

DEVELOPMENT OF FIRE PREVENTION CIRCUIT IN AIR-CONDITIONERS WITH IOT INTERFACE

*Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering*

by

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III year BE-EEE



DEPARTMENT OF ELECTRICAL AND ELECTRONICS
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SCHOOL OF ELECTRICAL AND ELECTRONICS
ENGINEERING

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade “A” by NAAC
Jeppiaar nagar, Rajiv Gandhi Salai, Chennai – 600 119

April 2023



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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of SHERYN F (Reg. No. 40140034) and SURIYAPRIYA M (Reg. No. 40140035) who carried out the project entitled "DEVELOPMENT OF FIRE PREVENTION CIRCUIT IN AIR CONDITIONERS WITH IOT INTERFACE " under our supervision from January 2023 to April 2023.

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1. 

2. 

DATE: 20.04.2022

PLACE: Chennai

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ABSTRACT

Fire incidents associated with air-conditioners in office and residential buildings are increasing day by day and results in loss of human life, valuables, materials and production. With the rising temperatures and climate change, the use of room air-conditioners is inevitable in domestic and industrial segment. Air-conditioning market in India is growing in a rapid pace due to growing retail and hospital sectors, construction of airports, metros, new housing societies and commercial hubs. Researchers predict that India's air-conditioner market revenue is expected to grow at 16% during 2022-28. In the application side, residential segment has captured 54.6% market revenue and room air-conditioners have captured 63.9% of market revenue in the year 2021. The availability of wide products in affordable ranges from various brands and attractive credit financing mechanisms drive the air-conditioners market growth in the country. Fire incidents with room air-conditioners needs to be dealt seriously by occupants and the Government by proper legislation.

This paper determines the underlining causes behind fire incidents in room air-conditioners and attempts to resolve these incidents by developing a fool proof fire prevention power and control circuit with additional safety features and also alerting the occupant with IOT devices.

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CHAPTER 1

1.1 INTRODUCTION

With the rising temperature and climate changes around the world, the need for air-conditioning in day to day life is inseparable. Air conditioning systems aren't even said to be a luxury these days, but a necessity at present. Air-conditioners provide the right temperature and humidity control for human comfort and for increasing the production. Room air-conditioners own a higher market share in India compared to other HVAC products. The availability of wide products in affordable ranges from various brands and attractive credit financing mechanisms drive the air-conditioners market growth in the country. On the other side, the electrical and fire safety features of the equipment are given least importance which becomes a potential fire hazard for human safety and cause loss of property. This paper aims to address the root cause of fire in unitary ACs with a modified fire protection circuit and also alerting the occupants with IOT devices.

1.2 GLOBAL SCENARIO

In Global scenario, room air conditioner fires are also major concern for the breakout of major fires. Air conditioners cause an average of 20 deaths, 140 injuries, and \$82 million in property damage annually, according to a report by the National Fire Protection Association.

1.3 PROBLEM STATEMENT

Fire incidents associated with air-conditioners in office and residential buildings are increasing day by day and results in loss of human life, valuables, materials and production. With the rising temperatures and climate change, the use of room air-conditioners is inevitable in domestic and industrial segment. To provide an air-conditioner with fire proof system without compromising on the safety of human life and property is the need of the hour.

1.4 MOTIVATION AND OBJECTIVE

The motivation to develop a fire proof system for air-conditioners came from growing AC fire incidents across India and Globe causing loss of life and property damage. The major reasons being noticed in all AC fires is inadequate electrical

protection provided by the manufacturers to beat the price competition in market. This project aims to develop and implement fool proof fire protection system with IOT interface for unitary air-conditioners like window and split units for safe operation.

CHAPTER 2

2.1 LITERATURE SURVEY

IS 1319 -2017-Room air conditioners specification- Unitary Air conditioners

IS 1319 -2018-Split air conditioners specification- Unitary Air conditioners

IS 302 :2008- Safety of household and similar electrical appliances- General requirements

IEC 60335-2-40:2018- Household and similar electrical appliances- Particular requirements for electrical heat pumps, air conditioners and dehumidifiers

IEC 60335-1:2020- Household and similar electrical appliances-Safety-General requirements

2.2 PROJECT TIMELINE

This project was conceived, designed and developed in 3 months starting from 1st week of January to 1st week of April.

