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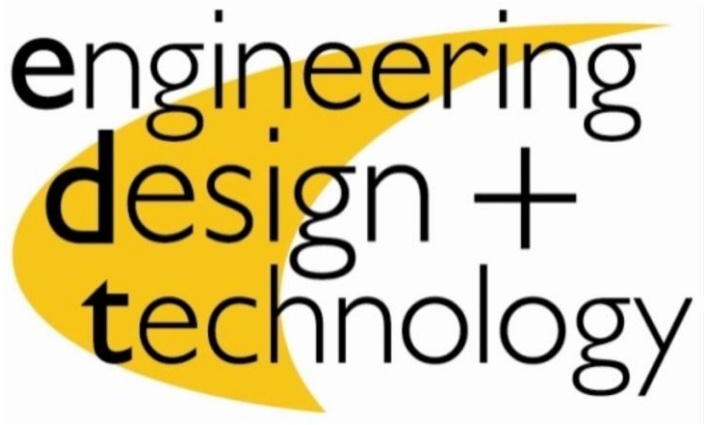
MAKING KNOWLEDGE WORK



WIRELESS BURGLAR ALARM SYSTEM

DESIGN PROJECT

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ABSTRACT

Now that security is a perception in many people and business premises, it is highly concerned with the safety at home and to our businesses, numerous techniques are developed to aid in this and the wireless burglar alarm system originates presciently in the grade. Manipulating alarm system, which is manageable by end user, inexpensive and operational, is the assignment to be fulfilled through the entire design project and the real resolution of this report.

The wireless burglar alarm structure, which is capable to detect any slightly interference and able to give a signal through an audible is the problematic to be resolved by means of project design in at a stated period. In the beginning were the researches of the available systems on the marketplace, and then by the design solution which is much equivalent to the system which will provide the same standards of security. The design comprises research, specification, design and builds with all simple necessities and adding high quality topographies such as intelligent and ability to distinguish between pets and intruders at the entry and warning the homeowner/ security with a sound instantly. Keypad security code to arm and disarm the system, i.e. some numerous hardware modules and software were used in design and make, the system to be powered by its own battery and power supply. In concluding the system packaging, it should be enclosed before final testing of its effective.

This is done lightly in providing most of the features in systems available on the market today. In addition, the aim is to design a lower cost system for an ordinary small business and home owner.

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ABBREVIATIONS

MDT	MAGNETIC DETECTOR TRANSMITTER
PIC	PERIPHERAL INTERFACE CONTROLLER
IDE	INTEGRATED DEVELOPMENT ENVIRONMENT
USB	UNIVERSAL SERIAL BUS
PIR	PASSIVE INFRARED
LED	LIGHT EMITTING DIODE
RS232	RECOMMENDED STANDARD 232
TCP	TRANSMISSION CONTROL PROTOCOL
IP	INTERNET PROTOCOL
LCD	LIQUID CRYSTAL DISPLAY
PWM	PULSE WIDTH MODULATION
ADC	ANALOGUE TO DIGITAL CONVERTER
DAC	DIGITAL TO ANALOGUE CONVERTER
OSC	OSCILLATOR
EPROM	ERASABLE PROGRAMMABLE READ ONLY MEMORY
ROM	READ ONLY MEMORY
CMOS	COMPLEMENTARY METAL OXIDE SILICON
RISC	REDUCED INSTRUCTION SET COMPUTER

ACKNOWLEDGEMENTS

Besides the efforts of me, the achievement of any project in a lifetime essentially depends mostly from the reinforcement and procedures as well as course of action of many individuals. I would like to give credit and precisely to the professional people who have been very influential in this success story of my design project.

I would like to give my highest thankfulness to Dr Roz. Halliwell and I cannot approximately acknowledge you sufficiently for her remarkable support and assistant. I sensationally inspired and fortified every week when I attend her meetings to discuss the progress of the project. Without her encouragement and supervision this design project would not have been materialised and accomplished accordingly.

The supervision and support and time honoured from members of Technical Staff especially Mr A Mistry, Mr A Leach, Mr J Hall and Mr P Grainger, their contribution to this design project was vigorously for the accomplishment of the design project. I am really appreciative for their endless technical support.

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1 INTRODUCTION

Through the expansion of the social order and the standard of living settings escalates. However, it 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 crime 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, 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.

The structure of this report is as follows, it comprises 10 Chapters as a system configuration it should follow up a structure.

These are the chapters of the report:-

- Chapter 1: Introduction
- Chapter 2: Literature Review
- Chapter 3: System description
- Chapter 4: Hardware description for this project
- Chapter 5: Software description for this report
- Chapter 6: Results
- Chapter 7: Discussion
- Chapter 8: Conclusion
- Chapter 9: Recommendations
- Chapter 10: References

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 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 microcontroller. 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 design project is to design a wireless burglar alarm system, which detects and differentiate an intruder and pets intelligently. The microcontroller performs as the significant part of the design. Some key objectives are also as follows:-

- To produce a working design of wireless burglar alarm system.
- Design of the control panel which is the motherboard of the alarm system.
- The system must use very high frequency (VHF) transmission that should be allocated to wireless burglar alarm system.
- This project design is intended to set the alarm for different zones of the house.
- 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.
- Design of the control panel which is the motherboard of the alarm system.
- 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

The literature review will emphasis on the thorough study carried; intricate on many methods in which this will assist the design and build 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

There are three types of alarm systems which are on the market currently; they are hard wired self-contained and wireless technology. [1]

2.1.1 CONTROL PANELS

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[2].

[3]

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.

2.1.2 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;[4]

2.2 ACTIVE INFRARED SENSORS

2.2.1 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 5º. The nearly styled housing conceals pivots which allow both the transmitter and receiver to be adjusted horizontally through 180º. 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[5].

2.3 SPACE DETECTION FUNDAMENTALS[6]

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.

2.4 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.[7]

2.4.1 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[8]

- 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.

DISADVANTAGES[9]

- 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.[10]

2.4.2 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.[11]

2.4.3 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.

2.4.4 WIRELESS ALARM PACKAGE[12]

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Figure 2: 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 [15]
- 85 dB internal sounder with voice siren
- Internal speaker and microphone
- Eight user codes and event log
- Rechargeable battery backup [16]

2.4.5 HARDWIRED ALARM SYSTEMS[17]

£74.00 [18]

Figure 3: 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

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.

2.4.6 HYBRID ALARM SYSTEM

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Figure 4: 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

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[20]
- Speaker with audible beeps to indicate:- System status, Entry/exit delay
- Four programmable function keys
- System functions clearly labelled
- SIREN provides 106 decibel dual-tone protection compatible with virtually any alarm panel. [21]

2.4.7 4-ZONE COMPACT WIRELESS ALARM SYSTEM [22]

[23]

Figure 5: AEI SECURITY SYSTEMS

Price £299

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
- 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 [24]

2.5 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.

3 SYSTEM DESCRIPTION

The wireless system will comprise of three focal features, the external inputs, control unit and output. There are several segments conveyed together to accomplish these necessary tasks. It consists of keypad, passive infrared and magnetic detector transmitter sensor, all they fall in input devices. The control unit which is the processing motherboard, it comprises the Arduino microcontroller and the in-built and external buzzer as well as indicators (LEDs). The block diagram on top level design solution gives an overview of the wireless burglar alarm system.

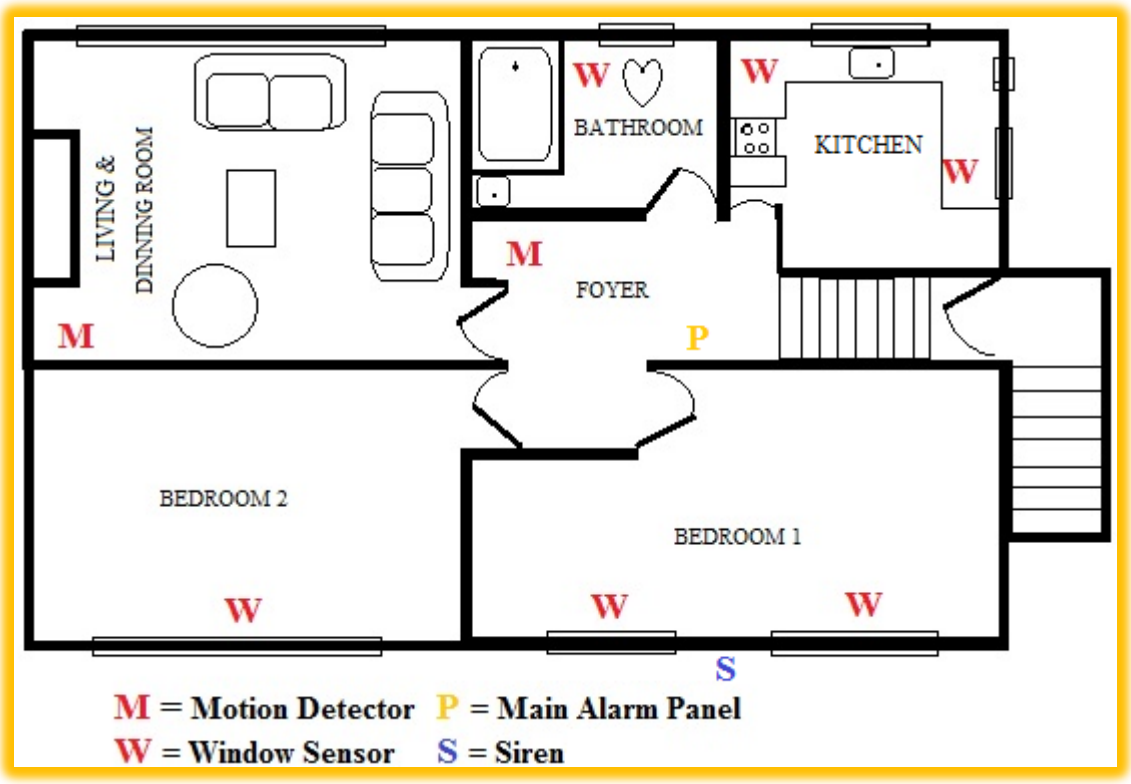


Figure 6: HOUSE PLAN AND SHOWING DETECTORS

Key:

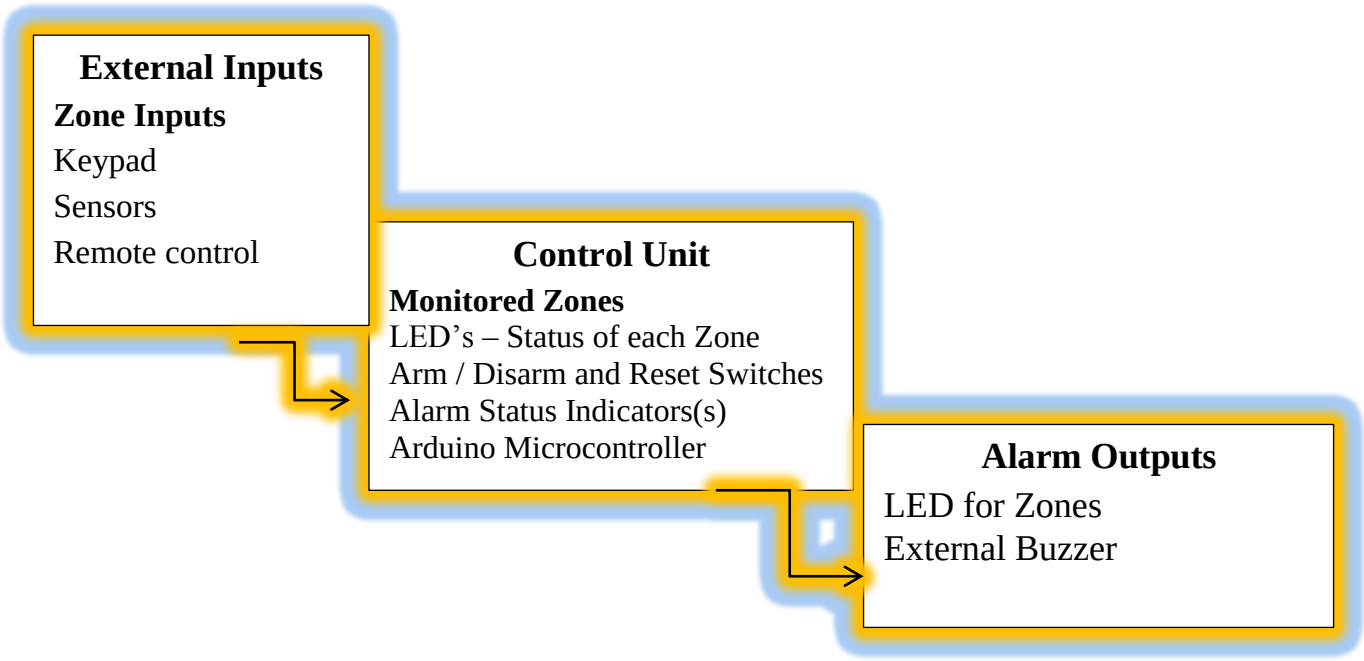
Input Devices	Control Unit Devices	Output devices
M: Motion Detector **W**: Window Sensor	**P**: Main Alarm Panel	**H**: Siren **S**: Strobe Light

Table 1: HOUSE PLAN KEYS

The above Figure shows the exact and possible way the system installed, while the sensors are inactive. The zones are covered and the control panel has to be installed where there is access to the entrance.

