

Design and Implementation
of
An Intruder Radio and Video Alert System

By

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Design and Implementation of an Intruder Radio and Video Alert System

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Cover: Intruder Radio and Video Alert System

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The Project "**Design and Implementation of an Intruder Radio and Video Alert System**" Submitted by **Shafait Ahmed**, Matric No. ET-071004, Session: 2010-11, to the department of Electrical & Electronic Engineering, International Islamic University Chittagong, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Engineering (Electrical & Electronic Engineering) and approved as to its style and contents for the examination held on April 09, 2011.

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Declaration

It is hereby declared that the work presented in this project or any part of this project has not been submitted elsewhere for the award of any degree or diploma, does not contain any unlawful statement.

Signature

.....
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All praises to Allah, the most benevolent, without whose help it would be quite impossible to complete this project.

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AUTHOR

Abstract

Engineering is not only a theoretical study but it is a implementation of all we study for creating something new and making things more easy and useful through practical study. It is an art which can be gained with systematic study, observation and practice.

For that sole purpose I choose to do my project on something new and innovative. In my project I tried to introduce a new trend to the home security system. I named it as “Design and Implementation of an Intruder Radio and video Alert System”. In it I choose a voice recording a play back IC which can record an emergency voice message and plays it when security of the house is disturbed in any way. Along with that I thought it beneficial if the message can be transmitted so that it can be heard in radio. Furthermore I choose a microcontroller for automatic operation of the voice IC on the basis of various sensing system. It’s a very good security system which will provide more security for our home.

Keywords: Intruder, Radio, Video, Alert, Message, FM.

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Chapter 1

Introduction

1.1 Background

Security is the ever growing concern of human society. That's why lots of different methods are developing day by day to provide better security in our day to day life. But as a matter of fact none of the security systems are helping that much to reduce burglary. There are various kinds of alarm system are present now a days like : triggering a siren, police siren, calling police, sending message to phone, calling in a cell phone, etc. I want to add something new on this sector.

This project is based on a voice recording and play back IC. This IC can be used to record some voice message which can include an alarming voice, or location of your house, or what has happened. Then the recorded voice will be played based on a microcontroller based sensing system. The microcontroller will activate a CCTV camera automatically when playing the message so that you can see on your TV what is happening. In case of you are not in home; the message will be transmitted through a FM transmitter so that if you are in the range of the transmission you will be alerted. If you are not within the range, at least there is a hope that someone will hear the alarm on the radio, and save your belongings on your behalf.

1.2 Objective

The objectives can be summarized as developing of the methods used for security system, introducing voice messages instead of sirens and alarms, playing the message in FM radio and showing the video of the security areas in TV.

1.3 Design and Implementation of an Intruder Radio & Video Alert System

This system consists of five parts:

- I. Sensing system: The sensing system can consists of various kinds of available sensor based systems like: calling bell, fire sensor, heat sensor, magnetic sensor, infrared sensor, motion sensor, etc. Though in this project I only used infrared sensors which work with conjunction of a low power Quad Operational amplifier LM324 and one calling bell switch.
- II. Microcontroller: PIC16F84 is the microcontroller I used in my project. It collects the signals from sensing system and outputs accordingly.
- III. Message playing system: The main part of this system is the voice record & playback IC APR9600. It can record message of total duration 40-60 seconds and works in five different modes. Therefore provides an excellent choice for voice record and play back.

- IV. FM transmission: A simple FM transmitter with a range of at least 200m will provide an excellent media for transmission. Though for experimental basis my FM transmitter is only capable to transmit the signal to 30 feet. But it can be overcome very easily by developing a better transmitter.
- V. CCTV camera: It is to watch through the home area to identify what is happening. A DVR system connected to it will provide accurate information about all the incidents.

1.4 Methodology

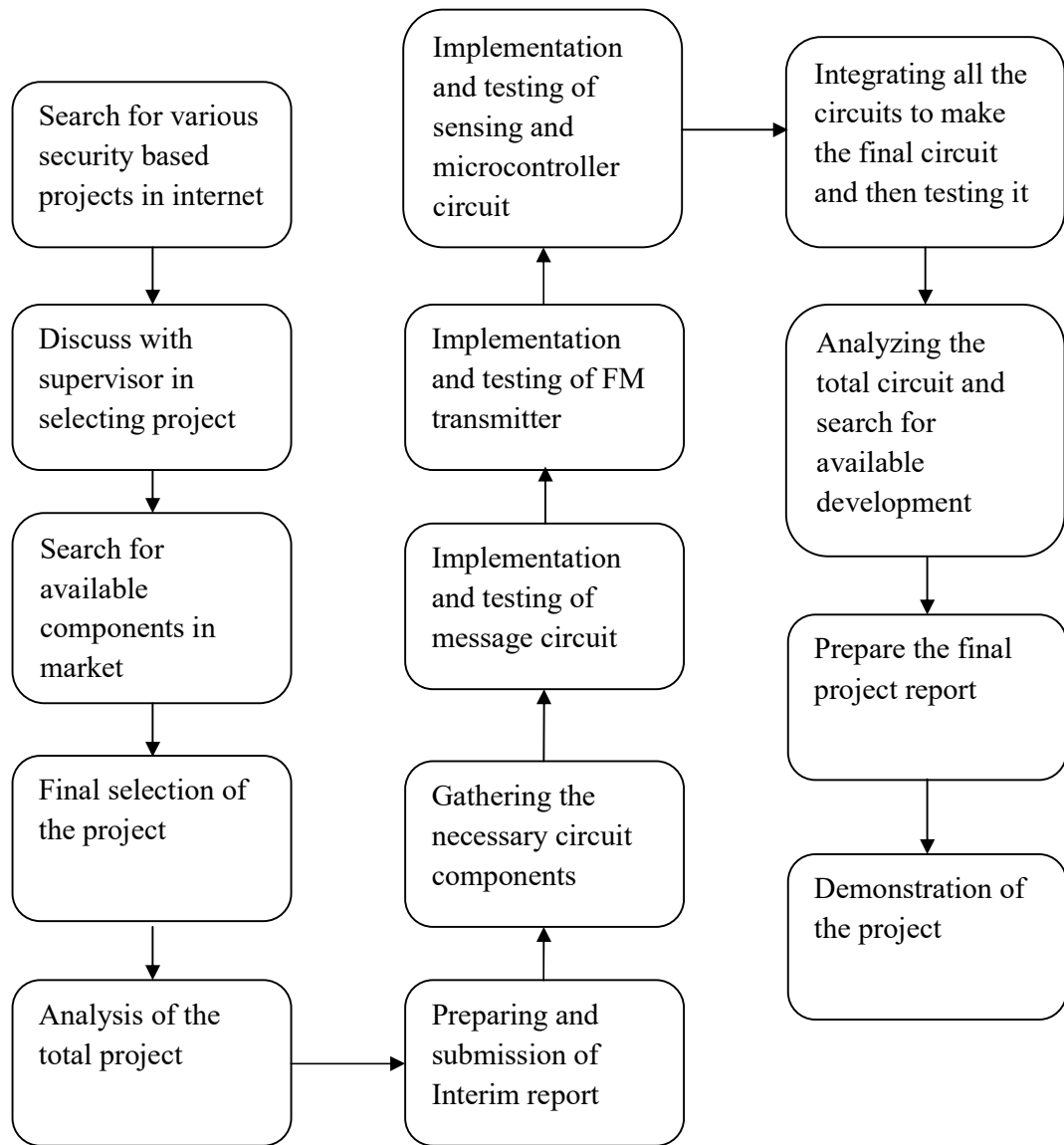


Fig 1.1 : Methodology of the project

Chapter 2

Literature Review

2.1 General basics

With the development of the modern engineering, electronic systems are being employed for automation of every aspects of human work. To make the life more easy and comfortable automatic devices are evolving day by day. Security system is a part of that too. Now a days there are a lot of researches going on for the development of the security of our valuable things. At first there were only sensors which will detect abnormalities of one particular zone and raise an alarm. But with the available use of microcontroller, all the systems are combining with one another to give better security. Moreover the sensors are becoming wireless for convenient process of detection. Now, more than one alarm system can be activated at the same time. Some examples are like: activating an alarm along with calling the owner or calling the police or fire service in case of fire. Also these systems are becoming wireless day by day. Some of the existing security systems are discussed in this chapter.

2.2 Some example security system

2.2.1 Simple door alarm system

The circuit in figure 2.1 is a door alarm circuit. It is a basic latching circuit consisting of a quad 2-input NAND Gate IC. It is configured such that the flip flop circuit U1A and U1B has both its input held at logic "1". Pin 1 is held at logic "1" by the magnetic contact and pin 6 is held at logic "1" by resistor R1. S1 switch is a normally open pushbutton switch which is used as a reset button. When S1 is pressed, the input pin 6 will be at logic "0", hence the output of U1B will go to logic "1". This logic is inverted by U1C and U1D to logic "0". The

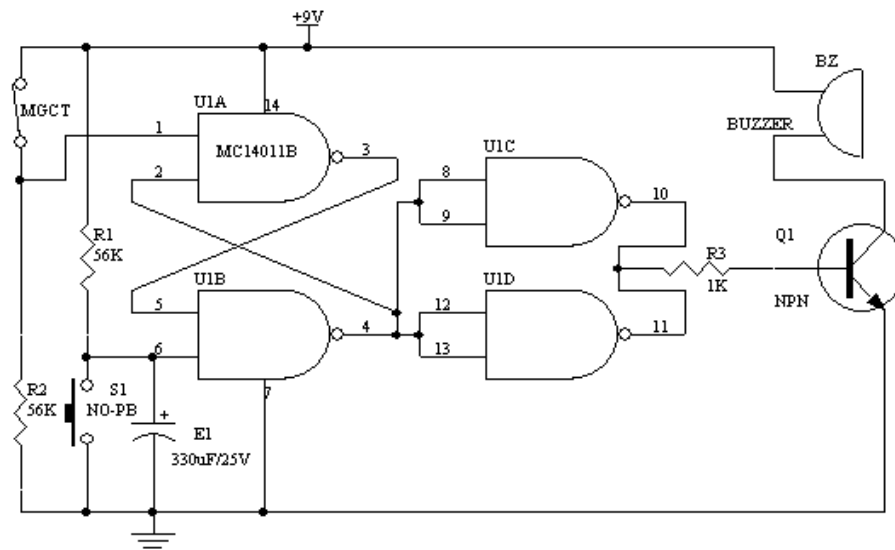


Fig 2.1: Simple door alarm system [20]

transistor Q1 will be OFF and buzzer will not sound. When the magnetic contact sensor is opened, the input to pin 1 will be at logic "0", giving an output of logic "1" at pin 3 of U1A. Pin 5 of U1B will go "1" and pin 6 will be "1" as well giving an output at pin 4 a logic "0". This will be inverted and a logic "1" will be generated at the base of transistor Q1. The transistor Q1 will turn ON and cause the buzzer to sound continuously until the reset switch S1 is pressed.

