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WIRELESS BURGLAR ALARM SYSTEM PROGRESS REPORT

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ABBREVIATIONS

VHF	Very High Frequency
LED	Light Emitting Diode

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STRUCTURE OF THE PROGRESS REPORT

Chapter 1: Introduction

In this chapter, states the aims and objectives of the project and the explanation of problem solving.

Chapter 2: Literature Review

In this chapter, it presents numerous types of burglar alarm systems on the market and investigates them to increase ideas and find a way out in improving them.

Chapter 3: Software Description

This chapter involves two types of software used in designing the entire project; this will be discussed in depth. Furthermore, a comparison of possible packages available which can be used instead.

1. INTRODUCTION

Through the expansion of the social order and the standard of living it has driven the high-level of crimes, particularly home raid and business premises robberies which happens daily. Definitely fencing, burglar bars on doors and windows are now distant from the necessity of home security, other than that these systems should be switched with well modernised and brainy alarm system.

These modernised systems can stop the criminal activity before it take course, it could track and observe the line of attack of criminal. The project of wireless burglar alarm system can continuously be upgraded as the technology changes frequently and ideas are of developments are always pop up daily. Therefore, there are many ideas and designs on the market now.

This project requires more time to test and evaluate the system, as an associate design engineer there is always problems arises when designing such types of system i.e. it is the duty of an engineer to solve the problem by debugging circuitry and programming perfectly to a degree of accuracy.

1.1. BRIEF

Why is security important? Home or business premises security is undeniably important in the current world. Whether you are away or inside your property, the common question is, is your property safe?

The security matter is not regulated to homeowners; it is widely emphasis in order to protect your property against potential break-in. The time has been changed drastically in the recent years, home and business security is an important factor that we should take into consideration nowadays. Those simple locks which have been on the market traditionally are no longer useful as the time pass on, in order to keep your premises secure you only need a proper alarm system which cannot be tampered easily. A simple wireless burglar alarm system is the solution for twenty four seven monitoring, all needed is a simple technology then the rest you live up to it.

Additionally, the foremost dynamics to consider especially when ordering these systems are reliability and cost effectiveness in the system. The costs of a system determine the

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effectiveness of the item. The wireless applications are compelling top on the market especially mobile security systems and wireless technology has demonstrated the benefit.

1.2 AIMS

The main purpose in this project is to produce a working design which is reliable and effective wireless burglar alarm system based on microcontrollers. The other issue to be concerned with is the price of the system, it should meet average working class people. This project aims to discover many possibilities of enhancing home and business security and a broad research undertaken from existing designs, though the main focus is features of the system that can be adapted which is user friendly. The research of many alarms in the market that performs different tasks at an affordable cost is to be carried. The delivery of quality at a relatively cheaper cost should be the motivating strength of this design project. The block and schematics diagrams defining the functionality of the design are to be illustrated.

1.3 OBJECTIVES

The key objective of this project is to design a wireless burglar alarm system, which detects and distinguish an intruder and pets. The microcontroller performs as the significant part of the design.

- This wireless security system represents a major improvement in protection for home and property.
- The use of wireless detectors provide easy and convenient method of use and enables the use of as many wireless detectors as required. The system receives all the input signals from the sensors and being controlled by remote control which set the mode and panic, and controls the output devices such as LED's and triggering the siren.
- The system operates under micro-processor control and the software has been pre-programmed to suit the majority of applications. In order to dispel some of the myths surrounding wireless alarm system, the system uses very high frequency (VHF) transmission that has been specially allocated to wireless burglar alarm system. It uses the frequency transmission as a medium for digital data information form system detectors. This type of digital information is unique to this system and generated by custom digital circuitry.

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- The daily usage of other typical radio transmitting devices and apparatus such as mobile phones, intercom systems and other wireless alarm systems will not affect the normal operation of this security system.
- This project design is intended to set the alarm for different zones of the house, and the design is a microcontroller based wireless burglar alarm system.
- The system should be able to distinguish between intruder and pets.
- The system shall operate with the remote controller.
- Designing and build the wireless burglar alarm system and test its functionality and the system to contain audible only.
- Once siren is activated and trapped, it will sound until the operator presses the correct code to the system keypad.
- Design of the control panel which is the motherboard of the alarm system, it is the main table which decide any action to be taken and transmission of signals using radio frequency to be controlled in that control panel circuit.
- The working principle of the passive infrared sensors will be the same with most on the market, and then magnetic detector will be used to provide the real system of the project.
- The end user of the product shall be able to program the system as it has been designed with a system memory which has been pre-programmed to suit the ordinary requirements.
- Most applications will only require a change to the keypad security code by the end user.

