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**

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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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Supervisor : Win Adiyansyah Indra

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 lost lasting for a long time as long as Radio Frequency signal is presence 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 improves to cut down on electrical bills since motion sensor is operated by the RF signal.

ABSTRAK

Gerakan sensor digunakan untuk mengesan sebarang kehadiran pergerakkan 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 kehairan 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 baikkan kualiti sekuriti di rumah untuk jangka masa panjang tanpa ragu-ragu untuk menukar batteri selalu dan ia juga menambah baikkan dengan mengurangkan bil elektrik setelah gerakan sensor beroperasi mengunakan 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.

May Allah Bless Us.

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
1	-	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