2.2.2 Infrared Intruder Alarm system

This circuit shown in figure 2.2 warns the trespasser infrared system or Infrared Intruder Alarm circuit that interesting. By when there is a person passes or cut the light infrared. The system will clearly warn immediately, command give relay work, build current give super siren or the other, this circuit then suit is burglar alarm circuits. When see the equipment the few compose IC 555 perform produce the frequency drives LED infrared in a part sends. The part takes as a result have photo diode perform take the light infrared. Then transmit transistor for boost up a signal gives the power goes up, and change double voltage be 2 times. Before change IC op-amp CA3130 perform compare with voltage model the turned around. Be when have no a signal reaches that outgoing have high voltage come out. But seek have usual signal have no current come out give BC109 drive relay get.

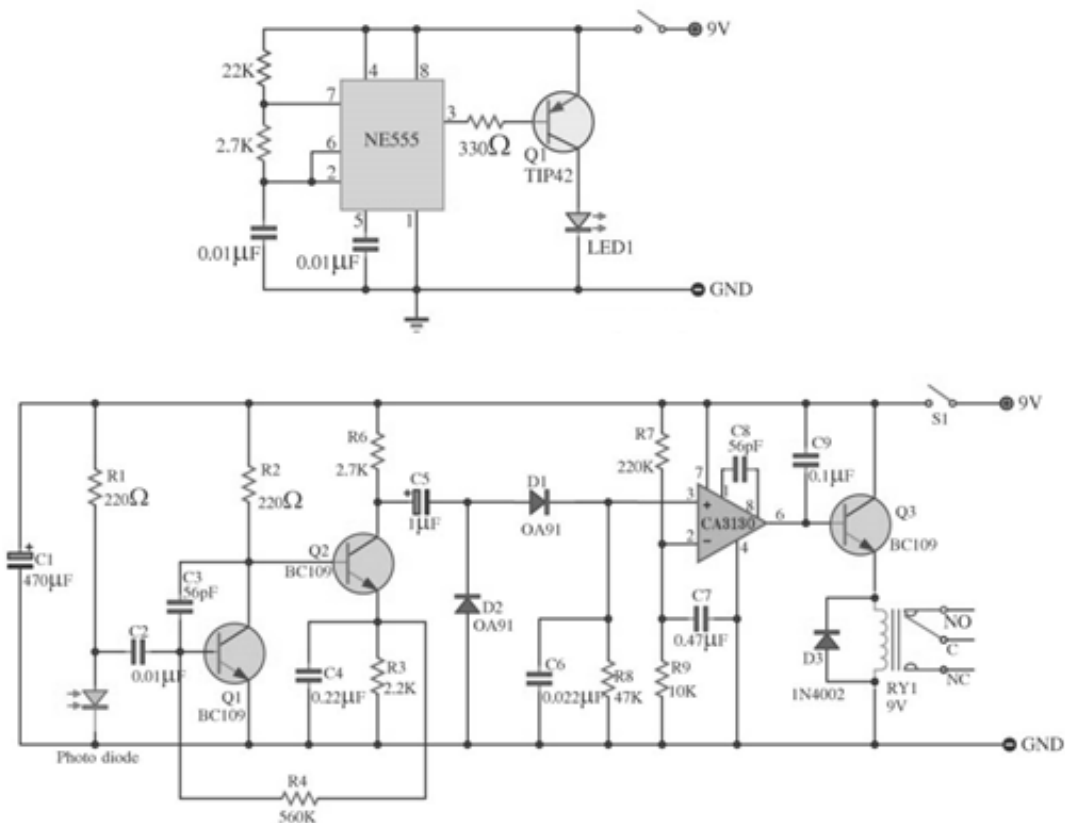


Fig 2.2 : Infrared Intruder Alarm system [21]

2.2.3 Burglar alarm system

This burglar alarm system circuit in figure 2.3 is using an infrared proximity detector that triggers an alarm when the rays falling on its sensor are interrupted. It is different from others burglar alarm systems because is a very simple project and can offer you great satisfaction.

The circuit of IR burglar alarm system comprises transmitter and receiver-cum-alarm sections. It works off 6V DC, 500mA uninterrupted supply and uses low-cost readily-available electronic components. LED2 is used for indicating power-on.

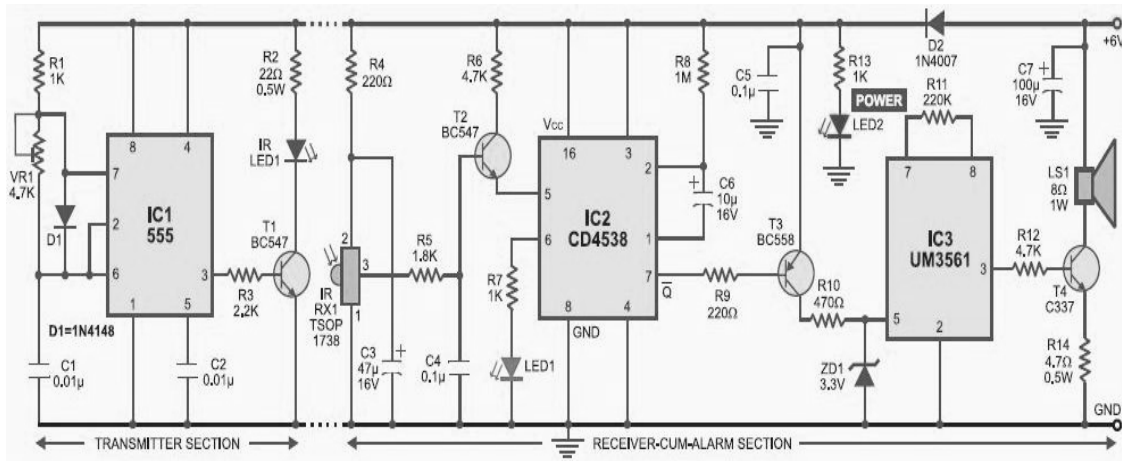


Fig 2.3 : Burglar alarm system [22]

The transmitted IR signal directly falls on IR sensor TSOP1738. Whenever the IR signal is interrupted, its output pin 3 goes low and IC2 is triggered at pin 5 through transistor T2. As a result, its output at pin 7 goes low (for a preset time) to forward bias siren-driver transistor T2. This condition is indicated by the glowing of LED1. The time-out period can be increased or decreased by changing the value of capacitor C6. The output tone of siren-sound generator IC3 can be set by connecting its pin 6 to either Vcc or GND. When you connect pin 6 to Vcc IC3 produces the sound of fire-alarm siren, but when you connect it to GND it produces the sound of ambulance siren.

2.2.4 Wireless home security system

The circuit in figure 2.4 is a wireless home security system. It has two main parts: an intruder sensor cum transmitter and a receiver. The intruder sensor reacts to light, sound, and

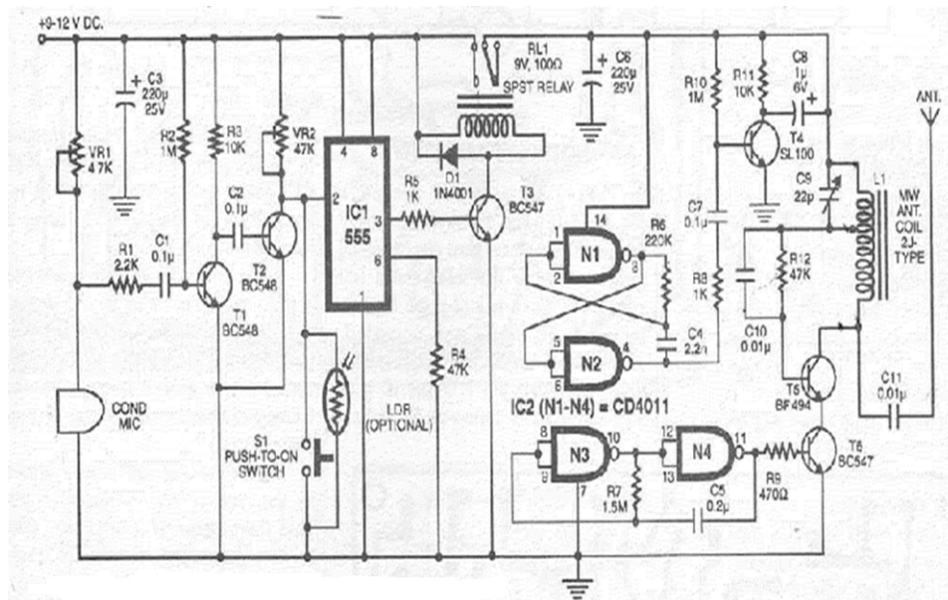


Fig 2.4 : Wireless home security system [23]

mechanical movements. When the sensor detects a disturbance, the transmitter gets triggered and begins to send wireless signals. The receiver placed away from the transmitter receives the signals and produces an audio alarm. At the same time, a relay switch is turned on so that other security systems can be energized through this relay.

2.2.5 Home alarm security system

The circuit shown in figure 2.5 is a simple, secure and cheap home security system. It is activated and deactivated by little Rolling Code transmitter. The security system is equipped with two sounder, internal with piezo speaker and AG8 external sounder, a microprocessor controlled external sounder with a built in strobe and rich of features (silent installation, two flash settings, optional sounder settings (multi-sweep or two tone), selectable timer). To detect intruder, there are two sensors are used in the project: magnetic contact for the door and impactor, a smart shock sensors for the door. The project uses microchip PIC16F877A microcontroller as main processor. MCU firmware is written in C and compiled with HI-TECH PICC-Lite.

