UNIVERSITI TEKNIKAL MALAYSIA MELAKA

INTELLIGENT IMAGE CAPTURING ALARM SYSTEM TO PROTECT YOUR LOCKER USING RASPBERRY PI

This report submitted in accordance with requirement of the Universiti Teknikal
Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology
(Bachelor of Electronic Engineering Technology)
(Industrial Electronic) (Hons.)

by

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DECLARATION

I hereby, declared this report entitled "Intelligent Image Capturing Alarm System To Protect Your Locker Using Raspberry Pi" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial
fulfillment of the requirements for the degree of
Bachelor of Electronic Engineering Technology (Industrial Electronic) with Honours.
The member of the supervisory is as follow:

………………………………

(En. Ir. Nik Azran Bin Abdul Hadi)

ABSTRAK

Pada masa kini, sektor perniagaan teknologi pengawasan muncul untuk menawarkan sistem amaran yang mahal serta tidak fleksibel. Sistem pengawasan rumah merupakan bahagian yang penting dalam gaya hidup hari ini. Salah satu fungsi utamanya adalah untuk membasmi aktiviti menyalahi undang-undang. Selain kebiasaan yang berkembang dengan produktif, sistem pengawasan rumah , melaksanakan sistem amaran masa nyata yang penting untuk pengguna. Dalam projek yang dicadangkan, sistem penggera menangkap imej untuk melindungi peti simpanan selamat menggunakan Raspberry Pi 2 dibangunkan. Di sini, Raspberry Pi digunakan sebagai pengawal utama (server). (PIR) sensor inframerah pasif digunakan untuk mengesan penceroboh apabila pencerobohan berlaku. Ia melaksanakan kapasitinya dengan mengukur perubahan sinaran inframerah dalam bidang perspektifnya. Pada ketika itu, apabila mana-mana pencerobohan dikenalpasti berlaku, webcam yang dipasang bersama Raspberry Pi 2 akan menangkap gambar penceroboh tersebut. Pada masa yang sama, lampu rumah yang diwakili oleh LED yang akan bertukar "ON" bersama bunyi penggera dari buzzer yang ditetapkan sebagai keluaran (output). Akhirnya , pengguna akan mendapatkan (e-mel) amaran elektronik dengan gambar yang ditangkap sebagai lampiran. Demikian itu, pengguna boleh mengesahkan e-mel yang diterima dan membuat langkah yang cepat dengan melaporkan pencerobohan itu kepada pihak berkuasa. Secara kesimpulannya, sistem penggera pengawasan ini menawarkan sistem yang murah dan mudah untuk digunakan.

ABSTRACT

As of late, the business sector of surveillance technology appears to offer costly and inflexible alert system. Home surveillance system assumes an essential part in this present day living style to help recognizing illegal activities. In addition to the expanding familiarity with productive home surveillance system, the execution of real-time alert system is vital for users. In the proposed project, an intelligent image capturing alarm system to protect locker using Raspberry Pi 2 is developed. Raspberry Pi 2 is used as the main controller (server). A Passive Infrared (PIR) sensor is utilized to detect the intruder when an intrusion occurs. It performs its capacity by measuring the changes of infrared radiation in its perspective field. At the point when any conceivable intrusion is identified, a webcam installed to Raspberry Pi 2 will capture the picture of the intruder. In the meantime, the spotlight or light of the house which represented by an LED will be turn "ON" alongside an alarm sound from a buzzer which is fixed as an output. Finally, the user will then get an electronic (email) warning with the caught picture as an attachment. Along these lines the user can confirm the received email and make quick move by reporting the occasion to the authorized party. Taking everything into account, this improvement offers reasonable and easy to use surveillance alarm system.

DEDICATION

Dedicated to my beloved parents,Subramaniam Salamah ,

and my family members

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

A/D	-	Analog to Digital
AC	-	Alternating Current
App	-	Application
AVR	-	Aboriginal Voices Radio
CMOS	-	Complementary Metal-Oxide Semiconductor
CSI	-	Camera Serial Interface
DC	-	Direct Current
DSI	-	Display Serial Interface
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
FAT32	-	File Allocation Table
Fps	-	Frames per second
FWT	-	Fixed Wireless Terminal
GND	-	Ground
GPIO	-	General-purpose input/output
GSM	-	Global System for Mobile communications
HD	-	High Definition
HDMI	-	High-definition multimedia interface
I/O	-	Input Output
IC	-	Integrated Circuit
INT	-	Interrupt
Kb	-	Kilobytes
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCU	-	Microcontroller
MHZ	-	Mega Hertz
Nm	-	nanometer
OS	-	Operating system
OUT	-	Output

