DESIGN AND CONSTRUCTION OF A VOICED INTRUDER ALARM

BY

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DEDICATION

I hereby dedicate this project to the Almighty God , my father above, the creator of Heaven and Earth, the one who moulds and shapes the destines of men; it is him that deserves all thanks and praise. Also to my lovely dearest parents, Late Mr. Joseph Muoka and Mrs. Victoria Muoka, for the solid foundation they have given to me and to my lovely siblings.

DECLARATION

I, Anibude Chibueze Barnabas, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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To my father in heaven, the creator of Heaven and Earth, the one who moulds and shapes the destinies of men; it is you that deserve all the praise and glory, for the favor, protection and honor you have bestowed upon me at this point in my life...God, I bless your name. Jesus, I thank you.

My parents; Late Mr. Joseph Muoka (May his gentile soul rest in peace, Amen) & Mrs. Victoria Muoka, words are definitely not enough to appreciate and thank you for your prayers, support and the trust you both have given to me. I look at both of you and you give me every reason to want to excel in life, you both undoubtedly are the best. I love you both. My prayer is that I continue to be a source of joy to you.

What can I do without my siblings; Amaka, Chikaodi, Onyebuchi, Chinweike and Chizoba, the five of you are my source of inspiration, my joy and my hope. I love you guys eternally. Together, the six of us are going to affect our generation positively and we are definitely bound to be at the top.

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To the class of 2009 graduates of Electrical and Computer Engineering; the top is where all of us belong; I will definitely miss you all.

Engr. A.S Raji, my best lecturer in the department, I pray that God bless you and all other lecturers in the department and Mr. Zungeru, God bless you.

Dayo, Chinenye, Elis, Bimbo, Sammy, Debby, Ngozi, Pius, Abey, Seyi, Efizzy, Ogochukwu and Abdul-Shalams : we remain friends for life.

ABSTRACT

This thesis: Design and Construction of an Intruder voiced alarm works on the basis of the thermal energy emitted in form of infrared rays by the human body which is sensed by the Pyroelectric sensor (PIR 325). This PIR sensor and its focusing lens (FL65) forms the core devices in this implementation. Once there is an intrusion across the sight of the sensor an analogue output is produced which is digitized by the ADC0804 and inputted to a microcontroller that compares the signal to a set threshold to fully concede that this is a human body. Connected to output port of the microcontroller is the edge triggered play input of a voice recording chip (ISD25120) on which has been stored a user defined message that should be replayed on command from the microcontroller once a true intrusion is detected. For a better sound output a TDA2822 audio power amplifier was connected between the ISD25120 and 16v speaker. The unit works off a 240v 50Hz a.c supply and a redundant battery supply. The system regulated power supply is +5v d.c and is realized using a 15v 2A step-down transformer, bridge rectifier and an LM317 voltage regulator.

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CHAPTER ONE

1.0 INTRODUCTION

The design and construction of a voiced intruder alarm is an implementation of a model that is used to detect intrusion into a monitored space and to consequently generate an automatic playback of a prerecorded audio message as an alarm. This model is designed in such a way that any individual can easily employ its services because of the RF remote controller interfaced to the system unit. As it is well known that our doors and windows do not really impede rogues from invading our homes and properties, therefore the need for an intruder alarm is inevitable.

Obviously, being one of the people whose doors have been burgled more than twice when neighbors are asleep ,have actually lead to the development of this idea, that is the design and construction of voiced intruder alarm. In the same manner, it has been established that in various personal offices where important files are kept, unauthorized entrance in such zone can be deterred using a piece of this work in that zone.

This model has an infrared sensing module that samples the infrared rays emitted by a black body detected and compares it to that of a human body which is between 8μm to 14μm [1], and if it matches to that the alarm system is triggered which in turn plays a stored message continuously to alert everyone in that vicinity.

A battery and its charging was also incorporated into this model to serve as a DC redundant supply when there is AC supply interrupt to the alarm system.

1.1 HISTORICAL BACKGROUND

Sir Fredrick Williams Hershel, the German born Royal astronomer, in 1800 discovered infrared radiation when he worked for the Royal navy [2]. He generated the radiation by vibration and rotation of the atoms and molecules within some materials at temperature above absolute zero; that is 0^0K or 273^0c. Hershel referred to the new portion of the spectrum (this infrared radiation) by such names as "invisible rays", "radiant heat", "dark heat and "the rays that occasion heart".

Many of the early experiments searched similarities between infrared energy and visible light. In 1847, Armand Hippolyte Louis Fizeau and Jean Bernard Leon Foucault of France showed finally that infrared radiation exhibited interference effects in exactly the same way as visible light. It has also been revealed among other things that infra-red radiation is reflected and refracted just like the visible light.

Today, after increasing emphasis on the research, design and improved technology, infrared find use in: material analysis, thermal imaging, remote temperature sensing and communication.

Material analysis: many complex molecules absorb infrared energy at specific wavelengths. This characteristic permits rapid identification of material without the use of chemicals and without destroying the material.

Thermal imaging: infrared scanning instrument (or image-forming cameras) produces thermal picture of their targets. Medical application of this include remote thermal mapping of human body temperature. Areas that exhibit abnormally high or low temperature are readily revealed and analyzed for body malfunctioning or disease. Also infrared microscope permits thermal mapping of very small objects such as transistors or micro-circuits.

Devices that exhibit localized and excessive high temperature are discarded as defective.

Communications: modulated sources of infrared energy provide highly directional infrared beam that can be detected only by the receiver at which they are aimed, thus providing a high degree of privacy.

Remote temperature sensing: radiation emitted by an object is a unique function of its temperature. The infrared radiometer or Pyrometer collects and measures the radiation from a target to determine its temperature. Versions of the infrared radiometer have been used to detect fires, plot ocean surface temperature from air craft and detect over-heated bearings on rail road vehicles as they move at high speed.

Militating application of radiometer are used at night or during the day when vision is diminished by fog, haze, smoke or dust. Also military applications of radiometer are found in heat-seeking missiles, aircraft and missiles tracker, aiming devices for locating vehicles and people in the dark and for gun fire control.

The radiometer remote temperature sensing brought about its application in an intruder alarm.

In 1858, a man named Edwin Holmes invented and installed the world's first intruder alarm. This invention occurred in a tiny factory in Boston, Massachusetts [3]. A spring was released upon the opening of a window or door which will then close an electric circuit [3].

Years afterwards, there were improvements upon this. Today there are many different types of intruder alarm that not only signifies intrusion but also alert the appropriate authorities of fire outbreak, natural disaster or even illness or fall.

1.2 PROJECT AIM AND OBJECTIVES

The aim of the project is to design and construct an intruder alarm system (voiced) using passive infrared based (PIR) sensor.

The design objectives are:

- To detect and deter intrusions into a monitored space –commercial or residential-at all time (day or night) by reading the thermal energy profile generated by the intruder. The audio playback incorporated into the implementation provides instant alert to the owner or management of the monitored zone
- To curb the menace, unnecessary fear and anxiety posed by intruders.
- To design an alarm system that is cost effective and as such affordable using discrete components that is readily available in the local market.

1.3 METHODOLOGY

The design and construction of a voiced intruder alarm indeed called for severe search of relevant materials and information. These useful information and important facts proffered solution to this particular problem as it affected some specification of the targeted design.

As a project that entailed putting into functional structure, where it performs function of detecting motion in a monitored environment. The voiced intruder alarm needed to be realized by a simple pattern of design which led to the choice of components available.

The design took off properly by first designing the block diagram which was achievable for the project design. The circuit diagram of each block was able to be realized, followed by the calculations involved at each stage. Preamble tests were not left out which helped to ascertain the workability of the design. Errors were detected and corrected on the breadboard which added to the final decision taken on the values of the components used. Followed with this, was the layout and positioning of the components on the veroboard which ensured good space management and wiring. Soldering was subsequently done on the veroboard as well. Testing was carried out again at the end of the implementation to reassure the efficient and effective functionality of the designed project. The testing corresponded to the various functions of the project like activating and deactivating of the sensing module.

1.4 Scope of study

The project work is going to be limited to banks and museum in the country and worldwide. This design work is targeted at providing a device that could be presented as a final year project. However, a well finished design with intrusion detection can profitably be marketed to the general public. This study is centralized on the area of motion detectors which are infrared based.

1.5 Sources of Material

Datasheet of all the IC's used in the project was of good help because it gave a good insight about the property of the IC's and the requirement for good working condition. Studies of textbooks, past project from the departmental and school libraries was very necessary in the design of the power supply and the RF handheld remote controller that activates the sensing module. Journals, magazines and materials from the internet were also employed to make the project a good reference material for people in the department, school and other schools who want to improve on this particular project or simpler ones for the benefit of man in his environment. My colleagues were also good source during times of sharing ideas.

CHAPTER TWO

2.0 LITERATURE REVIEW / THEORITICAL BACKGROUND

2.1 Evolution of Intruder Alarm

In the 18th century, a man named Edwin Holmes invented and installed the world's first intruder alarm. This invention occurred in a tiny factory in Boston, Massachusetts [2]. A spring was released upon the opening of a window or door which will close an electric circuit [2]. The limitation encountered in this invention is that it is a mechanical type of motion detection which can be false triggered by wind and it gets easily worn out.

Thanks to Sir Fredrick Williams Hershel, the German born British astronomer that discovered infra-red radiation when he worked for the royal navy [3] and today after increasing emphasis on the research, design and improved technology, there are improvements on the work of Edwin Holmes.

Today there are many different types of intruder alarm that not only signifies intrusion (i.e. motion detection) but also alert the appropriate authorities of fire outbreak, natural disaster and 60% of most of them uses infra-red beam [3].

2.2 Description of other relevant works in literature.

Recently, intruder alarm of this generation widely uses infra-red beams in motion detection applications. In addition, they are designed to play a polyphonic type of musical notes as alarm which is already stored in an electronic chip.

Engr. Abdul-Aziz Yusuf Momoh in 2008 from Electrical / Computer Engineering Department, Minna, designed a voiced burglar alarm system using the dual beam infrared sensor which detects apparent motion when an infrared beam radiated from an Infra-red transmitter is broken [4].

Another Engr. A. John in 2005 from same department designed a burglar alarm system with this same break beam principle but without a playback of any prerecorded voice as alarm but rather a polyphonic sound (e.g. siren).

2.2.1 My improvement and Contributions over previous intruder alarms

This project is a deviation sort of from other intruder alarm system previously done in this department for three (3) reasons:

It incorporates a Pyroelectric Infra-red (PIR) based sensor which detects thermal energy radiated by a black body not the normal dual beam infrared sensor which detects apparent motion when an infrared beam radiated from an infrared transmitter is broken. This dual beam principle can easily be false triggered by any insect e.g. housefly. But the PIR sensor measures the thermal energy radiated by the living that passes, compares it to that of a human body (14μm) and if it matches, it triggers the alarm system.

Secondly, this project incorporates a predefined voice alert system with the aid of an audio message storage device (ISD 25120) IC. This is an improvement upon previous projects that uses a polyphonic music or no voice playback alarm system at all (beep sounds). Consequently, playback of the recorded predefined voice helps to create an extreme cautionary note to any intruder in a monitored environment as well as security personnel in the zone.

Finally, to facilitate easy, convenient, and medium range activation/deactivation of the sensing module, a wireless RF remote scheme was implemented.

2.3 THEORETICAL BACKGROUND

We have been talking about motion detection device, what are they? Motion detection device are devices that can sense the changes in the normal wave pattern of an area and gives a signal to show that motion is being detected.[1]

An effective motion detector contains a motion sensor that transforms the detection of motion into an electrical signal. This can be achieved by measuring optical or acoustical changes in the field of view.

A motion detector may be connected to a burglar alarm that is used to alert the home owner of security service after it detects motion. There are different kinds of motion detector each with its own advantage and disadvantage.