3.1 TOP LEVEL DESIGN SOLUTION

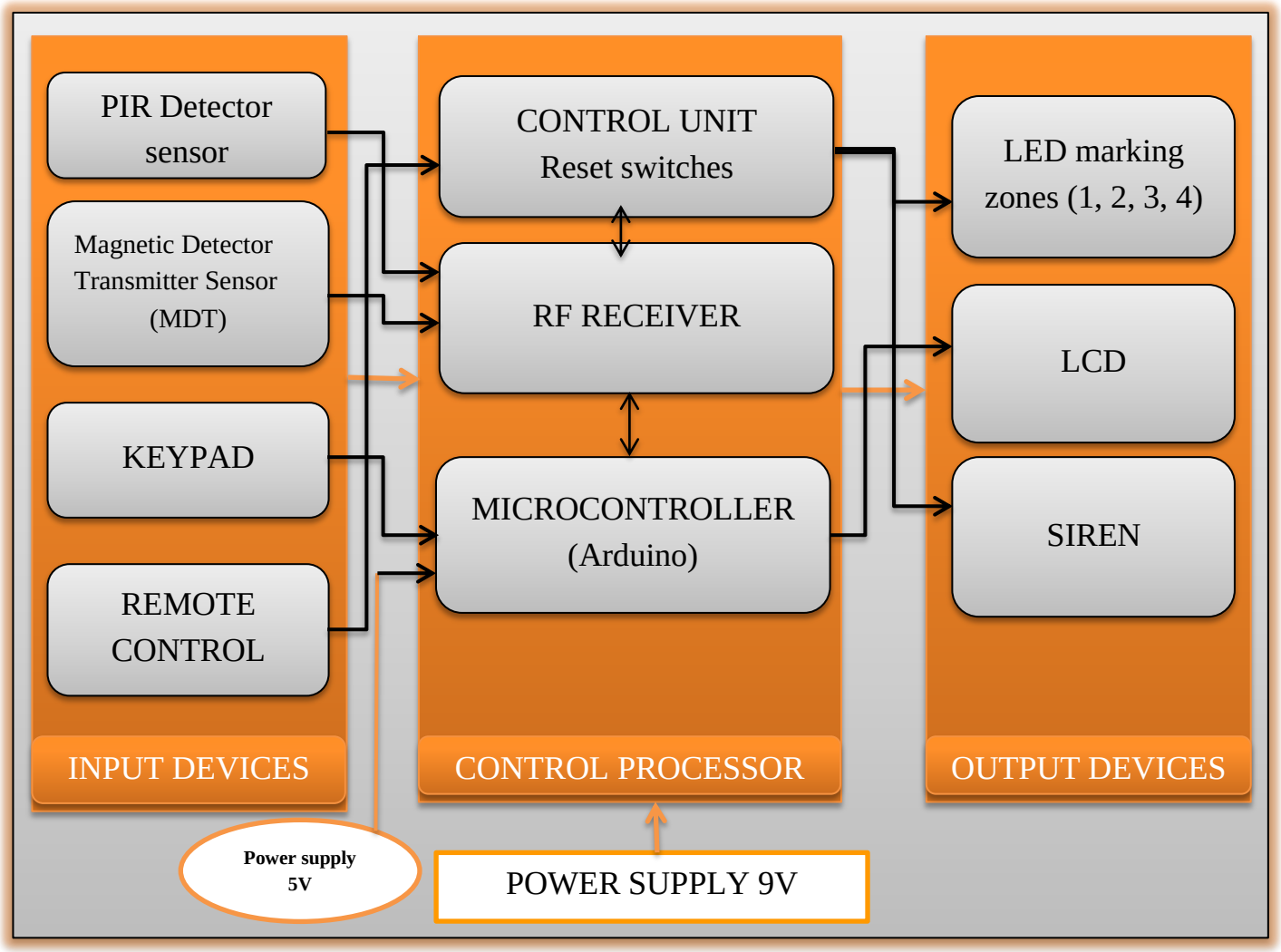
Table 2: TOP LEVEL DESIGN SHOWING SYSTEM BLOCK DIAGRAM



3.2 ELEMENTS EXPLANATION

In this section the entire components required for the system will be elaborated as in the system description and will be discussed in hardware description. There are many types of sensors available on the market but for this project it's only magnetic and PIR sensors used.

Table 3: SYSTEM BLOCK DIAGRAM



3.3 INPUT DEVICES

3.3.1 THE KEYPAD

The keypad allows access to the system control functions; it also enables the end user to type in security code. When a genuine alarm activated and the entire alarm system will be reset only when the correct security code is pressed.

3.3.2 REMOTE CONTROL

The remote control is used to arm and disarm the system by pressing the ON/OFF button,; it will also indicates that signal has been sent and the battery life is still working through LED and the usage of panic button which instantly trigger alarm during an emergency. The remote control uses radio frequency (RF), it uses radio waves which is much advantage because it can go through walls and any corners, probably with a range of around 100 ft (30 m)

3.3.3 MAGNETIC DETECTOR TRANSMITTER SENSOR

The sensor detects the opening of doors or windows and it has an indicator of LED which shows that a signal has been sent and unit is transmitting. This type of sensor detects intruder, they are installed on doors and windows.

3.3.4 PIR SENSOR

The passive infrared sensor is used to detect moving object within its protected area. This type of sensor normally installed/mounted facing the window or entrance. It is a common high-quality amid other sensors; they are broadly used motion sensors and operate by detecting infra-red radiated by human body.

3.4 CONTROL UNIT

3.4.1 MAIN CIRCUITRY

This is the motherboard of the wireless security system; it comprises various features that are available on the system. It assesses the collected data from the sensors depending on the points or secured view has been violated by intruders, if it is true the system will activate the siren. The Arduino hardware will be programmed to control the sensors and siren, as the system operates under micro-processor control and boosts a number of programmable features.

3.5 OUTPUT DEVICES

3.5.1 SIREN

Sirens are used where sound is required to cover a long distance. Mostly audible minimum limit is 60dB and high power sirens use mains voltage. Likewise in this wireless system the audible sound is around 100 - 120dB's. In this system it has two sirens the built in and external. The purpose for the built in is to sound when the system is triggered and it is designed to protect the rear cover from removal. The external siren is common with burglar alarms due to high pitch and may obtain with low consumption of current.

3.5.2 LIGHT EMITTING DIODES

LEDs indicates lights on control panel and wireless devices, such as magnetic detector transmitter, passive infrared detectors etc. It is a useful technique for the homeowner and emergency services to track where the alarm has been activated and the action may be required to reset the alarm. The entire detectors will tie with equivalent LED. 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;[25]

3.5.3 LIQUID CRYSTAL DISPLAY

The LCD gives the visual conveyance of the system, while the programming is mostly done from keypad which is connected to the main control unit. Though LCD display is much easier than using the LED's and the system with LCD screen you will be able to visually verify the steps which you are typing or the mode you are in. As we know every burglar alarm system is much different and the requirements of the design should be considered accordingly.

3.6 COMPARISON BETWEEN (PIC & ARDUINO)

A PIC microcontroller is a general purpose microcontroller device that is normally used in a standalone application to perform simple logic, which is timing and input/output control. PIC device provide a flexible low-cost solution that very effectively bridges the gap between single chip computers and the use of discrete logic and timer chips. [26]PIC microcontrollers are very easy to use and the PIC programming can be carried out using assembly language, C, basic and Flowcode or a mixture of these languages. [2728]The software and programming will be required to do all the work. The two most commonly used methods of programming a PIC chip are using a conventional PIC programmer and using a flash device in the target system. The programming software and source code is resident on a PC and downloaded as hex code into the PIC. The process or generating the source code, compiling and/or assembling it into hex code is invariably performed by software known as Source Boost Integrated Development Environment (IDE) using E-blocks PIC microcontroller/microprogrammer.

3.6.1 PIC PHYSICAL BOARD & PIN MAPPING

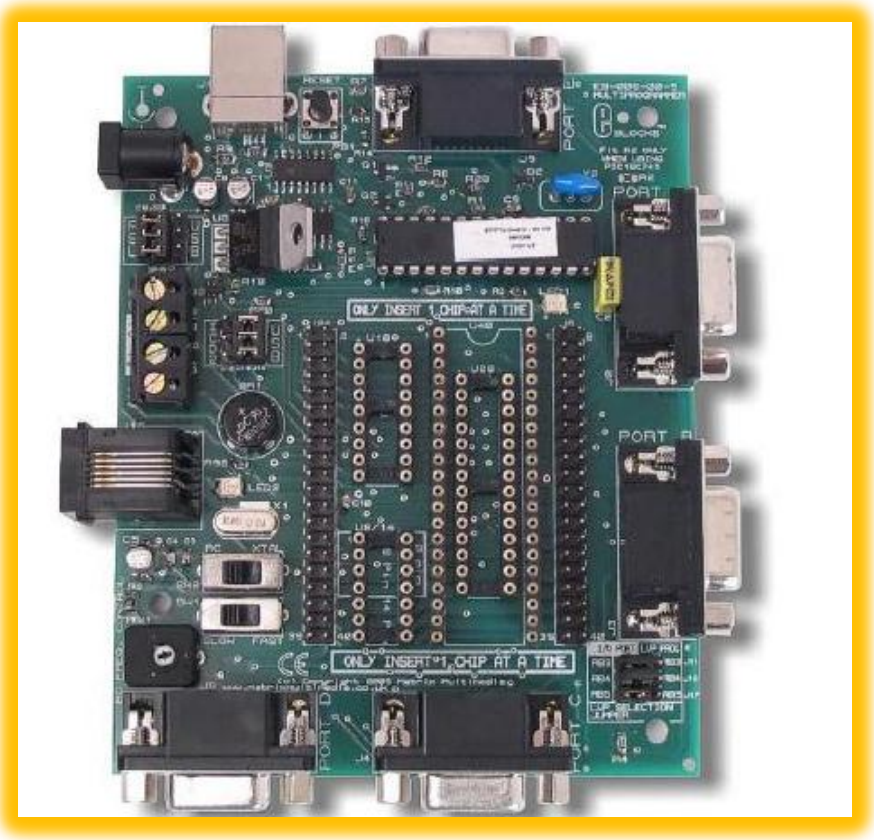


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Figure 7: MULTIPROGRAMMER BOARD

This multipurpose device on Figure 6 connects to a PC via USB and can be used to program most 14, 18, 28, 40 pin PIC chips. The development board has five I/O ports for connection to a wide variety of external peripherals modules.

The Circuit description of the multiprogrammer or development board on Figure 17 above; there are 5 Ports A-B-C-D-E on the development board which holds the following:

- PORT B-C-D with 8 bit functionality, PORT A with 6 bit functionality
- PORT E with 3 bit functionality, Pins 1-8 are connected with the pins of the corresponding port (Pin1 is connected to PB0, Pin 2 to PB1 etc.)
- Pin 9 of the D-type connector is always GND meaning that ground will not have to be connected externally to the downstream boards.
- **Power supply:** should be at least 12V and should be able to deliver 300mA.
- **USB Power supply:** capability to be programmed and powered only by USB.
- **The Reset switch:** connected to the PIC micro and if pressed, it will reset the PICmicro.
- **Clocking:** Every 4 clock-pulses, the PICmicro execute one single instruction.
- **XTAL-Mode:** For very fast operation; up to 20MHz we use a 19,660,800Hz Crystal.

3.7 MICROCONTROLLER (ARDUINO)[30]

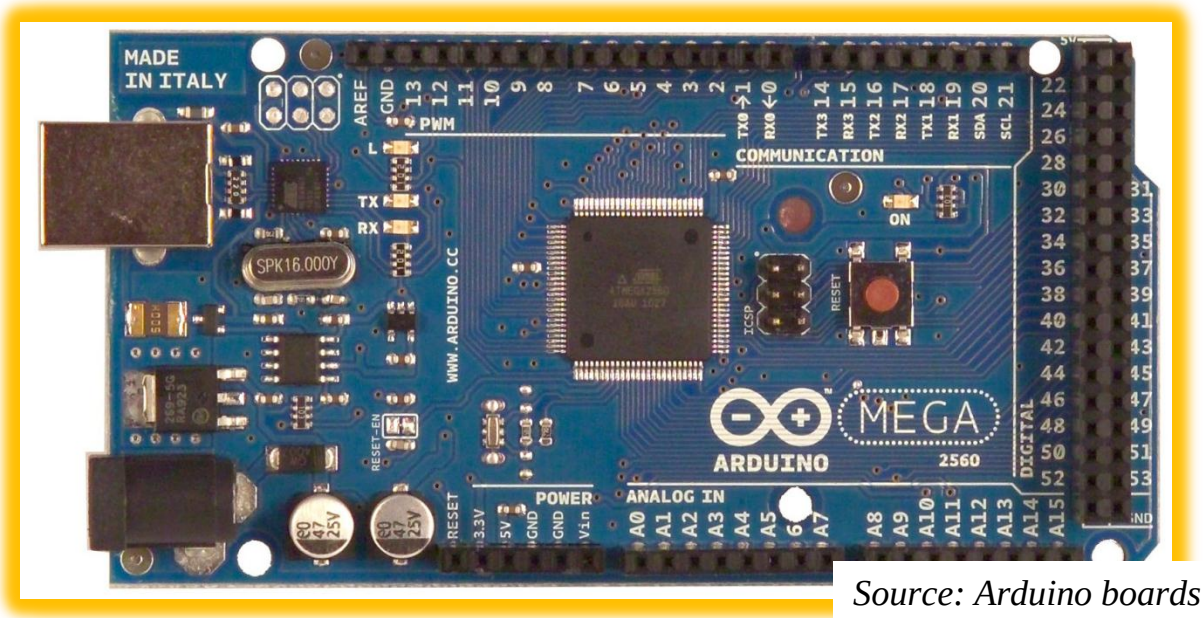
3.7.1 THE ARDUINO OVERVIEW

Arduino is a device for creating processors that are intelligent and control more of the physical things in our world than real computer desktop. It is a development source of physical computing stage built on an easy microcontroller board, and a simple development environment.

Arduino can be a usage in developing, collaborating things, taking inputs from a variety of switches, sensors, and controls variety of physical outputs. Arduino comprises everything needed to maintain the microcontroller; it is really simple, all needed is to connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get on-going. The ArduinoMega 2560 is an update to the Arduino Mega, which it substitutes.

3.7.2 ARDUINO PHYSICAL BOARD & PIN MAPPING[31]

The maximum length and width of the Mega2560 PCB are 4 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case.



Source: Arduino boards

Figure 8: ARDUINO BOARD TOP VIEW

3.7.3 FEATURES OF ARDUINO MEGA 2560

- **Power:** The Arduino Mega can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter or battery. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.
- The power pins are as follows:
    - **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). The voltage can be supplied through this pin,
    - **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
    - **3V3.** A 3.3 volt supply generated by the on-board regulator.
    - Maximum current draw of the board is 50 mA.
    - **GND.** Ground pins.

- **Memory:** The ATmega2560 has 256 KB of flash memory for storing code, 8 KB of SRAM and 4 KB of EEPROM.
- **Input and Output:** The 54 digital pins on the ArduinoMega can be used as an input or output, using *pinMode (), digitalWrite (),* and *digitalRead ()* functions. **PWM: 0 to 13.** Provide 8-bit PWM output with the *analogWrite()* function.
- **SPI: 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS).**
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- **TWI: 20 (SDA) and 21 (SCL).** Support TWI communication using the Wire library.
- The Mega2560 has 16 analog inputs, each of which provides 10 bits of resolution and there are a two other pins on the board:
- **AREF.** Reference voltage for the analog inputs.
- **Reset.** Bring this line LOW to reset the microcontroller.

- **Communication:** The Arduino Mega2560 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers.
- **Programming:** The Arduino Mega can be programmed with the Arduino software downloadable from the site.
- **Automatic (Software) Reset:** The Arduino Mega2560 is designed in a way that allows it to be reset by software running on a connected computer. The Mega2560 contains a trace that can be cut to disable the auto-reset.
- **USB Overcurrent Protection:** The Arduino Mega2560 has a resettable poly fuse that protects computer's USB ports from shorts and overcurrent. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed. [33]

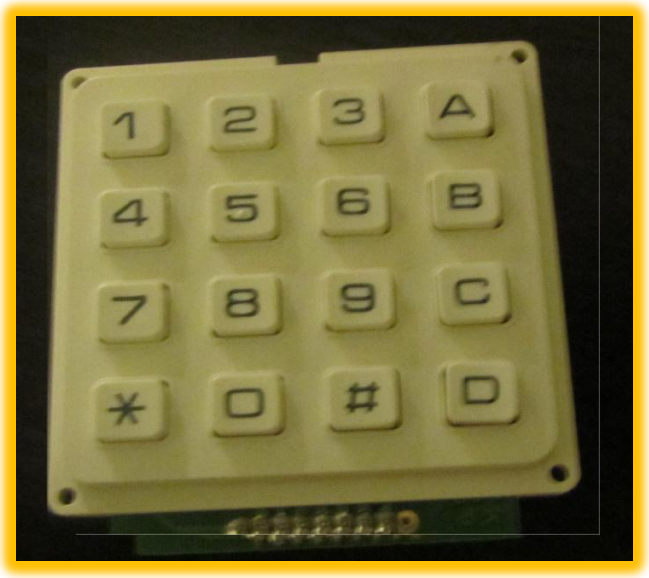
4 HARDWARE DESCRIPTION FOR THIS PROJECT

4.1 INPUT DEVICES

These are hardware devices that send data or information to the control panel which acts as a processor. Such input devices are explained below e.g. keypad, detectors, remote control etc.

