DESIGN AND CONSTRUCTION OF A WIRELESS FIRE ALARM MONITORING SYSTEM.

BY

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DEDICATION

I dedicate this project work to God.

CERTIFICATION

This is to certify that this project titled "DESIGN AND CONSTRUCTION OF WIRELESS FIRE ALARM MONITORING SYSTEM" was carried out by the student under the supervision of Engr, P.O Attah and submitted to the department of Electrical and Computer engineering, Federal University of Technology Minna, in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.Eng) degree in Electrical and Computer Engineering.

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ABSTRACT

Fire detectors save hundreds of lives and prevent severe property damage every year. A more efficient warning system, along with a more effective detection system could provide an even safer environment.

The project entails implementing a wireless network of fire detectors with a centralized base. The idea is to set off the alarm at a base station from detectors in the network (i.e. in a complex), thus allowing the warning to reach the base station in no distant time. The fire detectors will send warning signal after detecting smoke or after reaching a temperature threshold. The fire detector that goes off will wirelessly alert the base station so necessary action could be taken.

This project has resulted in the successful implementation of a wireless monitoring system. These features are interfaced through the use of a microprocessor. Hence, the wireless fire alarm monitoring system is a safe and convenient device that is marketable at a reasonable price for a large market. The concept of this product has several possibilities for future extensions and upgrades which is limited to ones imagination.

The hardware modules include the microcontroller, temperature sensor, transmitter, receiver and an alarm unit.

The software component includes the program and code implemented via the microcontroller.

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CHAPTER ONE

1.0 INTRODUCTION.

Fires destroy lives and properties. Each year in the United states more than 400,000 residential fires account for approximately 36,000 deaths and 18,600 injuries to residents [1,2]. Often the effects of the fires could have been reduced dramatically if a reliable and effective fire detection, monitoring and warning system had been present.

Over 50% of the aforementioned fatalities occur in homes without fire alarms. This statistics accentuate the importance of fire alarms in homes and office complexes and also substantiate the need for the most advanced fire alarm system possible.

Fire detection is one of the chief safety concerns for residential and office complex buildings. Traditional fire alarm systems are hard wired and as such, users find it cumbersome to handle wires and many face the inconvenience in installation with wires. The user may want to mount the fire detector and the control panel in a separate room [3]. Hence a fire alarm that incorporates features such as wireless communications, multiple detection methods and base monitoring system. The combination of a wireless communication system and a standard fire alarm create significant benefits. Users are no longer satisfied with a simple fire alarm detector that just sounds the alarm individually. Many would like to have a security system that monitors the fire detectors and alert them in case of an emergency especially when there is no one present in the location of the fire. Thus a product that is wireless and allows the signals to penetrate walls to enable detectors to communicate with the base station without stress.

1.1 Fire Detectors and Alarms

Smoke and heat are the two main features that characterize fire in a particular place. To this effect, to avoid or reduce the extent of fire damage to life and properties, the device used should either be able to detect both heat and smoke or either of the two. Thermal detectors and smoke detectors are the sensors commonly used in fire alarms. Some sensors are built with a combination of both types of detectors.

The implementation of either a smoke or heat detector can more than any other device improve the ch: nces :or survival in the case of fire.

There are two typ_s of smoke detectors in common use. [4]

i. The ionization or radioactive type.

ii. The photoelectric or light sensing type

The ionization type is more commonly found in some homes and offices, primarily because it is cheaper and readily available, although photoelectric detectors are probably more suitable for most homes. Thermal detectors are more suitable than smoke detectors for bathrooms kitchen areas. The major types of sensors used in thermal detectors are infrared sensors, thermistors and bimetallic elements. Thermistors are most commonly used as it is cheap and offers quick temperature response.

Thermal detectors do not detect smoke or light, they are not recommended for living areas of residence. They are used in attics unheated garages, kitchen and furnace rooms.

The ionization (radioactive) type detectors contain alpha – emitter Americanum. The alpha particles i[illegible] .he air in a cavity, and when a voltage is applied across the cavity, a small current is i.. .uced. When smoke particles enter this cavity, they absorb most of the alpha particles, and also increase the resistance of the air. This causes the current to fall, triggering the alarm.

The most commonly used photoelectric smoke detectors have a detection chamber with a light source and a photoelectric cell.

When smoke particles enter the chamber, the light is obscured and the current from the photo electric cell is reduced, triggering an alarm.

Ionization type detector, while offering some extra protection in the case of certain kind of fires, the are also prone to triggering nuisance alarms. In particular, if placed in or near kitchen or living areas with gas heaters or fireplaces, they will react to the cooking fumes and invisible combustion particles from the heaters, setting off the alarm. Photoelectric detectors are therefore recommended for use in such areas, as well as small home units and open plan houses.

1.2 PRODUCTS AVAILABLE IN THE MARKET

Fire detectors is available as standalone unit that is portable and battery powered. The detector may be connected together or can also be hard wired to a control panel. A simple control panel includes basic features to display may be a liquid crystal display (LCD) or light emitting diode (LED) indicator. Amore sophisticated fire alarm system usually make use of the personal computer (PC) as the monitor or control panel.

The communication link between the fire detector and the control panel can be implemented using the following technology;

i. Hard wired

ii. Infrared

iii. Bluetooth

The most common technology in fire alarm application is still the hard wired to the control panel.

1.3 AIMS AND OBJECTIVES.

- The wireless fire alarm monitoring system project is an attempt to integrate radio frequency (R.F) technology into the already available fire detector circuitry.
- Creating a base system using radio frequency signals to connect the house or office complex fire alarm system to a remote receiving station (base station). This station receives signals from all of the fire detectors, depending on their state of operation or status at a particular time.
- The project is also aimed at creating a system that is able to take over full - time surveillance responsibility alerting residents of an intending fire at hand.

1.4 ADVANTAGES OF WIRELESS SYSTEMS

The primary advantages afforded by RF signaling is the drastic elimination of : [2]

- wire runs
- underground conduit
- disruption of operations during installation
- ground fault
- lightening strikes

1.5 PROJECT OUTLINE

This project set out to present an orderly account of work done. It consists of five chapters:-

Chapter 1:- This chapter gives an insight into the project from an introductory point of view and presents the stated objectives of the project.