2.3.1 TYPES OF MOTION DETECTORS

There are various kinds of motion detector. The common ones include:

Ultrasonic motion detector

Microwave motion detector

Radar motion detector

Photoelectric motion detector

Video motion detector

Infrared motion detector

2.3.1.1 ULTRASONIC MOTION DETECTOR [4]

They are electrical devices that use sound at very high frequency to detect motion. The frequency of the sound detected is usually greater than the normal human hearing frequency range to boost its security. Ultrasonic detectors use a pair of transmitter and receiver (usually cloaked at the same frequency). The transmitter sends out sounds of some certain frequency too high for human ear to hear and the receiver picks up the reflected sound waves from the area under protection. Any motion made within this region of space will cause a distortion or shift in the frequency of sound transmitted (which results from the behavior of sound waves when they are being compressed by moving object). The receiver circuit detects the shift in frequency and thus gives off a signal. The frequency shift is called the "DOPPLER EFFECT"

2.3.1.2 MICROWAVE MOTION DETECTOR [5]

Microwave motion detector operates by transmitting microwave signal (electromagnetic fields) in the "X" band. Any slight movement in the field disturbs the transmitted wave signal and consequently an alarm is given off. These microwave signals are generated by a "GUN DIODE" operating at present limit that do not affect humans. Also as the case of ultrasonic detectors, the detection of intrusion is related to the principle of Doppler shift frequency. Objects that fail to produce a signal or produce a signal outside the turned frequencies are ignored. Only object that fall within the range cause the sensor to generate an alarm signal.

2.3.1.3 PHOTOELECTRIC MOTOR DETECTOR [6]

Photoelectric motion detectors are active detectors that make use of a transmitter and receiver. The transmitter uses a light emitting diode (LED) as light sources and transmits a consistent infrared beam of light to a receiver. The receiver consists of a photoelectric cell that detects motion when the beam is present. If photoelectric cell fails to receive at least 90% of the transmitted signal for as brief as 75 milliseconds (time of an intruder crossing the beam), an alarm signal is generated. The beam is modulated at a very high frequency which changes up to 1000 times per seconds in a pattern that correlates with the receivers' expectation to guard against a bypass attempt by a substitute light source. In order to bypass the sensor, the angle of the beam and modulated frequency would have to be matched perfectly.

2.3.1.4 RADAR MOTION DETECTOR [2]

The name RADAR which means radio detection and ranging is an active sensor which came into use first in the early 1940's but afterwards, it has undergone substituted enhancement. Many grocery stores have automatic door openers that use a very simple form of radar to detect when someone passes near the door. The box above the door sends out a burst of microwave radio energy and waits for the reflected energy to bounce back. When a person moves into the field of microwave energy, it changes the amount of reflected energy or the time it takes for the reflection to arrive, and the box opens the door. Since these devices use radar, they often set off detectors. Radar uses ultra high frequency radio waves to detect intrusion within a monitored area. Radar sensor transmits signals from an energy source in the ultra high frequency range of about $100MH_z$ to $1GH_Z$

2.3.1.5 VIDEO MOTION DETECTOR

Video motion detector, abbreviated VMD, use closed circuit television (CCTV) system to provide both an intrusion and detection capability. They provide means for security personnel to immediately and safely assess alarms (possible intrusion). CCTV system provides the added benefits of documenting the events of intrusion and the characteristics of the intruder. Video motion detention sensors detect changes in the area. Video motion detector monitors the video signals being transmitted from the camera. When a change in the signal is received, indicating a change in the image composition caused by some sort of movement in the field surveillance, alarm signal is generated and the intrusion scene is displayed at the monitoring station.

2.3.1.6 INFRARED MOTION DETECTORS [2]

These are motion detectors that use infrared energy radiation. Infrared radiations exist in the electromagnetic spectrum at a wavelength of 0.75 to 1000micron (one micron is 10^6 metres). These wavelengths are longer than those of visible light but shorter than the wavelength commonly used in radio communication. It cannot be seen but it can be detected. Any object that generates heat also generates infrared radiation and these objects include animals and the human body whose radiation is greatest at a wavelength of about 9.4μm.

Infrared in this range will not pass through many types of materials that pass visible light such as ordinary window glass and plastic. However, it will pass through with some attenuation through materials that are opaque to visible light such as germanium and silicon. An unprocessed silicon wafer makes a good IR window in a weather-proof enclosure for outdoor use. It also provides additional flittering for light in the visible range.

The detector (sensor) is the most critical component of any IR system since it is the singular device which converts optical energy into useful electrical signal. Hence, the entire workability of the circuit of any motion detector is solely dependent on the sensibility of the sensor.

2.4 BLOCK DIAGRAM OF THE SYSTEM

This project which uses infrared in intruder detention for houses, offices etc. is implemented on a circuit board in eight (8) main modules:

i. Power supply / battery charger
ii. Passive infrared (PIR) sensor
iii. Signal conditioner circuit
iv. Analogue-to-digital converter circuit
v. Micro-controller
vi. Audio storage device [ISD 25120]
vii. Power amplifier
viii. Loudspeaker

BLOCK DIAGRAM

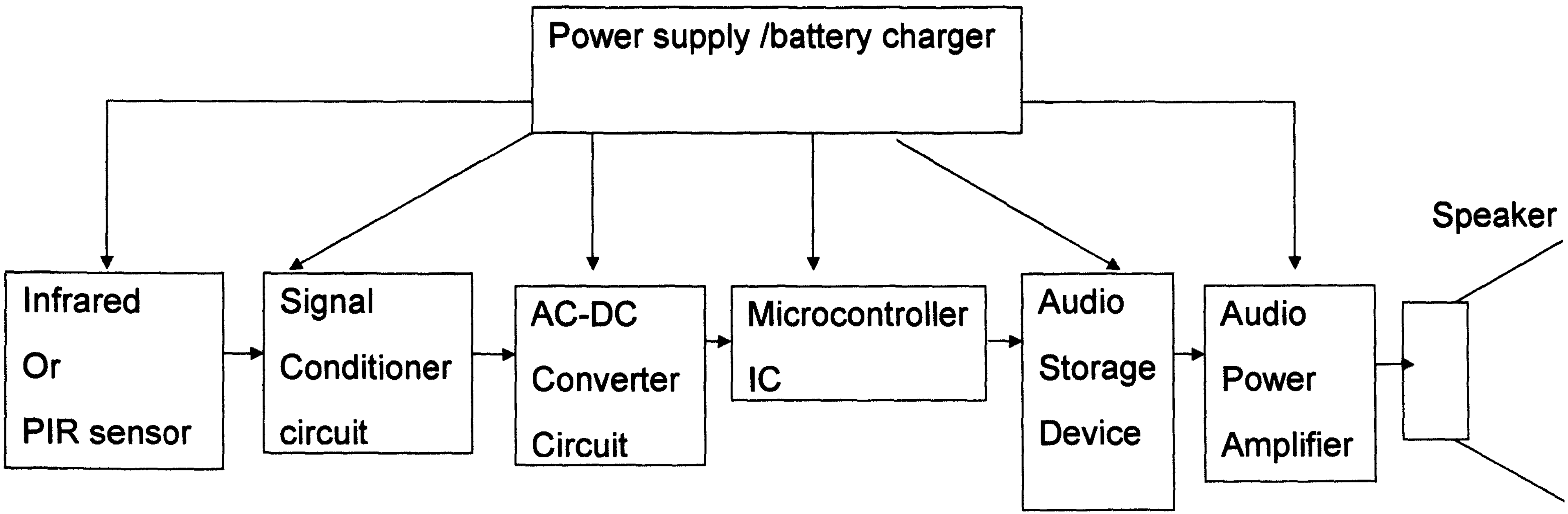


FIG. 2.1 Block diagram

CHAPTER THREE

3.0 DESIGN AND CONSTRUCTION

3.1 The Component Choice and Description

The design and implementation of this device were greatly influenced by the choice of component and the need to produce the device at a very low cost as possible without compromising either functionality or efficiency whilst utilizing easily available, affordable and durable components.

The circuit is designed and constructed with the following electronic components list below:

1. 12V/0.5A step down transformer
2. IN4001 Diodes
3. Capacitors
4. Resistors
5. 5V/1A 7805 regulator
6. Pyroelectric infrared (PIR) sensor
7. Light Emitting Diode (LED)
8. Fresnel lens
9. RLP434 receiver

10. TLP434 transmitter

11. 8-bit 0804 Analogue-to-Digital Converter (ADC)

12. 89C51 Microcontroller

13. ISD25120 voice recorder

3.1.1 CAPACITOR

Resistors respond to changes in current in a linear fashion according to ohm's law by exhibiting changes in voltage drop. Similarly, changing the voltage across the resistor causes the current through that resistor to change linearly. Resistor behaves this way because they do not store energy. They dissipate some energy as heat and pass the remainder through circuit. Capacitors store energy and consequently their voltage/current relationship is non linear.

A capacitor stores charges in parallel plates each of which is at a different arbitrary potential relative to the other. In this respect, a capacitor functions like a very small battery and holds a voltage according to how much charge is stored on its plates. Capacitance 'C is measured in farads (F). One farad capacitance is relatively large. As a capacitor builds up, its voltage increases in a linear fashion as defined by the equation $Q=CV$, where Q is the charge expressed in coulombs. The schematic symbol is shown below

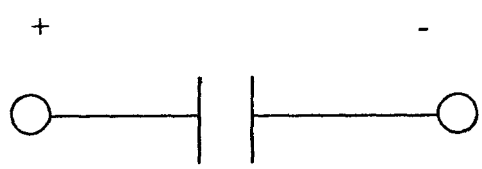


FIG 3.1 CAPACITANCE CIRCUIT SYMBOL

3.1.2 VOLTAGE REGULATOR IC

While there are many circuits that will tolerate a smoothened power supply, some must have a completely regulated supply with no ripple voltage. Regulator ICs provides this regular power supply. There are many types of regulator IC and each type will have different pin-outs and will need to be connected up slightly differently. There are seven regulators in the 78XX series, and each can pass up to 1A to any connected circuit. There are also regulators with similar type numbers that can pass a higher or lower current [3].

If a regulator is used after the smoothing block of the power supply, then ripple voltage may be of little concern since the whole point of using a regulator is to get a stable, accurate, known voltage for the circuit. However, if the ripple voltage is too large and the input voltage to the regulator falls below the regulated voltage of the regulator, then of course the regulator will not be able to produce the correct regulated voltage. The input voltage to a regulator should usually be 2V above the regulated voltage.

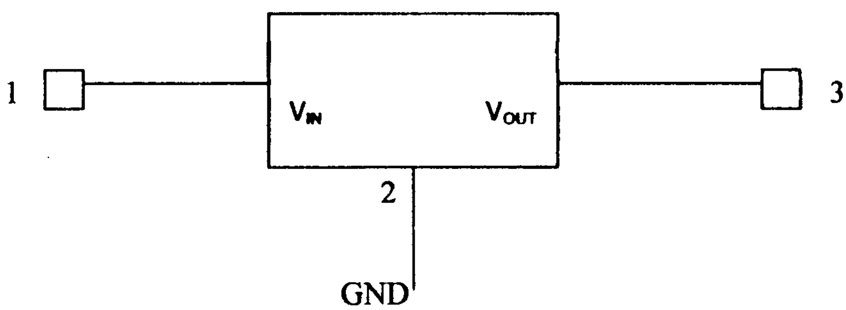


FIG 3.2 PIN-OUT 78XX SERIES VOLTAGE REGULATOR

3.1.3 DIODES

An ideal diode is a non-linear circuit element that conducts current only when the device is forward biased i.e. when the voltage applied across its terminals is positive. It thereby behaves as one way electrical valve that prevents current from flowing under conditions of reverse bias. A diode has two terminals: the anode and cathode. For the diode to be forward biased, the anode must be at a more positive voltage than the cathode. Diodes are the most basic semi-conductor structures and are formed by the junction of two semi-conductor materials of slightly differing properties

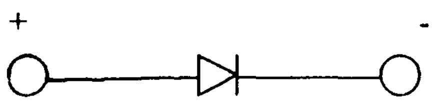


FIG 3.3 DIODE SYMBOL

3.1.4 TRANSISTORS

Transistors are silicon switches that enable weak signals to control a much larger flow, which is the process of amplification: magnifying the amplitude of a signal. Bipolar junction transistors (BJTs) are a basic type of transistor and are formed by two back-to-back pn junctions. The BJT consist of the three layers or regions of silicon in either of two configurations: NPN and PNP. The middle region is called the base and the two outer regions are separately referred to as collector and emitter.

The base-emitter junction is what enables control of a potentially large current flow between collectors and the emitter with a very small base-emitter current. BJTs construction is more than simply placing two diodes back to back. The base region is extremely thin to enable conduction between the collector and emitter, and according to the fabrication process.