4.1.1 KEYPAD

The keypad allows access to the system control functions, this device will arm and disarm the alarm system when the end user is not around and in around. It operates by the connection of corresponding key with row pin and column pin and the keys comprising row pins send to high voltage and read a *hi* or *lo* on the column pins to determine the common connected point which is a normally open switch. When programming the system, this will be scanning rows and columns being read.



The connection of keypad is made between the column and row pin, in this project design the keypad is with 16 keys though there are various types of keypads on the market e.g. 3 x 4 matrix keypad.

Figure 9: 4x4 MATRIX KEYPAD

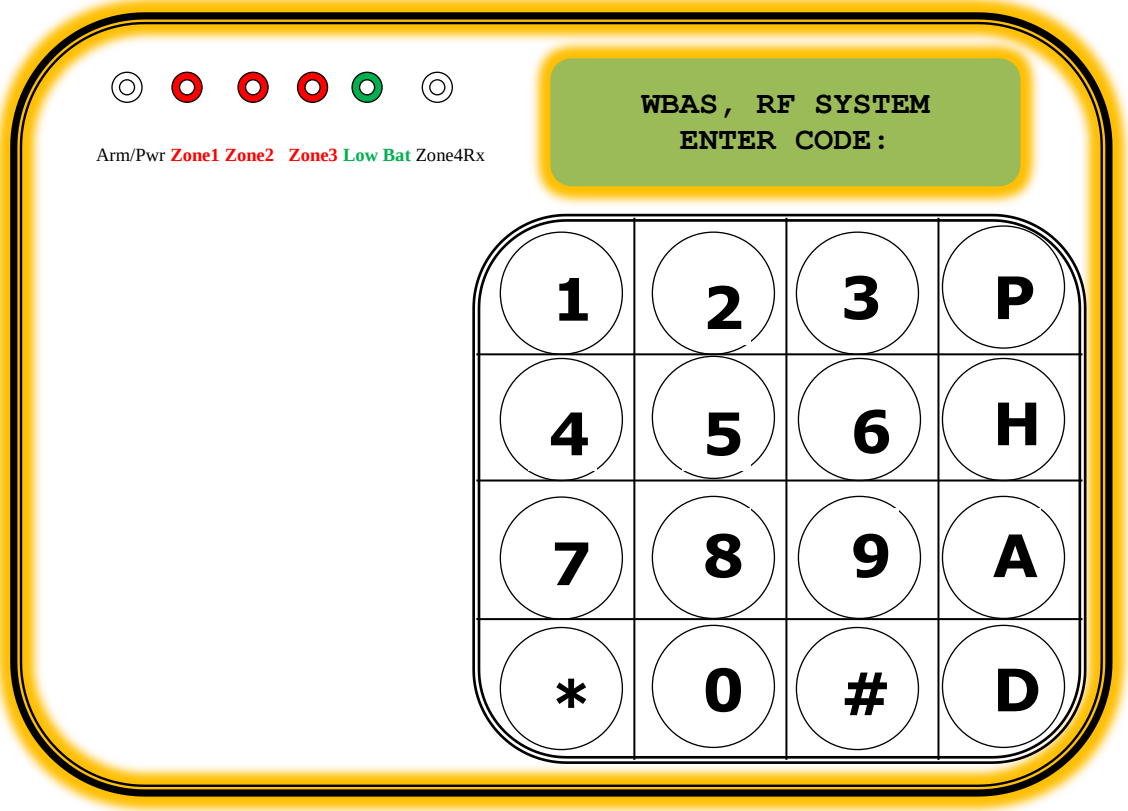


Figure 10: CONTROL UNIT PANEL

Keys: P (A), H (B), A (C), D (D)

P = Panic button activates built in and external siren.

H = Home button enables the homeowner to enter the system into home mode and arming detectors.

A = Arm button is used to arm the system following the code entry.

D = Disarm button is used to disarm the system after the code entry.

Zone 1, 2, 3, 4 are LED's they illuminate when a detector has been activated. The low bat LED it indicates the detector battery is running low and must be changed. The ARM/PWR LED is arm mode and disarm mode or power normal.

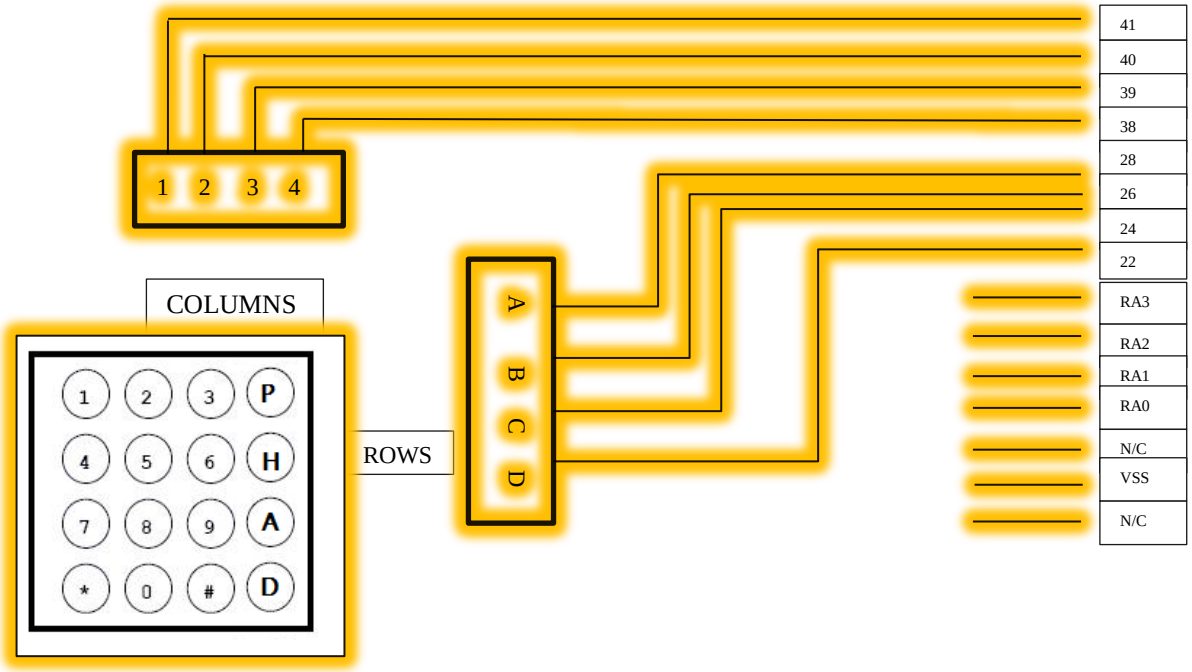


Figure 11: KEYPAD CONNECTION

4.1.2 REMOTE CONTROL

Source: AEI Security Systems

Figure 12: REMOTE CONTROL

1. Panic 2. Mode 3. LED

The remote control above has two main functions which instantly trigger alarm during an emergency and an ON/OFF mode button which is used to arm the system or disarm the system. Additionally, an LED indicator which indicates that a signal has been sent and the battery is still working. Once panic button is used it will activate internal and external sirens instantly. This remote is the master key to the security system of your house. It is intelligent enough to control and it allows arming or disarming whenever you choose. It has a long coverage area and it can be used from a distance of 30 metres. It has a panic button which is used to raise alarm if there is an emergency. If the home owner is outside the house and they may think that some intruders are inside, they can press the button and it will start all the flash lights and sirens scaring the burglars away. The circuit diagram below shows the schematic of it.

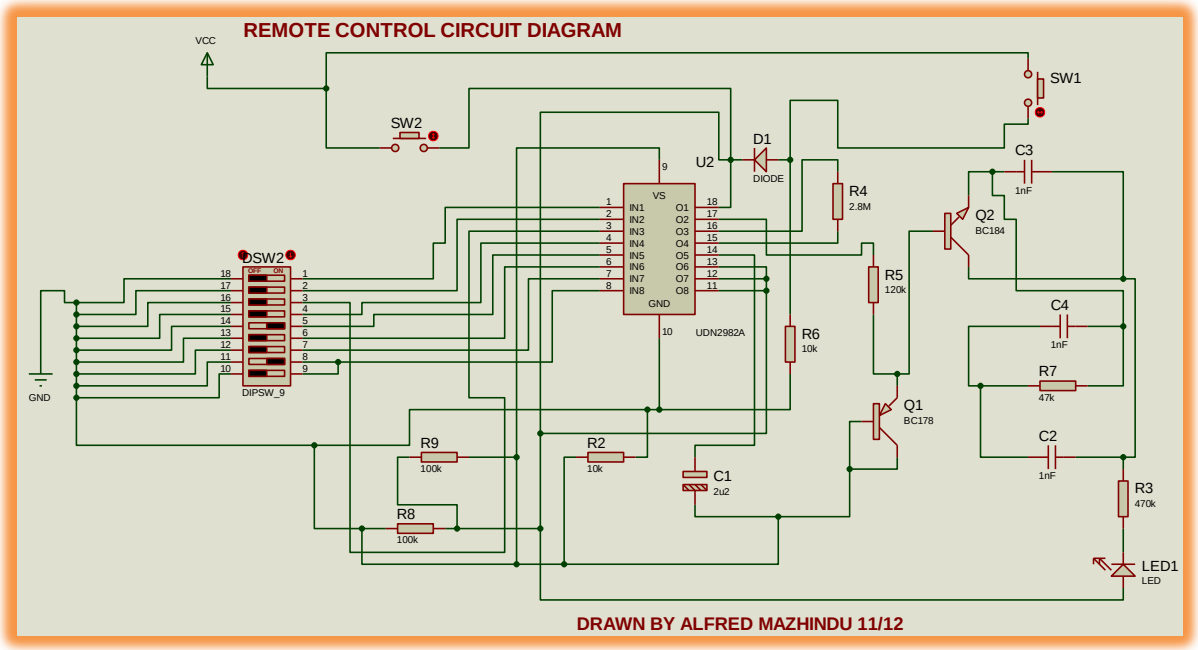


Figure 13: REMOTE CONTROL CIRCUIT DIAGRAM

4.1.3 SENSORS

4.1.3.1 WIRELESS PASSIVE INFRARED SENSOR

Source: AEI Security System

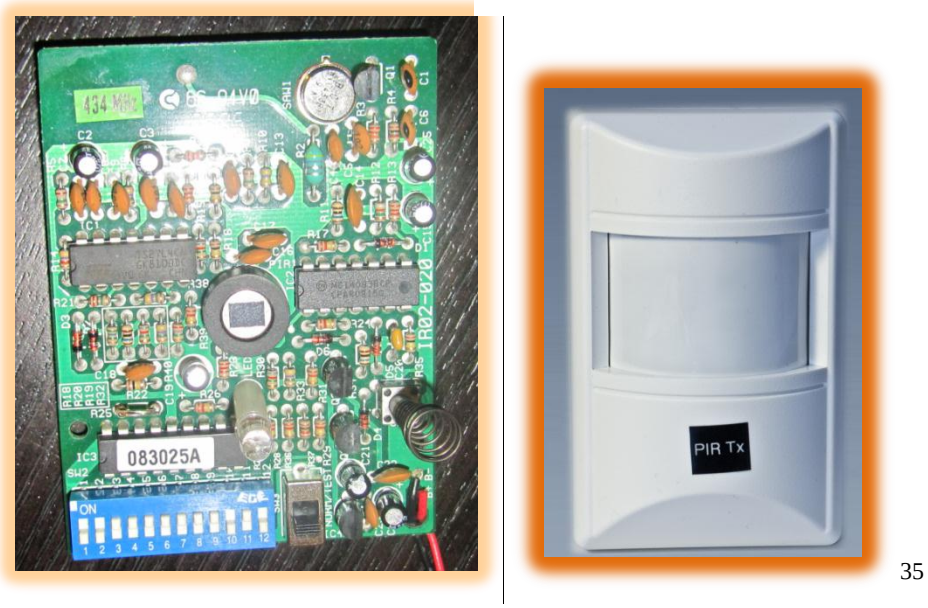


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Figure 14: WIRELESS PIR SENSOR (AEI SECURITY SOURCE)

The wireless passive infrared sensors are available on the market that can detect and distinguish between genuine intruders and home pets. The principle on this passive infrared sensor is that it detects infrared radiation. The pyroelectric sensor is made up of a crystalline material which transfer infrared signal to electric signal. The PIR provides 12 metres coverage and transmitting range up to 40 metres. The PIR device on this project contains amplifier and comparator with Schmitt trigger as well as series of encoders which acts as transmitter circuit. These modules process the voltage signals from the photodiode then send the information through output transmission to the control unit. This device works with transmission of 400MHz – 435MHz approx. which is enough to trigger the system. The PIR functions with a low power consumption rate of 9V with high sensitivity over an outsized transmission range.

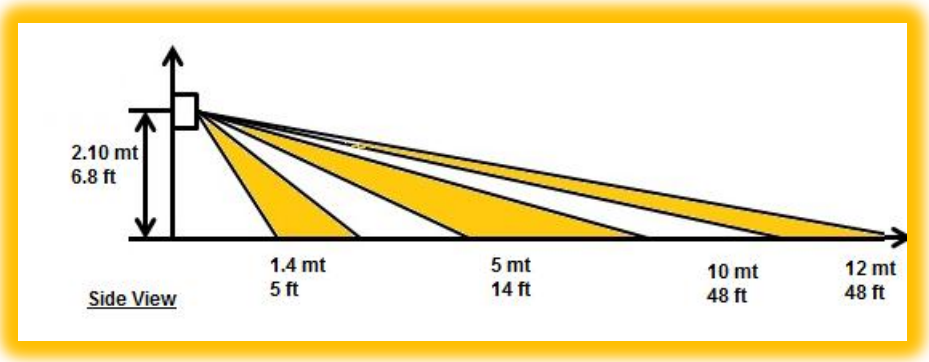

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Figure 15: SIDE VIEW OF THE PIR

The above side view of the PIR coverage range, it covers a wide angle with low power coverage, in addition, the PIR has built-in coded radio frequency SAW transmitter.

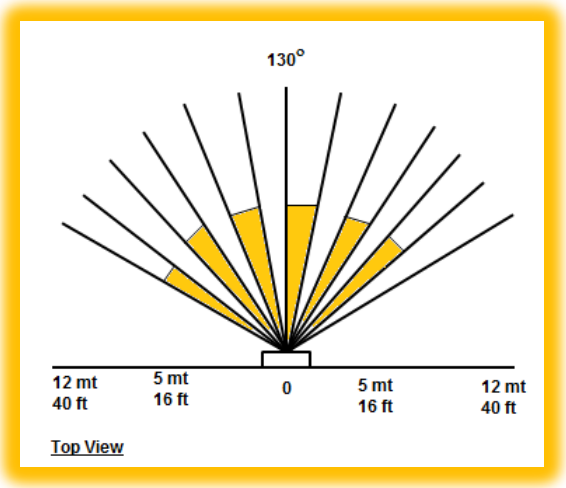


Figure 16: TOP VIEW OF PIR

The above diagram shows the top view of the PIR sensor coverage of 12 metres at an angle of 130º.