PC	-	Personal Computer
PIC	-	Peripheral Interface Controller
PIR	-	Passive Infrared Radiation
RAM	-	Random Access Memory
RF	-	Radio Frequency
RM	-	Ringgit Malaysia
SD	-	Secure Digital
Sftp	-	Secure File Transfer Protocol
SMS	-	Short Messaging Service
SMTP	-	Simple Mail Transfer Protocol
SRAM	-	Static Random-Access Memory
SSH	-	Secure SHell
SSL	-	Secure Sockets Layer
µA	-	MicroAmpere
uF	-	MicroFarad
USB	-	Universal Serial Bus
UVC	-	USB video device class
V	-	Voltage

CHAPTER 1
INTRODUCTION

1.0   Introduction

This section consists of the project background, problem statements, objectives, the work scope, and thesis outline.

1.1   Project Background

In present days, the system of home security turns into an indispensable issue with the expanding cases of home breaking or thievery cases. Moreover, the system of home surveillance is essential since the house owner wants to screen their home's circumstances by identifying any undesirable and illegal activity (Nguyen et al. 2013). Years ago, the traditional home surveillance systems have obtained much demand. As time passes, the technology of traditional home surveillance systems has evolved and offers many exciting benefits to the user. These improvements have conquered the weakness of traditional security systems such as power loss caused by the turning on and turning off the process (Hidayat & Firmanda 2015).

Home surveillance security system is a smart method for controlling and observing at home by utilizing information technology. Thus, this security system additionally gives a helpful, adaptable and secured environment that improves life quality (Hidayat & Firmanda 2015). Hence, the internet services have become more familiar with these devices and services which are being used to control the recent home surveillance security system.

Additional to the rising recognition of a proficient home security system, the utilization of continuous alert service is essential for the users (May 2012). Therefore, this project is developed using an Raspberry Pi 2 based image capturing alarm system. The intruder is detected using passive infrared (PIR) sensor's infrared (IR) radiation. The changes in radiation field are checked by the sensor. At the point when an intrusion happens, the presence of an intruder will be detected by the developed system and an image of an intruder will be captured simultaneously. From there on, an email will be sent to the user with the captured image as an attachment. Meanwhile, an LED will be turned on simultaneously in this developed system. The LED will be a replacement for house lamp due to the high cost of the lamp. Not only that, this system will also trigger an alarm sound to alert the house owner or surround people using a buzzer. As a conclude, the system will assist the house owner to make a report to authorized party with the intruder's image as an evidence.

In this era of technology, exploration towards a product that costs reasonable price and capable of solving ideas is increasing. A small embedded microcontroller with a flexible platform utilization of the hardware projects is known as the Raspberry Pi. The Raspberry Pi 2 crosses off both criteria (Qianqian Yang et al. 2015). Raspberry Pi is a card-sized minicomputer that can either operate on mains or battery power. It has Linux as its operating system.

1.2   Problem Statement

As house break-in cases increasingly rapidly, there is multiple intelligent home security system that is being developed with many necessary features (Kenny Chieng Tze Hing et al. 2012). One of the fundamental reasons that bring about the increase in the rate of this case is the failure in intruder confirmations (Poorani et al. 2010). In fact, these failures lead to prolonged crimes. A smart alarm system is developed in this project to be installed in the locker to overcome the intruder confirmation issues. The project works in a way that when an object's movement or action passes through infrared radiation and blocks it. Therefore, the movement will

be automatically detected by the motion detector thus the image of the moving object will be captured using the camera module installed. As a result, the snapped picture will be sent to the user or the house owner via email as an attachment. In respect to that, the proposed project will manage to capture an image upon detecting intruder's motion. Furthermore, a quick move to make a report to the authorized party with the intruder's image as an evidence can be made.

Besides that, an increase in locker break-in cases can occur due to the owner and the authorized party's late action or movement. Owner's lack of awareness of the unwanted incidents may cause this incident to occur often. Therefore, the system is developed to produce an alarm sound to alert surround people. Not only that, a notification will be sent via email to notify the owner that an intrusion had occurred in the house.

This project introduces a new technique by using Linux system software development with a USB camera (UVC compatible) attached together to it (Weerachai et al. 2011). The locker security system proposes a proper system that is convenient for the user to access. Besides that, some theft happens over and over due to lack of evidence. Hereby, the proposed project will give us enough evidence on the thief and makes it easier to make a report to the authorized party.

1.3   Objectives

The objectives of the project are:

  i.   To reduce the locker break-in cases.
 ii.   To alert the owner on possible locker intrusion .
iii.   To develop a notification system for the user via email notification with picture as an attachment.