Chapter 2:- This chapter gives an historical background, review of the project and also expatiates on some of the fundamentals which are applied in carrying out the task.

Chapter 3:- This chapter shows all the steps carried out in setting up the circuit element and report on the construction and listing of the circuit.

Chapter 4:- This chapter contains steps taken to test the work. Short comings or limitations of the work are also explained.

Chapter 5:- This chapter gives the conclusion of the work. Summary of the work is presented and result obtained and problems encountered are summarized.

CHAPTER TWO

2.0 HISTORICAL BACKGROUND

At the beginning of the 20th century, the threat of fire outbreak existed in both cities and towns.As a result, ways of preventing and fighting fires were invented, and the efficiency of these methods increased through the century. Until recent years, the prime method of preventing injury and death in building was by shielding the occupant from the fires, flame and heat. The smoke and toxic gases from fire were causing more death than the direct effect of the flame and heat. [2]

Today 80% of deaths in building fires are cause by smoke inhalation. A few breaths of some toxic gases will completely immobilize a person, with death following. In a matter of minutes the victims are dead before the fire ever reaches them [1].

In the industrial sector where safety is the watch ward, heat and smoke sensing is a necessity. Scientist observed that heat was fluid called caloric that flowed from hot bodies to cold bodies. Modern ideas explain heat and temperature in terms of motion of molecules of substances. For the purpose of this project we shall restrict ourselves to early detection and communication of fire outbreak from the source to the base station or local control authorities. The need for a smoke or fire detector emanates from rampant fire disaster happening in our offices, industries or residential places and so on from time to time. Fire disaster as a result of electrical hazards (cable sparking, generator explosion, gas explosion, petroleum explosion, e. t. c) could have been averted if as it were, Fire and smoke detector have been installed in all these public places, also, the installation of such a device saves the huge amount of money that is always spent on the renovation of burnt buildings and infrastructure which could have been used on some other beneficial and important projects.

The system is designed in a way that when it senses any smoke from such a dangerous situation, it is co ted to voltage level corresponding to the magnitude of the smoke, But if the smoke level is not enough to cause voltage more than the reference or threshold voltage the alarm will not come on. This is to say that any smoke like cigarette smoke will not cause any triggering that can make the voltage level exceed the threshold or reference voltage.

However it is pertinent to note that the fire and smoke detector does not prevent this non-conforming situation but announce its occurrence. With fire and smoke detection unit installed in public and residential buildings the rate of loses to lives and properties will surely reduce drastically, since it will provide users with an early warning that can save life and properties.

2.1 DESIGNS ALREADY AVAILABLE

The communication link between the fire detector and the control panel can be implemented using the following technology: [4]

- Hardwi
- RF sign
- Infrared
- Blue-Tooth

Conventional fire detectors or fire alarm networks are hardwired to the control panel. This technology is still by far the most common in fire alarm application as compared to the wireless types.

2.1.1 Hard Wired Communication System

Application: One approach to providing communication between the units is to hard wire all the units together. This uses a low voltage system consisting of relays, which in turn activate the alarm. In this system, a smoke detector that senses smoke would activates its alarm then sends a low voltage signal to all other smoke detectors in the house. This low voltage signal activates the individual relays in the other smoke detectors causing them to emit a tone that alerts residents that one of the smoke detectors senses smoke

- **Disadvantages**
  - Requires either installation at time of house construction, or a very costly and tedious post construction installation
  - Difficult to repair in case of problem with the wiring.
  - Difficult to expand for added detectors.
- **Advantages**
  - Simple design.
  - Easy to power (hard wired).
  - Cost of building parts is low.

2.1.2 Baseless Smoke Detector System Using R. f Signals.

Application: The operation is a wireless system wherein the transmitter and receiver are installed in the unit and the need for a base is eliminated. The individual smoke detectors are equipped with all the electronics required to both send and receive signals. They are battery operated and therefore they require no external connections. They are selfcontained. They can be installed by a homeowner just as they would a normal smoke detector.

❖ **Disadvantages**

- Battery power requires periodic maintenance.
- Does not allow for additional operations.
- Limited in applications.

❖ **Advantages**

- Cost efficient system.
- Compact design.
- Easily expandable.
- Simple to install.
- Replaceable components.

CHAPTER THREE.

3.0 DESIGN AND CONSTRUCTION.

This chapter is divided into two the Transmitter Section and the Receiver Section.

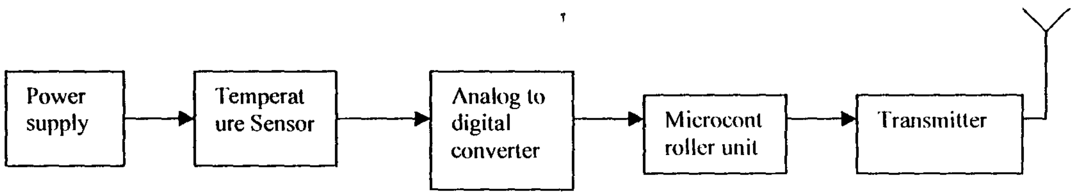

Fig 3.1 (a) Transmitting Unit Block Diagram

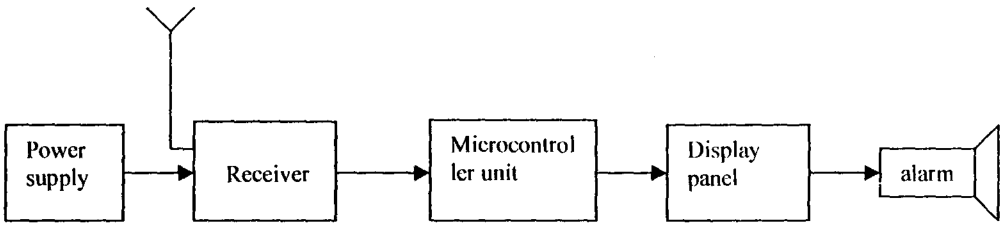

Fig 3.1(b) Receiving Unit Block Diagram

3.1 Power Supply Unit.

The 12-volt regulated power supply provides the needed DC voltage to power the detector/indicator portion of the system. It also establishes the switching points around the comparators/Schmitt triggers.