4.1.3.2 MAGNETIC DETECTOR TRANSMITTER (MDT)

Source: AEI Security System

Figure 17: MDT SENSOR

The circuit above on Figure 16, is magnetic detector transmitter (MDT), it protects a door or window against unlawfully entry and its transmitting range is up to 40 metres according to the datasheet of the devices used in that module. Inside that device there's reed switch (represented by R11) and the magnet see Figure 16, the reed switch is made up of metallic reeds closed in a hermetic glass inclusion. It only become active when it is close together with magnet, also depends with the circuit requirement.

4.1.4 POWER SOURCE

The power supply to the whole control unit will be 9V from the battery or AC adaptor, then the Arduino board will be supplied with the AC adaptor as well 5V i.e. for presentation only. When packed the supply source will be from the control unit from the 5V regulated. When programming the board, the USB will be connected to the computer i.e. supplying power to the board. The following items are the types of power supply to be used;

1. USB cable
2. AC-to-DC 9V adaptor
3. 9V battery

4.2 CONTROL PANEL

4.2.1 FUNCTIONS

The main processing unit which is the interface of two major processors such as control unit and Arduino board microcontroller. Its responsibility is to, "a co-ordinating activity of system and it performs computation and data manipulations to execute applications", and it sources the signals from inputs, i.e. keypad, sensors (PIR & MDT etc.) through 434MHz RF receiver. Once all signals are in control system they then executed in microcontroller which in turn indicate as it programmed through the outputs such as LED and siren.

The system control also contains the datapath control and memory, i.e. the Arduino Mega 2560 memory contains firmware and software which has program instructions, then input and output data, lastly the intermediate results will be produced. The datapath coordinates activities of the whole entire system in the circuitry that controls the flow of data through the processor, and coordinates the activities of the other units within it. It also controls what happens inside the processor, which in turn controls the rest of the burglar alarm system.[37] "The control unit performs the tasks of fetching instructions from memory of ArduinoMega 2560 then interprets instruction and performs the tasks indicated by the instruction", decoding, and managing execution of program instructions. [38][Halliwell. 2011 p8].[39]

4.2.2 MAIN PROCESSING CIRCUIT

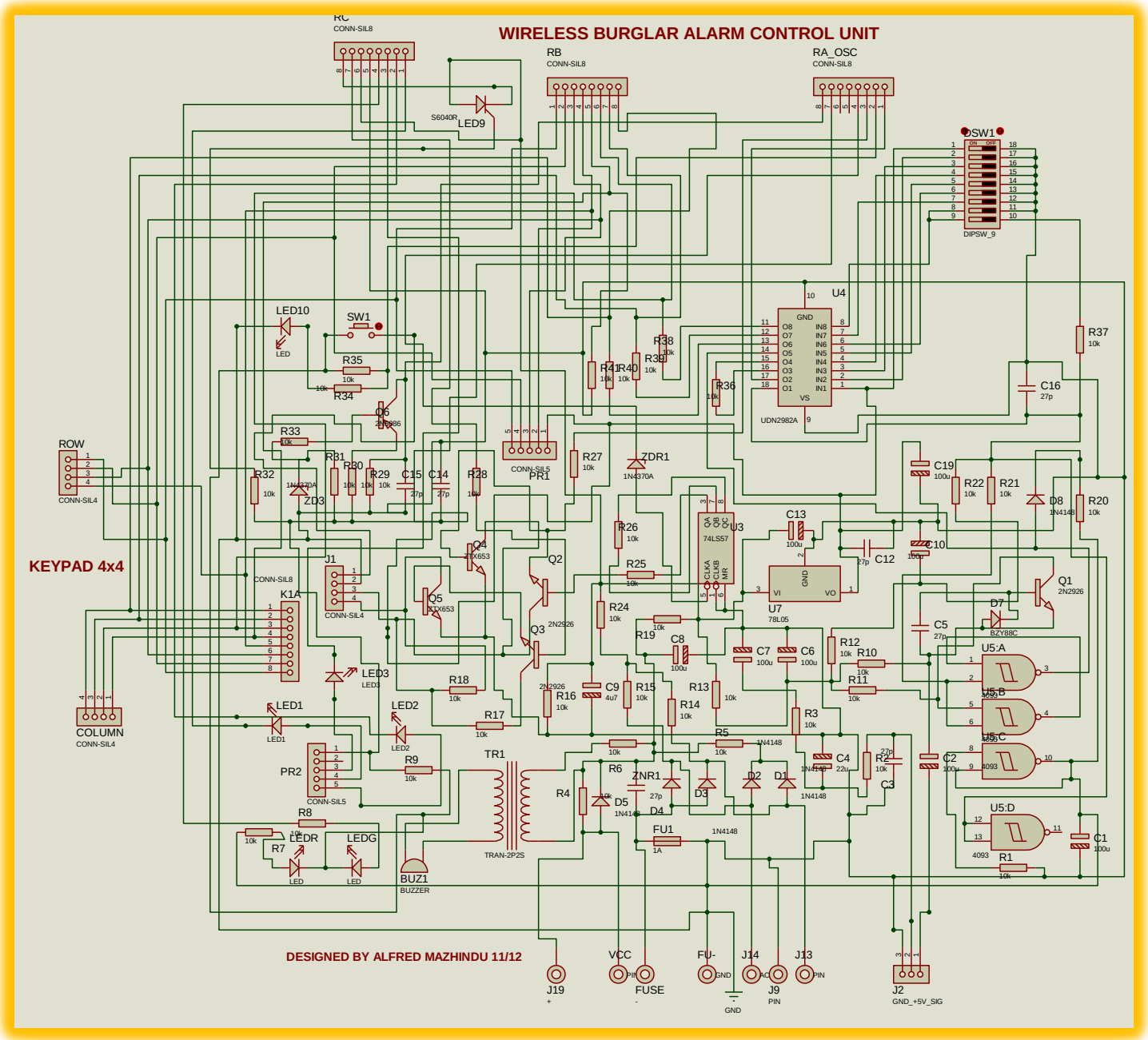


Figure 18: CONTROL UNIT

4.2.3 TRANSMISSION AND RECEIVER – RF

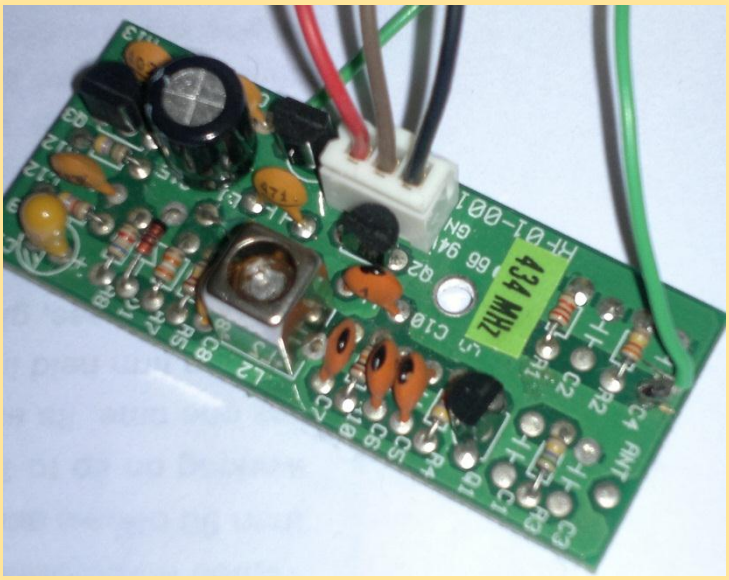


Figure 19: RADIO FREQUENCY RECEIVER SCHEMATIC DIAGRAM

This **RF module** contains an **RF Receiver**. The receiver (Rx) operates at a frequency of **434MHz**. An RF transmitter like (PIR sensor, MDT sensor) receives serial data and transmits it wirelessly through RF through its antenna connected at pins out.[40]

Transmission over RF (radio frequency) is much superior to IR (infrared) because of many reasons.

1. Signals through RF can be transportable over and done with long distances making it appropriate for long range applications, while IR mostly operates in line-of-sight mode,
2. RF signals can travel even when there is an obstruction between transmitter & receiver.
3. RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.[41]

4.3 OUTPUT DEVICES

4.3.1 SIREN

The buzzer attached to the system is the piezo buzzer type and it is coupled with the inductor for pure current limiting effect, it is also a self-oscillating buzzer with signal generator. It is of low cost and high sound output and as well as a type of audible sound transducer. This piezo is mounted on PCB as the internal siren and it can produce multi-tones when programmed perfectly.

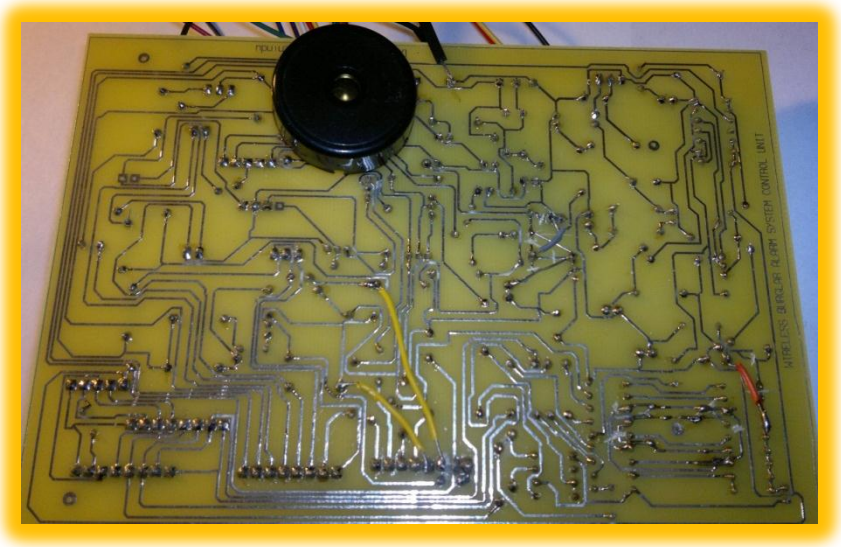


Figure 20: BUZZER SCHEMATIC DIAGRAM

4.3.2 LED's

The LED's in this designed are for the indication of six outputs which is the representation of 4 zones covered as well as receiving level from transmitter and arming and disarming.

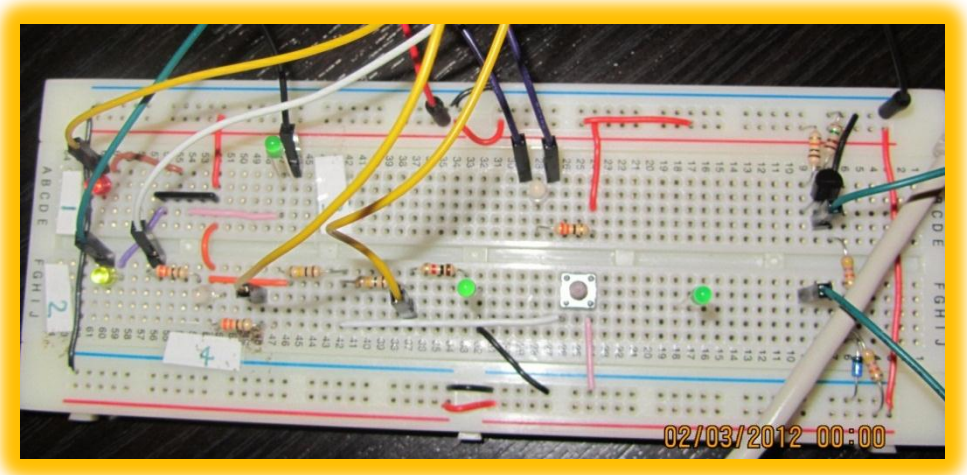


Figure 21: BREADBOARD PROTOTYPE

4.4 BUILDING THE SYSTEM ON BREADBOARD

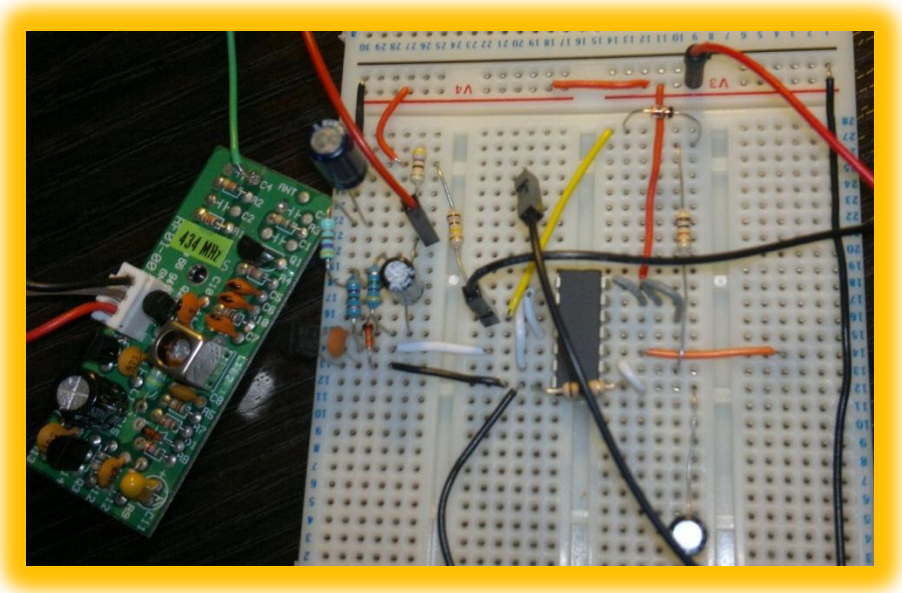


Figure 22: SCHMITT TRIGGER AND RF RX

4.5 SOLDERING THE COMPONENTS

In this stage I refer the soldering technique as soldering iron and solder, when this stage was about to be engaged, the connection parts ensured free from dirt and grease. [42]All the solder procedure were considered and the PCB itself shows off it was done properly according to the book. The Figure below shows the Control Unit when soldering completed.

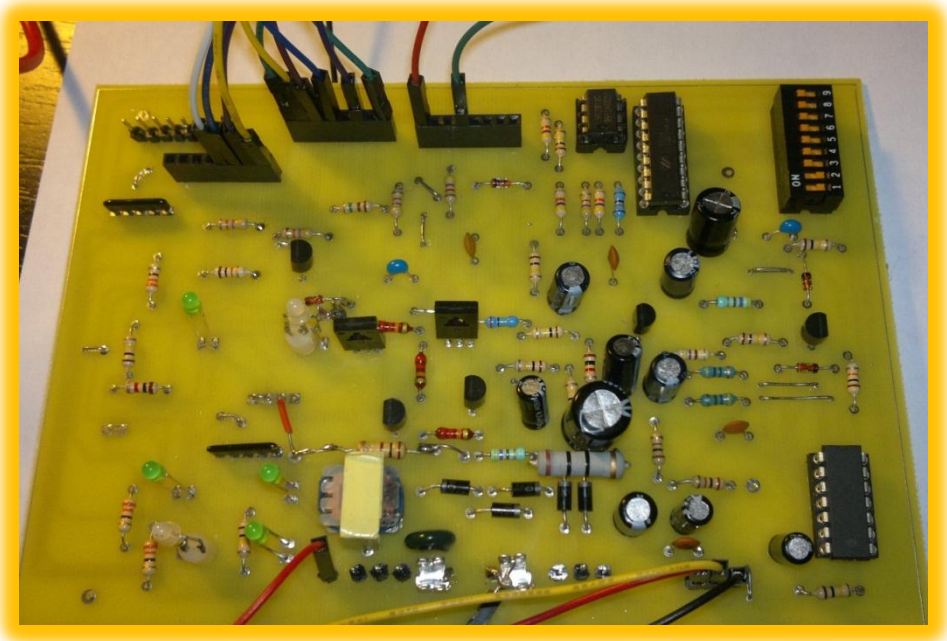


Figure 23: COMPLETE CONTROL UNIT PANEL

4.6 TESTING THE SYSTEM

When testing the system it is important to check whether there is loose soldering or any short circuit on the board and checking all components are correctly connected.