Current in an NPN transistor flows from the base to the emitter and from the collector current and is defined by a proportionality constant called beta β (also known as h_{fe}): $I_c = \beta I_b$ => D.c current gain

Beta is specific to each type of transistor and is characterized by manufacturer in datasheets. Typical values of beta are from 100 to or less than 1000. The beta current relationship provides a quick view of how a small base current can control a much larger collector current. A higher beta indicates greater potential for signal amplification. And because the base emitter junction is essentially a diode, it must be sufficiently forward biased for the transistor to conduct current ($V_{be} = 0.6$ under typical conditions). A PNP transistor functions similarly, although the polarities of current and voltages are reversed.

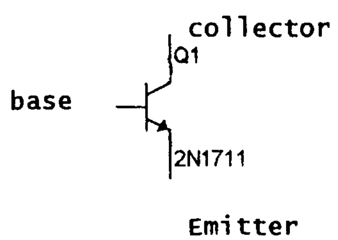


Fig. 3.4 circuit symbol of BJT transistor

3.1.5 POWER SUPPLY UNIT

For electronic circuits and other devices, the power supply mostly is designed to convert high voltage AC mains electricity to a suitable low voltage supply. A power supply can be broken down into various units, each which performs a particulars function.

3.1.5.1 THE TRANSFORMER

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step up transformers increase voltage, while step-down transformers reduce voltage. Most power supplies unit use a step-down transformer to reduce the danger of high mains voltage (220v) to a safer low voltage.

The input coil is called the primary windings and the output coil called the secondary windings. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft iron core of the transformer. The two lines in the middle of the circuit symbol represent the core as shown in the diagram below.

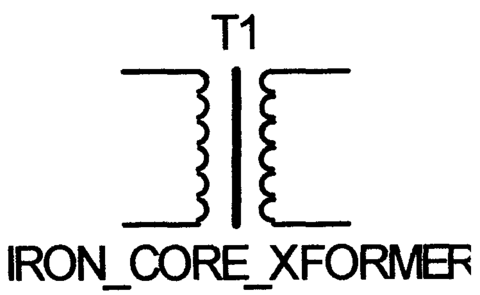


Fig 3.5 circuit symbol of a transformer.

The ratio of the turns on each coil, Np : Ns is called the turns ratio. It also determines the ratio of voltages .

Turn ratio = (Vp /Vs) = (Np / Ns)

Power = Vs x Is = Vp x Ip

Vp = primary (input) voltage

Ip = primary (input) current

Np = number of turns on primary coil

Vs = secondary (output) voltage

Ns = number of turns of secondary coil

Is = secondary (output) current

A step-down transformer would have larger number of turns on its primary (input) coil which is connected to the high voltage main supply, and a small number of turns on its secondary (output) coil to give a low output voltage [7].

3.1.5.2 RECTIFER

There are several ways of connecting diode to make a rectifier to convert AC to DC. The bridge rectifier is the most important and produces a full-wave rectification. Full-wave rectifier can also be made from just two diodes if a centre tapped transformer is used, but this method is hardly used now that diodes are cheaper. A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses the entire AC wave (both positive and negative sections). About 1.4v is used up in bridge rectifier because each diode uses 0.7v when conducting and at anytime there are always two diodes conducting. Bridge rectifiers are rated by the maximum reverse voltage they can withstand (this must be at least three times the supply rms voltage so the rectifier can withstand the peak voltage)[7].

3.1.5.3 FILTER

The smoothening is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The capacitor charge charges quickly near the peak of varying DC, and then discharges as it supplies current to the output. Smoothing is not perfect due to the capacitor voltage falls a little as it discharges; giving a small ripples voltage.

For many circuits a ripple which is 10% of the supply voltage is satisfactory and the equation below gives the required value for the smoothing capacitor. A larger capacitor will give fewer ripples. The capacitor value must be doubled when smoothing half-wave [7].

3.1.5.4 VOLTAGE REGULATOR

Voltage regulator IC's are available with fixed values (typically 5, 12, and 15v) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current (over load protection) and overheating (thermal protection).

3.1.6 ISD 25120 (VOICED IC) [8]

It is a single chip voice record/playback device for 120 secs duration. This information storage device provides high quality messaging applications. The CMOS (complimentary metal-oxide semi conductor) device include an on-chip oscillator, microphone pre-amplifier, automatic gain control, anti-aliasing filter, smoothing filter, speaker amplifier, and high density multilevel storage array. In addition, the ISD 25120 is microcontroller compactable, allowing complex messaging and addressing to be achieved.

Recordings are stored in on-chip nonvolatile memory chip cells, providing zero-power message storage. This unique single chip solution is made possible through ISD's patented multilevel storage technology. Voice and audio signals are stored directly into memory in their natural form, providing high quality, solid-state voice reproduction.

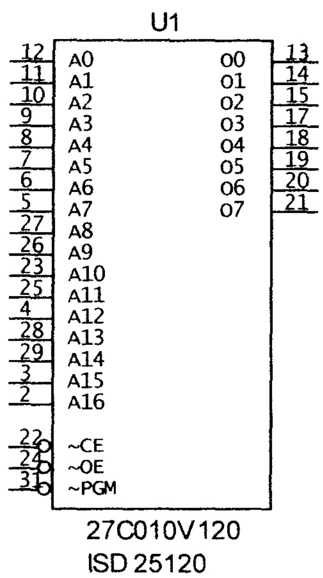


Fig 3.6 Schematic diagram of ISD 25120 device and pinouts

3.1.7 ADC0804 [8]

The ADC0804 is a CMOS (complementary metal oxide semi-conductor) 8-bit successive approximation analogue/ digital converters that use a differential potentiometric ladder – similar to the 256R products. These converters are designed to allow operations with the NSC 800 and INS8080A microcontroller family with TRI-STATE® output latches directly driving the data bus. This A/D appears like memory location or input/output port to the microprocessor and no interfacing logic is needed.

Differential analog voltage inputs allow increasing the common-mode rejection and off-setting the analogue zero input voltage value. In addition, the voltage reference input can be adjusted to allow encoding any smaller analog voltage span to the full 8 bits of resolution.

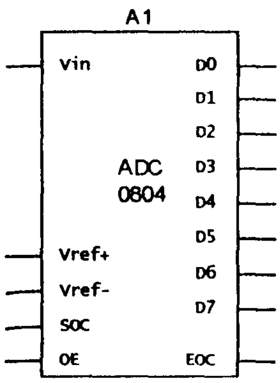


Fig 3.7 ADC 0804 pinout

3.1.8 8051 MICROCONTROLLER [9]

The 8051 microcontroller or the MCS-51™ is a family of microcontroller ICs developed, manufactured and marketed by Intel Corporation. The generic MCS-51 ICs is the 8051, which is the first device in the family offered commercially. Its features are summarized below;

4kbytes ROM (factory mask programmed)

128bytes RAM

Four 8-bits I/O (input/output) ports

Two 16-bits timers

Serial interface

64KB external code memory space

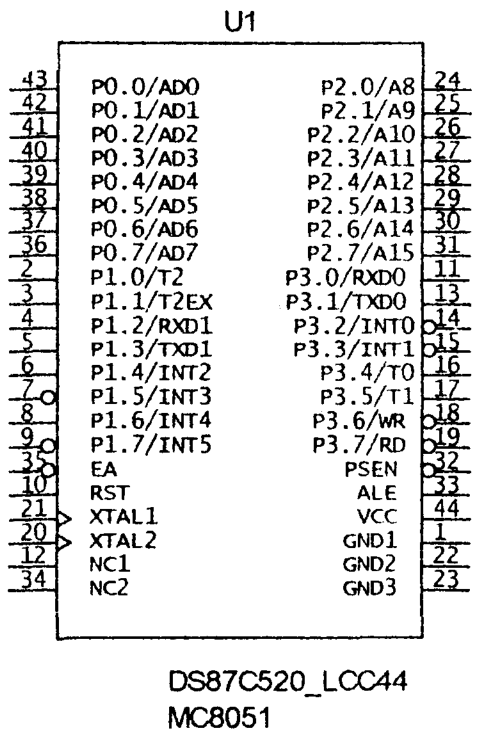
64KB external data memory space

Boolean processor (operates on single bits)

210 bit-addressable locations

4 μs multiply/divide

Fig 3.8 8051 pinouts



3.1.9 Pyroelectric Sensors PIR325 [10]

The pyroelectric sensor is made of a crystalline material that generates a surface electric charge when exposed to heat in the form of infrared radiation. When the amount of radiation striking the crystal changes, the amount of charge also changes and can then be measured with a sensitive FET device built into the sensor. The sensor elements are sensitive to radiation over a wide range so a filter window is added to the TO5 package to limit incoming radiation to the 8 to 14μm range which is most sensitive to human body radiation.

3.1.10 Fresnel Lens [10]

The FL65 Fresnel lens is made of an infrared transmitting material that has an IR transmission range of 8 to 14 μm that is most sensitive to human body radiation. It is designed to have its grooves facing the IR sensing element so that a smooth surface is presented to the subject side of the lens which is usually the outside of an enclosure that houses the sensor.

The lens element is round with a diameter of 1 inch and has a flange that is 1.5 inches square. This flange is used for mounting the lens in a suitable frame or enclosure. Mounting can best and most easily be done with strips of Scotch tape. Silicone rubber adhesive can also be used to form a more waterproof seal.

The FL65 has a focal length of 0.65 inches from the lens to the sensing element. It has been determined by experiment to have a field of view of approximately 10 degrees when used with a PIR325 Pyroelectric sensor.

3.2 Design Analysis

The intrusion detection system with voice playback comprises of the following;

1. Power supply unit
2. 12volt lead-acid battery charger
3. Handheld RF remote controller
4. PIR sensor and focusing lens
5. 8-bits microcontroller (8957)
6. 8-bits analog-to-digital converter
7. ISD 25120 voice chip/recorder
8. 5watts audio power amplifier

3.2.1 Power Supply Unit

The power supply unit comprises of a step-down transformer, an a.c rectifier circuit that serves as the source of supply to all unit. The operational voltage for all units is 5V d.c supply. This was derived from a 15V/2A step-down transformer connected to a bridge rectifier. From fig 3.9, D1 and D2 conduct on positive half cycle, while D3 and D4 conduct during the negative half cycle. Therefore, the rectified load current flows during both half cycles. D1 and

D2 are forward biased, thus produces a positive load voltage.

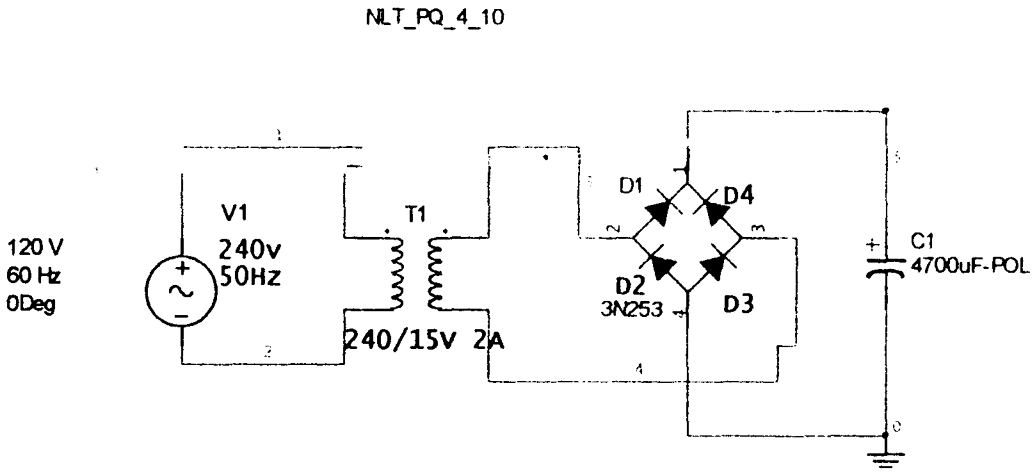


Fig. 3.9 A 240V AC supply rectification

Mode of operation: - The 240V a.c main was stepped-down using 240V/15V step-down transformer and rectified with the help of a full bridge rectifier. A capacitor of 25V/4700μF was used to smooth the d.c output voltage that has a.c ripples. The rms value of the induced e.m.f in the primary wing is from the Universal law of transformer which is stated as:

$$E_1 = 4.44fN_1\theta m \quad (3.0)$$

$$E_1 = 4.44fN_1IBmA \quad (3.1)$$

Similarly, rms value of the induced e.m.f of the secondary winding is

$$E_2 = 4.44fN_2\theta m \quad (3.2)$$

$$E_2 = 4.44fN_2IBmA \quad (3.3)$$

Comparing equations (3.0) and (3.2), we have;

$$E_2/E_1 = N_1/N_2 = K \quad (3.4)$$

where K is a constant called voltage transformation ratio.