2. LITERATURE REVIEW

This chapter will emphasise on the research carried; intricate on ways in which this will assist the design at end. Investigations of past home burglar alarm security system devices and well modernised systems on the market to be attained. Every homeowner and tenants are at risk of losing their hard earned possessions to the burglars. This has prompted them into looking for most effective systems which provide highly secure to their homes. In that way it will bar burglars from their premises, they will not gain access to their property easily. By providing some ways to control the insecure with the home owners and tenants with their property, engineers have been working day and night to trying to solve and improving the already placed systems, for instance some systems which are self-operational in monitoring as well as alertness.

The research of various security mechanisms available on the market nowadays, as well as theories behind them which make them reliable systems, the designing of wireless burglar alarm has to fulfil some requirements.

2.1. RESEARCHES ON TYPES OF SYTEMS AVAILABLE ON MARKET

2.2. Control Panelsⁱ

In most domestic alarm systems the intruder detection facility is needed only when the building is unoccupied. From the alarm company's point of view, multiple switching or zoning is justified on the grounds of ease of maintenance and locating and isolating faults should they occur. For some alarm companies to supply rather more comprehensive control panels than are strictly necessary, it is unknown and perhaps just to increase the sale value of the installation and probably to impress the customer.



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Figure 1: Example of Control Panel

The above Figure 1 shows the control panel, which is on the market as well as some types of panels, are shown on the different types of systems section; they are currently on market.

2.3. Indicator panels

Indicator lights can be associated on the control unit with each zone switch; this is done to convey accurate information to the controller or operator. Sometimes these indicators can be used for fault location;ⁱⁱⁱ

2.4. Active infrared sensors

2.4.1. Indoor active infrared sensors:

In learning about infrared beams, the LED transmits energy at a typical wavelength of 940nm towards a receiver lens having a fairly narrow acceptance angle of 5°. The nearly styled housing conceals pivots which allow both the transmitter and receiver to be adjusted horizontally through 180°. The angle used is concealed from the intruder by the fully radiused black looking combined filter and cover. The beam is modulated, with a range up to 125 metres.^{iv}



Figure 2: Remote Control; Source: Farnell

2.5. Space detection fundamentals^{vi}

If we want to know the human being is there, we can use electronic methods of detection of presence and of movement in space. In the security world, space detectors go under various names, such as microwave, radio, ultrasonic or infra-red. What these detectors do is either to transmit and receive, but specifically looking at space detection methods. The principal methods are passive infra-red, ultrasonic Doppler and microwave radar. Looking at the window problem, for example ultrasonic detection is likely to be used as the energy does not leak through glass. This is not on capability but on avoiding false alarms due to the possible detection movement outside the window. The passive infra-red detectors tend to come into their own in compact areas, and in areas that an intruder must pass through to reach his objective e.g. corridors.



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Figure 3: PIR Sensor Source: Farnell

2.6. Magnetic Sensors

The reed switch which requires of electronic control with much lower current acceptable to the reed switch; essentially a reed switch consists of two thin narrow strips of magnetic material sealed into a small-diameter glass tube with connecting wires brought through the seals at the ends of the glass tube. The two contact strips are normally held just separated – normally open, to give an open circuit. With the influence of a magnet brought close to the tube, the reeds can be made in the tube and to make contact with each other. The reed assembly embedded in a plastic or metal protective box, it can be recessed into the fixed frame of a door or window; and the magnet recessed into the moving part of the door or window and unobtrusive security switch can be made to sense the opening of the door or window. Given adequately strong magnets and good installation, reed switches give good security with reasonable tolerance to wear and warping and to vibration which could cause false alarms. The important point in installations of magnetic contacts in steel doors is to avoid the magnetic field being unduly affected by the steel of the door.^{viii}



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Figure 4: Reed Switch Source: *REUK.co.uk* and Magnetic Detector Transmitter Source: *Farnell*

2.7 Types of Alarm Systems

There are three types of alarm systems which are on the market currently; they are hard wired self-contained and wireless technology. ^{xi}

2.7.1 Wireless Systems

Wireless alarm systems are the simplest to install and the most convenient and popular choice for homes that are already built. They are the perfect solution for installing a security system into an existing home where running wires is impractical. The control panel of the wireless alarm system is usually smaller due to the fact that less wiring needed, its only main supply and siren cabling needed.