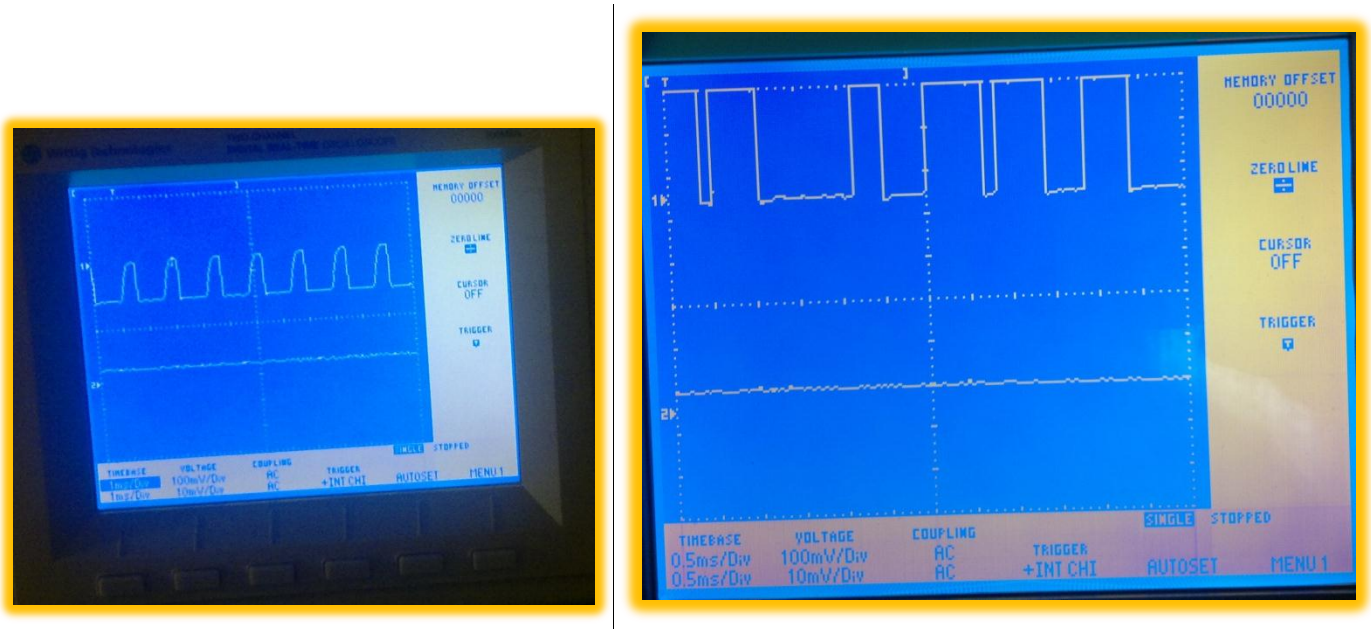


Figure 24: RECEIVED SIGNAL AND PROCESSED SIGNAL

4.7 PACKAGING[43]

The whole design is to be enclosed in a Matt black, mottled finish plastic boxes moulded in ABS and it has lipped lid to ensure a good fit and fixed by six recessed, self-tapping screws. These types of multipurpose ABS plastic enclosures boxes have slotted walls inside, to accept PCBs, etc. Then the walls of the box have a slight slant to accommodate all design which fits accordingly.[44]

Figure 25: COMPLETE PACKAGED SYSTEM

5 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 PIC and Arduino software to be applied carried out, the following sub topic represent the comparison between the PIC16F 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. [45]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[46].

5.1 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.

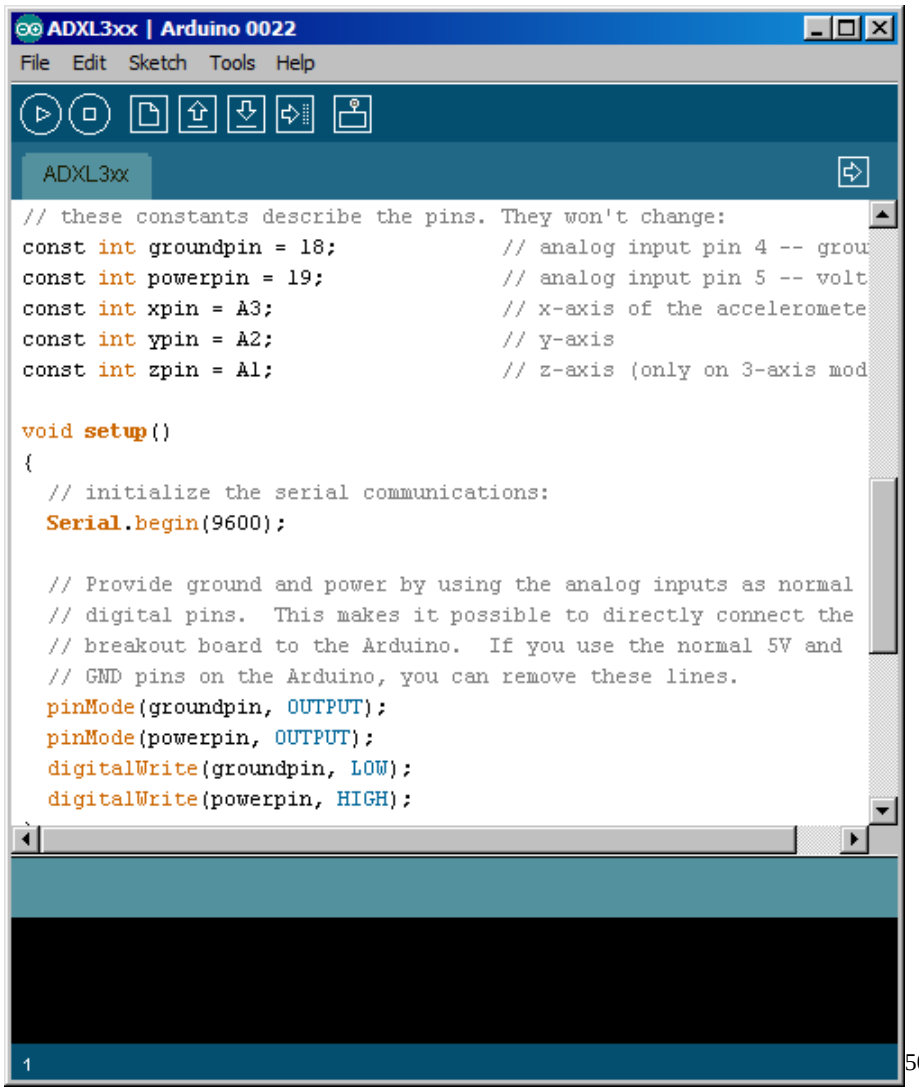
The Arduino Mega 2560 is programmed with its software from the web, it is easy to use and it is available. Its firmware is similar to C++ language, with its reference on site and the structure of the program coding was done on sketch. This sketch window, once the programmer is satisfied or would like to test, it has to be compiled and uploaded to the board through USB cable. The window on Fig 23, shows how the sketch window looks like;

5.2 ARDUINO[47]

Arduino is a programming environment that is designed to allow new to C programming language to develop complete applications with little or no knowledge of any higher level languages. Such as C+ language, it is possible to embed code written in other languages into Arduino programs. Programs written in C and assembly code can be easily embedded in Arduino.

5.3 ARDUINO SKETCH [48]

The Arduino sketch can be carried out using C language, C, basic and Arduino or a mixture of these languages. The software and programming will be required to do all the work. The most commonly used method of programming a Arduino is using a conventional sketch platform and using a libraries in the serial system. The Arduino software and sketch code environment is resident on a PC and downloaded through serial port into the Arduino board. The process or generating the code, compiling and upload it into board is invariably performed by software the same software whilst the PIC use software known as Source Boost Integrated Development Environment (IDE) using E-blocks PIC microcontroller/microprogrammer. [49]



[50]

Figure 26: ARDUINO SKETCH WINDOW

5.4 DESIGNING TOOLS

5.4.1 PROTEUS 7 PROFESSIONAL – ISIS & ARES[51]

Proteus is a software package that enables all the designs drawn to convert a schematic into a PCB layout. This software significantly reduces the time required for the process, when compared to some years back. Proteus actually consists of two main parts;

First is the **ISIS** part in Figure below, which allows drawing all the schematic, it includes components that are kept in the Proteus component library. This library contains all the details of each component such as the electrical characteristics (pin functions and pin numbers) and also physical characteristics such as sizes and shape of the components.[52]

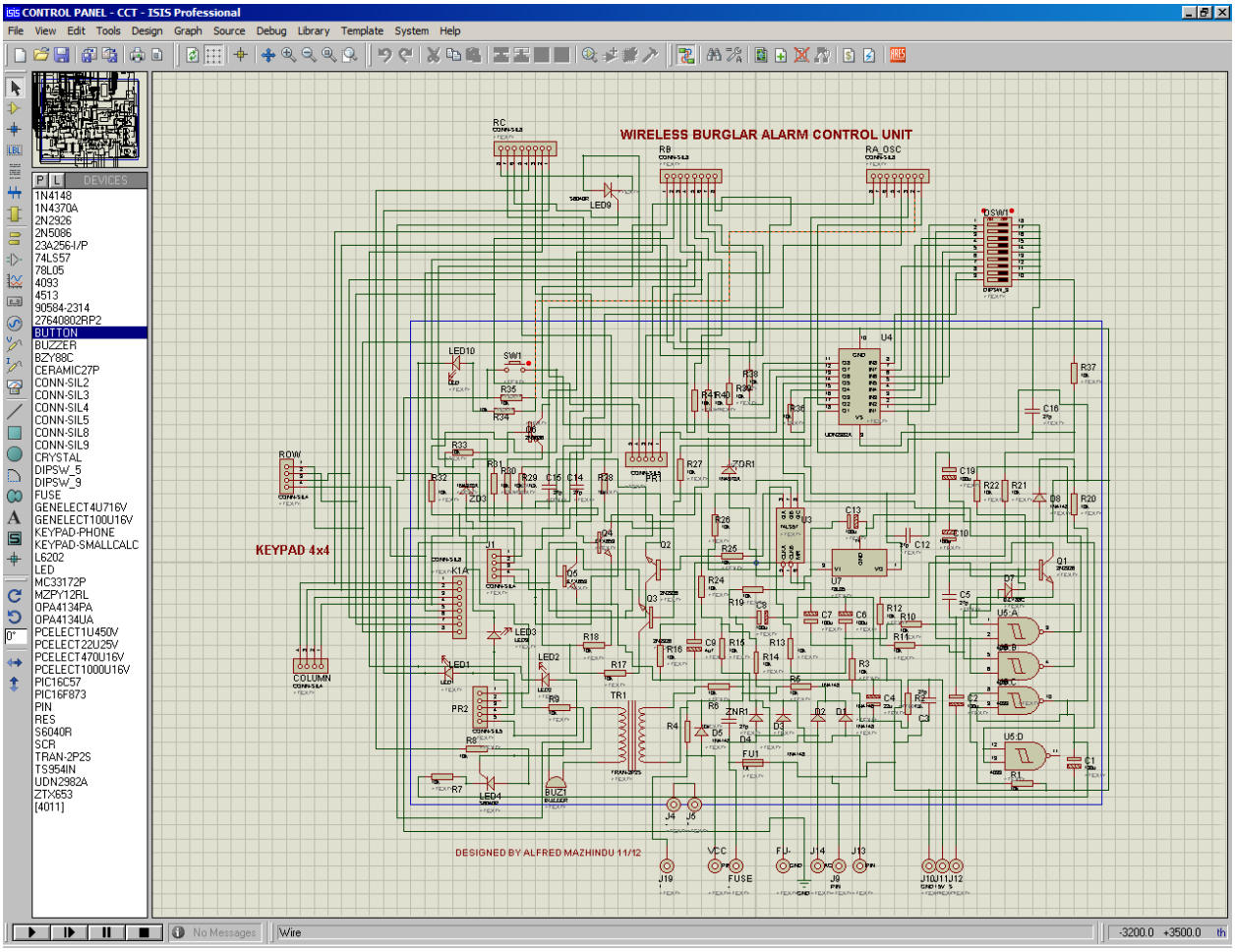


Figure 27: ISIS WINDOW

Second part of Proteus is **ARES** in Figure below is the part that allows the conversion of the schematic or circuit diagram into the PCB layout i.e. physical representation of the final circuit and as at first used the ISIS with library components, the ARES part of the software knows the size of the component and how they connect together. The final part is the layout produced by Proteus, it is exact replica of the arrangement of tracks and pads that have been actually placed on PCB and is generated almost automatically. The key notes when designing with this software are;

- Making sure that the schematic created or obtained is complete and accurate.
- Establishment of all components to be used are available and their sizes is known
- The maximum size of the PCB that can be used.

