POLITEKNIK SEBERANG PERAI

ALARM SYSTEM USING GPS AND ARDUINO UNO

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CERTIFICATE

Here we declare that this report is based on our own work with the help of information from sources that are told in confession. We also declare the result of our project were produced by any other students as well as from other institutions.

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ABSTRACT

Nowadays, individuals are very concerned about safety. They feel that the environment today is no longer safe because of an increases in crime rates. Many people have installed security systems in their homes. There are a lot of security system had been used and the technology used is always up-to-date according to the latest invasions. Home security is essential for part for a safe home. This project aims in developing a low-cost and intelligent security system using passive IR sensor. Arduino UNO board which act as a microcontroller unit receives continuous data from PIR sensor and processes them. The Arduino will trigger an alarm and alert messages will be sent to user's mobile via GSM in case of untoward situations. (PIR) detectors take advantage of pyro-electricity to detect a human body that is a constant source of infrared radiation. The main objective is to give a protection for house by helping users to aware about intruders and to be notify through a Short Message Service (SMS) if there any invasion. Hence the device serves the purpose of safety and protection.

Abstrak

Mutakhir ini, setiap individu amat menitikberatkan soal keselamtan. Mereka meraskan bahawa persekitaran pada hari ini sudah tidak lagi selamat disebabkan peningkatan kadar jenayah. Ramai pihak yang telah memasang system keselamatan di rumah masing-masing. Terdapat pelbagai jenis system keselamatan yang telah menggunakan teknologi terkini mengikut kepada penemuan teknologi baharu. Sistem keselamatn rumah adalah sangat penting kepada sebuah rumah yang selamat. Tujuan projek ini adalah membina satu system keselamatn yang berkos rendah dan pintar menggunakan sensor pasif IR. Arduino UNO bertindak sebagai unit mikropengawal yang menerima data secara berterusan daripada sensor PIR dan memproses data tersebut. Arduino UNO akan menghidupkan penggera dan satu mesej peringatan akan dihantar kepada telefon bimbit pengguna melalui sistem GSM. Pengesan PIR mengesan elektrik-pyro pada tubuh manusia yang merupakan sumber tetap radiasi infrared. Objektif utama adalah untuk memberi perlindungan kepada rumah dengan membantu pengguna peka tentang penceroboh melalui pemberitahuan melalui sistem khidmat peasanan ringkas (SMS) jika terdapat sebarang pencerobohan. Oleh itu peranti ini memain peranan sebagai salah satu medium keselamatan dan perlindungan.

CONTENT

CHAPTER 1

- INTRODUCTION -

1.1 INTRODUCTORY CHAPTER

These days with increasing risk of new ways of burglary safety and security of any living or working place is one of the most primary concerns. These forces the security system manufacturers to use modern technology have enhanced safety as well as security. Peoples living in agitated and uncomfortable because they are concerned about their safety especially residential area. Thus a cost-effective and fast-reactive security system is needed. So, there are a lot of invasion and solution founded to overcome this problem such as installation of security alarm at home. CCTV surveillance which is major part of security systems are very costly and many of these systems do not trigger any alarm if intrusion is detected. Therefore, we are trying to upgrade the existing security alarm into new form by using the latest technology with is a combination of motion sensor and mobile phone.

To build this project, we used PIR sensor and mobile phone in our project. This PIR sensor can detect human presence or motion within a range of 7 meters and alarm will active. At the same time it will deliver a simple message to your mobile phone just to inform you that someone try to invading your home.

1.2 PROBLEM STATEMENT

There are a lot type of security system with using various method. But some of them are not really practical and there are few weaknesses detected. We have heard about the use of the PIR sensor in the safety system. User have right to know that someone is trying to encroach on their place. They also need to be notify if presence strangers in their place during their absence. The people around should be notice that there are cases of aggression nearby, so they can take action to solve it while the owner is not around.

1.3 OBJECTIVE

Our main objective are :

1. To build a security system that is more practical than others
2. To help users detect intruders in their home
3. To notify user about presence strangers in their place during their absence
4. To ensure safety of users is at an optimum level

1.4 RESEARCH QUESTION

The research questions are :

i. Whether the use of the PIR sensor in the security system is adequate?

ii. How the user able to know that someone is trying to encroach on their place?

iii. How to awaken those around that there is a case of aggression nearby?

iv. If there are any ways or method on how to connect PIR sensor and GSM?

1.5 SCOPE AND LIMITATION OF PROJECT

Each project has their own scope, limitation and weakness. Our project scope is the alarm system that we build just for installation at home or small business premise. This mean that our scope only for small scale place. The technology we use are not suitable if we apply it at huge place like shopping mall or office.