From equation (3.4), if $N_2 < N_1$ i.e. $K < 1$ then it is a step-down transformer.

Also, for an ideal transformer

Input VA = Output VA

$$V_1/I_1 = V_2/I_2 \quad (3.5)$$

$$V_1/V_2 = I_2/I_1 = 1/K \quad (3.6)$$

In this design, a step-down transformer with the following characteristics was employed;

i) Primary voltage $V_p = 240V$

ii) Secondary voltage $V_s = 15V$

iii) Secondary current is = 2A

Using the transformer formula;

$$V_p/V_s = I_s/I_p \quad (3.7)$$

Make I_p subject of formula (where the I_p = the primary current)

$$I_p = V_s\, I_s/V_p$$

$$I_p = 15 \times 2/240$$

$$I_p = 125mA$$

This indicates that the transformer is a step-down with rating 240V, 125mA / 15V, 2A

Rectification: - The 15V a.c was rectified into a peak amplitude d.c voltage.

$V_{rms}\sqrt{2} - 2V_f$ (3.8)

$\sqrt{2}$ = rms – to – peak conversion factor.

V_f = Forward voltage drop in two adjacent diode pair and is as 0.7

For a 15V rms,

The peak amplitude of the d.c voltage is

$V_{peak} = 15\sqrt{2} - 2(0.7) = 19.8V$ (from equation (3.8))

Also $I_{peak} = I_{rms}\sqrt{2}$ (3.9)

$I_{peak} = 2\sqrt{2}$

$I_{peak} = 2.82A$

Filtration: - The d.c voltage was smoothened by a minimum capacitance of value deduced from:

$C = I\,t/V$ (4.0)

where I = maximum load current

t = period of the unsmoothened d.c voltage

V = maximum a.c ripple voltage superimposed on the d.c voltage

The maximum load current was computed from the summation of the current drawn by the different unit.

i) ADC0804 – 5mA

ii) AT89C51 – 1A

iii) ISD25120– 500mA

iv) Power amp. – 320mA

$\sum I = 1.5A$

For a regulated system supply voltage, the minimum input into the regulator is

$$V_{d.c} - (V_{out} + 9) \qquad (4.1)$$

where "9" in the equation is the minimum output – input differential voltage for the 7805 regulator used.

therefore, the maximum ripple voltage is thus:

$$19.8 - (5 + 9) = 5.8V$$

From equation 4.0,

$$C = \{1.5 \times (1/\{2 \times 50\})\}/5.8$$

$$C = 0.0015/5.8$$

$$C = 0.0002586F \approx 258.6\mu F$$

A value of 4700μF capacitance with a working voltage of 25v was utilized instead.

The smoothened d.c voltage powered both the sensing module and the battery charger. As a result of the redundant battery supply provided, a second voltage regulator circuit was provided. The diode 1N5392 (D7) was introduced to isolate voltage fluctuations in the high voltage side (power amplifier) not to affect the low voltage digital section as shown in the fig. below.

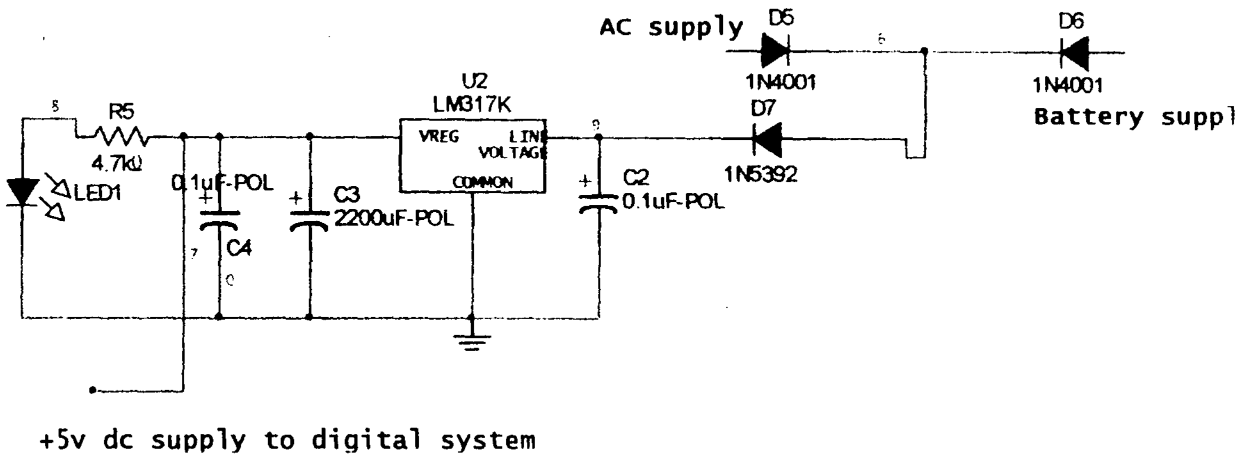


Fig. 3.10 5V DC Supply

3.2.2 LEAD-ACID BATTERY CHARGER

For continuous uninterrupted system operation, a 12volts dc battery was incorporated. The battery was charged by a constant current constant voltage system designed around an LM317T regulator.

The CC/CV arrangement facilitated charging the battery at a fixed charged current programmable using a resistor until the battery is fully charged at which point the cell is cycled indefinitely at a preset voltage. The CC/CV arrangement prevents battery from overcharging and that would reduce the life span of the cell.

An LM317T regulator was utilized as the control element in the charger. It was current programmed by a 1Ω resistance between the output and the adjust pin to yield a charging current given by the expression;

$$I_{out} = \frac{V_{ref}}{R_s} = \frac{1.25\text{volts}}{1\Omega} = 1.25A$$

The charger was wired as shown below

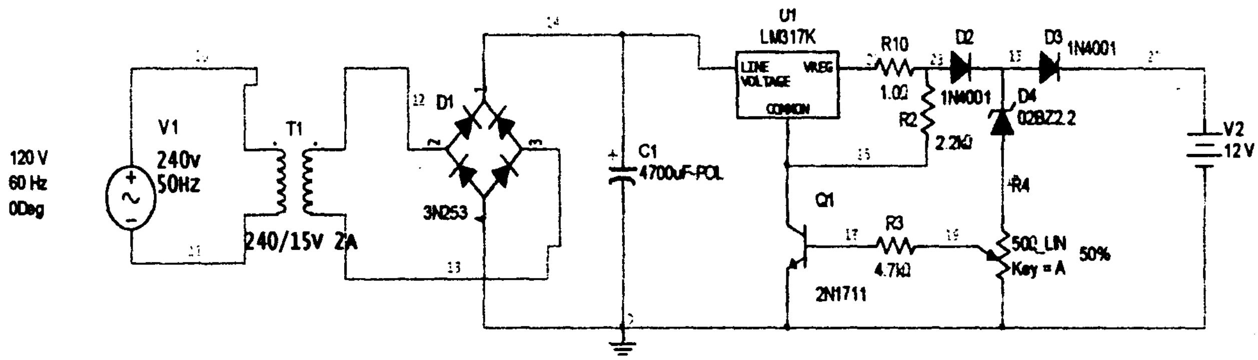


FIG 3.11 SYSTEM POWER / BATTERY CHARGER

The DC input to the charging system was derived from a 15volts Rms step down transformer connected to a full wave bridge rectifier as depicted in the figure above.

The 15v AC voltage was connected to a DC voltage with a peak amplitude given by the expression;

$V_{DC\ peak} = V_{Rms}\sqrt{2} - 1.4$

V_{RMS} = transformer secondary voltage = 15v

$\sqrt{2}$ = RMS to peak scaling factor

1.4v = combined forward voltage drop of the two diode in condition of every half cycle.

For a 15v ac input;

$V_{DC} = 15\sqrt{2} - 1.4 = 19.8V$

The voltage was smoothened by a capacitance of value given by the relation;

$$Q = CV = It$$

C = smoothening capacitance

V = maximum ac ripple voltage on the DC supply

I = maximum system current drain

(for a full-wave bridge rectifier)

$$T = \frac{1}{2F}$$

The maximum system operational current was fixed at 1.4A (during charging at maximum current). The AC ripple voltage on the DC rails was evaluated using the minimum input DC voltage needed to maintain the regulation in the LM317T regulator. For a minimum battery terminal voltage of 12volts, the minimum input voltage was 14volts.

On a 19.8v peak DC input, the maximum DC ripple voltage was 19.8-14 = 5.8v

Calculating the capacitance 'C' yielded;

$$C = \frac{It}{V} = \frac{I \times \frac{1}{2F}}{\Delta V} = \frac{1.5 \times \frac{1}{2 \times 50}}{5.8}$$

$$= \frac{0.0015}{5.8} = 2.586 \times 10^{-4} F$$

A value of 4700µF capacitance with a working voltage of 25v was utilized instead. The smoothened dc voltage powered both the sensing module and the charger.

The 19.8v supply was stepped down to 5v by a 7805 voltage regulator for use by the sensing module. The dc voltage was also fed into the CC/CV clogging sub-system to provide charging current to the 12v dc battery. The minimum battery terminal voltage was predetermined by a 5.6v Zener diode. The V_{be} of Q1 (transistor connected between the adjusted pin and ground), and the potential divider effect of RV1, a 10KΩ potentiometer.

The battery terminal voltage was fixed at 12v, the charger was put into the shutdown mode when Q1 saturates, this occurs when the voltage between its base and emitter assumes a V_{be}

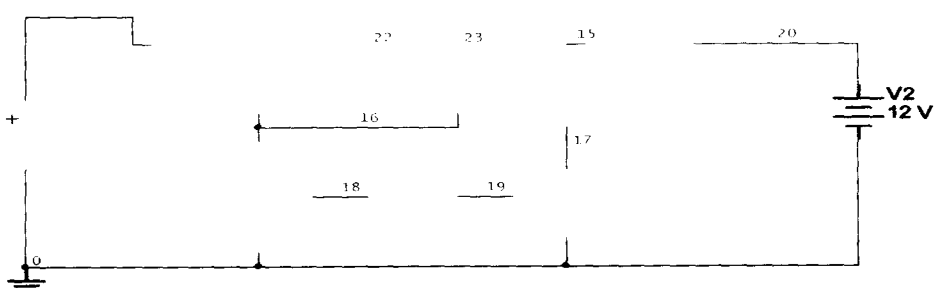


FIG 3.12 CHARGER

D2 prevent battery back discharged with the charging potential removed. D_3 prevents the zener diode-10KΩ-potential divider network discharging the battery over time if the charging potential is removed. The V_{be} of Q1 determines the battery maximum terminal voltage. V_{be} of Q1 (0.7v) is set by the zener diode and the potential divider. The resistance on alternate sides of Rv1 (10KΩ potentiometer) determines the battery voltage at which V_b of Q1 equal V_{be}.

Therefore;

$$V_b = V_{be} = \frac{(V_{baH} + V_{FD2} - V_Z) \times R_B}{R_A + R_B}$$

$R_A + R_B = 10K\Omega$

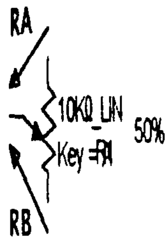


FIG 3.13 ALTERNATIVE RESISTANCE OF RV1

Since V_{FD2} **(0.7v)** and V_Z **(5.6v)** are both known, the battery terminal (V_{bah}) was adjusted to +12v by adjusting the potentiometer (10kv) to the desired battery maximum voltage.

At the preset battery voltage, the transistor is fully forward-biased, pulling the regulator's adjusting pin to ground and shutting down the LM3174 regulator. The battery is held at that voltage indefinitely as long as the system is connected to power. The unregulated dc output was passed through selector logic for seem less transfer of system operation from AC power or from DC .