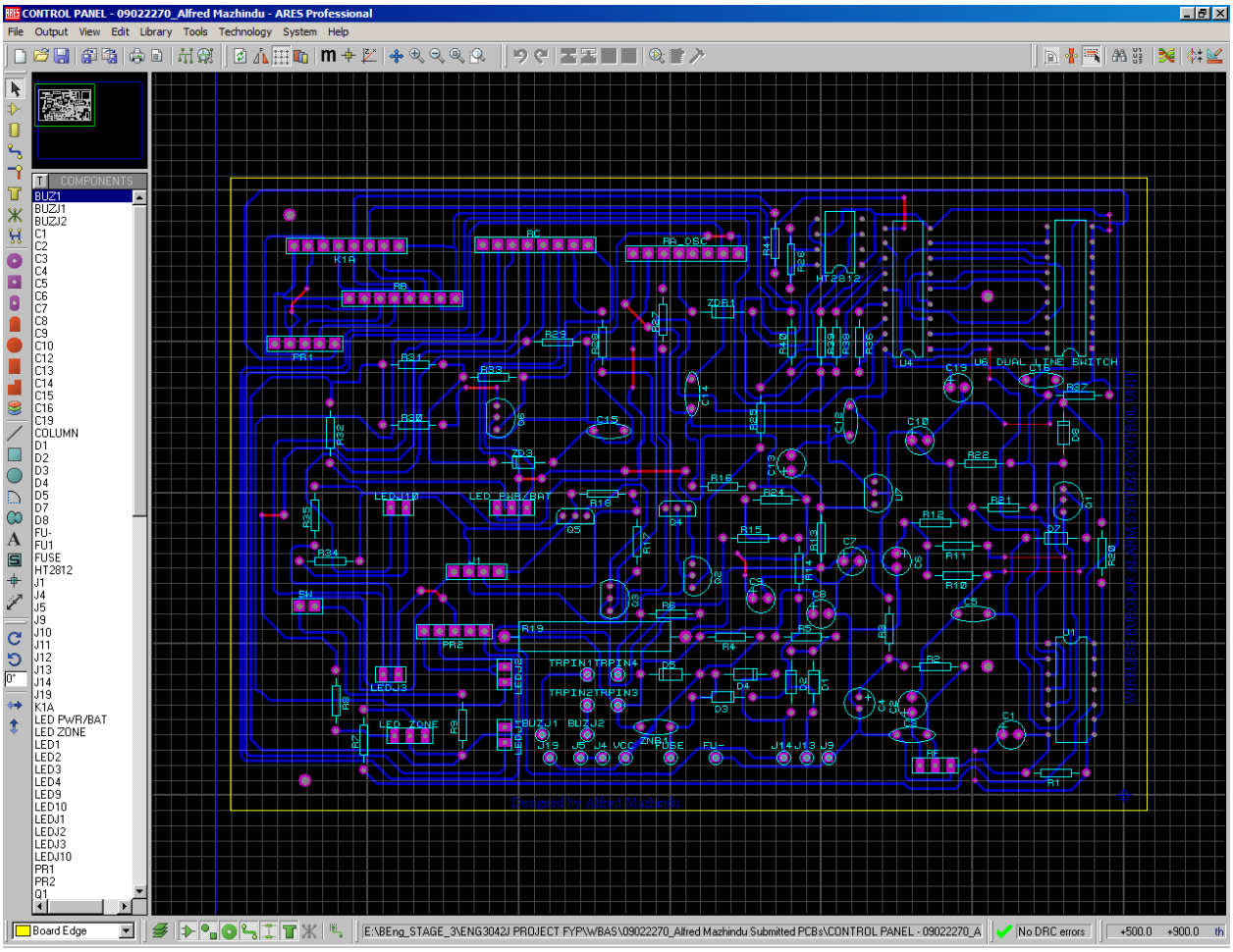
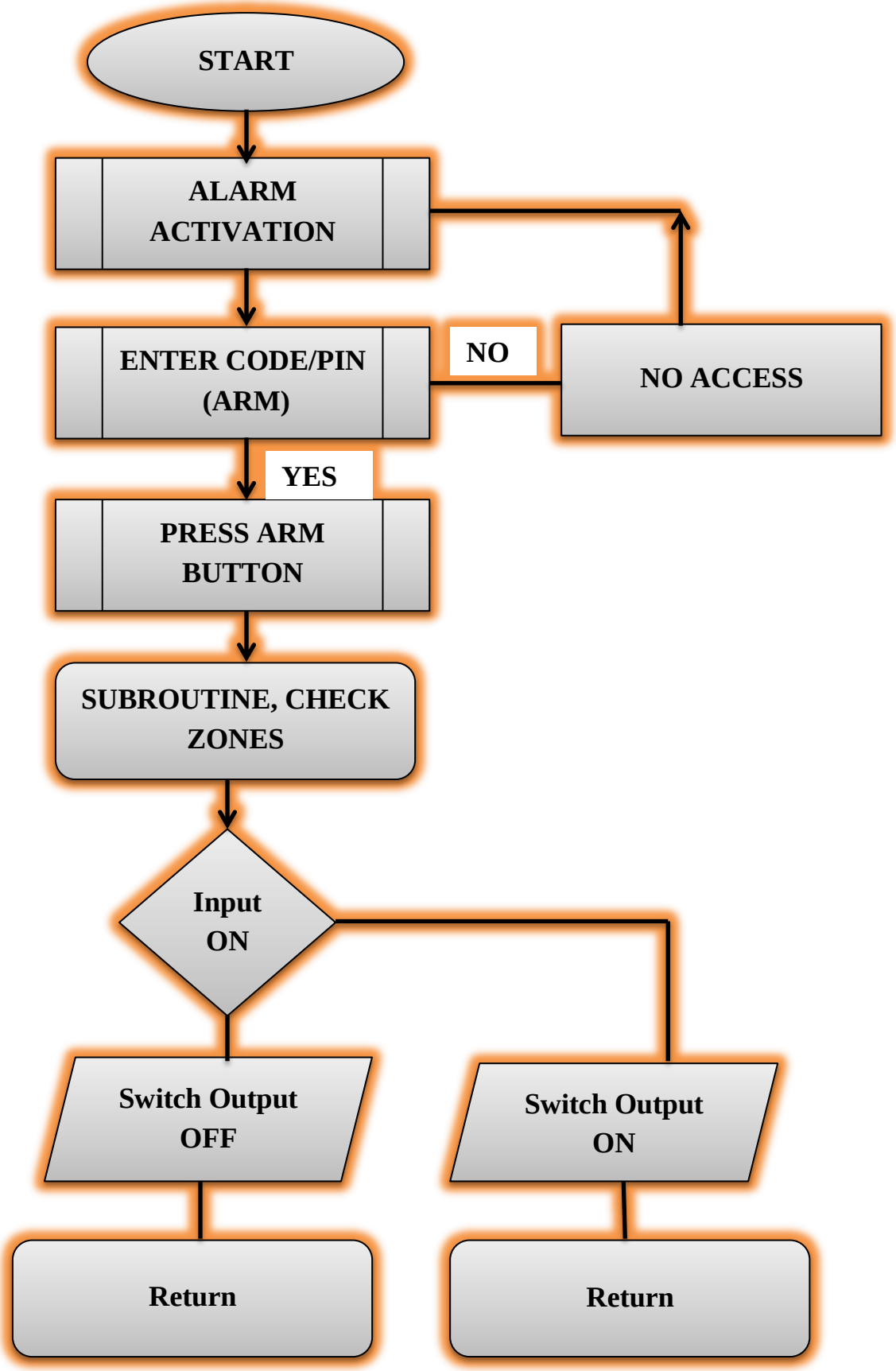


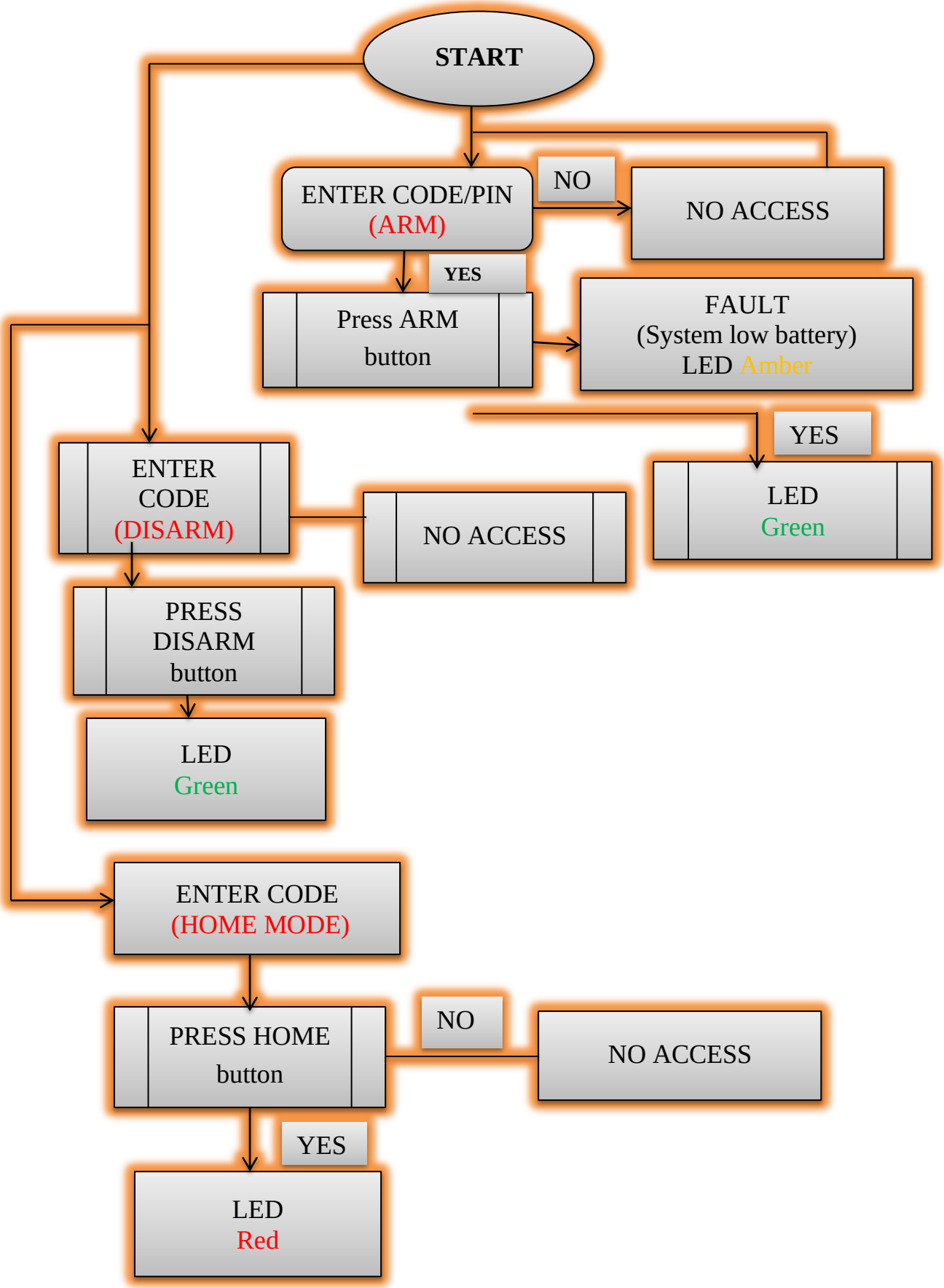
Figure 28: ARES WINDOW

5.5 SYSTEM PROGRAMMING FLOWCHART

The flowchart shows how the system has been implemented and the program code is to follow the same root as below.



The following flowchart demonstrates the chart on usage of keypad when entering data as nominated through the design.



5.6 KEYPAD SECURITY CODE/PROGRAMMING

The program code of the system is attached on Compact Disc.

6 RESULTS

The wireless system of the design is well working as it has been designed to perform, though it has achieved the objectives and goals which were set up that the hardware should do. The wireless system software was subdued with some small disturbing elements and the flow of the system completes or each task as designed through the program. However, the wireless system met some of the goals targeted and the received signal from RF module is shown through an LED and when the corresponding LED flashes when the relevant sensor has been activated. The LCD, which was a bit sceptical to configure using the Arduino sketch it is working well as designed through the program code. When such activation like sensor on PIR or MDT detects the alarm is producing a sound showing how active it is. This wireless security system represents a major improvement in protection for home and property and the use of wireless detectors provide easy and convenient method of use and enable the use of as many wireless detectors as required. The system uses very high frequency (VHF) transmission that has been specially allocated to wireless burglar alarm system. This type of digital information is unique to this system and generated by custom digital circuitry. 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. Though the system did not specifically perform what it should have according to the design but independently it is working fairly.

7 DISCUSSION

The system may also be improved in a number of ways, there is a vast room of improvement and as new product designs on the market with an equilibrium meeting the customer requirements. There is so much advantage of the system due to its four zones which may be altered to meet the customer requirements. Furthermore, it's possible for the customer or end user to understand its working condition or state and this system has an intelligent of separation of human and pets. The other advantages is that, as it is a wireless system no need for the intruder to cut the wires and easy to install because no need for the professional tech-man to drill whole house while installing the system.

8 CONCLUSION

As it is already mentioned on the objectives that the design is to construct a very simple wireless burglar alarm system which has four zones with very high frequency for domestic usage. The table below shows the results and tasks of design completed.

Table 4: CONCLUSION TABLE

AIMS AND OBJECTIVES	TASKS COMPLETED
To produce a working design of wireless burglar alarm system.	The system is a microcontroller based wireless burglar alarm system which has been achieved perfectly with slightly program code errors.
Design of the control panel which as 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 use of as many wireless detectors as required. The system uses very high frequency (VHF) transmission.	The system receives all the input signals from the sensors. It uses the frequency transmission as a medium for digital data information form system detectors and it has been specially allocated to wireless burglar alarm system.
To set the alarm for different zones of the house. To build and test its functionality and the system to contain audible only	The indication from the output devices such as LED's leads to triggering the buzzer. Once siren is activated and trapped, it will sound until the operator presses the correct code to the system keypad.
The system shall operate with the remote controller	The system is being controlled by remote control which set the mode (Arm and Disarm) and panic.
Display of any Activity on LCD	The LCD failed to be configured according to the design which puts the display aside though the active zones are indicated by LED's which an alternative way for displaying is also.

9 RECOMMENDATIONS

9.1 FURTHER WORK

Design and build a manageable and responsive functionality is an expansion process which topographies and functionalise, that could be upgraded, to offer operators with more easiness of usage and improved output.

When operating the Wireless Burglar Alarm System, the system is connected wirelessly with less voltage consumption through standalone Radio Frequency module of 434MHz.

Currently the system is implemented using Arduino programming environment and if such devices like CCTV were to be used it offers many benefits to the house or business owners. It also improves the efficiency and speed of the system in a way that the security is well updated.

The system is currently using two passive infrared and one magnetic transmitter and the optimization system that is used to detect intruders which gives results is not well generalized. If the system is improved to take into account more parameters and increase the compatibility of more detectors that would increase the efficiency of the system.

At present, the utility function

Though some progress was made in other areas of this design but there is a long way to go. There is also a need to have many sensors communicating with Arduino and PIC, both together sharing the interface and the improvement of sending data to the LCD display and Bluetooth transmission to the laptop and writing some program code using Matlab just to display the data to be a further work. It is exceptional that the Arduino software is nowadays used by Engineers, through the research and experience it is a mix of java and C code.

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[4] Walker. H.P. 1998. *Electronic Security Systems, Reducing false alarms:* 3rd Edition. United Kingdom: Newnes. Pg 194

[5] Walker. H.P. 1983. *Electronic Security Systems, Better Ways to Crime Prevention:* London: Butterworths. Pg 33

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APPENDIX

ELECTRICAL SAFETY[1]

In order to ensure that health and safety procedures are followed, I ensured that the power supply voltage is constantly at a safe voltage and correct voltage for the subsystem being tested. Ensuring that power supply is switched off whilst modifying and building the project. Also careful not operate voltage regulator IC without the heat sink, as this can get hot especially when the alarm system is at full load (alarm condition) for extended periods of time.

Making sure all components are operating within their voltage and current (power) range, and those protective resistors are used when necessary.

WASTE ELECTRONIC AND ELECTRICAL EQUIPMENT[1]

The Waste Electronic and Electrical Equipment (WEEE) directive is a European directive, with UK regulations, which aims to encourage more re-use, recycling and environmentally sound disposal of WEEE. It helps consumer's access safer and more environmentally friendly ways to dispose of unwanted electrical goods. Products covered by the WEEE directive are marked with the 'crossed out wheelie bin' symbol (Shown below).

Under the WEEE directive, all shops selling electrical products covered by the WEEE directive must help their customer to recycle old electrical goods for free. It is the same as the manufacturers should also be bind by the directive to the suppliers or retailer, to encourage greenness.