2.3 PROJECT COST

The cost of the project works out to be

Electrical components like RCCB, relays, transistor, capacitors - Rs. 2800/-

IOT components required for this project - Rs. 1250/-

Metallic enclosure - Rs. 950/-

Total cost of this project - Rs. 5000/-

CHAPTER-3

3.1 EXISTING METHODOLOGY

The circuit diagram of split air-conditioners commercial available is shown below. The power circuit and components used in the system are not fire proof and they are enclosed in the ABS plastic cabinet which is highly inflammable.

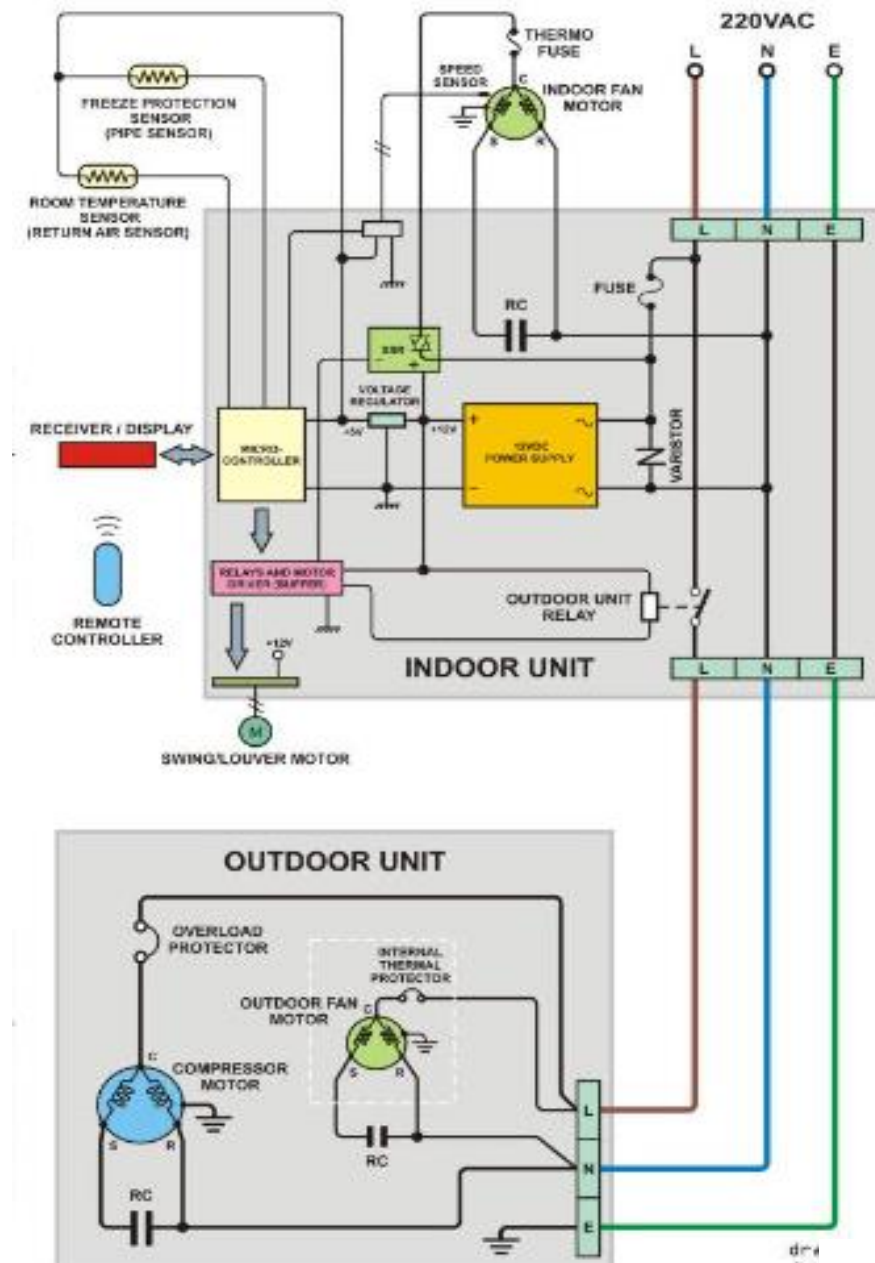


Figure 1 Wiring diagram of split AC

3.2 IDENTIFICATION OF ROOT CAUSE FOR FIRE

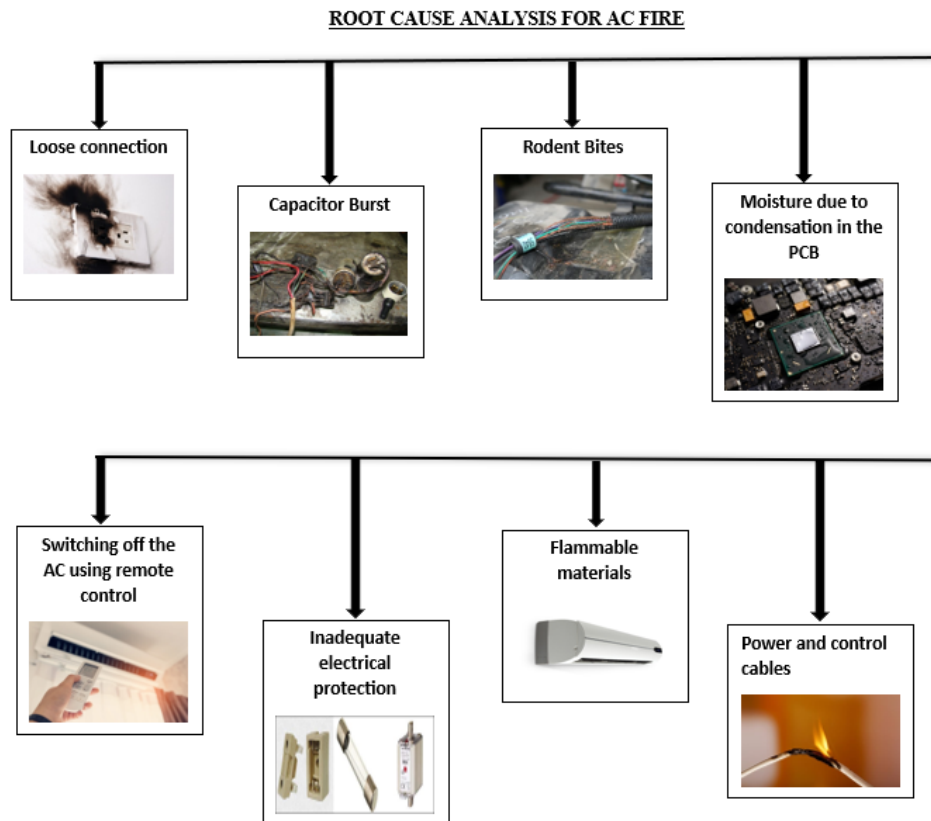


Figure 2 Flow chart of failure analysis

Loose connection: In most of the Air conditioners, clips are used for electrical connections and these clips are located inside the Split AC indoor units (IDU). Due to frequent ON and OFF of the compressor (thermal cycling), the fustie type clips become loose and cause fire due to sparking. Loose connections are known as “Arc fault”. It is dangerous because it can cause high temperature without a high current which can trip a circuit breaker. Arc fault are major reason for residential electrical fires.

Capacitor burst: Bursting of running capacitor either due to defective plastic body or due to weak dielectric material.

Rodent Bites: Physical damage of cable insulation in the event of mice bites triggers fire due to short circuit.

Moisture due to condensation in the PCB: Condensate formation on the printed circuit board (PCB) results in short circuiting and forms possible reasons for fire.

Switching off the AC using remote control: If the AC unit is switched off using the remote control, components like transformer gets heated up due to presence of prolonged power supply (230 V) which may results in ignition of plastic in the event of electrical spark.

Inadequate electrical protection to the AC compressor motor.

Flammable materials: The cabinet/grilles of the air-conditioner are made of ABS plastic which is highly inflammable.

Power and control cables- Use of non fire rated cables in the power and control circuits.