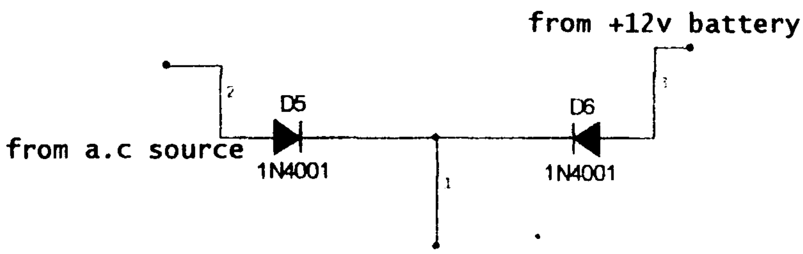


FIG 3.14 POWER SELECTOR LOGIC

When connected to Ac mains, the rectified voltage is at a value greater than the battery voltage. D5 is thus forward-biased and D6 reverse-biased. Power is then drawn from the Ac source. When the voltage across the smoothening capacitance drops lower than the battery voltage, D6 is forward-biased and D5 is reverse-biased. Power is then drawn from the battery.

3.2.3 RF REMOTE CONTROL

To facilitate easy, convenient and medium range activation/deactivation of the sensing module, a wireless RF scheme was implemented. The master RC was designed around an 8-bit microcontroller, a TLP 434 Ask digital transmitter and a 9-volt power source as shown in the figure below.

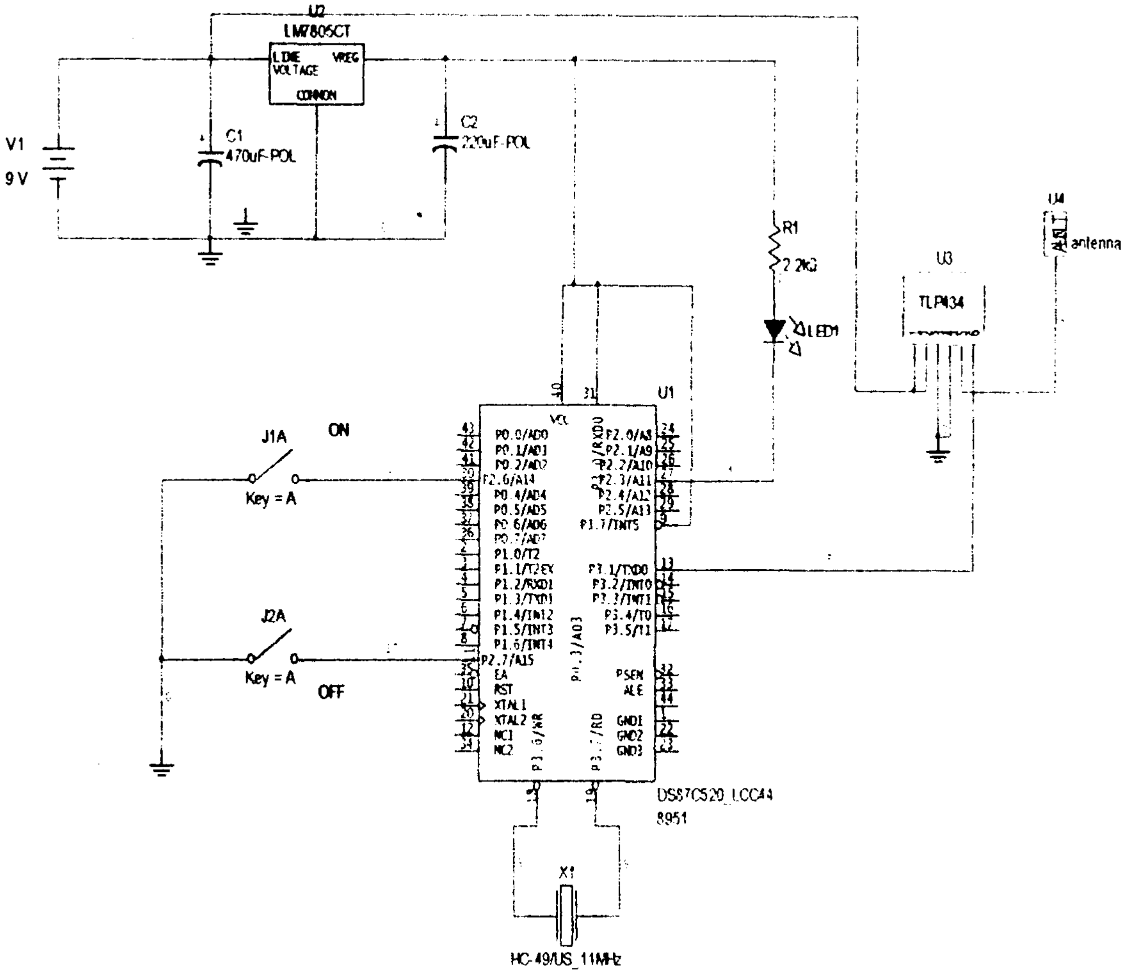


Fig 3.15 RF remote control unit

A 9volts power source was utilized. The microcontroller was run-off a regulated 5-volts DC supply via a 7805 voltage regulator. The 5-volts supply was smoothened by a 470μF capacitor and fed to the system. The ASK (amplitude shift keying) transmitter, TLP 434, was directly powered by the un-regulated 9v dc (operating supply voltage is 2-12v). Two normally open switches were interfaced to P1.0 and P1.1 for command input. Pushing the "ARM" button puts the sensing module in the operational mode after an 80secs delay to adjust the PIR sensor to its environment.

Pushing the "DISARM" button disables the intrusion monitoring. An LED interfaced to P2.0 indicates the detection that a button is pushed, and the transmission of the associated command.

The transmitter/receiver pair were set-up for operation at 2400bps using 8-bits data, no parity, one stop bit (2400,8, N, 1) to generate the required band rate, an 11.0592MHz crystal was attached to the controller's pin 18 and 19.

Command execution (key decoding) was effected by the software looping around the two keys to closure. If a closure is detected, a 3-byte command package is sent. The amount framed is depicted in fig. 3.2

Byte 0	byte 1	byte 2
header	command	Checksum

$ 55

FIG 3.16 COMMAND PACKET

A header was required to notify the sensing module that the master node (transmitter) is establishing a connection; the checksum was used to validate and authenticate the received data (on the receiver's side) as being correct and also sent from the master node without which random data appearing at the receiver output will simply be executed as a command.

Two commands were implemented;

ARM command: OCCH

Disarm command: OEEH

The checksum was computed by XORing the header byte ($55) with the selected command. The checksum was transmitted as the third byte of the packet. The red LED pulses twice to indicate a command transmission.

3.2.4 MOTION DETECTOR MODULE

This module consists of the other sensing elements making up the entire system.

In tune with current technological trends, a new technology method of detecting motion was utilized.

A PIR 325 and an FL65 Fresnel lens were interfaced to a high gain amplifier as shown in fig 3.17

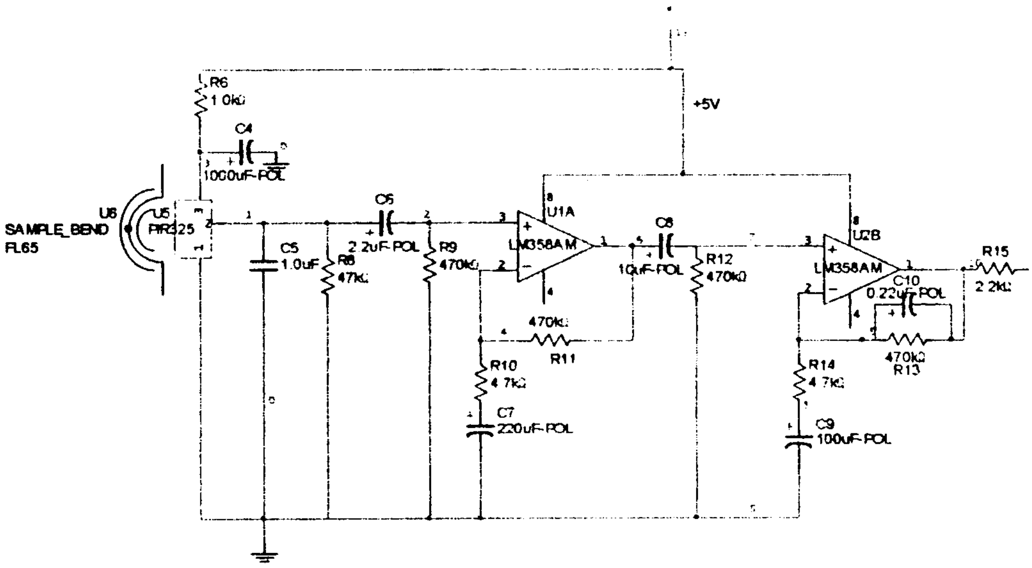


Fig 3.17 PIR – Amplifier connection

A 2-stage AC amplifier with individual stage gain of 100 was used to amplify the milli-volt signal from the PIR 325. The gate of the PIR sensor was connected to an 0.16Hz filter made up of an 0.1μF and a 47kΩ resistance.

The amount of frequency was calculated from

$$F = \frac{1}{2\pi RC} = \frac{1}{2\pi \times 47000 \times 10^{-7}}$$

$$F = 33.86HZ$$

A 2.2μF blocking capacitor was coupled to the sensor with the non-inverting input of amplifier A1.

The gain of A1 was evaluated using :

$$A1 = 1 + \frac{R_f}{R_1} \qquad R_f = 470k\Omega \qquad R_1 = 4.7k\Omega$$

$$A1 = 1 + \frac{470}{4.7} = 101$$

A similar amplifier configuration was used for A_2, but with the inclusion of an 0.22μF capacitor across the feedback resistor producing a LPF with an F3dB roll-off frequency of

$$F = \frac{1}{2\pi RC} = \frac{1}{2\pi .\ 470{,}000 \times 0.22 \times 10^{-6}}$$

F = 1.54HZ

The filter frequency was chosen to match the sensor's characteristics. The amplifier output was fed into an 8-bits ADC (ADC 0804) where a translation from the analog domain was implemented. The gain of the 2-stage amplifier was made definitely large so that the 0-5v input swing at the ADC 0804 could be achieved.

3.2.5 ADC0804

This 8-bit ADC was interfaced with the microcontroller over port P1. It was run off from a clock source determined by an RC combination of values 10kv and 150pf respectively.

The converter clock frequency was computed from the expression;

$$F = \frac{1}{1.1RC} = \frac{1}{1.1 \times 10^{4} \times 150 \times 10^{-12}}$$

$$F = 0.6MH_Z$$

A reference voltage of 0.64v was selected with the device producing the maximum output digital value with an input voltage of 1.28v.

The digitized ADC value was read into the microcontroller over port P1 pin. This value was compared to a threshold value to detect whether presence of motion was gotten or not.

3.2.6 SYSTEM CONTROLLER

An 8-bit 8951 microcontroller was selected for system controller. The device has the specification stated in the 8951 datasheet.

The microcontroller performs amongst others these housekeeping functions:

I. Recording and decoding of commands sent from the master node (i.e. remote controller).
II. Carries out comparative operation on the digitized output of the ADC0804
III. Playback of the audio message stored in the ISD25120 voice chip

The controller was setup for serial port communication at 2400bps using an 11.0592 MHz oscillator crystal. Timer 1 was loaded with a value of 0F4h to generate the required serial port data transfer speed for communication with the master remote control.

At system power up, the control loop around a flag is set under by the ARM command from the master controller. If the ARM flag is detected set, the controller generates an 80 secs delay window which acclimatizes the PIR 325 to its sensing environment. During this 80 secs window, zero or no form of movement must occur in the PIR's 325 field of view.

With the delay over, the system goes into a loop in which it periodically;

I. Samples the voltage at the ADC input
II. Compares the digital equivalent with a threshold value
III. Increments a software counter that defines how many valid greater-than-threshold values make a true detection of motion.

The threshold value of 40 and a minimum pulse count of 5 were set in software to implement the motion detection algorithm.

Once motion is detected, the controller initiates playback of the audio message stored in the ISD25120 device. The ISD25120's message is played back with a break of 1 min between each playback. The assembly program used is found in the appendix.

3.2.7 ISD 25120

This is a solid state 120 secs recorder. The device was configured for usage in the operation mode A6. Mode A6 is the simple push button mode. The device was preprogrammed with a voice input via an ISD programmer. The differential audio output from the ISD was fed into an TDA 2822 monolithic power amplifier for further amplification.

