pattern of electromagnetic waves in the surroundings. However, just a little value of RF source is utilized for this transmission in the communication field and the remaining is squandered by dispersal of warmth or retention in different forms of materials. The abundance of RF energy may be implemented as a renewable energy. In addition, RF energy scavenging system which power-driven from the surrounding can be “recycled” or used by the various ultra-low

power electronics equipment and devices as a power supply. The electrical power enhanced via RF energy harvesting system is commonly small hence. Thus, rely on this technique, it is likely to supply only Ultra Low Power devices in a stable system.

In this project, RF energy harvesting will powered all the operation of the PIR motion sensor. There are two stage of security system that implement in this project which is outdoor referred as first stage while indoor referred as the second stage. For the first stage of security system, bulbs will situate in outdoor which means in gate or the car porch. When the PIR motion sensor detects infrared radiation emitted or transmitted from an object, it will trigger the bulb to ON mode. Thus, if this sensor situated in the front gate at home, it will catch the attention or awareness of the owner of the house since the bulb is ON which means there is someone in front at their house. If the owner of the house feels conscious or suspicious of the presence of the person as it looks like a burglar, the owner of the house can take an action to call the police to take further actions.

Next, a second stage of security system is placed in indoor of the house to detect any burglars or thefts which enter the main door. Once the PIR sensor that powered by the RF Energy Harvesting detect motion of infrared radiation, it will trigger the speed dial key of the GSM phone and called the preference number that have being set by the owner of the house. The preference number which means it can refer to the number of the owner house, police station or the guard house. Once the Alarm Call is dialled the preference number, the owner of the house can take an early action to call to police to make a report. This second stage of security system is very convenient, low cost and practical to implement. This stage also is very important to implement during the owner