Investigation of these incidents had narrowed down to sparking due to electrical fault is the major cause of the incidents. The cabinet/grilles of the air-conditioner are made of ABS plastic which is highly inflammable. In most of the Air conditioners, a bunch of control and power cables is coiled and placed in the indoor unit along with control board. Clips are used for electrical connections. Due to prolonged presence of high current and as well as thermal cycling, the clips used for termination becomes loose and sparking occurs. The spark ignites the combustible ABS plastic body of the Air conditioner and triggers the fire.

Following a root cause analysis of few fire incidents, it was proved that the failure of electric components ignited the fire in presence of combustible material and oxygen as shown in fire tetrahedron.

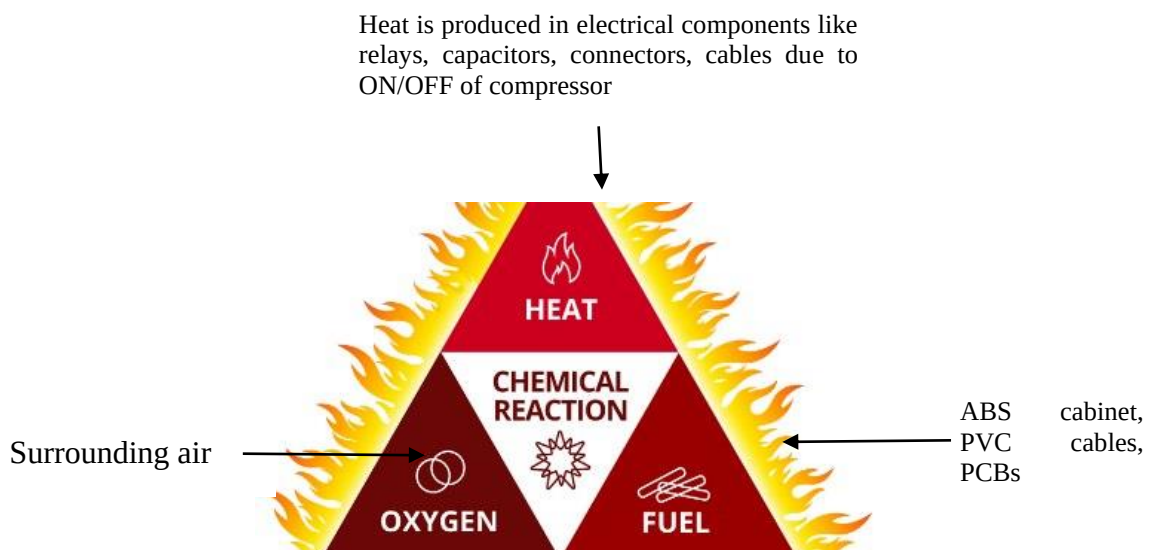
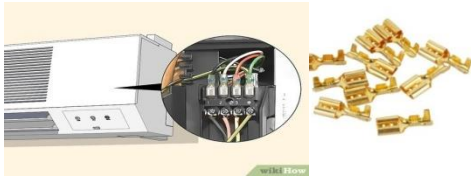
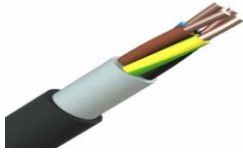


Figure 3 Fire tetrahedron for AC fires

3.3 PROPOSED METHODOLOGY

3.3.1 ANALYSIS:

The components failing frequently in the old circuit and causing the fire was identified and replaced with different fail safe components in the new circuit. The list of components replaced in old circuit is shown in the table below

OLD CIRCUIT COMPONENTS	NEW MODIFIED CIRCUIT COMPONENTS
Clip type connectors 	Screw type connectors 
PLASTIC BODY CAPACITOR 	METAL BODY TYPE CAPACITOR 
THERMAL FUSE FOR COMPRESSOR 	BI-METAL RELAY FOR COMPRESSOR 
ALL COMBUSTIBLE MATERIAL ENCLOSED IN ABS PLASTIC ENCLOSURE 	ALL COMBUSTIBLE MATERIAL ENCLOSED IN FIRE CONTAINMENT MS BOX. 
PVC POWER AND CONTROL CABLE 	FIRE RETARDANT LOW SMOKE (FRLS) 