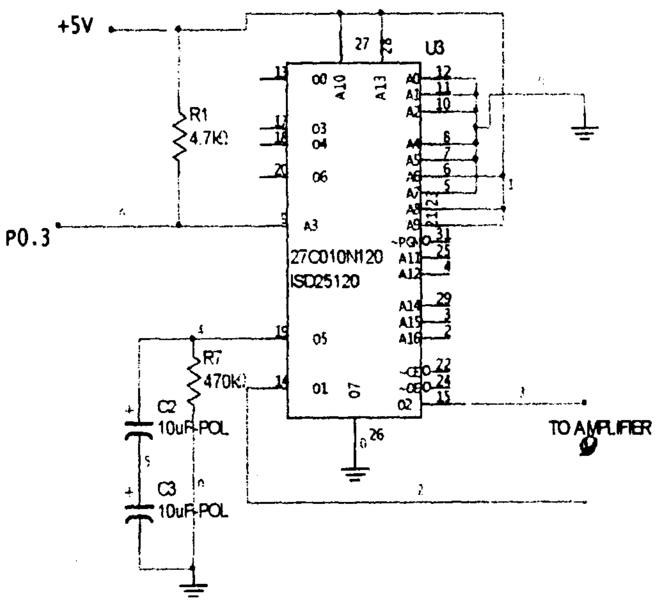
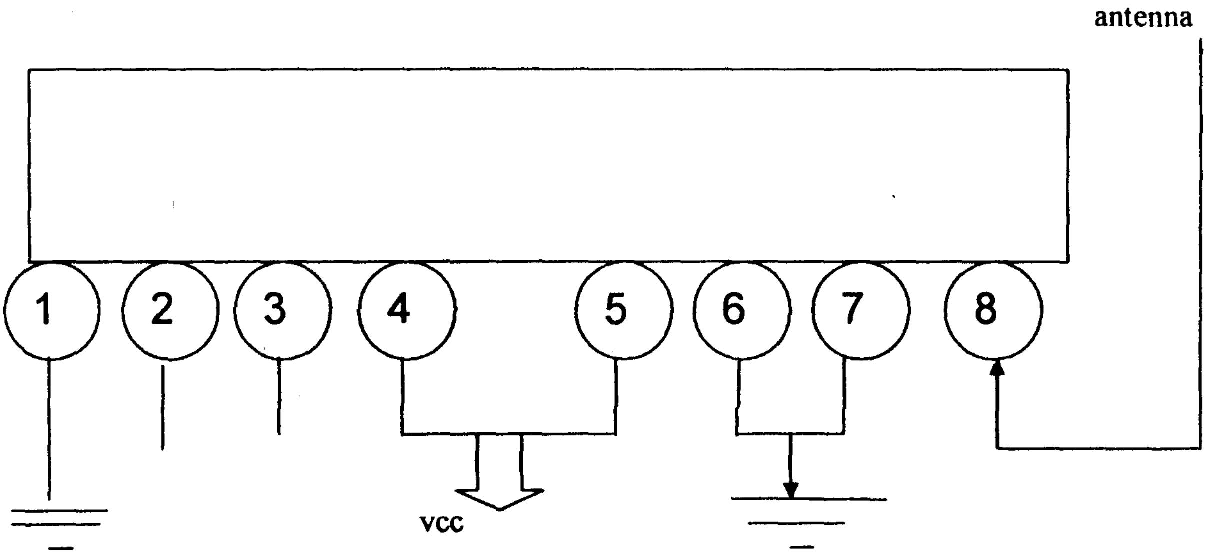


FIG 3.18 ISD 25120 CONNECTION

3.2.8 RLP 434

The ASK receiver was interfaced with port P3.0 on the controller for reception of command packets from the master node. The device was configured as shown in the figure below

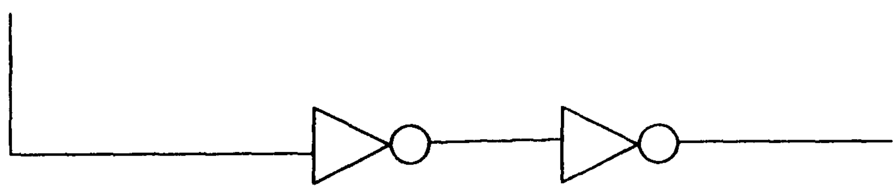


Data out to 74Ls04 Not gate

FIG 3.19 RLP 434 ASK RECEIVER

The receiver's digital output was fed into a 74LS04 non inverting NOT gate before feeding into the RXD (P3.0) pin of the microcontroller.

from pin of TPL434 to 74LS04



to P3.0 (RXD)

FIG 3.20 74LS04 - 434 INTERFACE

This two series connected gates formed a non-inverting buffer which helped to clean-up the noise output of the receiver. (the RLP always output data whether there is a valid signal or not).

The buffered output was decoded by software to extract the commands (if transmitted from the master node. Service port interrupt was enabled to prevent the receiver missing any byte of the command packet.

The software re computes the command packet and circulates the command bytes (OCCH or OEEh) matches the third byte transmitted in the command frame; the command (byte 2) of the received data is executed. Otherwise it is discarded as noise-induced binary data.

3.2.9 POWER AMPLIFIER

To produce a moderately realistic sound level, a two-channel audio power amplifier was incorporated in the system.

A TDA 2822 device was utilized as the gain element. The device was configured as shown below. The connection is adopted from the manufacturer's application note as shown in the data sheet..

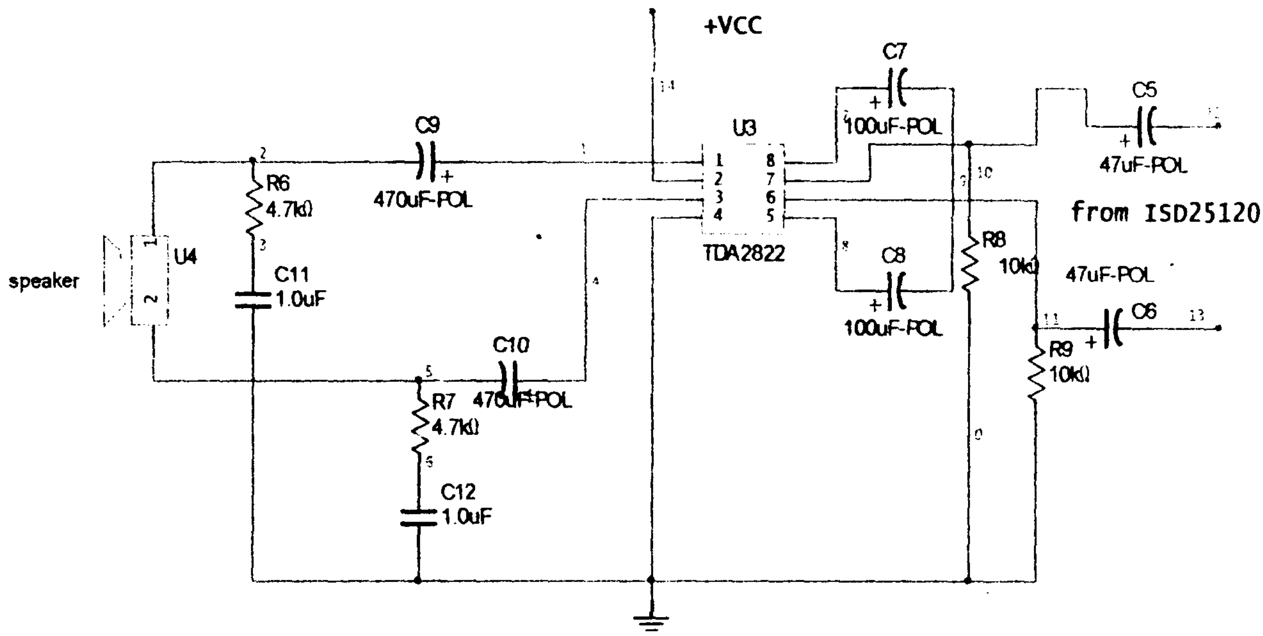
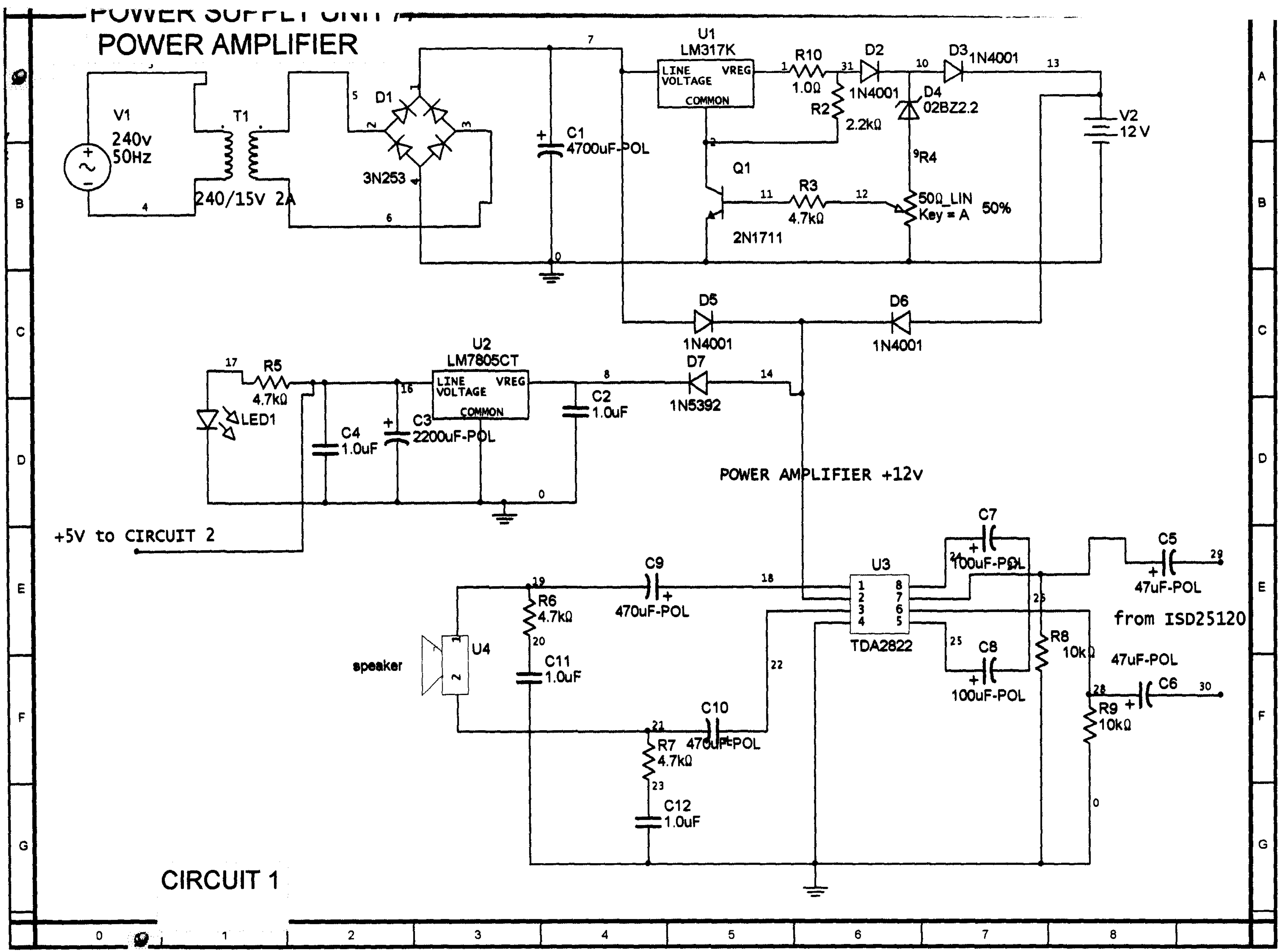
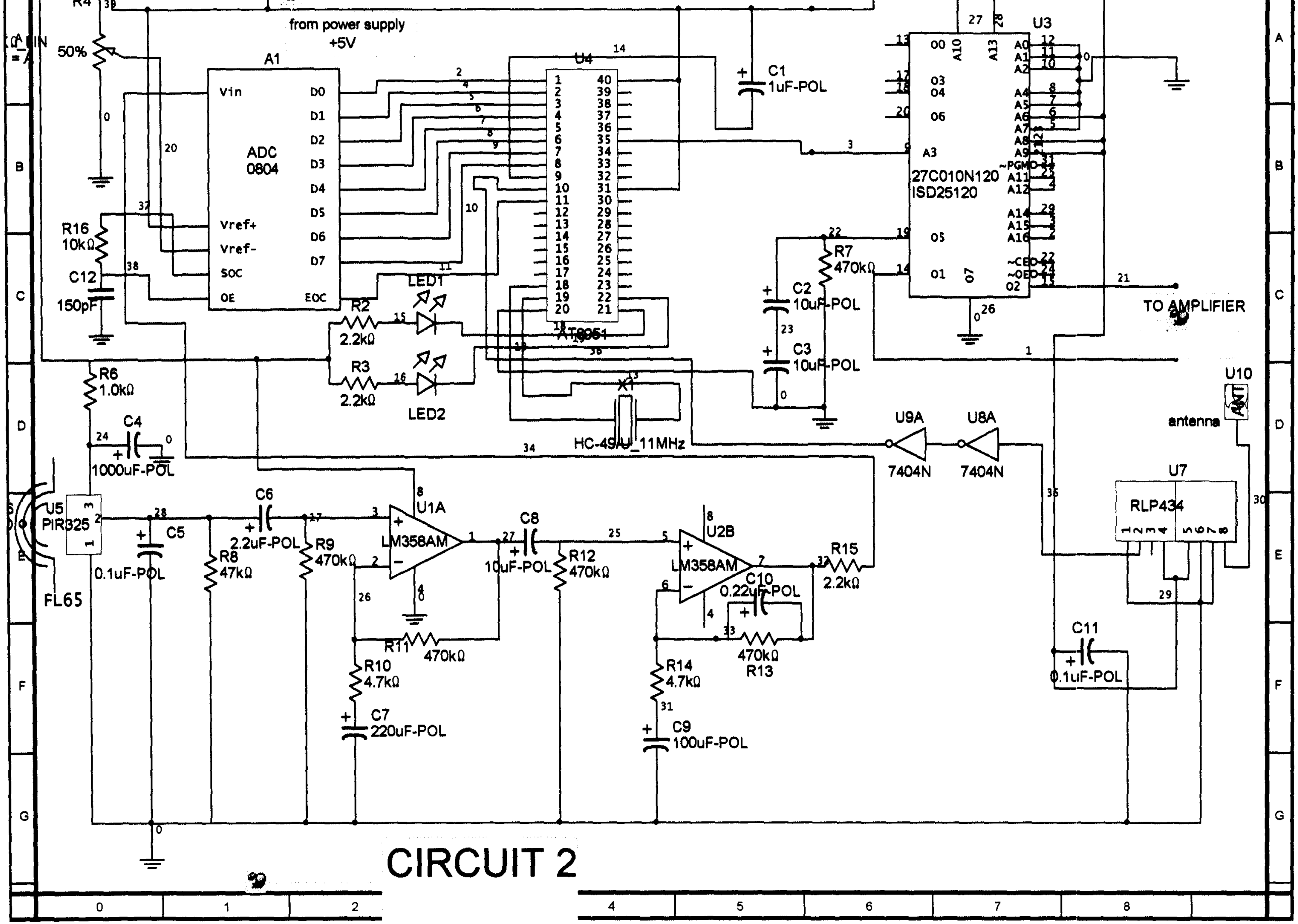