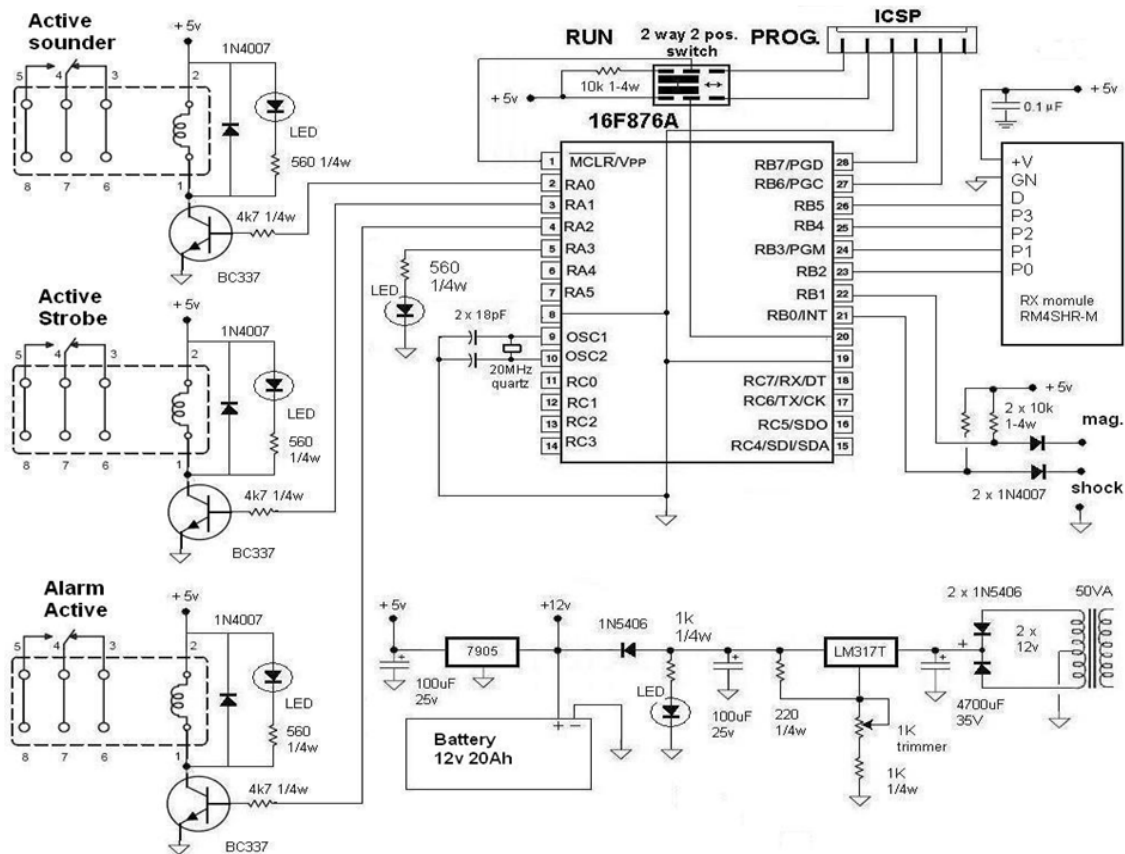


Fig 2.5 : Home alarm security system [24]

2.3 Summary

There are a lot of security systems available now a days like some of the above. Almost all the security system is used for a particular zone. May be its for door, or for main entrance, window or fire. But development of the security systems demands more and more sensing systems working together. In this case my alert system provides room for several sensing

system to work at a time. Therefore it can provide security against intruder, fire or any other hazards as long as it can be sensed.

Now, there are some systems which combine several sensing system. But none of them can detect this sensing system separately. I mean to say; almost all this systems generate a particular sound. Therefore it is hard to detect which zone is affected. In this case my system is more reliable than the others. As in this system the alarm is a voice message, therefore variations in the played messages can be easily done. This variation is very much helpful to detect the problem immediately.

Wireless detection is another interesting advancement in security system. In case of we are not in home; it is convenient if we can get the alarm through wireless medium. My system uses a most common and widely used form of wireless technology, FM transmission. As FM receivers are widely available now a days, even we have it in our mobile phone. In my system the alarm is transmitted through FM so it can be heard easily through a radio. Therefore not only us, but the neighbors; even the patrol police can hear the alarm and take necessary actions in earliest possible time.

Moreover the CCTV camera provides a nice view of our home in the TV so that we can immediately find who is responsible for the alarm. If we are not in home, a DVR will definitely provide ultimate protection by filming the intruder and his activities and saving them in its memory.

Overall my system is better than any other available security systems available in the market. Also its low price makes it easier to get it and use it for all kind of people.

Chapter 3

Component Details

3.1 Voice record and playback IC (APR9600)

3.1.1 General Description

The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly amplify system design. The device is ideal for use in portable voice recorders, toys and many other consumer and industrial applications.

APLUS integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.

3.1.2 Features

- i. Single-chip, high-quality voice recording & playback solution
 - No external ICs required
 - Minimum external components
- ii. Non-volatile Flash memory technology
 - No battery backup required
- iii. User-Selectable messaging options
 - Random access of multiple fixed-duration messages
 - Sequential access of multiple variable-duration messages
- iv. User-friendly, easy-to-use operation
 - Programming & development systems not required
 - Level-activated recording & edge-activated play back switches
- v. Low power consumption
 - Operating current: 25 mA typical
 - Standby current: 1 uA typical
 - Automatic power-down
- vi. Chip Enable pin for simple message expansion
- vii. Have three modes of configuration.
- viii. Can record eight different messages.
- ix. Low price and widely available.

3.1.3 Pin diagram

Figure 3.1 represents the pin diagram of the voice record and playback IC APR9600.

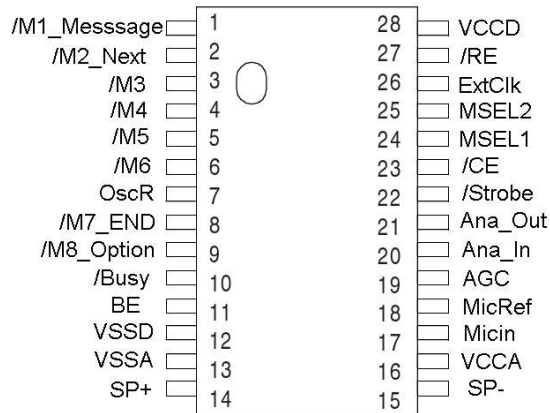


Fig 3.1 : Pin diagram of APR9600 [7]

3.1.4 Internal block diagram

Figure 3.2 represents the internal functional block diagram of the voice record and playback IC APR9600.

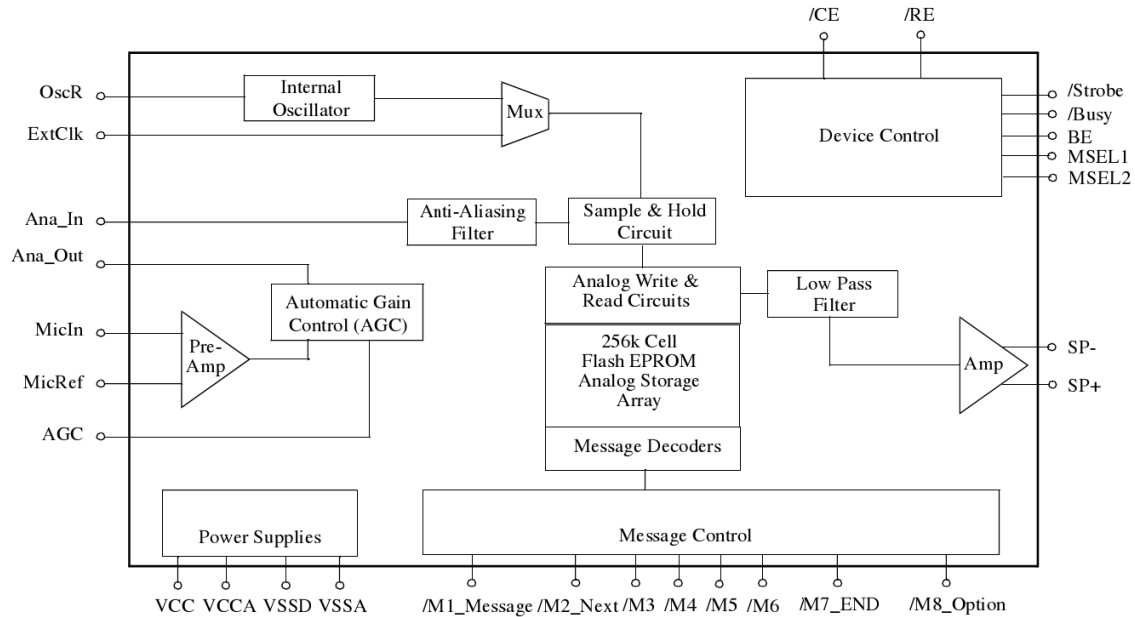


Fig 3.2 : Internal block diagram of APR9600 [7]

3.1.5 Description of the pins

Table 3.1 represents the pin numbers, their designation and function of voice record and playback IC APR9600.