CHAPTER 4

4.1 HARDWARES OF NEW DESIGN

- RCCB
- ATmega328P Microcontroller
- ARDUINO UNO
- ESP8266 WIFI
- LCD
- SMOKE SENSOR
- PIR SENSOR
- TEMPERATURE SENSOR
- Resistors
- Capacitors
- Diodes
- PCB
- Transformer/Adapter

RCCB

A Residual Current Circuit Breaker (RCCB) is an important safety measure when it comes to protection of electrical circuits. It is a current sensing device, which can automatically measure and disconnect the circuit whenever a fault occurs in the connected circuit or the current exceeds the rated sensitivity. RCCB is aimed at protecting an individual from the risk of electric shocks as well as electrocution and fires; RCCB is particularly helpful in instances of sudden earth fault. The presence of RCCB ensures that in such cases, the circuit will trip immediately and the person is thus protected from an electric shock.



Figure 5- Residual Current Circuit Breaker

RCCB works on the principle of Kirchhoff's law, which states that the incoming current must be equal to the outgoing current in a circuit. RCCB thus compares the

difference in current values between live and neutral wires. Ideally, the current flowing to the circuit from the live wire should be the same as that flowing through the neutral wire. In case of a fault, the current from the neutral wire is reduced, the differential between the two known as Residual Current. On spotting a Residual Current, the RCCB is triggered to trip off the circuit. A test circuit included with the Residual Current device ensures that the reliability of RCCB is tested. When the test button is pushed, the current starts to flow through the test circuit. As it creates an imbalance on the neutral coil of the device, the RCCB trips and supply is disconnected thereby checking RCCB's reliability.

Atmega 328P Microcontroller

ATMEGA328P is high performance, low power controller from Microchip. **ATMEGA328P** is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards. The pin diagram of atmega 328P is shown in fig. The features of processor are furnished in the table below.

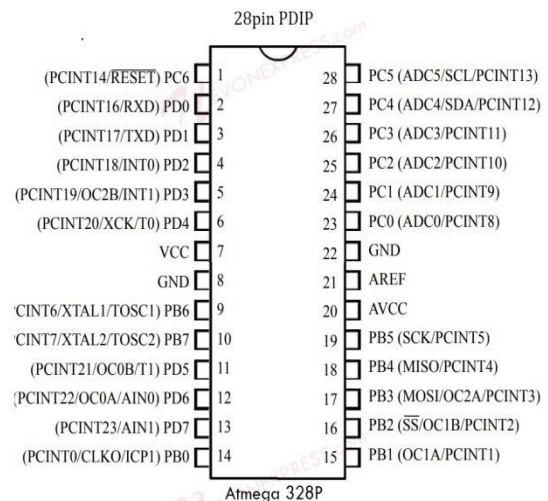


Figure 6 Pin diagram of ATMEGA 328P

ATMEGA328P – Simplified Features	
CPU	8-bit AVR
Number of Pins	28
Operating Voltage (V)	+1.8 V TO +5.5V
Number of programmable I/O lines	23
Communication Interface	Master/Slave SPI Serial Interface(17,18,19 PINS) [Can be used for programming this controller] Programmable Serial USART(2,3 PINS) [Can be used for programming this controller]

	Two-wire Serial Interface(27,28 PINS)[Can be used to connect peripheral devices like Servos, sensors and memory devices]
JTAG Interface	Not available
ADC Module	6channels, 10-bit resolution ADC
Timer Module	Two 8-bit counters with Separate Prescaler and compare mode, One 16-bit counter with Separate Prescaler,compare mode and capture mode.
Analog Comparators	1(12,13 PINS)
DAC Module	Nil
PWM channels	6
External Oscillator	0-4MHz @ 1.8V to 5.5V 0-10MHz @ 2.7V to 5.5V 0-20MHz @ 4.5V to 5.5V
Internal Oscillator	8MHz Calibrated Internal Oscillator
Program Memory Type	Flash
Program Memory or Flash memory	32Kbytes[10000 write/erase cycles]
CPU Speed	1MIPS for 1MHz
RAM	2Kbytes Internal SRAM
EEPROM	1Kbytes EEPROM
Watchdog Timer	Programmable Watchdog Timer with Separate On-chipOscillator
Program Lock	Yes
Power Save Modes	Six Modes[Idle, ADC Noise Reduction, Power-save, Power-down, Standby and Extended Standby]
Operating Temperature	-40°C to +105°C(+105 being absolute maximum, -40 being absolute minimum)