Next, the motion sensor with is PIR Module can detect human presence or motion within a range of 7 meters. This show that if the subject are not standing in range of 7 meters, our security system can't be activated. So, improvement works are needed to solve this problem. Last but not least, our project is just for prototype only. Our security system can only be use in Asian country only. It is because our GSM module SIM900A only compatible with Asian country only. This is because SIM900A is a dual band GSM modem being able to operate only in 900, 1800 MHz bands with is only suitable with Asian country only.

1.6 IMPORTANCE AND IMPACT PROJECT

This project are really important to ensure our safety because the purpose of this project is to protect our home from any disruption. So we can avoid from any problem such as loss of property and any accident that affect our lives.

We predict that our project can give a huge impact for security alarm system industries. Through the project we build, we can assume that our project can be accepted by public and will be a perfect choice for home security alarm system.

CHAPTER 2

- LITERATURE RESEARCH -

2.1 INTRODUCTORY CHAPTER

Burglary rate in Malaysia is at an alarming stage lately. Malaysia's crime index recorded a 4.6 per cent increase between January and April this year due to an increase in property crimes. Federal police Crime Prevention and Community Safety Department director Datuk Acryl Sani Abdullah Sani said a total of 38,877 crimes involving properties were recorded in the first quarter of the year. Roughly, it means that about 58 per cent of property crimes were committed. Since the start of the year, 12,216 motorcycle thefts, 6,662 house break ins and 3,656 cases involving cars, were recorded. (New Straits Times by Hani Shamira Shahrudin - 7 May 2016 @ 5:06 PM)

Studies show home security system installation is more effective steps to overcome this problem. There are various types of sophisticated security systems and powerful on the market. These systems are constantly being upgraded day by the day by using newer technology and more sophisticated. An increasingly sophisticated security system is, the price become more expensive. This led to low-income groups hard to get it. A low-cost security technologies need to be developed to meet the demands of this group.

2.2 CONCEPT/THEORY

Basically, our project is about security system but in form of easiest way. We try to combine existing technology by using PIR sensor, Arduino UNO and GSM module sim 900A. We also try to design a security system that can detect invader that will generate alarm and at the same time it will send a simple message to the owner. In order to implement this project, we are struggling to find a way to create a security system with the lowest cost. So everyone is affordable to have it.

2.3 LITERATURE REVIEW

PIR sensor will detect any motion that consist IR wave in range of 7 meter. When it detect any movement, it will produce an output to Arduino. Arduino will analyse the output from PIR sensor and it will decide to switch on the buzzer and at the same time GPS module will active. GPS will transmit data to user in simple message just to inform that there are something not right happen in their house. The buzzer will keep running as long as it can detect any motion and will only stop when the motion stop.

2.4 PREVIOUS RESEARCH

The following are some examples of products that have been using the same technology as the technology used in our project :

1. **New Anti-Theft PIR Sensor** alarm systems security home Send Alarm to TOPVICO alarm IP cameras or alarm host.

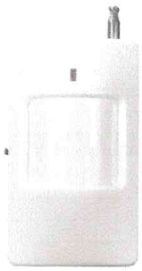

Figure 2.4.1 New Anti-Theft PIR device

Features :

-Mini size

-Simple to operate and easy to install

-Wireless PIR Alarm detector

-Perfect to protect your shop, office, home, car or anywhere requiring protection

-Intelligent Wireless Alarm with handsome and decent appearance

-Economical and practical

-Alarm with ON/OFF switch, and easy operation

-360 degrees bract for ceiling or wall mount for easy installation

Specifications :

-Price : RM 55.33

-Housing: Plastics

-Alarm protocol: international RF 433 protocol

-Alarm mode: Send Alarm to TOPVICO alarm IP cameras or alarm host-

-Detective Distance: 4m

-Detective Range: Horizontal 110 degrees, Vertical 60 degrees

-Transmission Distance: About 30m with one barrier

-1×9V battery (include)

-Battery Life Time: About 12 months

-Size: 104x42x45mm

-Colour: White

How to use :

-Install battery

-Turn on the alarm, 10 to 15 seconds will ready for alarm

-Learn code with TOPVICO alarm IP cameras or alarm host

-When detect PIR, will Send Alarm to TOPVICO alarm IP cameras or alarm host

2. **Wireless GSM Alarm System** - Sends you an SMS when triggered. 1 x PIR, 1 x Gap detector.

Figure 2.4.2 Wireless GSM Alarm System device

Supports GSM cell phone, sends message when triggered, stores five phone numbers, can take up to 6 wireless and 3 wired detectors, Long distance to arm/disarm/listen in, password operated, . Suitable for House, Office, factory ect.