It is derived from a 15V rms secondary voltage transformer wired to a full wave bridge rectifier to produce high voltage pulsating DC voltage smoothened by a 1000uf filtering capacitor.

The equations governing the rectified voltage are given below:

$$V_{peak} = (V_{rms} * \sqrt{2}) - 1.4 \qquad \text{------------I}$$

$$V_{dc} = \frac{Vpeak}{1 + \frac{1}{4FCR_{load}}} \qquad \text{-------------II}$$

In equation1, Vpeak is the peak value of the rectified secondary voltage; sqr2 is the forward -voltage drops in any two forward-biased diodes in the bridge rectifier.

In equation2, F is the mains line frequency,

c is the value of the smoothening capacitance connected across the rectifier's output ,

R_{load} is the load resistance presented to the rectifier.

The value of the smoothening capacitance, c1 is deduced from the relation stated below:

$$Q = CV = It \qquad \text{--------------------III}$$

$$C = \Delta V = t\Delta I \qquad \text{---------------------IV}$$

ΔV = maximum allowable ripple on the rectified DC;

ΔI = current change in the supply due to load.

Since $C\Delta V = T\Delta I$

$T = ½ \times F = ½ \times$ mains frequency.

$= 1/100 = 0.01s$

$C\Delta V = T\Delta i$

$$C\Delta V = R\Delta I \qquad \text{----------------------V}$$

$$C\Delta V = \Delta I \qquad \text{----------------------VI}$$

$$C = \frac{\Delta I}{\Delta V}$$

I.e. C is proportional to ΔI, and C is proportional to $1/\Delta V$.

To keep the ripple at a minimum, the value of C must be high. Thus, a 1000uf capacitor was used.

The second factor that informed the choice of value for the smoothening capacitor was the need for the system to track input voltage fluctuations as rapidly as possible.

The 1000uf capacitor was connected in parallel with a 1K ohm resistance, the resistance serving to discharge the capacitor as rapidly as possible.

For R = 1KΩ and C = 1000uf

The discharge time = RC = 1s.

The peak rectified voltage is calculated from below using the given variable:

V_{rms} = 15V

C = 1000uf

R_{load} = 1kΩ

V_{peak} = $(5\sqrt{2})-1.4$ = 19.8V.

$$V_{dc} = \frac{V_{peak}}{1+\frac{1}{4FCR_{load}}} = \frac{19.8}{1+\frac{1}{4*50*1000*10^{-6}*1000}} = \frac{19.8}{1+(0.005)}$$

$$= \frac{19.8}{1.005} = 19.70V$$

This value of DC voltage was fed into a 78012 regulator to provide a regulated +12V ripple free output buffered by a 3300uf capacitance.

The 19.8 DC supply was also fed into a 7805 regulator to produce a regulated +5v output that powers the relay.

3.2 Transmitter

The purpose of the transmitter is to receive binary input relating the status of the sensor from the AT85C52 and sends the signal to the base station in the housed location (network) in order to alert the local authorities and set off the audible fire warning. Again, capacitors and resistors are added to the circuit to smooth out the signal from the power supply, thereby reducing the circuit noise [5].

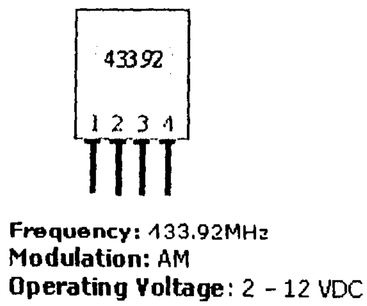

Fig 3.2 TWS-434A R.F Transmitter

3.3 Receiver

This module is the counterpart to the transmitter. Its purpose is to receive the signal from the transmitter and to relay the signal to the microcontroller, which in turn performs the appropriate action (sets off the alarm if necessary). Capacitors and resistors are added to the circuit to smooth out the signal from the power supply, thereby reducing the circuit noise [5].

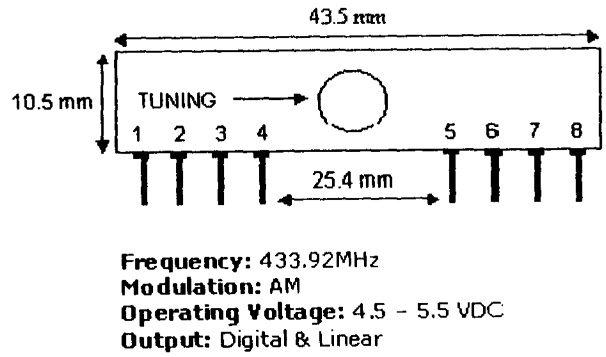

Fig 3.3 RWS-434A .RF Receiver

3.4 Smoke Sensor (not available for use)

The smoke sensor will send a signal to the microcontroller when the smoke level reaches a pre-determined threshold. This module provides a mean to detect smoke and serves as an early fire warning .

3.5 Temperature Sensor Unit

The temperature sensor used in this project is an LM35DZ. The sensor is a precision semiconductor temperature sensor giving an output of 10mA per degree centigrade. The supply voltage could be in the range of -0.2V to +35V, while its output voltage could be in the range of -1.0V to 6V. The temperature sensor sends a signal to the microcontroller when the temperature reaches a pre-determined threshold level. This module provides a way to detect a fire [5].