Table 2: Features of ATMEGA 328 P microcontroller

Arduino Uno

Arduino UNO is a microcontroller board based on the ATmega 328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. Features of Aurdino UNO R3 board is given below

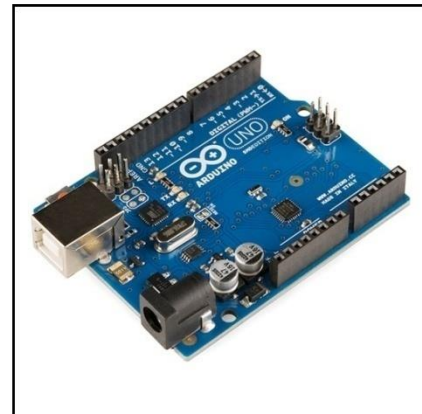


Figure 7 Aurdino Uno R3 board

Board	Name	Arduino UNO R3
	SKU	A000066
Microcontroller	ATmega328P	
USB connector	USB-B	
Pins	Built-in LED Pin	13
	Digital I/O Pins	14
	Analog input pins	6
	PWM pins	6
Communication	UART	Yes
	I2C	Yes
	SPI	Yes
Power	I/O Voltage	5V
	Input voltage (nominal)	7-12V
	DC Current per I/O Pin	20 mA
	Power Supply Connector	Barrel Plug
Clock speed	Main Processor	ATmega328P 16 MHz
	USB-Serial Processor	ATmega16U2 16 MHz
Memory	ATmega328P	2KB SRAM, 32KB FLASH, 1KB EEPROM
Dimensions	Weight	25 g
	Width	53.4 mm
	Length	68.6 mm

Table 3: Features of Aurdino Uno R3 board

Wifi Module- ESP 8266

The **ESP8266** is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making **Internet of Things** as easy as possible.

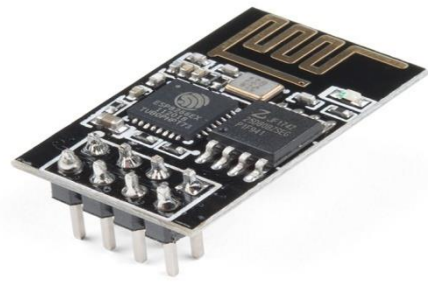


Figure 8 Wifi module

Features

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- Built-in low power 32-bit MCU @ 80MHz
- 512kB Flash Memory
- Can be used as Station or Access Point or both combined
- Supports Deep sleep (<10uA)
- Supports serial communication hence compatible with many development platform like Arduino
- Can be programmed using Arduino IDE or AT-commands or Lua Script

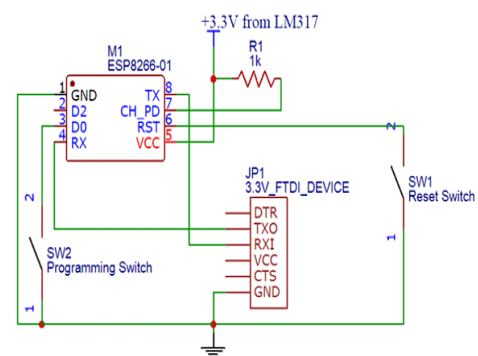


Figure 9 Circuit diagram of Wifi module

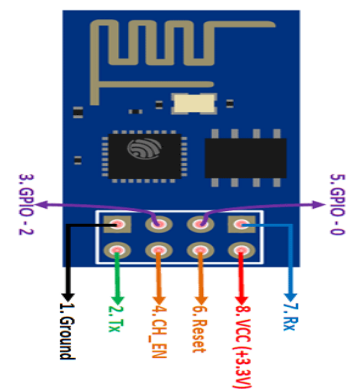


Figure 10 Pin diagram of Wifi module

LCD:

An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 20x4 LCD display is a very basic module commonly used in circuits. In this LCD each character is displayed in pixel matrix. The command register stores the

control directions given to the LCD. A command is an instruction given to LCD to perform a predefined task like initializing it,

clearing its display, placing the cursor position, controlling screen etc. The data register stores the data to be displayed on the LCD. The information is the ASCII value of this character to be shown on the LCD.