Table 3.1 : Pin description of APR9600 [7]

Pin name	Pin no	Function
/M1_Message	1	Message 1: A low edge on this pin forces a jump to message 1 for either recording or playback.
/M2_Next	2	Message 2: A low edge on this pin forces a jump to message 2 for either recording or playback.
/M3	3	Message 3: A low edge on this pin forces a jump to message 3 for either recording or playback.
/M4	4	Message 4: A low edge on this pin forces a jump to message 4 for either recording or playback.
/M5	5	Message 5: A low edge on this pin forces a jump to message 5 for either recording or playback.
/M6	6	Message 6: A low edge on this pin forces a jump to message 6 for either recording or playback.
OscR	7	Oscillator Resistor: this input allows an external resistor to be connected to the tank circuit of the internal oscillator. Refer to table for a list of resistors and their resultant sampling rates.
/M7_END	8	Message 7: A low edge on this pin forces a jump to message 7 for either recording or playback. In tape mode a low level on this pin indicates end of memory array was reached.
/M8_Option	9	Message 8: A low edge on this pin forces a jump to message 8 for either recording or playback. This pin also sets record and playback operating mode in conjunction with MSEL1 and MSEL 2.
/Busy	10	This pin indicates that the device is currently busy performing internal functions and can neither record nor playback at the current time.
BE	11	If this pin is pulled high Beep is enabled. If this pin is pulled low beep is disabled
VSSD	12	Digital GND Connection: Connect to system ground.
VSSA	13	Analog GND Connection: Connect system ground.
SP+	14	Positive Output for Speaker Connection: Should be connected to the positive terminal of the output speaker. Total output power is.1 W into 16 ohms. Do not use speaker loads lower than 8 ohms or device damage may result.
SP-	15	Negative Output for Speaker Connection: Should be connected to the negative terminal of the output speaker.
VCCA	16	Analog Positive Power Supply: This connection supplies power for on-chip analog circuitry. Should be connected to the positive supply rail as outlined in the reference schematics.
MicIn	17	Microphone Input: Should be connected to the microphone input as outlined in the reference schematics.
MicRef	18	Microphone GND Reference: Should be connected to the microphone input as outlined in the reference schematics.
Pin name	Pin no	Function
AGC	19	Automatic Gain Control Attac Time: The time constant of the RC network connected to this input determines the AGC attack time. The attack time is defined as the delay present before the AGC circuit

		begins to adjust gain. The values shown in the reference schematics have been optimized for voice applications.
Ana_In	20	Analog In: This pin must be connected to Ana_Out through a 0.1µF Capacitor.
Ana_Out	21	Analog Out: This pin must be connected to Ana_In through a 0.1µF Capacitor.
/Strobe	22	Strobe: This pin indicates programming of each individual recording segment. The falling edge represents the beginning of the sector. The rising edge indicates that the sector is half full.
/CE	23	Chip Select: A low level on this pin enables the device for operation. Toggling this pin also resets several message management features.
MSEL1	24	Mode Select1: This pin in conjunction with MSEL2 and /M8_Option sets record and playback operating mode.
MSEL2	25	Mode Select2: This pin in conjunction with MSEL1 and /M8_Option sets record and playback operating mode.
ExtClk	26	External Clock: This clock can be used instead of the internal clock for greater programming control and or accuracy. When using the internal clock this pin should be tied to system GND.
/RE	27	Record Enable: this pin controls whether the device is in write or read mode. Logic level high is read.
VCCD	28	Digital Positive Power Supply: This connection supplies power for on-chip digital circuitry. Should be connected to the positive supply rail as out lined in the reference schematics.

3.1.6 Available modes and mode selection procedure

Table 3.2 represents the available modes, their configuration and requirements; for the voice record and playback IC APR9600.

Table 3.2 : Mode selection procedure of APR9600 [7]

Mode	MSEL1	MSEL2	/M8_Option Pin 9
2 fixed duration message	0	1	Pull this pin to VCC through 100K resistor
4 fixed duration message	1	0	Pull this pin to VCC through 100K resistor
8 fixed duration message	1	1	Becomes the /M8 message trigger input pin
Tape mode-Normal	0	0	0
Tape mode-Auto rewind	0	0	1

3.1.7 Effect of Rosc. resistor on recording message

Table 3.3 represents the effect of Rosc resistor on the quality of recorded voice.

Table 3.3 : Effect of Rosc. resistor [7]

Ref. Oscr	Sampling Frequency	Input Bandwidth	Voice Duration
84 K Ohm	4.2 KHz	2.1 KHz	60 sec.
38 K Ohm	6,4 KHz	3.2 KHz	40 sec.
24 K Ohm	8.0 KHz	4.0 KHz	32 sec.

3.2 Microcontroller (PIC16F84)

3.2.1 General description

PIC16F84 is a CMOS Flash/EEPROM-based microcontroller developed by Microchip. It is a 8 bit microcontroller having 18 pins. It is really a suitable microcontroller for automotive, industrial, appliances low power remote sensors, electronic locks and security applications.

3.2.1 Features:

- Only 35 single word instructions to learn
- All instructions single-cycle except for program branches which are two-cycle
- Operating speed: DC - 20 MHz clock input
DC - 200 ns instruction cycle
- 1024 words of program memory
- 68 bytes of Data RAM
- 64 bytes of Data EEPROM
- 14-bit wide instruction words
- 8-bit wide data bytes
- 15 Special Function Hardware registers
- Eight-level deep hardware stack
- Direct, indirect and relative addressing modes
- Four interrupt sources:
 - External RB0/INT pin
 - TMR0 timer overflow
 - PORTB<7:4> interrupt-on-change
 - Data EEPROM write complete
- 13 I/O pins with individual direction control
- High current sink/source for direct LED drive
 - 25 mA sink max. per pin
 - 25 mA source max. per pin
- TMR0: 8 bit timer/counter with 8bit programmable prescaler

3.2.3 Pin diagram

Figure 3.3 represents the pin diagram of the microcontroller PIC16F84.

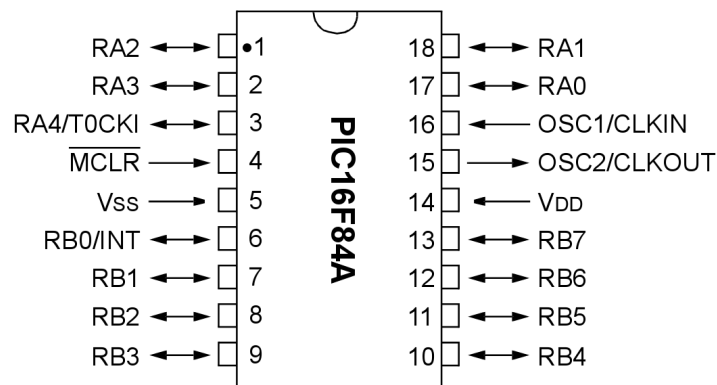


Fig 3.3 : Pin diagram of PIC16F84 [9]

3.2.4 Description of the Pins

Table 3.4 represents the pin number, their designation and functional description of the microcontroller PIC16F84.

Table 3.4 : Pin description of PIC16F84 [9]

Pin name	PDIP No.	I/O/P Type	Description
OSC1/CLKIN	16	I	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	15	O	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode. In RC mode, OSC2 pin outputs CLKOUT, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
MCLR	4	I/P	Master Clear (Reset) input/programming voltage input. This pin is an active low RESET to the device.
RA0 RA1 RA2 RA3 RA4/T0CKI	17 18 1 2 3	I/O I/O I/O I/O I/O	PORTA is a bi-directional I/O port. Can also be selected to be the clock input to the TMR0 timer/counter. Output is open drain type.
RB0/INT RB1 RB2 RB3 RB4 RB5 RB6 RB7	6 7 8 9 10 11 12 13	I/O I/O I/O I/O I/O I/O I/O	PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs. RB0/INT can also be selected as an external interrupt pin. Interrupt-on-change pin. Interrupt-on-change pin. Interrupt-on-change pin. Serial programming clock. Interrupt-on-change pin. Serial programming data.
VSS	5	P	Ground reference for logic and I/O pins.
VDD	14	P	Positive supply for logic and I/O pins.
Legend:	I= input	O = Output	I/O = Input/Output P = Power

3.3 Quad Operational Amplifier (LM324)

3.3.1 General Description

The LM324 series consists of four independent high gain internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Figure 3.4 shows the pin diagram of LM324. Application areas include transducer

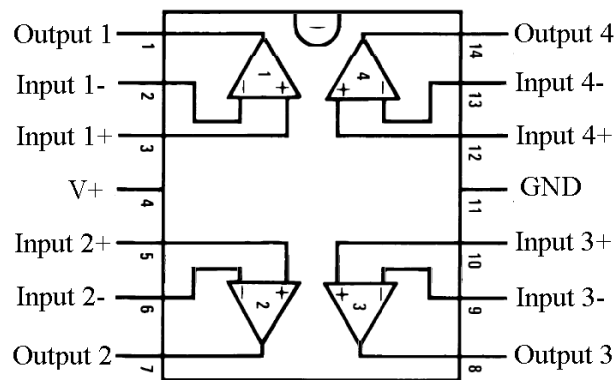


Fig 3.4 : Pin diagram of LM324 [11]

amplifiers DC gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example the LM324 series can be directly operated off of the standard 5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional 15V power supplies.

3.3.2 Features

- ❖ Eliminates need for dual supplies
- ❖ Four internally compensated op amps in a single package
- ❖ Allows directly sensing near GND and VOUT also goes to GND
- ❖ Compatible with all forms of logic
- ❖ Power drain suitable for battery operation
- ❖ Internally frequency compensated for unity gain
- ❖ Large DC voltage gain 100 dB
- ❖ Wide bandwidth (unity gain) 1 MHz
- ❖ Wide power supply range
 - Single supply 3V to 32V
 - Or dual supplies 1.5V to 16V
- ❖ Very low supply current drain (700 μ A) essentially independent of supply voltage.
- ❖ Low input biasing current 45 nA (Temperature compensated)
- ❖ Low input offset voltage 2 mV and offset current 5 nA
- ❖ Input common-mode voltage range includes ground
- ❖ Differential input voltage range equal to the power supply voltage
- ❖ Large output voltage swing 0V to 15V

3.4 NPN transistor (2N3904)

This device is designed as a general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier. Figure 3.5 represents the physical view of 2N3904 and its pin orientation. Table 3.5 shows its various characteristics.



Fig 3.5 : NPN transistor 2N3904

Table 3.5 : Absolute maximum ratings for 2N3904 ($T_a=25\text{ }^\circ\text{C}$) [13]

Symbol	Parameter	Value	Units
V_{CEO}	Collector-Emmitter Voltage	40	V
V_{CBO}	Collector-Base Voltage	60	V
V_{EBO}	Emitter-Base Voltage	6.0	V
I_C	Collector Current – Continuous	200	mA
T_j, T_{stg}	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

3.5 NPN transistor (C828)

It is an ordinary NPN transistor used in this project for switching purpose. It allows maximum 50 mA collector current with 5 mA base current. Figure 3.6 shows its physical view and table 3.6 shows its various ratings.

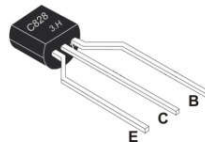


Fig 3.6 : NPN transistor C828

Table 3.6 : Absolute maximum ratings for C828 ($T_a=25\text{ }^\circ\text{C}$) [14]

Symbol	Value	Unit
V_{CBO}	30, 45	V
V_{CEO}	25, 45	V
V_{EBO}	7	V
I_{CP}	100	mA
I_C	50	mA
P_C	4000	mW
T_j	150	$^\circ\text{C}$
T_{stg}	-55~+150	$^\circ\text{C}$

3.6 IR LED and IR sensor:

Figure 3.7 represents physical view of some IR. IR LED emits infrared radiation. This radiation illuminates the surface in front of LED. Surface reflects the infrared light. Depending on reflectivity of the surface, amount of light reflected varies. This reflected light is made incident on reverse biased IR sensor.