Advantages

- Low cost and straightforward installation
- It is more flexible when adding additional sensors
- Requires no wiring except for the connection between the control panel to the transformer which plugs into a standard wall plug.
- Quick and simple to install thus avoiding the costs of hiring a professional to install the alarm.
- A lack of disruption (and potential damage) resulting from installing a hard-wired alarm (e.g. drilling, removing floorboards, re-plastering etc.).
- Sensors and devices that can be placed almost anywhere as location is not dictated by wiring issues.
- Easily removed and re-installed alarms for individuals such as tenants in rented accommodation where landlords will not allow alterations.
- Easily added additional sensors. For example, if a property is extended or the level of security or fire protection needs changing.
- Less wire needed.

Disadvantages

- Wireless sensors are expensive.
- Each device will run on batteries so these will need to be regularly checked and replaced.
- A more sophisticated alarm system can inform of a low battery device via control panel display.
- Poorly charged batteries may result in false alarms to be triggered.
- Some materials in the property may impair or even disable a device's ability to communicate with the control panel. Thick concrete walls and iron/steel work will not help the device communication.
- Also long distances could prove a problem.

2.7.2 Hardwired Systems

Hardwired alarm systems are ideal for installation in new constructed homes with easy access in basements and attics. A new constructed home is easy because the walls and ceilings are still exposed; wiring is easily accomplished without having to search wires through finished surfaces.

This adds a layer of security because the control panel cannot be disabled by knocking a keypad off the wall. , The control panel is generally larger as devices need to be wired into terminals on the panel.

Advantages

- It offers more durability and longevity
- Less expensive than wireless systems, do not require batteries for sensors and allow for locating the control panel remote from keypads.
- No batteries are required.
- Cables and detectors relays can be subjected to diagnostic checks

Disadvantages

- You will have to run wires from each sensor to the control panel.
- Drilling required at some point.
- Some limitation of detector types available.

2.7.3 Hybrid Systems

A hybrid system is the systems incorporated both hardwired and wireless features. The control panel of the system is hardwired to the keypad which contains a wireless receiver using radio frequency that will receive wireless signals from the wireless sensors. A hybrid system allows usage of both hardwired and wireless sensors.

In the areas that you can easily hardwire a sensor to the control panel, you will save money on the sensor. In areas that cannot easily be wired, you have the convenience of using a wireless sensor.

Existing hardwired systems can be made hybrid by simply wiring a stand-alone wireless receiver to the control panel

Advantages

- Less expensive on sensors as they can be wired to control panel.
- In some areas which are not convenience you can use wireless sensors.
- Some systems which are hardwired can be converted to hybrid by wiring a stand-alone wireless receiver to the panel.

Disadvantages

- It is very expensive to buy.
- Expensive to install as it require professional technician.
- The radio frequency is not dedicated to any particular zones.

2.7.4 Wireless Alarm Package



Figure 5: Honeywell/ADEMCO Wireless Alarm system

£136.00

The high-end Honeywell/Ademco wireless equipment above is extremely dependable but the customer has to be prepared to spend a little money for all of the wireless sensors. The system includes;

- 1-L3000 control panel and transformer
- 1-5800PIR-RES motion detector
- 3-5816 door/window transmitters with magnets
- 1-5804 Keyfob

Features:

- Supports two-way voice over GSM radio (with the GSMVLP radio module)
- GSM signal strength indicator on the display
- Up to 39 wireless zones and real time clock
- One hardwired zone on board, voice prompt programming mode
- Full 16-button keypad with easy-to-read LCD display and status LEDs
- 85 dB internal sounder with voice siren
- Internal speaker and microphone
- Eight user codes and event log
- Rechargeable battery backup
- Voice prompted clock setting
- Remote phone control and bidirectional remote provides system status feedback
- Wireless, programmable remotes offer single-button system control
- Single button operation