WEEE Directive and product disposal, at the end of its serviceable life, this product should not be treated as household or general waste. It should be handed over to the applicable collection point for the recycling of electrical and electronic equipment, or returned to the supplier for disposal.[1]

WEEE Logo

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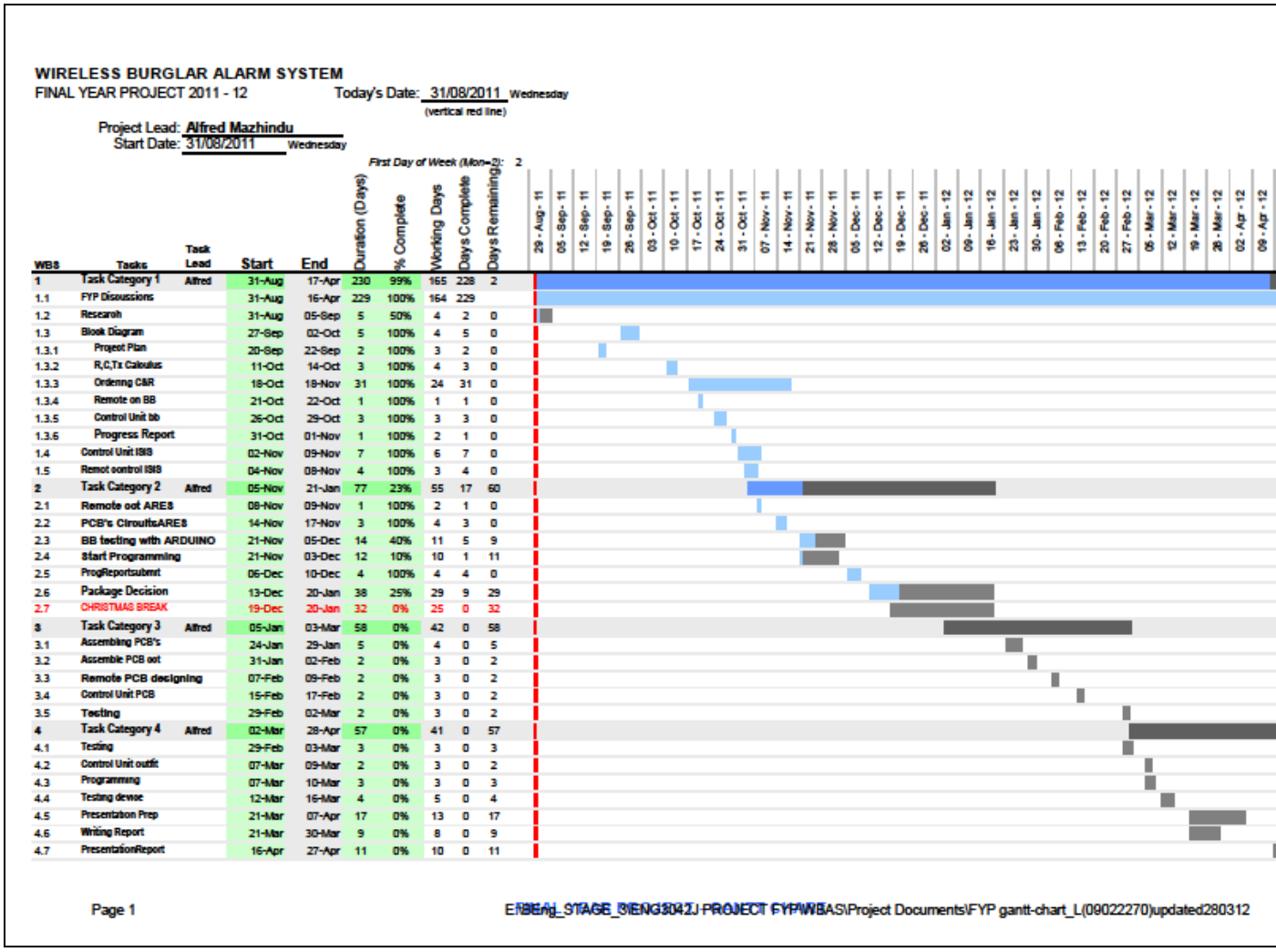


WIRELESS BURGLAR ALARM SYSTEM
FINAL YEAR PROJECT 2011 - 12 Today's Date: 31/08/2011 Wednesday
(vertical red line)

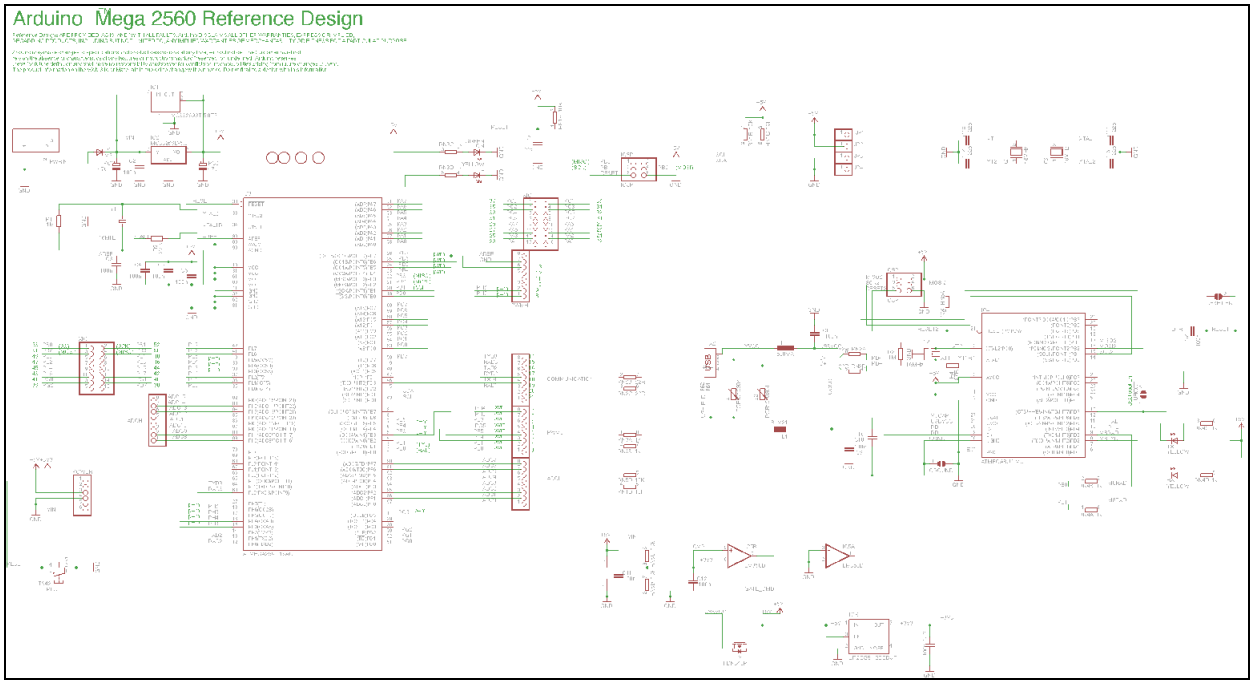
Project Lead: Alfred Mazhindu
Start Date: 31/08/2011 Wednesday

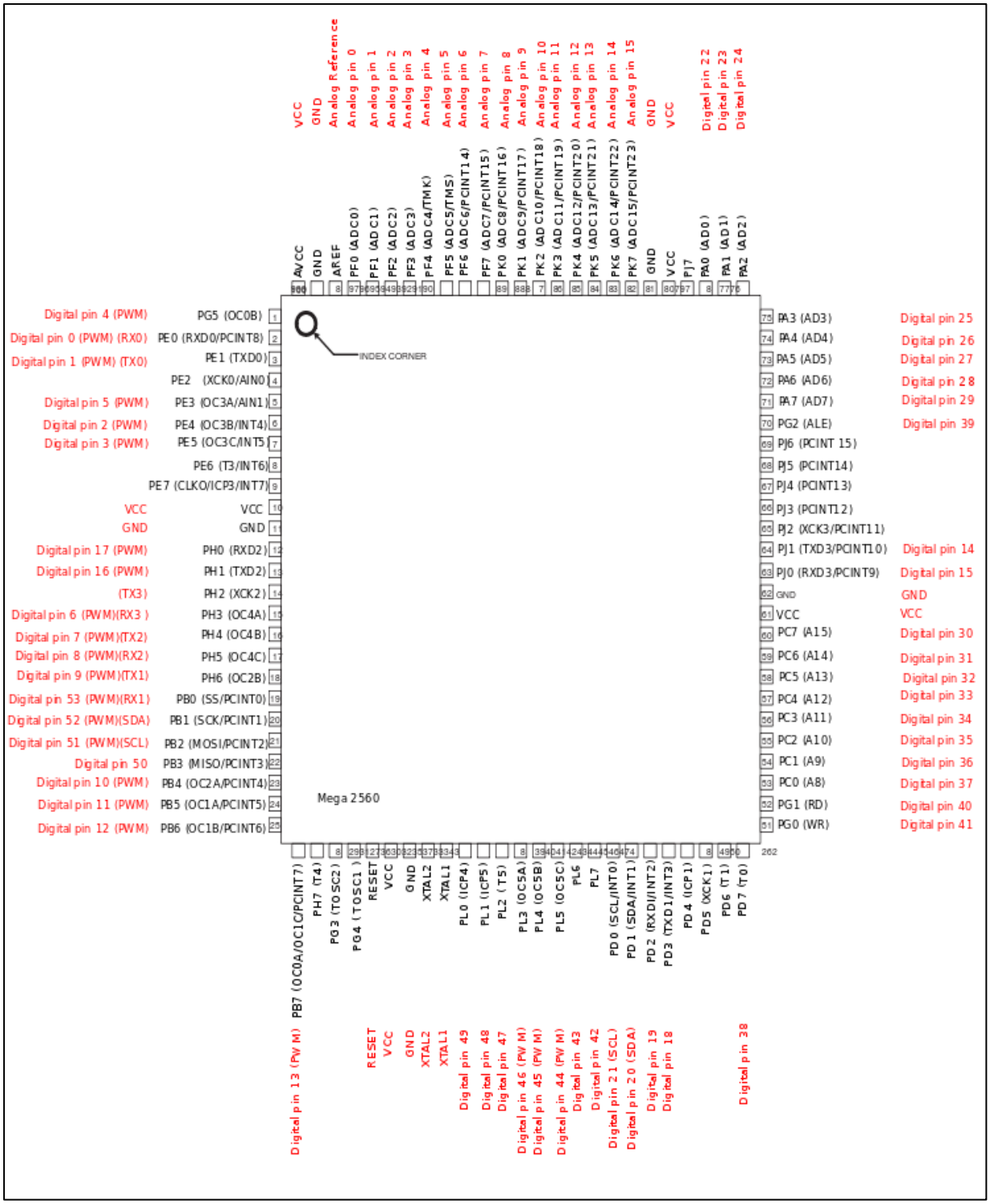
First Day of Week (Mon=2): 2

WBS	Tasks	Task Lead	Start	End	Duration (Days)	% Complete	Working Days	Days Complete	Days Remaining
1	Task Category 1	Alfred	31-Aug	17-Apr	230	99%	165	228	2
1.1	FYP Discussions		31-Aug	16-Apr	229	100%	164	229	
1.2	Research		31-Aug	05-Sep	5	50%	4	2	0
1.3	Block Diagram		27-Sep	02-Oct	5	100%	4	5	0
1.3.1	Project Plan		20-Sep	22-Sep	2	100%	3	2	0
1.3.2	R,C,Tx Calculus		11-Oct	14-Oct	3	100%	4	3	0
1.3.3	Ordering C&R		18-Oct	18-Nov	31	100%	24	31	0
1.3.4	Remote on BB		21-Oct	22-Oct	1	100%	1	1	0
1.3.5	Control Unit bb		26-Oct	29-Oct	3	100%	3	3	0
1.3.6	Progress Report		31-Oct	01-Nov	1	100%	2	1	0
1.4	Control Unit ISIS		02-Nov	09-Nov	7	100%	6	7	0
1.5	Remot control ISIS		04-Nov	08-Nov	4	100%	3	4	0
2	Task Category 2	Alfred	05-Nov	21-Jan	77	23%	55	17	60
2.1	Remote out ARES		08-Nov	09-Nov	1	100%	2	1	0
2.2	PCB's CirouitsARES		14-Nov	17-Nov	3	100%	4	3	0
2.3	BB testing with ARDUINO		21-Nov	05-Dec	14	40%	11	5	9
2.4	Start Programming		21-Nov	03-Dec	12	10%	10	1	11
2.5	ProgReportsubmit		06-Dec	10-Dec	4	100%	4	4	0
2.6	Package Decision		13-Dec	20-Jan	38	25%	29	9	29
2.7	CHRISTMAS BREAK		19-Dec	20-Jan	32	0%	25	0	32
3	Task Category 3	Alfred	05-Jan	03-Mar	58	0%	42	0	58
3.1	Assembing PCB's		24-Jan	29-Jan	5	0%	4	0	5
3.2	Assemble PCB out		31-Jan	02-Feb	2	0%	3	0	2
3.3	Remote PCB designing		07-Feb	09-Feb	2	0%	3	0	2
3.4	Control Unit PCB		15-Feb	17-Feb	2	0%	3	0	2
3.5	Testing		29-Feb	02-Mar	2	0%	3	0	2
4	Task Category 4	Alfred	02-Mar	28-Apr	57	0%	41	0	57
4.1	Testing		29-Feb	03-Mar	3	0%	3	0	3
4.2	Control Unit outfit		07-Mar	09-Mar	2	0%	3	0	2
4.3	Programming		07-Mar	10-Mar	3	0%	3	0	3
4.4	Testing device		12-Mar	16-Mar	4	0%	5	0	4
4.5	Presentation Prep		21-Mar	07-Apr	17	0%	13	0	17
4.6	Writing Report		21-Mar	30-Mar	9	0%	8	0	9
4.7	PresentationReport		16-Apr	27-Apr	11	0%	10	0	11

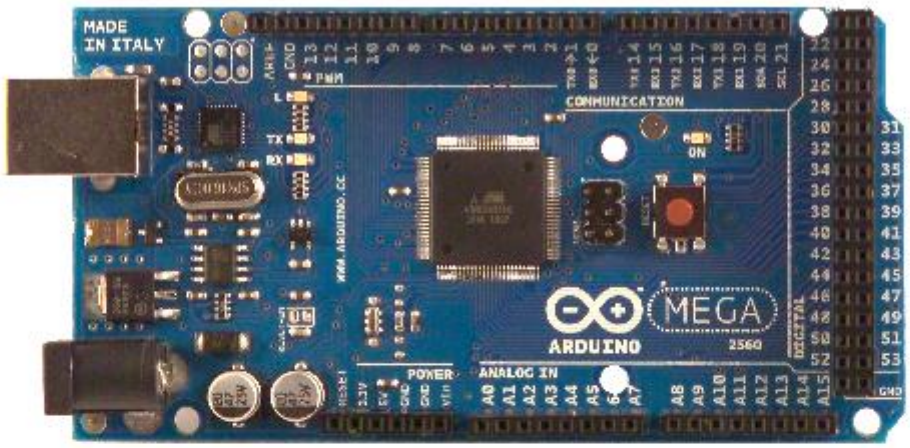
Page 1

E:\Eng_STAGE_3\ENG3042J PROJECT FYP\WBAS\Project Documents\FYP gantt-chart_L(09022270)updated280312