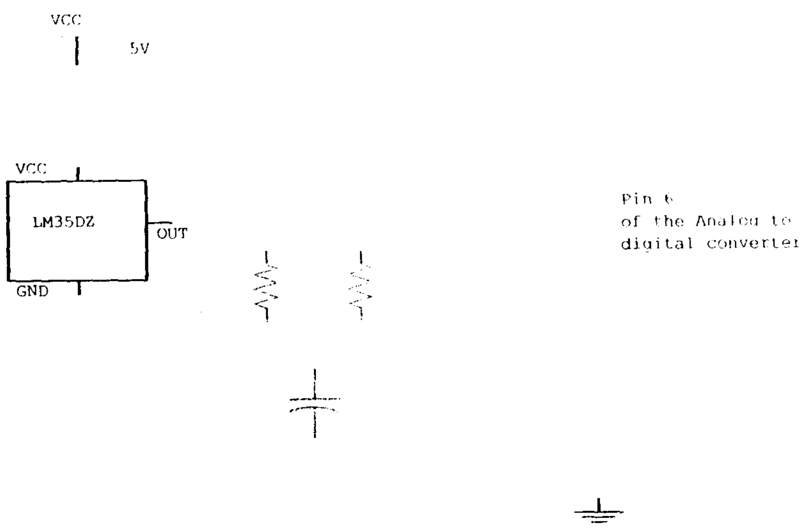

Fig 3.4 The temperature sensor circuitry

3.6 Analog-to Digital Converter

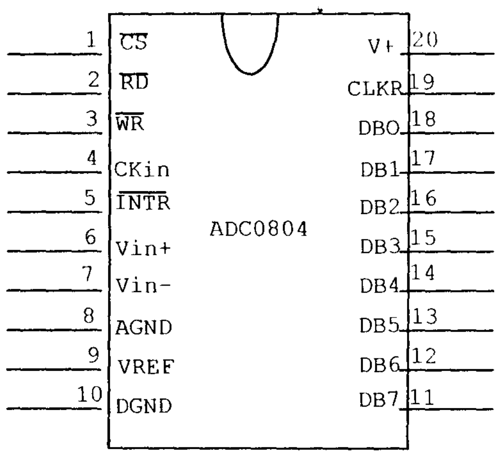

Fig 3.5: Fig ADC0804 pin out

There are many degrees of complexity associated with testing an using A/D converter. The usual method of converting analog signals into digital ones is to use an analog-to-digital converter ADC. This design incorporates such an ADC. The ADC0804 intension is to change an analog voltage level to an 8-bit digital signal that can be understood by a microprocessor. The ADC0804 pin out is shown above.

The analog voltage from the temperature sensor is applied to pin6 of the ADC, the binary equivalent is available at pin11 through pin18. pin1 and pin2 (clip select and read) will be connected to the ground so that the clip is always enabled . Since the ADC0804 includes an internal oscillator which requires an external capacitor and a resistor to operate, I connected a 150pf resistor from pin14(clock in) to ground and a 10k ohm resistor from pin4 to pin19 (clock R). The ADC is operated in the free running mode by connection pin3 (WR) to pin5 (INTR).

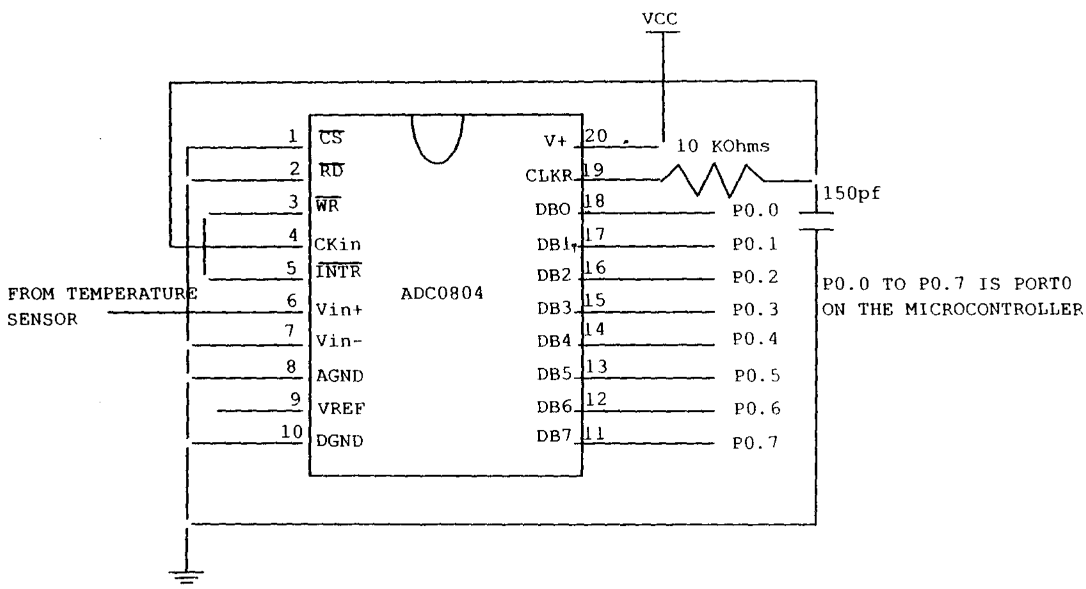

Fig. 3.6 The interface between the ADC and the Microcontroller

In this design there are two important factors, Vref and Vin. Where Vref is the reference voltage and Vin is the output voltage of the temperature sensor to be measured The reference v...ge is the maximum value that the ADC can convert. Therefore Vref controls the maximum voltage that the input will recognize. Since the ADC0804 is an 8 bit ADC, it can convert values from a span of OV to the reference voltage of 5V. This voltage range is divided into 256 values or step. The step size of the converter defines the converter resolution or the number of potential codes. The size of the step is given by.

$$Step-voltage = {}^{Vref}\!/_{256}\;,$$

$$= {}^{2.55}\!/_{255}$$
$$= 0.01V$$
$$= 10mV$$

3.7 The Microcontroller Unit

No modern electrical system in today's world be complete without a microcontroller or microprocessor. In the scope of this project a microcontroller is used to capture, process and save the digital data.

The microcontroller used in this project is AT89C52 from Atmel 89 Series Microcontrollers. The AT89C52 is a low power- high performance CMOS 8-bit microcomputer with the following features.