FIG 3.21 TDA 2822 POWER AMPLIFIER

The 2822 was chosen due to its minimal external part count. The gain was fixed internally. The power output into a 40v speaker load is about 2.5watts per channel. The inputs to the power amplifier were connected directly to the audio output of ISD 25120.


POWER SUPPLY UNIT /
POWER AMPLIFIER
V1
240v
50Hz
T1
240/15V 2A
D1
3N253
C1
4700uF-POL
U1
LM317K
LINE VOLTAGE
VREG
COMMON
R10
1.0Ω
D2
1N4001
D3
1N4001
R2
2.2kΩ
D4
02BZ2.2
V2
12 V
Q1
2N1711
R3
4.7kΩ
R4
50Ω_LIN
Key = A
50%
D5
1N4001
D6
1N4001
U2
LM7805CT
R5
4.7kΩ
LED1
C4
1.0uF
C3
2200uF-POL
C2
1.0uF
D7
1N5392
POWER AMPLIFIER +12v
+5V to CIRCUIT 2
C9
470uF-POL
R6
4.7kΩ
C11
1.0uF
speaker
U4
C10
470uF-POL
R7
4.7kΩ
C12
1.0uF
U3
TDA2822
C7
100uF-POL
C8
100uF-POL
C5
47uF-POL
from ISD25120
R8
10kΩ
47uF-POL
C6
R9
10kΩ
CIRCUIT 1

VOICED INTRUDER ALARM CIRCUIT



CIRCUIT 2

CHAPTER FOUR

Construction, Testing and Result

4.1 Construction

This project consists of two parts in terms of construction namely:

i) Circuit Construction

ii) The Casing Construction

4.1.1 Circuit construction

This part of the project involved practical exercise on making the circuit diagram on the paper into a real working hardware. The specified components in the circuit design were carefully connected together under the guide of the circuit diagram. The breaking of the complete circuit that was involved during the design analysis was of great important of the construction because each unit was executed one after the other. The circuit construction was made of ceramics.

Most of the equipment tools used during construction work is listed below:

1) Vero board

2) Copper Wire and a Plier

3) Soldering Iron, Lead and Suction

4) Glue and Razor blade

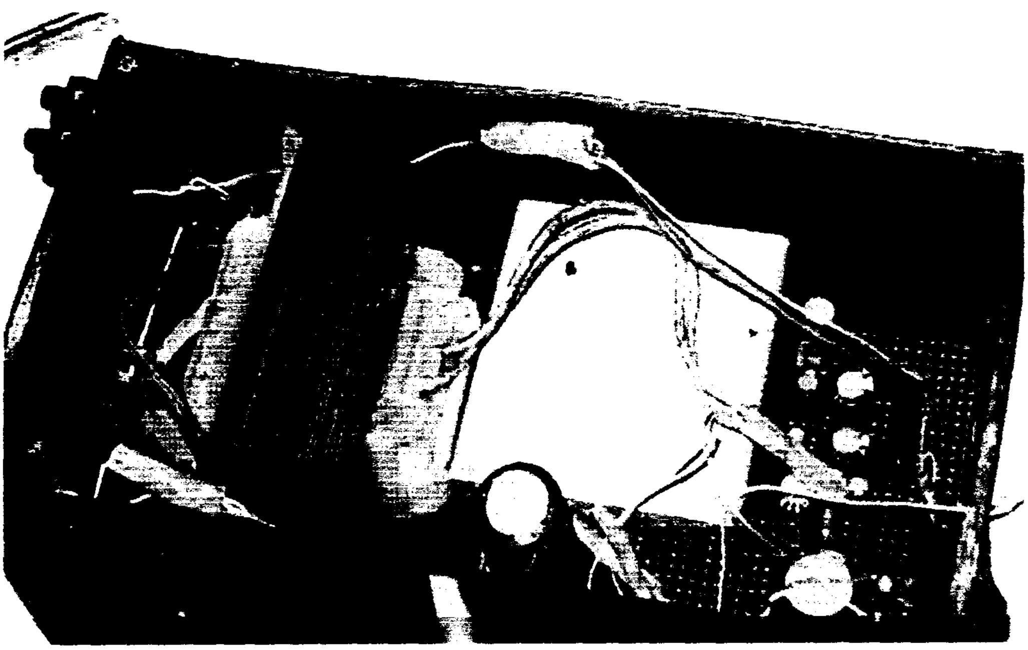
5) Plastic sheath

6) Digital Multimeter

During the circuit construction process before mounting any component, each component's terminals and functionality are verified. Interconnections were made through etching of the Veroboard and the use of insulation copper wire to avoid short-circuiting. All excess wires were neatly clipped off with a plier making sure that all of soldered connections were properly made. The components were laid out on the Veroboard with enough space to give room for ventilation, troubleshooting and replacement of fault components.

The power supply unit was quite delicate during construction and was properly checked for short circuit and unwanted bridges.

Fig. 4.1 shows all the components on veroboard used in the design of this project



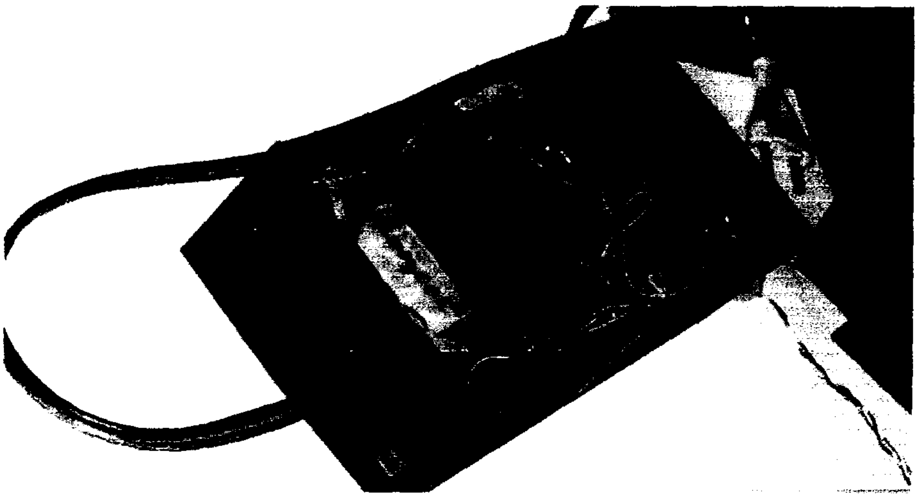
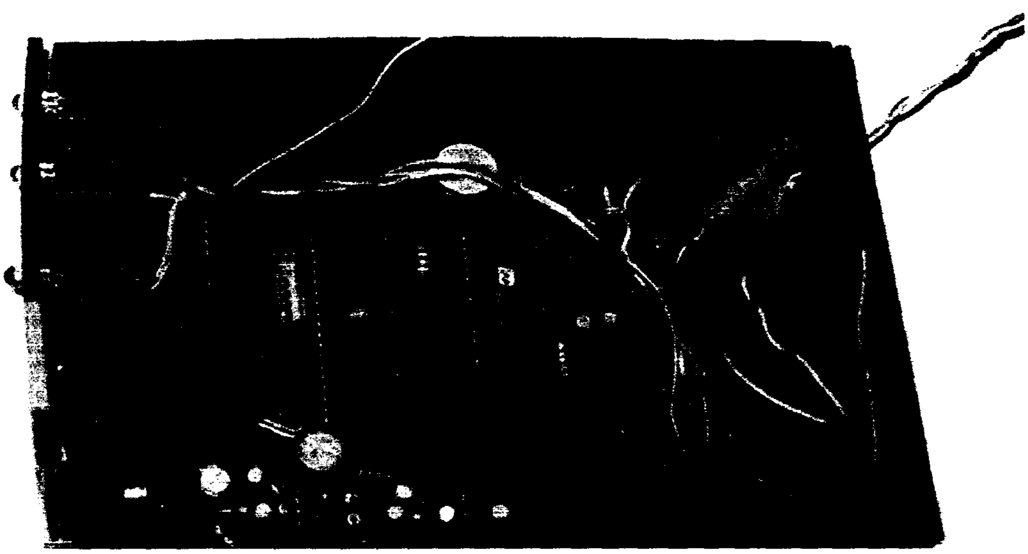


Fig 4.1a Construction of power /power amplifier unit on the Vero board



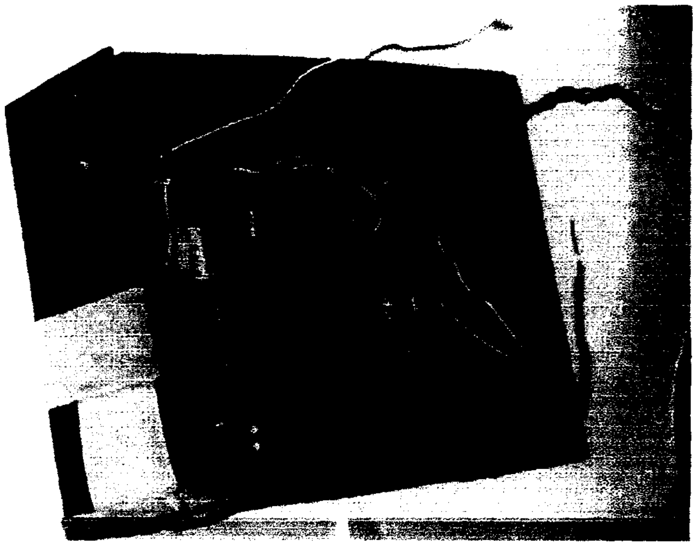


Fig 4.1b Construction of sensing module on veroboard

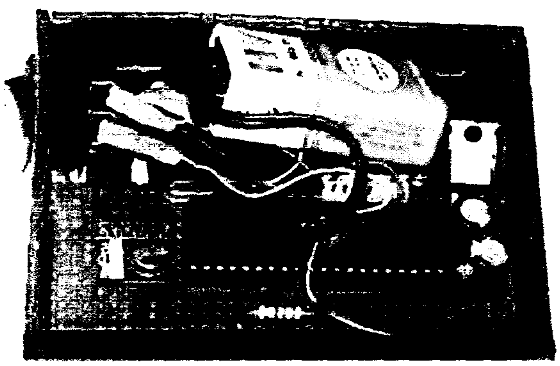


Fig. 4.1c Construction of the remote controller on veroboard

4.1.2 The Casing Construction

Three plastic cases were constructed for housing the circuit. One was constructed for the remote controller, the second one constructed for the sensing module and finally the third one constructed for the power unit.