Arduino Mega 2560 Reference Design



Arduino MEGA 2560



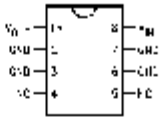
CE

Product Overview

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, 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. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

Index

- **3-Terminal Regulators**
- **Output Current up to 100 mA**
- **No External Components**
- **Internal Thermal-Overload Protection**
- **Internal Short-Circuit Current Limiting**
- **Provided Pb-Free packages from the end of 2004**



description

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. In addition, they can be used with power-pass elements to make high-current voltage regulators. One of these regulators can deliver up to 100 mA of output current. The internal limiting and thermal-shutdown features of these regulators make them essentially immune to overload. When used as a replacement for a zener diode-resistor combination, an effective improvement in output impedance can be obtained, together with lower bias current.

electrical characteristics at specified virtual junction temperature, V_I = 10 V, I = 40 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T ‡				UNIT
			MIN	TYP	MAX	
Output voltage		25°C	4.8	5	5.2	V
	o	Full range	4.75		5.25	
	I_O = 1 mA to 70 mA	Full range	4.75		5.25	
Input voltage regulation	V_I = 7 V to 20 V	°		32	150	
	V_I = 8 V to 20 V			26	100	
Ripple rejection	V_I = 8 V to 18 V, f = 120 Hz	25°C	41	49		dB
Output voltage regulation	I_O = 1 mA to 100 mA	°		15	60	
	I_O = 1 mA to 40 mA			8	30	
Output noise voltage	f = 10 Hz to 100 kHz	25°C		42		µV
Dropout voltage		25°C		1.7		V
		25°C		3.8	6	
		125°C			5.5	
Bias current change	V_I = 8 V to 20 V	range			1.5	
	I_O = 1 mA to 40 mA				0.1	

‡ Pulse-testing techniques maintain T_J as close to T_A as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.1-µF capacitor across the output. Full range for the 78L05 is T_J = 0°C to 70°C

TOSHIBA 2SC1815

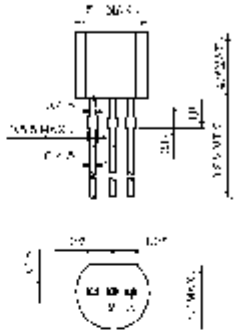
TOSHIBA TRANSISTOR SILICON NPN EPITAXIAL TYPE (PCT PROCESS)

2SC1815

AUDIO FREQUENCY GENERAL PURPOSE AMPLIFIER APPLICATIONS.
DRIVER STAGE AMPLIFIER APPLICATIONS.

- High Voltage and High Current
  : V_{CEO} = 50V (Min.), I_C = 150mA (Max.)
- Excellent h_{FE} Linearity
  : $h_{FE(2)}$ = 100 (Typ.) at V_{CE} = 6V, I_C = 150mA
  : h_{FE} (I_C = 0.1mA) / h_{FE} (I_C = 2mA) = 0.95 (Typ.)
- Low Noise : NF = 1dB (Typ.) at f = 1kHz
- Complementary to 2SA1015 (O, Y, GR class)

Unit in mm



1. EMITTER
2. COLLECTOR
3. BASE

JEDEC	TO-92
EIAJ	SC-43
TOSHIBA	2-5F1B

Weight : 0.21g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	50	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	150	mA
Base Current	I_B	50	mA
Collector Power Dissipation	P_C	400	mW
Junction Temperature	T_j	125	°C
Storage Temperature Range	T_{stg}	−55~125	°C

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	V_{CB} = 60V, I_E = 0	—	—	0.1	μA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 5V, I_C = 0	—	—	0.1	μA
DC Current Gain	$h_{FE(1)}$ (Note)	V_{CE} = 6V, I_C = 2mA	70	—	700	
	$h_{FE(2)}$	V_{CE} = 6V, I_C = 150mA	25	100	—	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 100mA, I_B = 10mA	—	0.1	0.25	V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	I_C = 100mA, I_B = 10mA	—	—	1.0	V
Transition Frequency	f_T	V_{CE} = 10V, I_C = 1mA	80	—		MHz
Collector Output Capacitance	C_{ob}	V_{CB} = 10V, I_E = 0, f = 1MHz	—	2.0	3.5	pF
Base Intrinsic Resistance	$r_{bb'}$	V_{CE} = 10V, I_E = −1mA, f = 30MHz		50		Ω
Noise Figure	NF	V_{CE} = 6V, I_C = 0.1mA, f = 1kHz, R_G = 10kΩ	—	1.0	10	dB

Note : h_{FE} Classification O : 70~140 Y : 120~240 GR : 200~400 BL : 350~700

961001EAA2

1997-04-10 1/3

Transistors

2SC5662 / 2SC4726 / 2SC4083 / 2SC3838K / 2SC4043S

High-Frequency Amplifier Transistor (11V, 50mA, 3.2GHz)

2SC5662 / 2SC4726 / 2SC4083 / 2SC3838K / 2SC4043S

●Features

1) High transition frequency. (Typ. fr= 1.5GHz)
2) Small rbb'·Cc and high gain. (Typ. 4ps)
3) Small NF.

● Absolute maximum ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Collector-base voltage		V_{CBO}	20	V
Collector-emitter voltage		V_{CEO}	11	V
Emitter-base voltage		V_{EBO}	3	V
Collector current		I_C	50	mA
Collector power dissipation	2SC5662, 2SC4726	P_C	0.15	W
	2SC4083, 2SC3838K		0.2	
	2SC4043S		0.3	
Junction temperature		Tj	150	°C
Storage temperature		Tstg	−55~+150	°C

●Packaging specifications and hFE

Type	2SC5662	2SC4726	2SC4083	2SC3838K	2SC4043S
Package	VMT3	EMT3	UMT3	SMT3	SPT
hFE	NP	NP	NP	NP	P
Marking	AD	AD	TD	AD	-
Code	T2L	TL	T106	T146	TP
Basic ordering unit (pieces)	8000	3000	3000	3000	5000

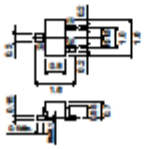
●External dimensions (Units : mm)

2SC5662

ROHM : VMT3

(1) Base
(2) Emitter
(3) Collector

2SC4726



ROHM : EMT3
EIAJ : SC-75A

(1) Emitter
(2) Base
(3) Collector

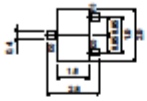
2SC4083

ROHM : UMT3
EIAJ : SC-70

(1) Emitter
(2) Base
(3) Collector

Each lead has same dimensions

2SC3838K

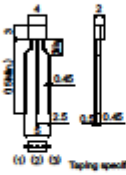


ROHM : SMT3
EIAJ : SC-59

(1) Emitter
(2) Base
(3) Collector

Each lead has same dimensions

2SC4043S



ROHM : SPT
EIAJ : SC-72

(1) Emitter
(2) Collector
(3) Base

Taping specifications

ROHM

2SD882

NPN medium power transistor

Features

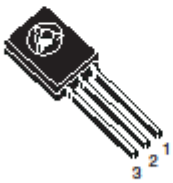
- High current
- Low saturation voltage
- Complement to 2SB772

Applications

- Voltage regulation
- Relay driver
- Generic switch
- Audio power amplifier
- DC-DC converter

Description

The device is a NPN transistor manufactured by using planar technology resulting in rugged high performance devices. The complementary PNP type is 2SB772.



SOT-32
(TO-126)

Figure 1. Internal schematic diagram

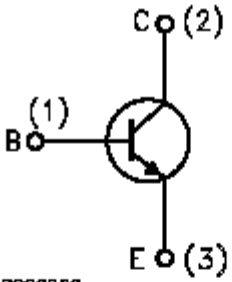


Table 1. Device summary

Order code	Marking	Package	Packing
2SD882	D882	SOT-32	Tube

October 2007 Rev 3 1/8
www.st.com

HOLTEK

HT2812
Single Sound Generator

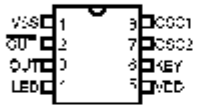
Features

- Single power supply: 2.4V~3.3V
- Low standby current at 3V, 1μA (Typ.)
- Auto power-off function
- Speaker or direct piezo application
- Built-in envelope control circuit
- 1Hz~8Hz programmable LED flash output
- Minimum external components

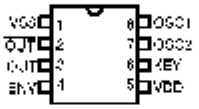
General Description

The HT2812 is a CMOS LSI chip designed for use in sound effect products. It is equipped with tone circuit, noise circuit, and other control logic to generate different sounds including rifle gun, machine gun, booming sound, door bell, alarm etc. The customer supplied sound source can be analyzed and programmed into an internal ROM by changing a mask layer during device fabrication. The HT2812 is suitable for various toy applications.

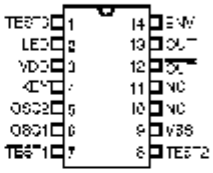
Pin Assignment



HT2812
– 8 DIP

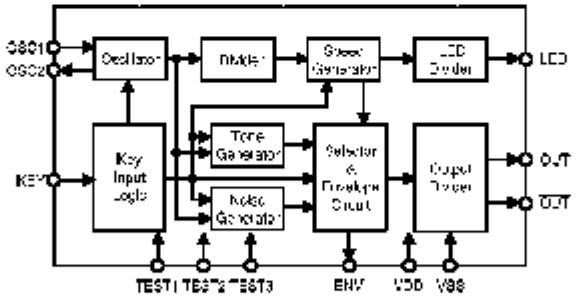


HT2812
– 8 DIP



HT2812
– 14 DIP

Block Diagram



HOLTEK

HT6010/HT6012/HT6014
3^{12} Series of Encoders

Features

- Operating voltage: 2.4V~12V
- Low power and high noise immunity CMOS technology
- Low standby current
- Minimum transmission word
  - Four words for $\overline{TE}$ trigger
  - One word for Data trigger
- Built-in oscillator needs only 5% resistor
- Easy interface with an RF or an infrared transmission medium
- Minimal external components
- Pair with Holtek's 3^{12} series of decoders
- 18-pin DIP, 20-pin SOP package

Applications

- Burglar alarm system
- Smoke and fire alarm system
- Garage door controllers
- Car door controllers
- Car alarm system
- Security system
- Cordless telephones
- Other remote control systems

General Description

The 3^{12} encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding 12 bits of information which consists of N address bits and 12-N data bits. Each address/data input is externally trinary programmable if bonded out. They are otherwise set floating internally. Various packages of the 3^{12} encoders offer flexible combinations of programmable address/data which meet various applications. The programmable address/data is transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. A $\overline{TE}$ (HT6010) or a DATA (HT6012/HT6014) trigger can be selected for application flexibility.

Selection Table

Function / Part No.	Address No.	Address/ Data No.	Data No.	Oscillator	Trigger	LED Indicator	Package
HT6010	8	4	0	RC oscillator	$\overline{TE}$	No	18DIP, 20SOP
HT6012	10	0	2	RC oscillator	D10~D11	Yes	18DIP, 20SOP
HT6014	8	0	4	RC oscillator	D8~D11	Yes	18DIP, 20SOP

Note: Address/Data represents pins that can be either address or data according to the application requirement.

HOLTEK

HT6030/HT6032/HT6034
3^{12} Series of Decoders

Features

- Operating voltage: 2.4V~12V
- Low power and high noise immunity CMOS technology
- Low standby current
- Capable of decoding 12 bits of information
- 8~12 address pins
- 0~4 data pins
- Trinary address setting
- Received data are checked two times
- Built-in oscillator needs only 5% resistor
- VT goes high during a valid transmission
- Easy interface with an RF or an infrared transmission medium
- Minimal external components
- Pair with Holtek's 3^{12} series of encoders
- 18-pin DIP, 20-pin SOP package

Applications

- Burglar alarm system
- Smoke and fire alarm system
- Garage door controllers
- Car door controllers
- Car alarm system
- Security system
- Cordless telephones
- Other remote control systems

General Description

The 3^{12} decoders are a series of CMOS LSIs for remote control system applications. They are paired with 3^{12} series of encoders. For proper operation a pair of encoder/decoder with the same number of address and data format should be selected (refer to the encoder/decoder cross reference tables).

The 3^{12} series of decoders receive serial address and data from its corredponding series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. Then it compares the serial input information twice continuously with its local address. If no errors or unmatched codes are encountered, the input data codes are decoded and transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

The 3^{12} series of decoders are capable of decoding 12 bits of information that consists of N bits of address and 12−N bits of data. To meet various applications they are arranged to provide a number of data pins ranging from 0 to 4 and an address pin ranging from 8 to 12. Thus, various combinations of address/data number are available in different packages.

Selection Table

Function / Part No.	Address No.	Data No.	Data Type	VT	Oscillator	Trigger	Package
HT6030	12	0	—	√	RC oscillator	DIN active "Hi"	18DIP, 20SOP
HT6032	10	2	L	√	RC oscillator	DIN active "Hi"	18DIP, 20SOP
HT6034	8	4	L	√	RC oscillator	DIN active "Hi"	18DIP, 20SOP

Note: Data type: L stands for latch type data output.
VT can be used as a momentary data output.

MC14093B

Quad 2-Input "NAND" Schmitt Trigger

The MC14093B Schmitt trigger is constructed with MOS P–channel and N–channel enhancement mode devices in a single monolithic structure. These devices find primary use where low power dissipation and/or high noise immunity is desired. The MC14093B may be used in place of the MC14011B quad 2–input NAND gate for enhanced noise immunity or to "square up" slowly changing waveforms.

Features

- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low–Power TTL Loads or One Low–Power Schottky TTL Load Over the Rated Temperature Range
- Triple Diode Protection on All Inputs
- Pin–for–Pin Compatible with CD4093
- Can be Used to Replace MC14011B
- Independent Schmitt–Trigger at each Input
- Pb–Free Packages are Available*

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range	−0.5 to +18.0	V
V_{in}, V_{out}	Input or Output Voltage Range (DC or Transient)	−0.5 to V_{DD} + 0.5	V
I_{in}, I_{out}	Input or Output Current (DC or Transient) per Pin	±10	mA
P_D	Power Dissipation, per Package (Note 1)	500	mW
T_A	Ambient Temperature Range	−55 to +125	°C
T_{stg}	Storage Temperature Range	−65 to +150	°C
T_L	Lead Temperature (8–Second Soldering)	260	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Temperature Derating:
   Plastic "P and D/DW" Packages: – 7.0 mW/°C From 65°C To 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high–impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

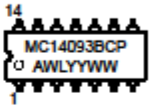
*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor®

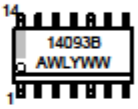
http://onsemi.com

MARKING DIAGRAMS

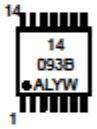
PDIP–14
P SUFFIX
CASE 646



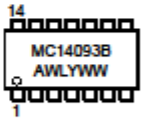
SOIC–14
D SUFFIX
CASE 751A



TSSOP–14
DT SUFFIX
CASE 948G



SOEIAJ–14
F SUFFIX
CASE 965



A – Assembly Location
WL, L – Wafer Lot
YY, Y – Year
WW, W – Work Week

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

February, 2005 – Rev. 5

Publication Order Number:
MC14093B/D

PIC16C5X

Data Sheet

EPROM/ROM-Based 8-bit CMOS

Microcontroller Series

 Preliminary DS30453D