Features :

-Price : RM 56.46

-Starter Kit, Easy Self Installation

-Alarm system uses GSM communicator, no distance limits to receiving alarms or dial in to control the alarm system.

-Stores and dials 5 phone numbers (16 character each).

-If alarm occurs, numbers will be dialled in sequence.

-Using remote control, user can activate the alarm to arm, disarm or panic to a distances up to 80 meters line of sight.

-User can control the system and activate functions by using a telephone or cell phone anytime, wherever you are.

-For security reasons a PIN code must be used to access system.

-Additional wireless sensors, such as PIR detectors, door (gap) sensors, gas sensors, smoke sensors, panic buttons and infrared balusters can be added.

-Suitable for cottage, house, shop, garage.

From two example products above, we can conclude that it hard to find security system device that combine two technologies features with is PIR sensor and GSM module. If any product as are referred, it's definitely costly products. Based on this situation, we decide to make project that use Arduino to combine both of that features with the lowest cost.

2.5 BRIEF INTRODUCTION OF THE PROJECT PROPOSED WORK

Our project consists combination of three main electronic component likes PIR sensor, Arduino UNO and Global System for Mobile Communications (GSM). Each component play a different function.

➢ PIR SENSOR

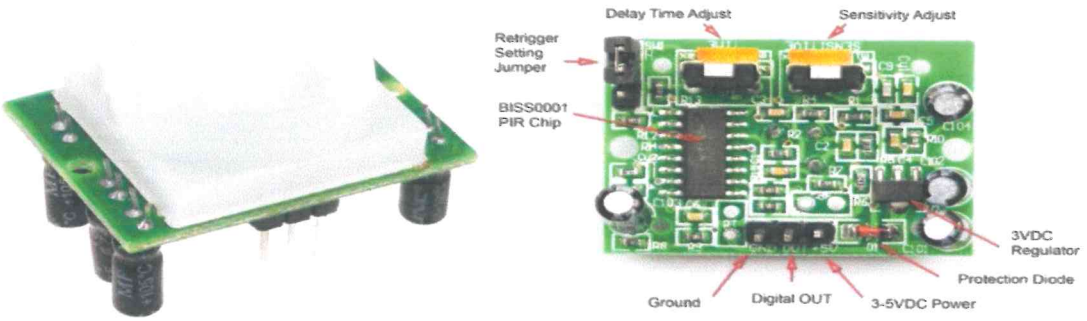

Figure 2.5.1 Standard PIR sensor

PIR (passive infrared) sensors are widely applied in wireless residential security systems, home alarms systems and many more security circuits as motion detector sensors. A typical PIR sensor detects the infrared red (IR) waves from human body and so it is also known as 'human sensor'.

Operating principles :

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy

given off by other objects. PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object.

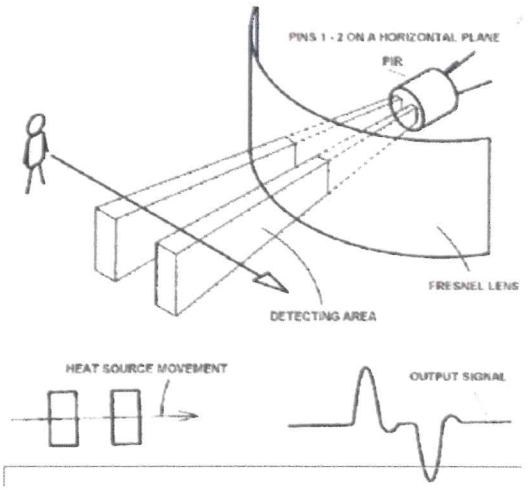

Figure 2.5.2 PIR sensor range detection

Construction :

Infrared radiation enters through the front of the sensor, known as the 'sensor face'. At the core of a PIR sensor is a solid state sensor or set of sensors, made from pyroelectric materials—materials which generate energy when exposed to heat. Typically, the sensors are approximately 1/4 inch square (40 mm2), and take the form of a thin film. Materials commonly used in PIR sensors include gallium nitride (GaN), caesium nitrate (CsNO3), polyvinyl fluorides, derivatives of phenylpyridine, and cobalt phthalocyanine. The sensor is often manufactured as part of an integrated circuit. A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector".

Operation :

An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well.

PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available—typically designed to mount on a ceiling. Some larger PIRs are made with single segment mirrors and can sense changes in infrared energy over one hundred feet away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow "curtain" coverage, or with individually selectable segments to "shape" the coverage.