2.7.5 Hardwired Alarm Systems



£74.00

Figure 6: Honeywell /ADEMCO Hardwired alarm system

The kit above Includes:

- Ademco Vista-15P Control Panel
- Deluxe Keypad
- PIR Motion Detector
- Wave 2 Siren
- Back-Up Battery 12 Volt 4AH
- Transformer
- RJ Block and Cord

Features:

- 6 hardwired zones but can support up to 32 zones, (16 hardwired and 26 wireless expansion zones).
- The Keypad is easy to install and simple to use.
- The PIR Motion Detector allows for pets up to 40lbs.
- It operates on low voltage,
- The SIREN provides 106 decibel dual-tone protection compatible with virtually any alarm panel.

2.7.6 Hybrid Alarm system



Figure 7: Honeywell /ADEMCO Hybrid Alarm system

£111.00

The Hybrid kit includes:

- Control Panel
- Deluxe Keypad
- Button Wireless Keyfob
- PIR Motion Detector
- Wave 2 Siren
- Back-Up Battery 12 Volt 4AH
- Transformer
- RJ Block and Cord

Features:

- Eight standard zones, hardwired and on-board and 48 zone expansion to hook up to hardwired and wireless expansion modules
- Wireless keys can be programmed independently of zones
- Relays and 100 Event Log viewable via system keypads with time and date stamp
- 48 system user codes
- Built-in phone line cut monitor with programmable options - System keypads display:
- Speaker with audible beeps to indicate:- System status, Entry/exit delay
- Four programmable function keys
- System functions clearly labelled
- Functions performed by entering security code
- PIR Motion Detector allows for pets up to 40lbs.
- SIREN provides 106 decibel dual-tone protection compatible with virtually any alarm panel. ^{xii}

2.7.7 Wireless Alarm System

Source: AEI Security and Communications



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Figure 8: AEI Security Systems

Price £112

The four zone compact wireless alarm system above is a low-cost, wire-free alarm system with an excellently compact control panel.

Features:

- 4 Zone Control Panel, with Keypad and Full/ Part arm options.
- 2 x PIR detectors
- 1 x Door or window Contact
- 1 x Remote Keyfob.
- 1 x Live Bell Box, with 110db Siren, Strobe, Flashing Comfort LED
- 1 x Decoy Bell Box.
- zones with the zone 4 LED also reporting signal level quality
- operation is performed using the handy remote control included or via the control panel keypad
- semi-programmable and
- Low cost external siren with cable that requires connection to the control panel.
- All detectors are wire free including the handy remote control which operates through walls and ceilings.
- The system is expandable and a low battery within any detector is reported on the control panel by alternate flashing of the low bat LED and the Zone LED.
- Zones including entry/exit zone and panic/tamper zone
- Wireless anti-scan function
- Low battery indication per zone
- Built-in panic button
- 110dB siren
- Mains power failure indicator
- Requires 6x AA rechargeable batteries ^{xiv}

3 ANALYSIS

In view of all the varieties explored in the earlier fragments, we notice that many dissimilar types of alarm systems that can be used for household safety, there are some systems which are in place already and some still under examination to the world market.

At the moment, many systems which are available on the market they contain features of electronic systems which are mostly in use to offer necessary safety for the home and those systems can be customised according to the necessary acquirement. These systems they have an inclusive of sophisticated brainy utilities such as phone texting, speech, wireless utilities and so on.

Entirely these systems would work flawlessly in homes for any owner, but they ensure with an added drawback, which is the cost. The typical cost of these systems is around £200.00 - £500.00. A properly installed alarm system which fit the homeowner needs will protect the household without any disadvantages other than having to pay for it. You will get piece of mind for sure. However, the operator has to remember to turn it on and off which is also the downside of the most common system in the market. The large number of homeowners and business owners are not ready to spend a fortune on security but they are forced with the insurance companies. With the economy meltdown most families are too tight with their budget.