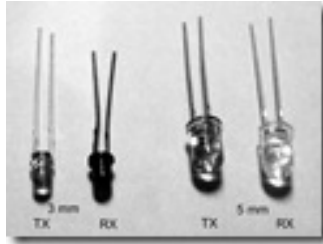


Fig 3.7 : IR transmitters and sensors

When photons are incident on reverse biased junction of this diode, electron-hole pairs are generated, which results in reverse leakage current. Amount of electron-hole pairs generated depends on intensity of incident IR radiation. More intense radiation results in more reverse leakage current. This current can be passed through a resistor so as to get proportional voltage. Thus as intensity of incident rays varies, voltage across resistor will vary accordingly. This voltage can then be given to OPAMP based comparator.

IR LED is used as a source of infrared rays. It comes in two packages 3mm or 5mm. 3mm is better as it requires less space. IR sensor is nothing but a diode, which is sensitive for infrared radiation. This infrared transmitter and receiver is called as IR TX-RX pair. Following snap shows 3mm and 5mm IR pairs.

3.7 Voltage regulator IC: - L7805CV & L7812CV

The power supply needed for the whole operation is provided by two positive voltage regulator IC's developed by STMicroelectronics. The electronics equipments needs +5V power supply which is provided from L7805CV IC and +12 supply needed for the CCTV camera is provided from L7812CV IC.

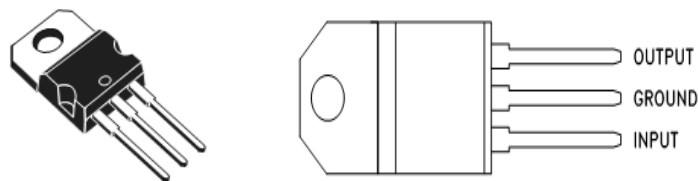


Fig 3.8 : Physical view of LMXX series IC's

Features

- Output voltage tolerances of $\pm 5\%$ over the temperature range
- Output current of 1.5A
- Internal thermal overload protection
- Output transistor safe area protection

- Internal short circuit current limit

3.8 Electret Microphone

An Electret microphone is a type of condenser microphone, which eliminates the need for a polarizing power supply by using a permanently-charged material.

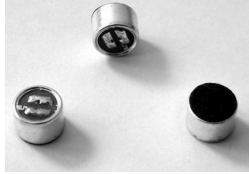


Fig 3.9 : Electret condenser microphone

3.9 Crystal oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric



Fig 3.10 : Crystal Oscillator

resonator used is the quartz crystal, so oscillator circuits designed around them became known as "crystal oscillators." It is very useful to provide the clock frequency of a PIC microcontroller.

3.10 Capacitor

There are two types of capacitors are used in this project.



Fig 3.11 :Ceramic Capacitor



Fig 3.12 : Electrolytic Capacitor

3.11 Resistor

A resistor is a two-terminal passive electronic component which implements electrical resistance as a circuit element. All of the resistors used in this project is of $\frac{1}{4}$ watt. Figure 3.13 represents physical view of $\frac{1}{4}$ watt resistor.



Fig 3.13 : $\frac{1}{4}$ watt Resistor

3.12 LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps. Figure 3.14 represents physical view of LED's.



Fig 3.14 : Light emitting diode

3.13 CCTV Camera

Closed-circuit television (CCTV) is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. It differs from broadcast television in that the signal is not openly transmitted, though it may employ point to point (P2P), point to multipoint, or mesh wireless links. Though almost all video cameras fit this definition, the term is most often applied to those used for surveillance in areas that may need monitoring such as banks, casinos, airports, military installations, and convenience stores. Figure 3.15 shows physical view of a simple CCTV camera.



Fig 3.15 Close circuit camera

Chapter 4

Design, Construction & Implementation

4.1 Block Diagram

Figure 4.1 shows the flow chart of the total project through block representation.

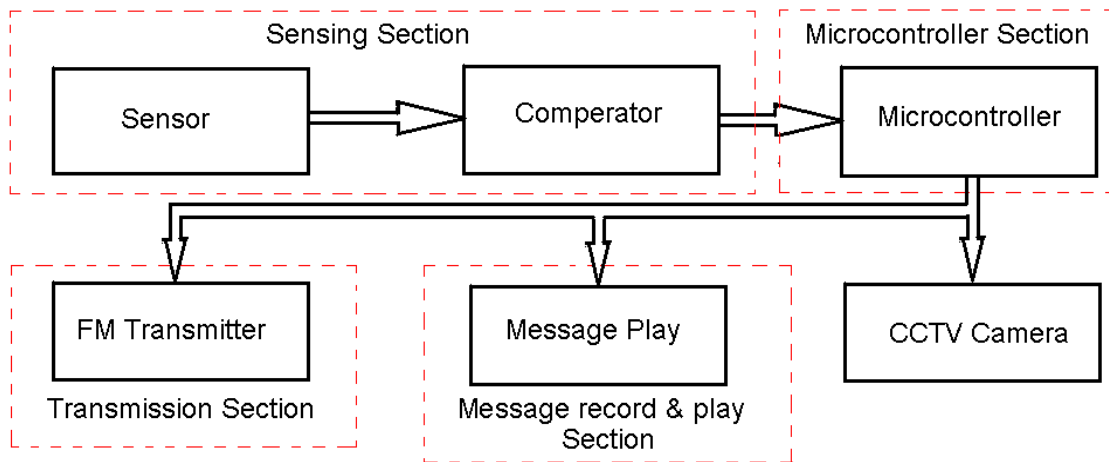


Fig 4.1 : Block diagram of the entire project

4.2 Sensing Section

Figure 4.2 shows the circuit diagram of the sensing section of the total circuit.

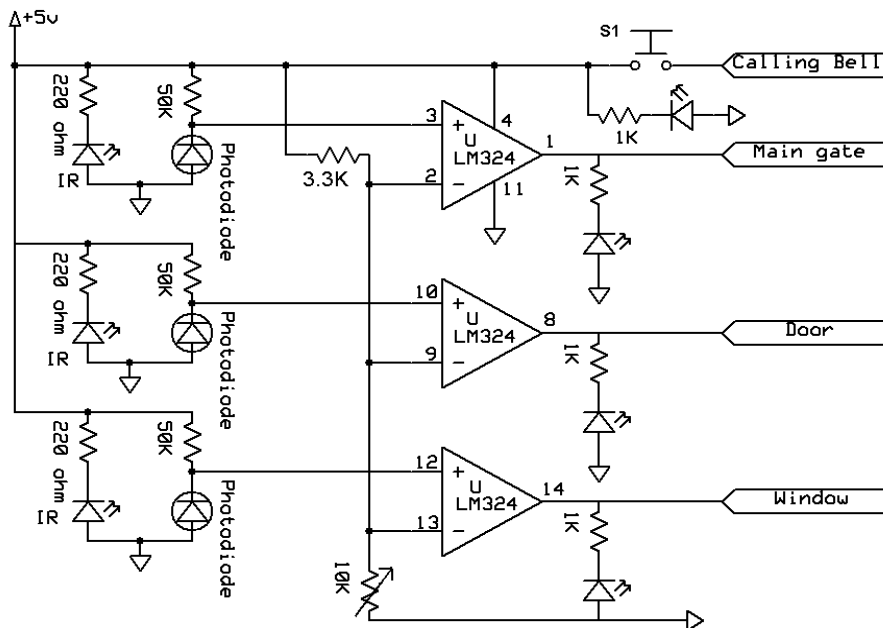


Fig 4.2 : Sensing circuit diagram

In this section three IR transmitter (TX) and receiver (RX) pair is used for security of different areas of the house. In this project three areas to be secured are main gate, front door and window. A 220Ω resistor is connected to the IR TX to limit the current flow through it and for RX the value of the resistor is $50K\Omega$. The TX and RX are placed face to face so the reception is clear. In working condition when infrared ray transmitted by the TX falls on to the RX the voltage drop across the RX is approximately 1V. When anything comes between the TX and RX the RX can no longer receive the ray and its drop rises to nearly 1.7V. This difference of voltage is compared to a reference voltage with the help of a comparator, in this case LM324. The reference voltage is given from a $10K\Omega$ variable resistor. The reference voltage is kept between 1V to 1.7V. Depending on the distance between the TX and RX this voltage can be adjusted. Therefore when something blocks the way of transmission, the comparator gives a +5V output to its respective pin. Here output of pin 1, pin 8 and pin 14 is appointed as the interruption from the main gate, front door and window respectively. The calling bell system is appointed by applying a +5V output through a push button switch S1. All the four outputs are parallelly connected to four different indicating LED's to ensure the correct operation of the sensing system.

4.3 Microcontroller Section

Figure 4.3 shows the circuit configuration of the microcontroller section.

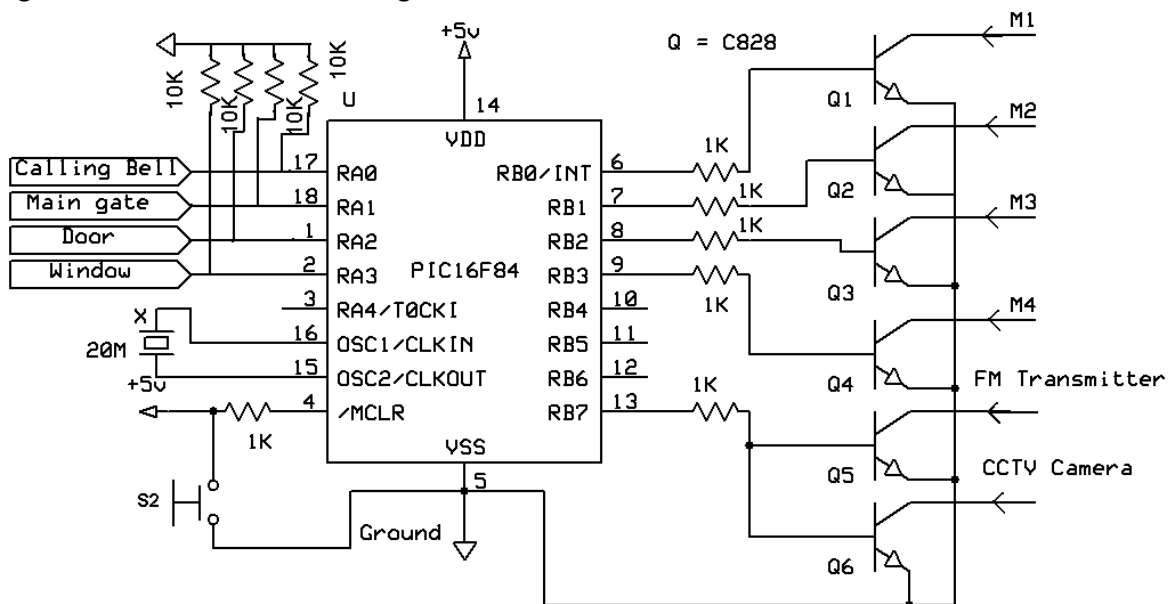


Fig 4.3 : Microcontroller circuit diagram

PIC16F84 is the microcontroller used in this project. VDD pin is provided by +5V dc supply and VSS is grounded. /MCLR pin is kept high through $1K\Omega$ resistor. It can be grounded through a push button switch S2 in order to reset the microcontroller. A 20MHz crystal is connected between the pin15 and pin16 to provide the clock speed. The four I/O pins of PIC16F84:- RA0, RA1, RA2 and RA3 are used to read the outputs from the sensing section i.e. outputs corresponding to calling bell, main gate, front door and window respectively. According to the input to these pins the microcontroller will give an output of +5V (logic 1) to the pins RB0, RB1, RB2, RB3 and RB7. The logic sequences are