Differential detection :

Pairs of sensor elements may be wired as opposite inputs to a differential amplifier. In such a configuration, the PIR measurements cancel each other so that the average temperature of the field of view is removed from the electrical signal; an increase of IR energy across the entire sensor is self-cancelling and will not trigger the device. This allows the device to resist false indications of change in the event of being exposed to brief flashes of light or field-wide illumination. (Continuous high energy exposure may still be able to saturate the sensor materials and render the sensor unable to register further information.) At the same time, this differential arrangement minimizes common-mode interference, allowing the device to resist triggering due to nearby electric fields. However, a differential pair of sensors cannot measure temperature in . this configuration, and therefore is only useful for motion detection.

➢ ARDUINO UNO

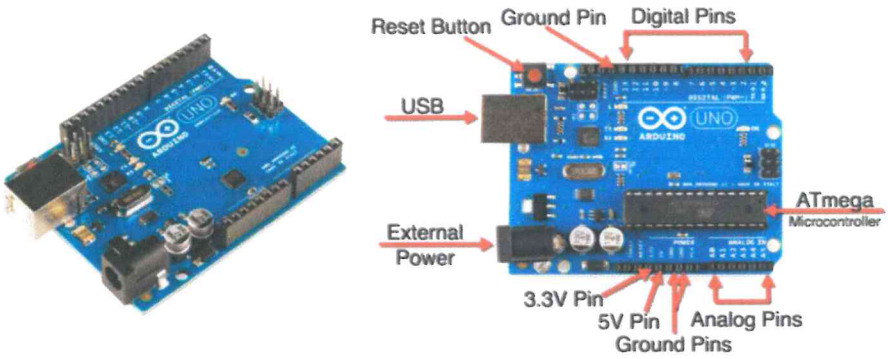

Figure 2.5.3 Standard Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a

reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. We can tell our board what to do by sending a set of instructions to the microcontroller on the board. To do so we use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Why we use Arduino?

Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than RM100.

- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

- **Open source and extensible hardware** - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

There are many type of Arduino. In this project, we use arduino UNO. "UNO" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

Table 2.5.1 - Arduino Microcontroller

Microcontroller	Atmega328
Architecture	AVR
Operating voltage	5V
Flash memory	32KB which 0.5KB by bootloader
SRAM	2KB
Clock speed	16MHz
Analog I/O pins	6
EEPROM	1KB
DC current per I/O pins	40mA on I/P pins; 50mA on 3, 3V pin

Table 2.5.2 – General specification

Input voltage	7-12V
Digital I/O pins	20 (of wich-6 provide PWM output)
PWM Output	6
PCB size	53.4×68.6mm
Weight	25g
Product code	A000066(TH); A000073(SMD)

➢ GSM SIM900A MODULE

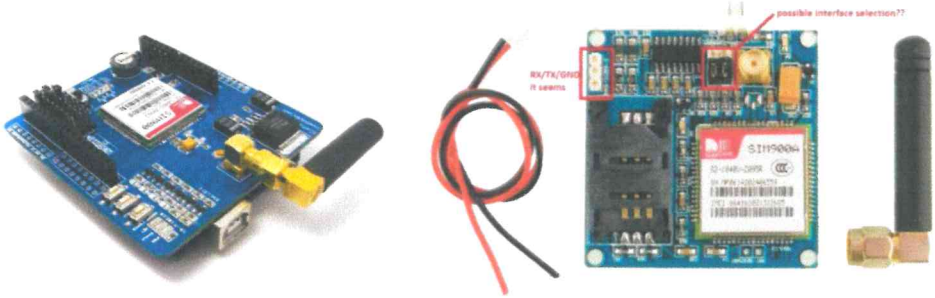

Figure 2.5.4 Standard GSM module

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment.

Features :

- Quad-Band 850/ 900/ 1800/ 1900 MHz
- Dual-Band 900/ 1900 MHz
- GPRS multi-slot class 10/8GPRS mobile station class B
- Compliant to GSM phase 2/2+Class 4 (2 W @850/ 900 MHz)
- Class 1 (1 W @ 1800/1900MHz)
- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- Low power consumption: 1.5mA(sleep mode)
- Operation temperature: -40°C to +85 °C

Table 2.5.3 - Electrical characteristics

Parameter	**Min.**	**Typical**	**Max.**	**Unit**
Power voltage (Vsupply)	4.5		5.5	VDC
Input voltage VH	0.7VCC		5.5	V
Input voltage VL	-0.3	0	0.3VCC	V
Current consumption (pulse)			2000	mA
Current consumption (continuous)			500	mA
Baud rate				Bps