- Compactable with MCS-51 products.
- 8K bytes of In-system Reprogrammable flash memory.
- Endurance; 1000 write\ Erase cycles.
- Full sta... operation; 0 Hz to 33 MHz.
- Three level program memory lock.
- 256x 8 bit internal RAM
- 32 programmable I \ O (Input\ Output) lines

- Three 16-bit Timer\counters
- Eight interrupt sources
- Programmable serial channels
- Low – power Idle and Power-down Mode
- 4.0V to 5.5V Operating Range
- Interrupt Recovering from Power-down Mode
- Watchdog Timer
- Dual Data Pointer
- Fast Programming Time
- Flexible ISP Programming (Byte and Page mode)

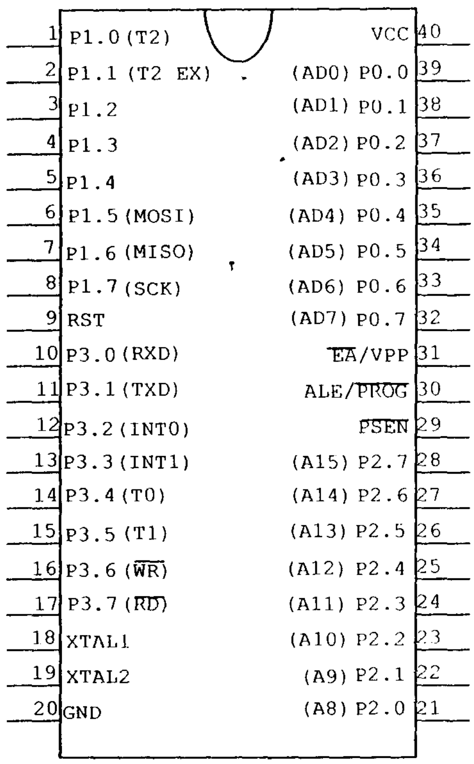

Fig 3.7 AT89C52 pin out.

3.8 Reset circuitry

This circuitry is needed by the microcontroller. This prevent the unusual resetting of the microcontroller, which could be as a result of electric spark etc, the circuitry also provided a way of manually resetting of the microcontroller through a push button.

3.9 Clock source circuitry

XTAL1 and XTAL2 are input and output, respectively, of an inverting amplifier which can be configured for use as an On-chip Oscillator, as shown in Figure 19. Either a quartz crystal or a ceramic resonator may be used. For resonators, or crystal the maximum frequency is 24 MHz. C1 and C2 should always be equal for both crystals and resonators.

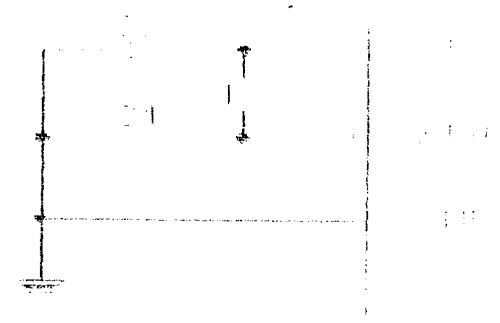

Fig. 3.8 Interface between the clock source unit and the microcontroller.

3.10 Relays

Relays are electromechanical devices or solid state devices which operate in response to a signal which may be voltage, current, temperature etc. Electromagnetic relays operate due to magnetic fields. They are composed basically of two parts:

i. The operating coil

ii. The magnetic switch

When an input pulse is introduced in the coil, a magnetic field is produced in the core of the electromagnet. This action causes the switch to slide. Relays are either normally open or normally close. Relays are available for DC or AC excitation and coil voltages range from 5V to 230V. The primary use of relays is in remote switching, whereby the circuit is to be switched is electrically isolated from the switching circuit.

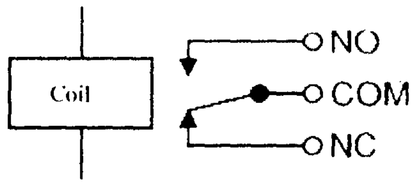

Fig 3.9 Symbol of a relay

Transistors cannot switch AC or high voltages (such as mains electricity) and they are not usually a good choice for switching large currents (> 5A). In these cases a relay will be needed, but note that a low power transistor may still be needed to switch the current for the relay's coil.

*Advantages of relays over transistors:

- Relays can switch **AC and DC**, transistors can only switch DC.
- Relays can switch **high voltages**, transistors cannot.
- Relays are a better choice for switching **large currents** (> 5A).
- Relays can switch **many contacts** at once.

* Disadvantages of relays over transistors:

- Relays ... **ulkier** than transistors for switching small currents.

- Relays **cannot switch rapidly**, transistors can switch many times per second.
- Relays **use more power** due to the current flowing through their coil.
- Relays **require more current than many chips can provide**, so a low power transistor may be needed to switch the current for the relay's coil.