1.4   Work Scope

There are advancement and coordination of numerous hardware and software with a specific end goal to accomplish the project objectives. The proposed project mainly focuses on a locker security system that will capture an image once the intruder is detected, as the work scope. The python language is used to program the Raspberry Pi 2 which acts as a server in this project. Other than that, a camera module and PIR sensor also been programmed using Python language to perform its desired function since it is attached to the Raspberry Pi 2. The PIR sensor is utilized to recognize any movement of the human or intruder to be specific. Then, those movements will be captured by the camera module. Since notification via email is included, a configuration is made to the Raspberry Pi 2 to install the SMTP library. The software and hardware components developed are integrated together. Finally, the analysis and verification are conducted to the system performance.

1.5   Thesis Outline

In this thesis, there three sections, namely chapters 1, chapter 2, and chapter 3. The project background, problem statements, objectives, and also the work scope are explained in chapter 1.

Chapter 2 consists of a literature review. The past researches by senior undergraduates and different researchers on the available home and locker security system on the market as of now will be discussed here.

In chapter 3, the methodology and flow of the project are done. Thus, the study on programming and equipment development of the undertaking and the project administration are talked about.

CHAPTER 2
LITERATURE REVIEW

2.0   Introduction

This part of the report focuses on the past studies on a couple of vital keys related to the proposed project. Additionally a study on different projects that have been conducted by different researchers on the advancement of locker security system and also the availability in the current market (Khera & Verma 2014). The purpose of this chapter is to get valuable information, a general knowledge, and skills to develop this project successfully.

2.1   Home Surveillance Security System

Recently, the necessity of home surveillance security system is turning out to be extremely important and it is oftentimes utilized in the house or residence, business firms, offices, and also for traffic monitoring systems (Munoz-Ferreras et al. 2008). The purpose of home surveillance security system is essentially used to screen the activities, behavior or other changes in information in order to manage or protect personal belongings. These days, this surveillance system is being installed at home to monitor and avoid any unwanted activities to occur (Nguyen et al. 2013). Thus, the owner can quickly take necessary actions in case of any aggravations (Hariprakash et al. 2008).

2.2   Related Research

The proposed project was produced subsequent to directing some looks into to various researches that have been conducted by senior undergraduates. By examining the elements and the system design of the existing projects, recognizing their weakness or disadvantages will help to reach the objectives.

2.2.1   Research on the Wireless Sensor Network for Motion Detection

In this project, researcher has developed a system using Atmel ATMega 644PV as the fundamental microcontroller, a movement sensor, and the XBee radio frequency (RF) wireless module transceiver in order to build the sensor node. On the other hand, the XBee RF wireless module transceiver, MAX232 chip, and the RS232 serial port are used to make the end node (Hou et al. 2008). Figure 2.1 shows the block diagram of the sensor node and Figure 2.2 end node respectively.
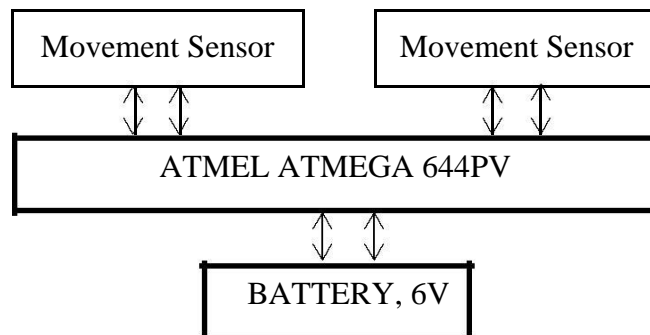
Figure 2.1   Sensor node block diagram