1. when RA0=1, RB0=RB7=1, RB1=RB2=RB3=0; for only ten seconds.
2. when RA1=1, RB1=RB7=1, RB0=RB2=RB3=0; until S2 is pressed to reset
3. when RA2=1, RB2=RB7=1, RB0=RB1=RB3=0; until S2 is pressed to reset

4. when RA3=1, RB3=RB7=1, RB0=RB1=RB2=0; until S2 is pressed to reset

All the output pins are connected to six npn transistor C828. RB0, RB1, RB2 and RB3 are connected to the Base of transistor Q1, Q2, Q3 and Q4 respectively through 1KΩ whereas RB7 is connected to the base of both transistor Q5 & Q6. All the Emitters of the transistors are connected directly to the ground. Therefore all the transistors will act as a switch which will connect their respective loads (connected with the collector) to the ground. The transistors Q1, Q2, Q3 and Q4 will provide the ground connection for message pin M1, M2, M3 and M4 of APR9600. Transistor Q5 will provide ground connection only for the microphone of FM transmitter and Q6 will provide that for the ground connection of CCTV camera.

Program code for the microcontroller: Developed and compiled by PLSPIC compiler

```
'General hardware configuration (#chip model, osc.); description of how to write the
hardware configuration
#chip 16F84A, 20 ; chip name 16F84A, 20MHz clock
'Device connection settings ; description
#define Bell PORTA.0 ; RA0 pin will be defined as Bell
#define Main PORTA.1 ; RA1 pin will be defined as Main
#define Door PORTA.2 ; RA2 pin will be defined as Door
#define Wind PORTA.3 ; RA3 pin will be defined as Wind

'Sets the direction of IO pin 0=OUT, 1=IN ; description
DIR PORTA IN ; port A will be used as input
DIR PORTB OUT ; port B will be used as output

Main: ; starting of main program
Set PORTB.0 0 ; pin RB0=0
Set PORTB.1 0 ; pin RB1=0
Set PORTB.2 0 ; pin RB2=0
Set PORTB.3 0 ; pin RB3=0
Set PORTB.7 0 ; pin RB7=0
If Main 1 Then ; if the RA1 pin is 1 then,
Set PORTB.0 0 ; pin RB0=0
Set PORTB.1 1 ; pin RB1=1
Set PORTB.2 0 ; pin RB2=0
Set PORTB.3 0 ; pin RB3=0
Set PORTB.7 1 ; pin RB7=1
L1: ; infinite loop
nop ; no operation
Goto L1 ; jumps to L1 and continues the loop
End If ; if the RA1 pin is not 1, then program
will jump to this point from the start of if

If Door 1 Then ; if the RA2 pin is 1 then,
Set PORTB.0 0 ; pin RB0=0
Set PORTB.1 0 ; pin RB1=0
Set PORTB.2 1 ; pin RB2=1
Set PORTB.3 0 ; pin RB3=0
Set PORTB.7 1 ; pin RB7=1
```

L2:	; infinite lope
nop	; no operation
Goto L2	; jumps to L2 and continues the loop
End If	; if the RA2 pin is not 1, then program will jump to this point from the start of if
If Wind 1 Then	; if the RA3 pin is 1 then,
Set PORTB.0 0	; pin RB0=0
Set PORTB.1 0	; pin RB1=0
Set PORTB.2 0	; pin RB2=0
Set PORTB.3 1	; pin RB3=1
Set PORTB.7 1	; pin RB7=1
L3:	; infinite lope
nop	; no operation
Goto L3	; jumps to L3 and continues the loop
End If	; if the RA3 pin is not 1, then program will jump to this point from the start of if
If Bell 1 Then	; if the RA0 pin is 1 then
Set PORTB.0 1	; pin RB0=1
Set PORTB.1 0	; pin RB1=0
Set PORTB.2 0	; pin RB2=0
Set PORTB.3 0	; pin RB3=0
Set PORTB.7 1	; pin RB7=1
wait 10 sec	; holds the outputs for 10 second
End If	; if the RA0 pin is not 1, then program will jump to this point from the start of if
Goto Main	; the program will start again from main

4.4 Message Record and Playback Section

Figure 4.4 represents the circuit configuration for the voice IC.

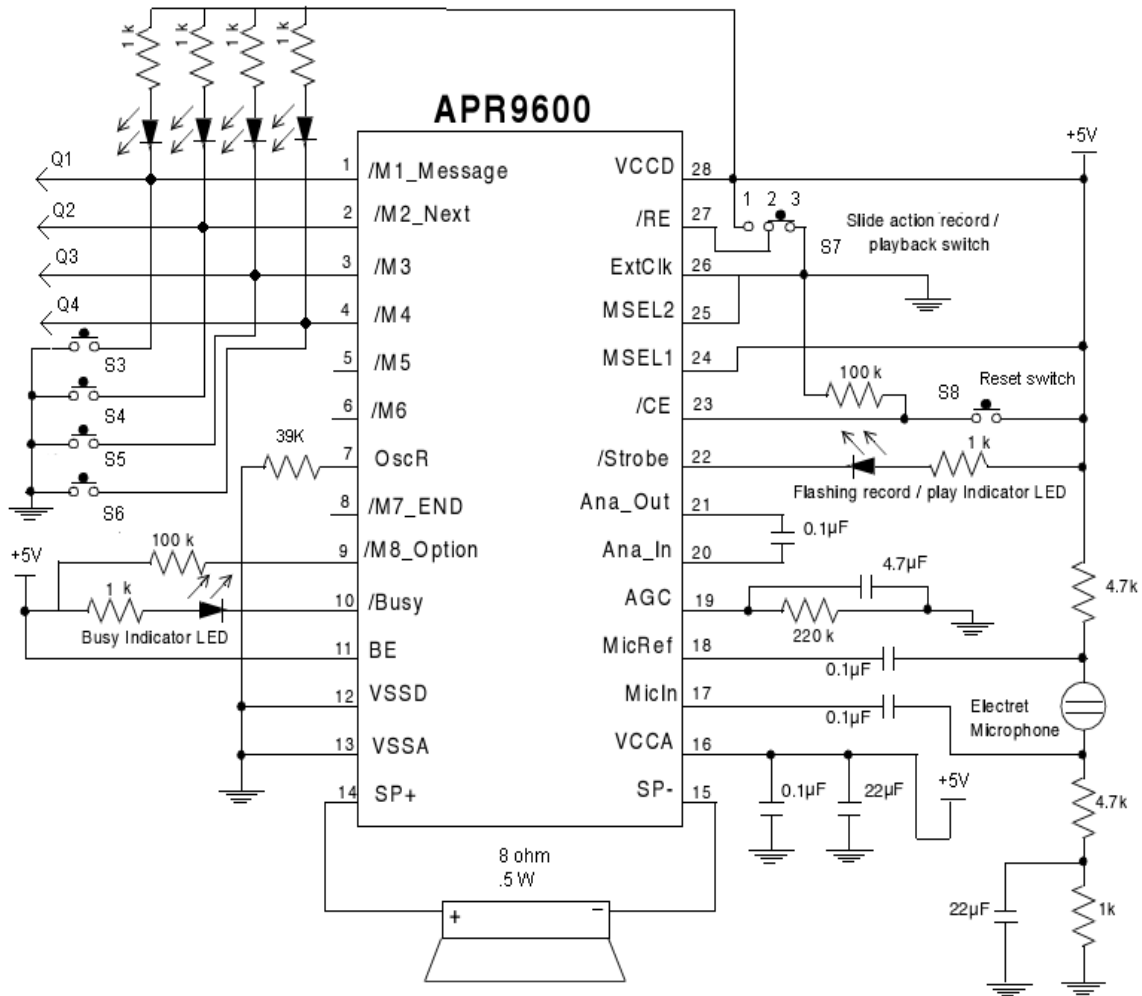


Fig 4.4 : Message record and playback circuit diagram

The circuit diagram needed for this project is given above. As can be seen the analog and digital biasing pin VCCA (pin 16) and VCCD (pin 28) is provided with +5V dc. /RE(pin 27) is connected to a sliding switch S7. When the switch is in between position 1 & 2, the IC will be in playback mode. When it is put between position 2 & 3, the IC will be in recording mode. ExtClk (pin 26) is connected to the ground; therefore internal clock will be used.

As 4 fixed message is needed to play, MSEL1 is provided with +5V, MSEL2 is grounded and /M8_option (pin 9) is pulled high through 100K Ω resistor. /CE is connected to ground through 100K Ω resistor to enable the chip and to +Vcc through a push button switch S8 for resetting purpose.

All the pins from 10-22 are connected as per schematic. The output pins for the speaker are connected to a .5W, 8 Ω speaker.

OscR pin is connected to the ground through 39K Ω resistor. It will provide a sampling frequency of nearly 6KHz and a message recording and playback duration of 44 second.