Figure 11 - 20x4 LCD display board

Features

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

FLAME SENSOR

In this project, we are using an **IR based flame sensor**. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. It can detect infrared light with a wavelength ranging from 700nm to 1000nm and its detection angle is about 60°. The flame sensor module consists of a photodiode (IR receiver), resistor, capacitor, potentiometer, and LM393 comparator in an integrated

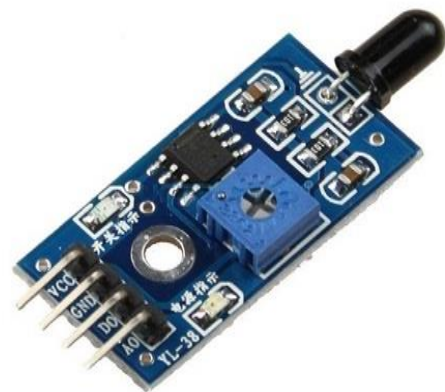


Figure 12 IR based flame sensor

circuit. The sensitivity can be adjusted by varying the onboard potentiometer. Working voltage is between 3.3v and 5v DC, with a digital output. A logic high on the output indicates the presence of flame or fire. A logic low on output indicates the absence of flame or fire. When fire burns it emits a small amount of Infra-red light, this light will be received by the Photodiode (IR receiver) on the sensor module. Then we use an Op-Amp to check for a change in voltage across the IR Receiver, so that if a fire is detected the output pin (DO) will give 0V(LOW), and if there is no fire the output pin will be 5V(HIGH).

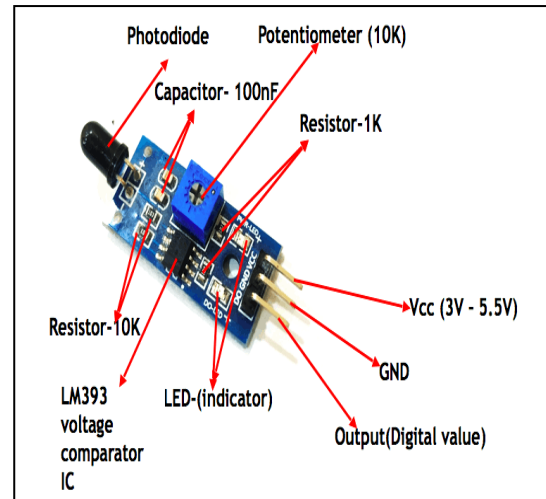


Figure 13 Pin diagram of flame sensor

The pin configuration of this sensor is shown below. It includes four pins which include the following. When this module works with a microcontroller unit then the pins are

- Pin1 (VCC pin): Voltage supply ranges from 3.3V to 5.3V
- Pin2 (GND): This is a ground pin
- Pin3 (AOUT): This is an analog output pin
- Pin4 (DOUT): This is a digital output pin

PIR Sensor Module Infrared Motion Sensor

PIR infrared sensor module works on infrared sight of operation, programmed control options. It has high dependability, low power utilization, Variable sensitivity, low voltage task mode. Generally utilized as a part of different automated-detection electrical gear, particularly for battery-powered and programmed control systems. It has a wide working voltage, default voltage DC 3.6V ~ 18V. Induction blocking time (default setting : 2.5S piece time)



Figure 14 PIR sensor module

The PIR sensors are commonly used in many appliances these days. The sensors have ability to sense motion and can be used to detect any trespassing occurrence in the sensor's range. The PIR are made out of pyroelectric sensor, a material having ability to generate electricity after given heat or cold, thus giving them

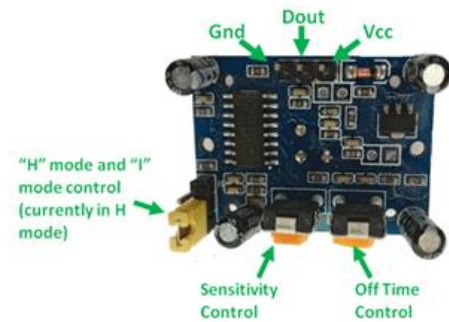


Figure 15 Pin diagram of PIR sensor module

As every living body emits some amount of heat from their body, hence the sensor detects the change in amount of IR emission when someone passes by. The sensors are split into two, so they can sense out past some distance. When a worm body enters the sensor's perimeter, firstly one of half detects it and the other remains the same, causing a positive differential change in both half of the sensors and when the body leaves the perimeter the exactly reverse happens causing negative differential change. The sensor detects the change between these two and gives the desired output.