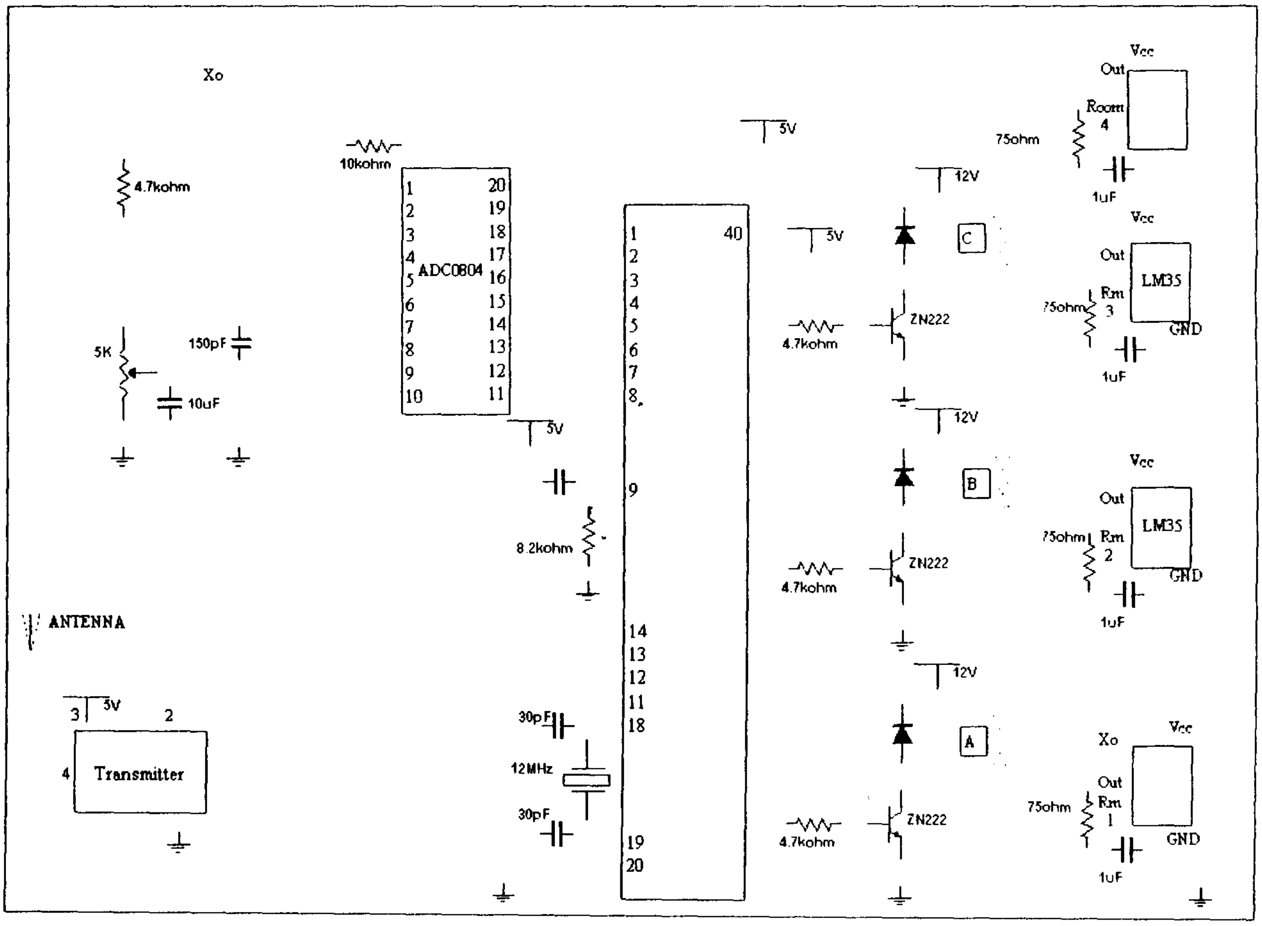

Fig. 3.9 Circuit Diagram Of Transmitter Unit.

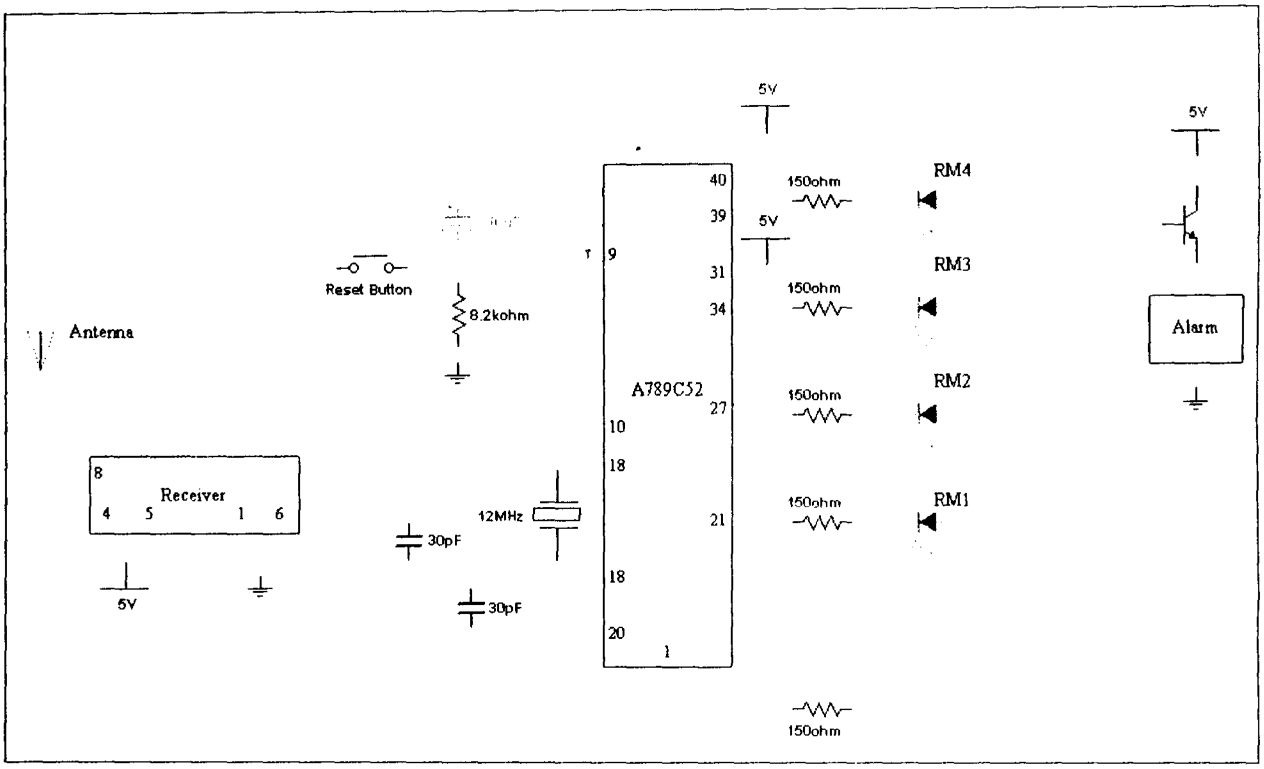

Fig. 3.10 Circuit Diagram of Receiver.

CHAPTER FOUR

4.0 Test, Result and Discussion.

4.1 Temperature Sensor

A heat source—lighter—was used to test the temperature sensor. The output signal of the temperature sensor was then measured to ensure proper functionality. With repeated trials, verification was conducted to observe the proper functionality of the temperature sensor when exposed to a variety of temperatures. Tests were also performed to verify that the indicator and sound was emitted when the temperature threshold was reached.

Tests and trials were conducted to ensure the AT89C51 microcontroller ran the correct program sequence and outputted the correct signals to the tone generator for the fire alarm to be sounded (under high temperature conditions).

To test reliability ... eated trials were run to ensure proper functionality.

4.2 Transmitter and Receiver

To test the transmitting and receiving pins of the microcontroller, a program to generate a high and low signal was written first and a LED was made to come on when there is a one and off when there was a zero the transmitting pin and the receiving pins were connected serially with a common ground as the transmitting and receiving components were not readily available. The completion of the project was done and tested with a serial wire but with no doubt in mind that if the TWS-434A and RWS-434A were available the circuit would perform as described to be a wireless system. Other tests were conducted to ensure proper signal strength readings and to verify that the signal was detected to set off the appropriate alarm.