With the above research, it indicates that the subject area of design should be an affordable wireless burglar alarm system with most modern functions and most required with the homeowners. This will be the main dynamic force which is behind the design and it will equip the homeowners easily and the installation of the system will safeguard their households and will make them feel more relaxed when away from the property.

4 SOFTWARE DESCRIPTION FOR THIS PROJECT

The final decision on the software usage, the control unit will be collaborated with the Arduino board. However, the software features of the alarm system will be in the internal chip built inside the board. When choosing the best software to use on the design, a number of researches are well done in terms of programming and the environment the system being used as well as the number of inputs and outputs, and functions. The comparison between two software to be applied carried out, the following sub topic represent the comparison between the PIC16F 8xx and the Arduino software and its development boards.

The PIC chip can be is used to control the entire system, **Peripheral Interface Controller** is the meaning of PIC, and they function like a small computer because of its peripheral processing unit and high level features and performance. PIC micro as its name suggests, a microcontroller is a tiny device used to control other electronic devices. It consists of central processing unit, memory, input ports and output ports.

In this design the PIC was to be used (PIC16C57) though it is incompatible with the latest development platforms and software tools. Despite this, it is possible to locate a modern device that is compatible with and will generally out-perform. This type of chip falls into the class of base-line and now the devices on high-end class feature many of these devices is Flash program memory, these devices can be erased and programmable electrically. These types of PIC's are signified with a letter 'F' in their part number e.g. the PIC to replace PIC16C57 is PIC16F843, these flash devices are much easier to work with for one-off prototyping because erasure and reprogramming is greatly simplified.

4.1 Difference between Arduino and PIC; Why Arduino?

Though PIC and Arduino have the same packaging sometimes for instance DIP packaging, all you will need is something cheap that is easy to work with especially if it's one off or prototype project. Additionally on price, the PIC and Arduino depending on number of pins they all fall in the same category of pricing.

The advantages of Arduino over PIC is such that the PIC in terms of languages it is not efficient cause you have to get into the working register first, so Arduino is much better when it comes to assembly itself. The Arduino works with Windows in a nice distribution while the PIC is also free compiler and open source and compiles C code for many but not all the PIC devices. Arduino software is real C that is the ports code are really easy and all of the PIC compilers are not full compatible and the Arduino generates good, fast small and correct code, so the Arduino software is a free high quality compiler with full optimisations and constant updates. The Arduino has small development board and the programming is done in sketches with some macros which is compatible to work with any interface.

When Arduino device chosen, especially for this particular design project, it was its importance to select a device that is well supported and easier, both in terms of being a member of one of the current Arduino families but also in terms of the programming and environment that this system is intended to use for software development. Furthermore, it is also important to ensure that the device incorporates all of the peripheral input/output facilities that are needed for example bus and communication interfaces though PIC is cheaper in price but the best and well modernised board with some extras has to be chosen.

4.2 Arduino Programming

The Arduino Mega 2560 is programmed with its software from the web, it is easy to use and it is available. Its firmware is similar to C++ language, with its reference on site and the structure of the program coding was done on sketch. This sketch window, once the programmer is satisfied or would like to test, it has to be compiled and uploaded to the board through USB cable. The window below shows how the sketch window looks like;



```

ADXL3xx | Arduino 0022
File Edit Sketch Tools Help
ADXL3xx
// these constants describe the pins. They won't change:
const int groundpin = 18;           // analog input pin 4 -- grou
const int powerpin = 19;           // analog input pin 5 -- volt
const int xpin = A3;               // x-axis of the acceleromete
const int ypin = A2;               // y-axis
const int zpin = A1;               // z-axis (only on 3-axis mod

void setup()
{
  // initialize the serial communications:
  Serial.begin(9600);

  // Provide ground and power by using the analog inputs as normal
  // digital pins. This makes it possible to directly connect the
  // breakout board to the Arduino. If you use the normal 5V and
  // GND pins on the Arduino, you can remove these lines.
  pinMode(groundpin, OUTPUT);
  pinMode(powerpin, OUTPUT);
  digitalWrite(groundpin, LOW);
  digitalWrite(powerpin, HIGH);
}
1

```

Figure 9: Arduino Sketch window

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