For maximum circulation of air the case construction for the power unit was made more large (dimension 19×10cm) and consequently the one for the sensing unit was constructed as small as possible because it needs to be hanged and frequently adjusted at it field of view (dimension 15×11cm). Definitely, the casing for the remote controller was very small (9.5×7cm) in such a way that it can be handheld. On the sensing unit casing was attached the Fresnel lens which when glued was about 1cm apart from the PIR SENSOR. Also three holes were perforated on that same casing for the three LEDs to be visible

A two port connector and four port connector was glued to the power unit casing and electrically connected to it too for connecting externally the lead acid battery and the speaker respectively.

4.2 Testing

The purpose of every engineering project is to solve a problem, to achieve a particular set objective. In science and technology, testing is an important procedure employed for the effective presentation of genuine result. When testing is correctly concluded, absolute theories are confirmed and effective result obtained. On this basis, proper testing was ensured at various stage of construction to enable proper execution of the project.

All components excluding I.C's were tested immediately after purchase to determine their operability and confirm stated values. The testing was carried out by using a digital multimeter so as check its response and performance with the aim of the project.

Firstly, continuities of copper wires used in the construction were tested. The plugging of the device to the a.c mains supply and powering it ON by the use of the power switch and getting the required output voltage measured approximately 15V as expected, the output of the regulated voltage as approximately 5V and the desired output at each unit were tested using a digital multimeter.

When switched ON, the system is powered but remains in an idle state as anticipated which was indicated by the blue LED coming on. The ON button on the remote controller was pushed to activate the alarm system, but the PIR sensor according to the manufacturer's specification needs 80secs to study its environment before the system is fully activated which was indicated by the green LED. At this point the alarm system is now ARMED and any trace of human body motion across the monitored area triggers the alarm and my initial recorded voice in the voice chip was played back as alarm for 1min. (THIEF, THIEF, THIEF, etc...)

4.3 Result

The result obtained at the end of repeated tests was found to be consistent and matched up to expected results. Thus, following the construction of this project, the desired aim of this project was achieved.

The switching ON and OFF of the alarm system from the remote controller and instant detection of motion at its sight of view shows that this working model has performed according to expectation. The red light indicator (LED) indicates that a human motion in the monitored zone has been detected.

4.4 Limitations

It is weather dependent (not suitable during hot weather). The sensing device (PIR) performance is highly affected by the weather conditions. When the weather temperature is above 32 °c, the sensor's effective distance of view is reduced and at temperatures below that its effective distance is increased thereby improving its performance.

CHAPTER FIVE

5.0 Conclusion and Recommendation

5.1 Conclusion

A functional voiced intruder alarm for detecting human motion in a monitored area was successfully designed and constructed. The device demonstrated how easily the infrared rays emitted by a black body (human being) can manipulated for security purpose. The results obtained are close enough to theoretical and expected results given room for construction errors.

The attributed simplicity of the circuit corresponded to limited number of problems during the circuit's design and construction. In fact, relevant information was acquired on the involved components during the course of the project.

The project provided a real practical experience in electronics and has broadened my knowledge on many topics. The importance and applications of the theory taught in the lecture room are now well appreciated.

Finally, it is economically valuable when the cost of the entire construction is weighted with its usefulness on the same balance scale.

5.2 Problems encountered

During the construction of this project, the problem encountered was adjusting the output signal of PIR sensor to the threshold voltage set at the microcontroller at various atmospheric temperatures using the voltage regulator so as to improve the systems performance.

5.3 Recommendation

Having completed this project, the following are hereby recommended for future improvement.

- Since the sensing model is easily affected by high temperature conditions, a variable resistor could be connected to the circuit for manual reset of the threshold voltages at various atmospheric temperature conditions.
- A more standard and portable way for constantly recording voice message in the ISD25120 should be created so as to vary an alarm system sound output to is monitored area.

REFERENCE

[1] Neil Cumming, A Guide to Security System Design and Equipment Selection and Salvation.

[2] http://www.wikipedia.com/motiondetector.

[3] http://www.howstuffworks.com

[4] http://www.ultrasonics.com/motiondetector

[5] http://www.wsc.org

[6] http://www.pololu.com

[7] Microsoft Encarta Premium 2006, Alarm systems.

[8] http://national.com

[9] Tom Harris. How Burglar Alarm System Works, pp140-143

[10] http://www.glolab.com/sensors.

APPENDIX

SYSTEM ASSEMBLY PROGRAM

```
INCLUDE 89c51.mc
;********************************
;********************************
record BIT p2.5
a3_dx BIT p0.3
enable bit p2.3
eom bit p2.2
power_dn bit p2.4
;******************************
;******************************
adc_select BIT p3.2
adc_write BIT p3.3
motion_led BIT p2.0
ARM_LED BIT P2.1
;******************************
;******************************
stack EQU 100
;******************************
;******************************
PIR_vALUE DATA 8
COUNT1 DATA 9
COUNT2 DATA 10
count3 DATA 11
count4 DATA 12
cmd_0 DATA 13
cmd_1 DATA 14
cmd_2 DATA 15
count5 DATA 16
;******************************
;******************************
UPPER_tHRESHOLD EQU 30
MAX_MOTION_COUNT EQU 5
;*********************************
;*********************************
ADC_PORT EQU P1
;*********************************
;*********************************
Arm BIT 0
motion_ok BIT 1
play_sound BIT 2
sec1 BIT 3
;*********************************
;*********************************



;**********************************
org 0000h
```

```
RETI
;*********************************
ORG 000BH
jmp tf0_isr
;*********************************
ORG 0013H
RETI
;*********************************
ORG 001BH
RETI
;*********************************
ORG 0023H
JMP READ_PORT
;*********************************




;***********************************
ORG 0030H
;***********************************

start_up:        CLR ea
                 MOV sp,#stack
                 ACALL sys_init
;**************************************
;**************************************
WAIT1:           JNB ARM,wait1

main2:           ACALL get_motion
                 SJMP WAIT1

;**************************************
;**************************************
sys_init:        call reset_25120
                 call init_adc
                 CALL INIT_SERIAL
                 CLR ARM
                 MOV ie,#10010010b; re-edit thia line to enable only
needed ints
                 RET
;**************************************
;**************************************
init_adc:        CLR adc_Select
                 ret
;**************************************
;**************************************
reset_25120:     CLR a3_dx
                 SETB record
                 SETB eom
                 SETB power_dn
```

```
                SETB enable
                ret
;*****************************************
;*****************************************
get_motion:     MOV R3,#0
get_loop:       JNB ARM, EXIT_GET_MOTION
                ACALL get_pir
                ACALL compare_pir
                JNB motion_ok, exit_get_motion
                INC R3
                CJNE R3, #max_motion_count, get_loop
                CLR MOTION_LED
                call play_sound
                SETB motion_led
                RET

exit_get_motion: SETB motion_led
                RET
;*********************************************************
get_pir:        CLR adc_Write
                NOP
                NOP
                SETB adc_Write
                MOV R0,#100
                DJNZ R0,$
                MOV pir_Value, adc_port
                RET
;*****************************************
;*****************************************
delay_long:     MOV R7,#5
reload2:        MOV R6,#0
reload1:        MOV R5,#0
                DJNZ R5,$
                DJNZ R6, reload1
                DJNZ R7, reload2
                ret
;*****************************************
;*****************************************
play_sound:     call play
                ;call pause
                ;DJNZ count5, sound_loop
                call stop_sound
                RET
;*****************************************
;*****************************************
stop_sound:     call reset_25120
                ret
;*****************************************
;*****************************************
pause:          call start_pause_timer
pause_loop:     jnb sec1,$
                clr sec1
                djnz count3, pause_loop
                RET
```

```
;*******************************************
INIT_SERIAL:        MOV tcon,#00000000b
                    MOV tmod,#00100010b
                    MOV scon,#50h
                    MOV TL1,#0F4h
                    MOV th1,#0F4h
                    MOV TL0,#16
                    MOV TH0,#16
                    CLR ti
                    CLR ri
                    SETB ren
                    SETB TR1
                    RET
;*******************************************
;*******************************************
READ_PORT:          PUSH ACC
                    PUSH PSW
                    CLR TI
                    JNB RI,EXIT2
                    CLR RI
                    MOV A, SBUF
                    CJNE A,#55H, EXIT2
                    MOV CMD_0, A
                    JNB ri,$
                    CLR ri
                    MOV CMD_1, SBUF
                    JNB RI,$
                    MOV CMD_2, SBUF
;*******************************************
;*******************************************
                    MOV A, CMD_0
                    XRL A,CMD_1
                    XRL A,CMD_2
                    JZ CHK_CMD
EXIT2:              POP PSW
                    POP ACC
                    RETI
;*******************************************
;*******************************************
CHK_CMD:            MOV A, CMD_1
                    CJNE A,#99H, CHK_CMD2
                    JB arm, exit2
                    SETB ARM
                    CLR ARM_LED
                    call delay_60sec
                    JMP skip2


chk_CMD2:           CJNE A,#0eeh, EXIT2
                    CLR ARM
                    SETB ARM_LED

skip2:              SETB motion_led
```

```
                call stop_sound
                call stop_timer
                MOV sp,#stack
                POP psw
                POP acc
                MOV DPTR,#wait1
                PUSH dpl
                push dph
                RETI
;*****************************************
;*****************************************
DELAY_60SEC:    MOV R4,#50
loop_60sec:     call delay_LONG
                CPL ARM_LED
                DJNZ R4, loop_60sec
                CLR ARM_LED
                RET
;*****************************************
;*****************************************
compare_pir:    CLR motion_ok
                MOV A, pir_Value
                CJNE A,#upper_Threshold,compare2
compare1:       SETB motion_ok
                RET

compare2:       JNC compare1
                RET
;*****************************************
;*****************************************
tf0_isr:        djnz count1, exit_isr
                mov count1,#200
                djnz count2, exit_isr
                mov count2,#20
                setb sec1
exit_isr:       reti
;*****************************************
;*****************************************
stop_play:      call reset_25120
                ret
;*******************************************
;*******************************************
start_play_timer:MOV count3,#40
                JMP skip_over

start_pause_timer:MOV count3,#20
skip_over:      CLR sec1
                CLR tf0
                CLR tr0
                MOV count1,#200
                MOV count2,#20
                MOV tl0,#06h
                SETB tr0
                ret
;*******************************************
```

```
;**********************************************
stop_timer:        CLR tr0
                   CLR sec1
                   RET

;**************************************************
;**************************************************
play:              call reset_25120
                   CLR power_dn
                   call start_play_timer
                   MOV R0,#0
                   DJNZ R0,$
play3:             CLR enable
                   mov r0,#0
                   djnz r0, $
                   setb enable
play_loop2:        JNB sec1,play2
                   clr sec1
                   DJNZ count3, play2
                   jb eom,$
                   call stop_sound
                   call stop_timer
                   RET

play2:             JB eom, play_loop2
                   call reset_25120
                   CLR power_dn
                   jmp play3
;**********************************************
;**********************************************<PIXTEL_MMI_EBOOK_2005>1
                                                       </PIXTEL_MMI_EBOO
K_2005>
57
```