CHAPTER FIVE

5.0 CONCLUSIONS

5.1 SUMMARY

This project has illustrated that the Wireless fire Alarm monitoring system is an effective, reliable, and convenient device to monitor the safety and protect lives and properties. These attributes were achieved through the design and integration of several subsystems and components, each contributing separate features to the product.

Each component in the circuit entirety functioned properly and successfully; the only minor issue was the in availability of the TWS-434A and the RWS-434A which did not make the circuit to work properly as expected.

Furthermore, during and after the project, engineering knowledge was constantly assimilated. Experience and confidence in practical, designing, presenting (a formal presentation) were also gained.

5.2 Problems Encountered

Throughout the course of completion of the project, a number of complications arose. While working on the individual components, a number of the devices that were bought did not function properly. Two of the original temperature sensors failed to work properly, as they did not give any warning when the lighter was brought close to them.

Also, the original oscillator for the AT89C52 microcontroller failed to function properly, as the transmission was at first delayed as the delay in the cycle was not being eliminated. The microcontroller also got burnt twice.

While these problems were not too easy to fix, they took some time to identify what the problem was.

5.3 Recommended Solutions

Implementation on a PCB (printed circuit board) is another solution to greatly reduce noise frc... parts of the circuit components as no extraneous wires are needed, thereby l. ding to cleaner and stronger signals to the components. Also, implementation on a PCB makes the overall system unit more compact.

The use of a battery as the power supply would make the design more compact and function also in the case of a power failure because this design did not consider the use of battery as power source.

Other future work might include dialing a pre-determined cell-phone number to contact the residents of a fire or dialing the local fire department to notify of a potential fire.

A simple transmitter and receiver pair greatly decreases the overall cost of the project, as the current transmitter and receiver inavailability contributed to the ineffectiveness of the system.

REFERENCES

[1] Institute of Electrical and Electronics engineering (IEEE)

www.ieeeexplore.com IEEE History Center Electric Fire Alarm System, 1852

[2] www.worldelectronics.com

[3] Wireless Smoke Alarm "The New Creation" Matthew Kane

[4] Ion vs. Photo Smoke Alarms? What? the Difference?

http://www.firstalert.com/home_safety/smoke_alarms/sensors.htm

[5] Semiconductor, *How to Simplify the Interface between Microcontroller and Temperature Sensor*, *http://dbserv.maxim-ic.com*

[6] National Semiconductor, *National Semicoductor Temperature Sensor Handbook*, *http://www.national.com*

[7] Simplex and Grinnell Fire and Protection, *Fire Detection and Alarm*

http://www.simplexgrinnell.com

[8] http://www.8052.com

[9] Dongbang Electronic Industrial Co Ltd,

http://www.dbe[illegible]o.kr/e_dbe/e_product.htm

[10] "Fire Alarm System Technical Specifications". http://www.kentec.co.uk/specs2.pdf.

[11] "Smoke Detectors". http://www.cfdonline.org/detector.htm.

[12] Sedra, A. S. and Smith, D. C., Microelectronic Circuits. New York. Oxford University Press, 1998.

[13] http://en.wikipedia.org/wiki/Heat_detector

[14] Harris semi..ductors

http://www.kpsec.freeuk.com/

[15] B.L THERAJA & A.K THERAJA, Electrical Technology.

[16] "Handbook of Electricity Metering" by'The Edison Electric Institute-- the Bible of electric meters, continuously updated since electricity was discovered.

[17] Millman J.; (1979), Microelectronics: Digital and Analog Circuits and Systems.

McGraw-Hill Inc. Singapore.

APPENDIX

1.1 Microcontroller Program in Assembly Language

1.1.1 TITLE: Transmitter Program Code

```
;DEVICE:  AT89C52
;LANGUAGE:   ASSEMBLY
;COMPILER:   KEIL uVISION3
;==========================================================
;  DEFINATIONS
;==========================================================
;Registers
RXData       equ 01h
;==========================================================
;Memories
SecCtr    Equ 08h
;==========================================================
;Bit Memories
Status          equ 20h
;==========================================================
;Ports
IndicatorPort0 equ P0
IndicatorPort1 equ P2
SerialPort    equ P3
;==========================================================
;Bits
Room1Indicator equ P0.0
Room2Indicator equ P0.6
Room3Indicator equ P2.6
Room4Indicator equ P2.0
AlarmPin      equ P1.0

Room1        equ 00h
Room2        equ 01h
Room3        equ 02h
Room4        equ 03h

Room1Data   equ 65
Room2Data   equ 66
Room3Data   equ 67
Room4Data   equ 68

;==========================================================

;  VECTOR ADDRESSES
;==========================================================
```

```
    Org 0000h      ;RESET VECTOR ADDRESS
    ljmp Start     ;Jump to start of program
;=====================================================================
    Org 0003h      ;EXTERNAL INTERRUPT0 VECTOR ADDRESS
    reti           ;Not used
;=====================================================================
    Org 000Bh      ;TIMER0 INTERRUPT VECTOR ADDRESS
    clr TR0
     acall nBlink
     setb TR0
     reti                              ;Not used
;=====================================================================
    Org 0013h      ;EXTERNAL INTERRUPT1 VECTOR ADDRESS
    reti                          ;Not used
;=====================================================================
    Org 001Bh      ;TIMER1 INTERRUPT VECTOR ADDRESS
    reti                          ;Not used
;=====================================================================
    Org 0023h      ;SERIAL INTERRUPT VECTOR ADDRESS

  acall SInt
  reti                            ;Not used
;=====================================================================
    Org 002Bh      ;TIMER2 INTERRUPT VECTOR ADDRESS
    reti                          ;Not used
;=====================================================================
    Org 0038h      ;Program starts here
Start:
    mov SP,#40h    ;Stack Pionter intialized

    clr RS0        ;Bank0 selected
    clr RS1

    mov Status,#0
    mov SecCtr,#2

    mov IndicatorPort0,#255
    mov IndicatorPort1,#255

    setb Room1Indicator
    setb Room2Indicator
    setb Room3Indicator
    setb Room4Indicator
    clr AlarmPin

  clr SM0        ;Select Serial mode1
```

```
setb SM1
setb REN

mov TMOD,#33    ;Timer1=8Bit auto reload
mov TH1,#255;230    ;Timer1 reload value

setb TR1        ;Start Timer1

setb ET0        ;Timer0 Interrupt enabled
setb TR0        ;Start Timer0
setb ES         ;Enable Serial interrupt

setb PS

mov PCON,#0
setb EA   ;Enable Global Interrupt

ajmp $
;==========================================================

;   INTERRUPT CALLS
;==========================================================
;==========================================================
SInt:

jnb RI, EndSI
mov RXData,SBUF
clr RI

mov A,RXData
cjne A,#Room1Data,Next0
setb AlarmPin
setb Room1
Next0:
cjne A,#Room2Data,Next1
setb AlarmPin
setb Room2
Next1:
cjne A,#Room3Data,Next2
setb AlarmPin
setb Room3
Next2:
cjne A,#Room4Data,EndSI
setb AlarmPin
setb Room4
```

```
EndSl:
ret
;==========================================================
nBlink:
djnz SecCtr,EndB
mov SecCtr,#2

jnb Room1,BProceed0
cpl Room1Indicator
BProceed0:
jnb Room2,BProceed1
cpl Room2Indicator
BProceed1:
jnb Room3,BProceed2
cpl Room3Indicator
BProceed2:
jnb Room4,EndSl
cpl Room4Indicator
EndB:
mov TH0,#0
mov TL0,#0
 ret
;==========================================================
;   SUBROUTINE CALLS
;==========================================================
end
```