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┌─────────────────────────────────────────────┐
│              Computer Interface               │
└─────────────────────────────────────────────┘
                      ↕
┌──────────────────┐          ┌──────────────────┐
│     MAX232       │ ←──────→ │   XBee Module    │
└──────────────────┘          └──────────────────┘
          ↕
┌──────────────────┐
│      RS 232      │
└──────────────────┘
```
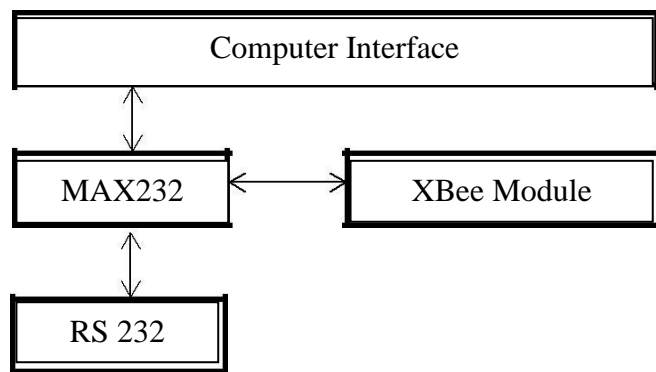
Figure 2.2   End node block diagram

Researcher has used the XBee module as a junction to communication the sensor node and the end node to form a system topology. Based on the study, this system has a weakness where users will not have an evidence of the intruder since no image will be captured during an intrusion. Hence, the disadvantage to verify the intruder occurs in this system. As a result, the users will not get any sort of alert if they have left the house. This system can't guarantee whether the alarm truly showed the intruder.

2.2.2   Research on Wireless Sensor Node for Detection of Intruders

An improvement made referring to the Intelligent Home Security Surveillance System Based on ZigBee project (Hou et al. 2008). Based on the survey made, this project differs by adding a camera to the sensor node. The camera used is the C328R complementary metal-oxide semiconductor (CMOS). Otherwise, the sensor and end node's microcontroller and components are the same. Figure 2.3 shows how the sensor node is set up.
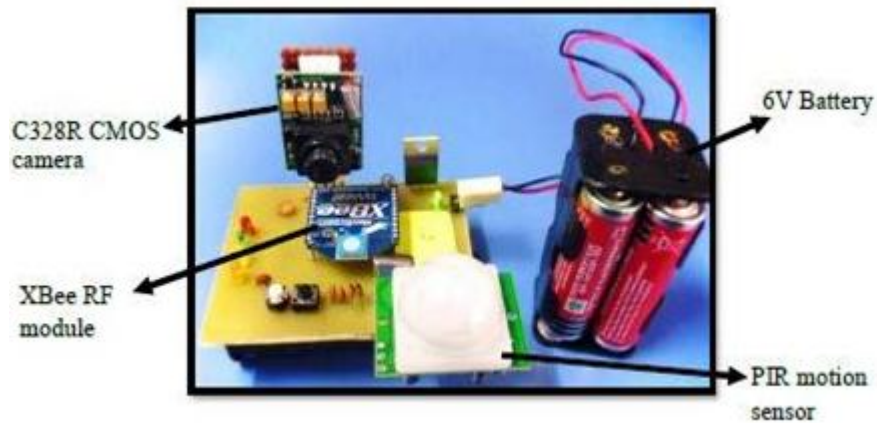
Figure 2.3   Sensor node setup.

This project was improved by catching the picture of the intruder after a movement or motion is detected. After that, the picture will be sent to the base station. At the same time, a Short Message Service (SMS) will be generated and send to the remote user to alert on the intrusion. In order to use low-cost components, the C328R (CMOS) camera is used. Figure 2.4 shows the C328R CMOS camera used in this project.
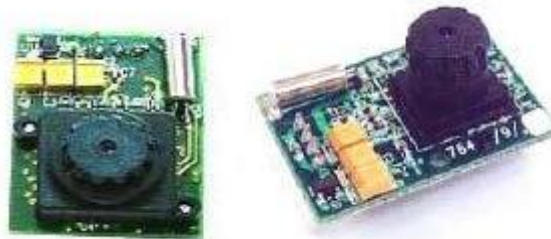

Figure 2.4   C328R (CMOS) camera

As this project develops an SMS notification system, the major disadvantage is the users cannot quickly view the captured image via SMS. This negative feedback may lead to increase in crime rate.

2.2.3 Research on Home Alert Security System using ZigBee Technology

The microcontroller (PIC 18F4550) and XBee module were used in this research. The XBee module consists of two parts called the 802.15.4 RF transceiver and ZigBee protocol stack. The microcontroller acts as the main controller or server in this development. The coding is programmed as per desired functions (Ahmad et al. 2011). Figure 2.3 shows the XBee module used in this research.
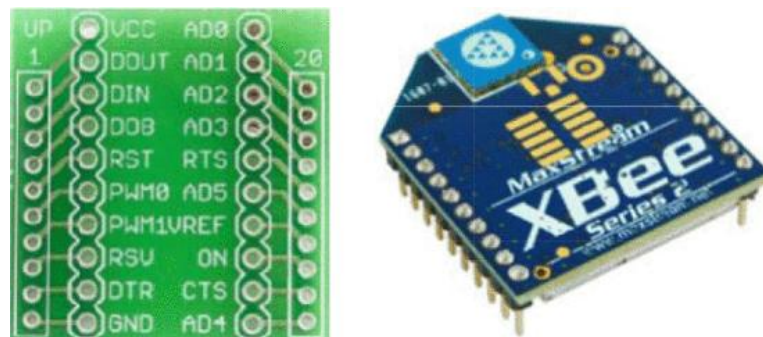

Figure 2.5 XBee Module (S2)

Besides that, in order to alert the surrounding people when the user experienced any inconveniences, this project is developed accordingly but with cheaper rates. This system works in a way that when the user presses the push button to look for a help, an alarm sound will be triggered from a buzzer and a liquid crystal display (LCD) will display user's residential numbers at the monitor to seek people's attention.