As message pins are needed to be grounded for triggering, M1, M2, M3 and M4 pins are connected to the collectors of Q1, Q2, Q3 and Q4 transistors respectively. Therefore with appropriate base current these transistors will trigger the message pins. The message pins are also connected with four push button switch S3, S4, S5 and S6 for grounding to ease the process for recording. Four indicator LED's are connected with the message pins to indicate which pin is triggered.

The operation of APR9600 is such that in playback mode if the trigger pin is grounded once the message will be played once. And if the trigger pin is held low continuously the message will be repeatedly played. Again in recording mode, it will record message as long as the trigger pin is held low. Recording will end if the trigger pin is not held low. Therefore the above configuration will provide an excellent operation of the APR9600 IC.

4.5 FM Transmission Section

Figure 4.5 represents the FM transmitter circuit.

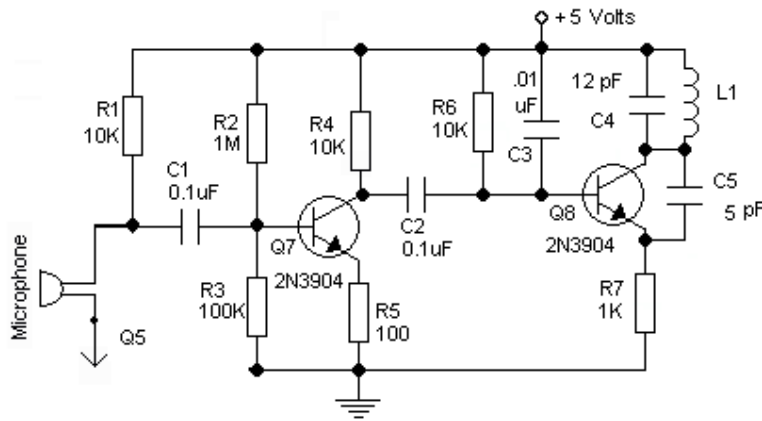


Fig 4.5 : FM transmitter circuit diagram [12]

This miniature transmitter is easy to construct and its transmissions can be picked up on any standard FM receiver. It has a range of up to 30 feet or more. The range can be increased by designing a suitable antenna and connect it with the transmitter. It is great for room monitoring, baby listening, nature research, etc. It consists of two 2N3904 npn transistors. The first transistor Q7 amplifies the signal received from the microphone. Second transistor varies the frequency of the tank circuit according to the voice signal. L1 is 4.5 turns of #18 gauge hookup wire close wound around a non-conductive 3mm diameter form. The microphone is grounded through transistor Q5. Therefore though power will exist in the circuit all the time, the transmission will only occur when RB7 is logic 1.

4.6 Power Supply

Figure 4.6 represents the power supply circuit for the whole project. Required supplies for the project is +5V and +12V. These voltages are provided by two regulator IC's L7805CV and L7812CV. The input to these IC's are fed from a 220V/12V ac transformer of 1A rating. The 12V ac is rectified through diode and filtered by a 100uF capacitor to give nearly 15V dc as a supply to the regulator IC's.

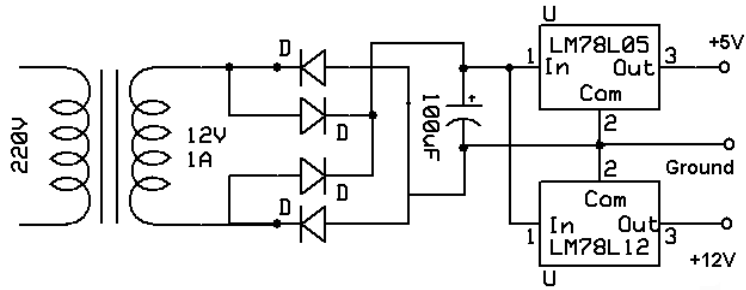


Fig 4.6 : Power supply circuit diagram

4.7 CCTV Camera

The input of the CCTV camera is +16V which is provided from the output of L7812CV. It is grounded through transistor Q6. Figure 4.7 represents the supply connection system for the CCTV camera.

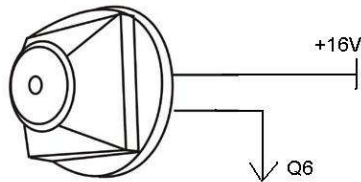


Fig 4.7 : CCTV camera circuit

4.8 Total Circuit

Figure 4.8 represents the total circuit connection merging all four sections.

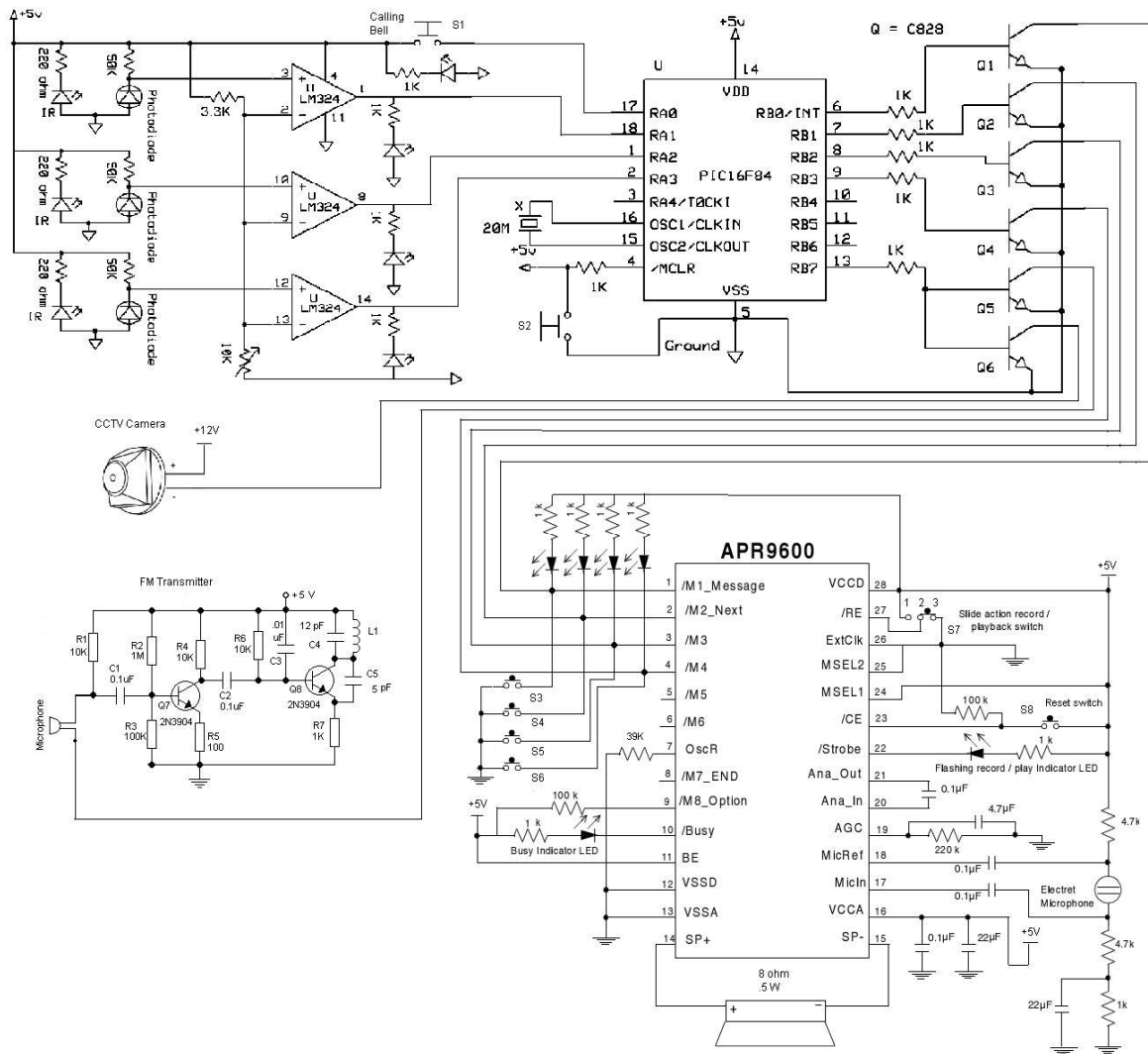


Fig 4.8 : Total circuit diagram of the project

4.9 Summary of Operation

The total operation of the project can be concluded as

The sensors will detect the abnormalities and generate appropriate signal. The comparator will compare the signal with a reference signal and will give input to the port A of microcontroller. The microcontroller will output through port B according to the input in port A which will operate the C828 transistors. The message pin will become low when C828 transistor will operate and will play the desired voice message. The voice message will be transmitted by FM transmitter for radio reception. The CCTV camera will show the current affairs going on.

4.10 List of components and cost analysis

Table 4.1 represents the component details, their costing and total cost of the components required for the project except the CCTV camera.

Table 4.1 : List of components and cost analysis

Component No.	Component name		Quantity	Price (Taka)	
1	Voice record and play back IC- APR9600		1	200	
	PIC microcontroller- PIC16F84		1	150	
	Quad operational amplifier- LM324		1	30	
	NPN transistor- 2N3904		2	6	
	NPN transistor- C828		6	12	
	Voltage regulator	L7805CV	1	10	
		L7812CV	1	10	
	Crystal oscillator- 20MHz		1	30	
	Transformer- 12V, 1A		1	80	
	Electret microphone		2	10	
	Speaker- 8Ω, .5W		1	25	
	Infrared transmitter		3	9	
	Infrared sensor		3	9	
	Switch	Push switch	7	14	
		Slide switch	1	3	
	Variable resistor- 10KΩ		1	3	
	Resistors (all 1/4watt)	1MΩ	1		
		220KΩ	1		
		100KΩ	3		
		50KΩ	3		
		39KΩ	1		
		10KΩ	7		
		4.7KΩ	2		
		3.3KΩ	1		
		1KΩ	18		
		220Ω	3		
		100Ω	1		
		Total	41		20.5
		Electrolytic capacitor	100μF		1
	22 μF		2	2	
	4.7 μF		1	2	
	Ceramic capacitor	.1 μF	6	12	
		.01 μF	1	2	
		12pF	1	2	
		5pF	1	2	
	Diode- 1N1004		4	8	
			Total =	656.5/-	

Chapter 5

Results and Discussion

5.1 Results

5.1.1 Sensing section

The sensors are working fine. Whenever the voltage across IR sensors rises more than the reference voltage ($\approx 1.5V$), the operational amplifier LM324 gives an output of 3.5V which is enough to trigger the microcontroller. The output of the S1 switch is 5V. Figure 5.1 represents the output from the LM324 measured by a multimeter.