1.1.2 TITLE: ...eiver program code

```
;DEVICE:   AT... 52
;LANGUAGE:   ASSEMBLY
;COMPILER:   KEIL uVISION3



;   DEFINATIONS
;==========================================================
;Registers
RXData       equu 01h

;==========================================================
;Memories

SecCtr    Equ 08h
```

```
;=====================================================
;Bit Memories
Status          equ 20h
;=====================================================
;Ports
IndicatorPort0 equ P0
IndicatorPort1 equ P2
SerialPort    equ P3

;=====================================================
;Bits
Room1Indicator equ P0.0
Room2Indicator equ P0.6
Room3Indicator equ P2.6
Room4Indicator equ P2.0
AlarmPin      equ P1.0

Room1       equ 00h
Room2       equ 01h
Room3       equ 02h
Room4       equ 03h

Room1Data   equ 65
Room2Data   equ 66
Room3Data   equ 67
Room4Data   equ 68

;=====================================================

;   VECTOR ADDRESSES
;=====================================================
   Org 0000h      ;RESET VECTOR ADDRESS
   ljmp Start     ;Jump to start of program
;=====================================================
   Org 0003h      ;EXTERNAL INTERRUPT0 VECTOR ADDRESS
   reti           ;Not used
;=====================================================
   Org 000Bh      ;TIMER0 INTERRUPT VECTOR ADDRESS
   clr TR0
acall nBlink
setb TR0
reti                ;Not used
;=====================================================
   Org 0013h      ;EXTERNAL INTERRUPT1 VECTOR ADDRESS
   reti            Not used
```

```
;===========================================================
   Org 001Bh      ;TIMER1 INTERRUPT VECTOR ADDRESS
   reti           ;Not used
;===========================================================
   Org 0023h      ;SERIAL INTERRUPT VECTOR ADDRESS
   acall
   reti         ;Not used
;===========================================================
   Org 002Bh      ;TIMER2 INTERRUPT VECTOR ADDRESS
   reti         ;Not used
;===========================================================
   Org 0038h      ;Program starts here
Start:
   mov SP,#40h     ;Stack Pionter intialized

    clr RS0        ;Bank0 selected
   clr RS1

   mov Status,#
   mov SecCtr,#2

  mov IndicatorPort0,#255
  mov IndicatorPort1,#255

  setb Room1Indicator
  setb Room2Indicator
  setb Room3Indicator
 setb Room4Indicator
 clr AlarmPin

 clr SM0        ;Select Serial mode1
 setb SM1
setb REN

mov TMOD,#33    ;Timer1=8Bit auto reload
mov TH1,#255;230    ;Timer1 reload value

setb TR1       ;Start Timer1

setb ET0      ;Timer0 Interrupt enabled
setb TR0      ;Start Timer0

setb ES       ;Enable Serial interrupt

setb PS
mov PCON,#0
```

```
setb EA     ;Enable Global Interrupt
ajmp $
;   INTERRUPT CALLS
;=================================================

SInt:
jnb RI, EndSI
mov RXData,SBUF
clr RI

mov A,RXData
cjne A,#Room1Data,Next0
setb AlarmPin
setb Room1
Next0:
cjne A,#Room2Data,Next1
setb AlarmPin
setb Room2
Next1:
cjne A,#Room3Data,Next2
setb AlarmPin
setb Room3
Next2:
cjne A,#Room4Data,EndSI
setb AlarmPin
setb Room4

EndSI:
ret
;=================================================
nBlink:
djnz SecCtr,EndB
mov SecCtr,#2

jnb Room1,BProceed0
cpl Room1Indicator
BProceed0:
jnb Room2,BProceed1
cpl Room2Indicator
BProceed1:
jnb Room3,BProceed2
cpl Room3Indicator
BProceed2:
jnb Room4,EndSI
cpl Room4Indicator
EndB:
```

```
mov TH0,#0
mov TL0,#0
ret
;==================================================================
;   SUBROUTINE CALLS
;==================================================================
end
```

WIRELESS FIRE ALARM PROJECT MANUAL

The project is a protective device which alerts the occupants of a building in the case of a fire incidence or the case of an unsafe temperature rise which in event might result to the case of loss of lives and properties.

The project major components includes the following.

- Temperature Sensor LM35
- Relay
- Analog-to-Digital Converter ADC0804
- R.F Transmitter TWS-434A
- AT89C52
- R.F Receiver RWS-434A
- Power Supply Unit
- Alarm
- Reset Button on the Receiver.

OPERATING THE DEVICE

The whole operation of the device after being connected to power supply begins with the relay which serves as the switching device in the circuit and switches each of the sensors OFF and ON sequentially from room 1 to room 4 This is to enable the status of each of the rooms be determined without conflict. The alert in the case of any is sent via the transmitter to the receiver and from the receiver to the AT89C52 this in turn activates the alarm and puts on the appropriate blinker to indicate an unsafe situation in the affected room or location.