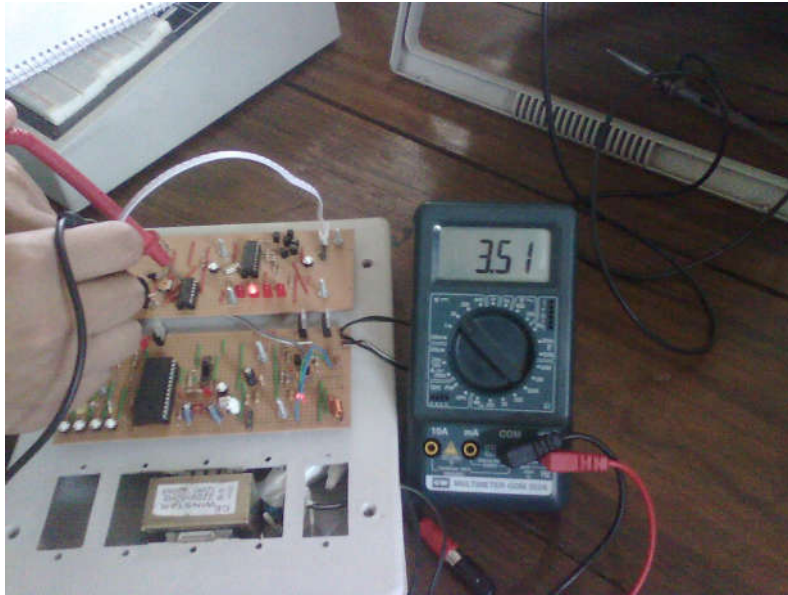


Fig 5.1 : Output from the LM324

5.1.2 Microcontroller section

All the outputs from the microcontroller port B is of a value 4.58V. This voltage is enough to provide the base current of npn transistor C828 and triggers the message pins. Figure 5.2 represents the output voltage from the microcontroller pins.

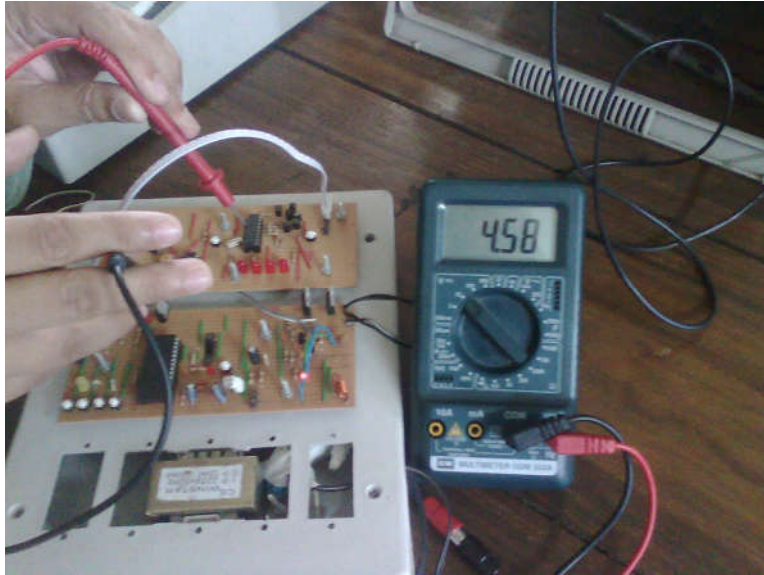


Fig 5.2 : Output from the microcontroller

5.1.3 Message record and playback section

The triggering of the message pins is accurate. The output of the IC APR9600 through the SP+ and SP- pin is given in the figure below. It is seen that the played message contains a carrier signal of approximately .7V having a frequency near 400 KHz. Figure 5.3 and 5.4 represents the output from the APR9600 measured by a oscilloscope showing the carrier output and the total message output which have the carrier merged with it respectively.

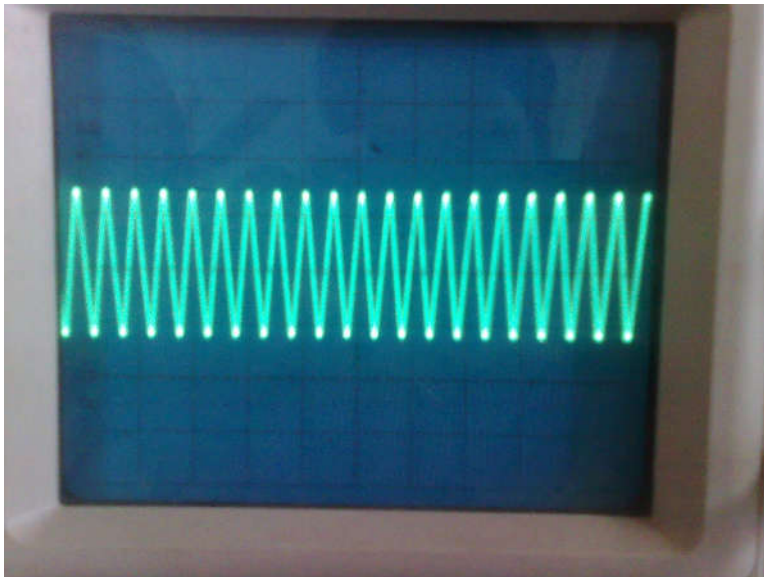


Fig 5.3 : Output signal from APR9600 (carrier) [x-axis = $5\mu\text{s}$, y-axis= .5V pp]

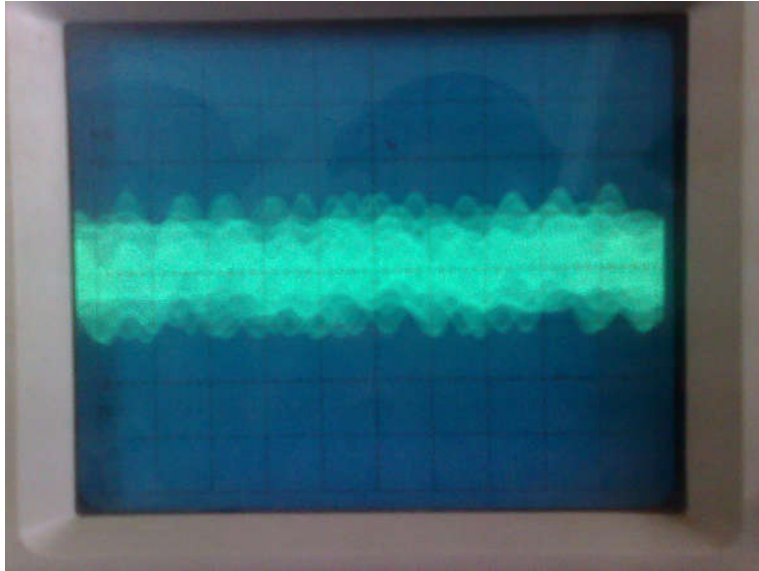


Fig 5.4 : Output signal from APR9600 (carrier+message) [x-axis = 1ms, y-axis= 1V pp]

5.1.4 FM transmission section

The transmission frequency of the FM transmitter can be varied from nearly 96MHz to 104MHz. The transmitted frequency is not shown in the oscilloscope as it malfunctions whenever I connect the probe to it. But the transmission is good and clear. Though it has a short range, the transmission is clear. Connecting a well configured antenna may increase the range. Now the range is only 30 feet approximately.

5.2 Discussion

I was expecting a lot more efficient working of the total project but I am disappointed with some performance. First of all I wanted to transmit the output of the message IC directly by the transmitter. But as can be seen the output signal of the message IC contains a carrier signal and the output looks to be AM modulated. Therefore I wasn't able to transmit it directly. Therefore I chose to play the message through a speaker and take the voice output of the speaker as an input to a microphone and then transmit it. The idea worked well, but still the output is so weak that it can barely hear from the speaker directly. Though the microphone grabs it well and the radio sound is clear and strong. I tried to amplify the signal but it wasn't satisfactory. Another problem is that the FM transmitter is very sensitive to electromagnetic fluxes around it. Therefore the transmission frequency remains constant only if there is no electromagnetic field around it. Though I hope a powerful transmitter will eliminate this problem. Nevertheless the total project is a success.

Chapter 6

Conclusion

6.1 Overview of the project

In this report I have tried to explain every part of my project. In chapters I have discussed about the idea of this project; the components used and their description; the circuitry developed in sections and their operation; total circuit diagram and summary of the operation. In this chapter I will discuss some problems and limitations of this circuit and its future development.

6.2 Problems

The output of APR9600 is a modulated output and has a low power. Therefore not so satisfying output gained from the total system. As it is modulated, it is hard to amplify it further for better sound. Again the transmission of the FM transmitter is noisy. The inductor of the tank circuit is greatly sensitive to any changes in the circuit and electromagnetic waves around it. The stray capacitance makes the transmission frequency unstable.

6.3 Future Development

Selecting a better recording and playback IC with more storage capacity and better output voice quality will increase the efficiency of the whole system. Designing a powerful FM transmitter for transmission will eliminate all the problems with the transmission. Adding more sensing system like: fire sensor, magnetic sensor, motion sensor etc will definitely increase its adoptability. Connecting a DVR system for recording when not in home will help to identify the intruder. If possible transmitting the videos of the CCTV camera instantly for better response from police

6.4 Conclusion

I have tried to design a new type of security system in my project and developing the idea of security system. Intruder radio alert system is the beginning of a new trend in the security system. It will surely increase the level of security of our home and our friends next door. As radio transmission is faster the response against a burglary in progress will be faster than other security systems. More over a large number of people will know about the incident in no time will make the burglars afraid of doing any crime. It's a extremely good quality security system in very low cost.

References

- [1] Electronic Communication systems, George Kennedy & Bernard Davis, Fourth Edition.
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Appendix

Abbreviation of some shortcut used

Chapter 1

IC	- Integrated Circuit
CCTV	- Close Circuit Television
FM	- Frequency Modulation
DVR	- Digital Video Recorder

Chapter 3

AGC	- Automatic Gain Control
GND	- Ground
VCC	- Positive Supply
CMOS	- Complementary Metal Oxide Semiconductor
RAM	- Random Access Memory
DC	- Direct Current
IR	- Infrared Ray
LED	- Light Emitting Diode
OPAMP	- Operational Amplifier

Chapter 4

TX	- Transmitter
RX	- Receiver
ExtClk	- External Clock