Temperature Sensor

A temperature sensor is a thermocouple or a resistance temperature detector (RTD) that gathers the temperature from a specific source and alters the collected information into understandable type for an apparatus or an observer. This temperature sensor that can be

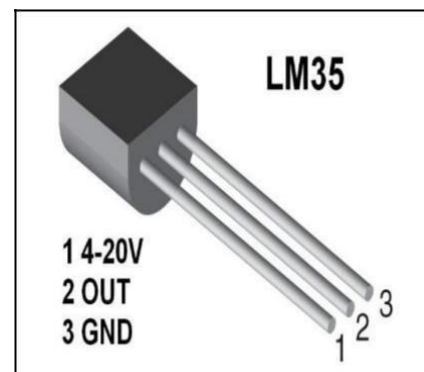


Figure 16 Temperature Sensor

used to measure temperature with an electrical o/p comparative to the temperature (in °C). It can measure temperature more correctly compare with a thermistor. This sensor generates a high output voltage than thermocouples and may not need that the output voltage is amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/°C.

Features

Calibrated Directly in Celsius (Centigrade)

Linear + 10-mV/°C Scale Factor

0.5°C Ensured Accuracy (at 25°C)

Rated for Full –55°C to 150°C Range

Suitable for Remote Applications

Resistors

The resistor is a passive electrical component to create resistance in the flow of electric current. In almost all electrical networks and electronic circuits they can be found. The resistance is measured in ohms. An ohm is the resistance that occurs when a current of one ampere passes through a resistor with a one volt drop across its terminals. The current is

proportional to the voltage across the terminal ends. This ratio is represented by Ohm's law:

Formula with ohm's law: $R=V/I$

Resistors are used for many purposes. A few examples include delimit electric current, voltage division, heat generation, matching and loading circuits, control gain, and fix time constants. They are commercially available with resistance values over a range of more than nine orders of magnitude. They can be used to as electric brakes to dissipate kinetic energy from trains, or be smaller than a square millimeter for electronics.

Capacitor

The capacitor is a component which has the ability or “capacity” to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery.

There are many different kinds of capacitors available from very small capacitor beads used in resonance

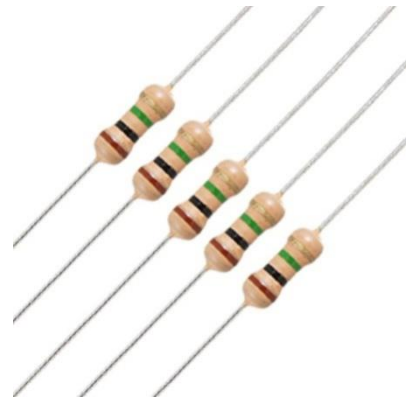


Figure 17 Resistors



Figure 18 Capacitors

circuits to large power factor correction capacitors, but they all do the same thing, they store charge.

In its basic form, capacitors consists of two or more parallel conductive (metal) plates which are not connected or touching each other, but are electrically separated either by air or by some form of a good insulating material such as waxed paper, mica, ceramic, plastic or some form of a liquid gel as used in electrolytic capacitors. The insulating layer between a capacitors plate is commonly called the Dielectric.

Due to this insulating layer, DC current cannot flow through the capacitor as it blocks it allowing instead a voltage to be present across the plates in the form of an electrical charge.

The conductive metal plates of a capacitor can be either square, circular or rectangular, or they can be of a cylindrical or spherical shape with the general shape, size and construction of a parallel plate capacitor depending on its application and voltage rating.

Diode:

A diode is a two-terminal electronic component that conducts current primarily in one direction (asymmetric conductance); it has low (ideally zero) resistance in one direction, and high (ideally infinite) resistance in the other. A diode

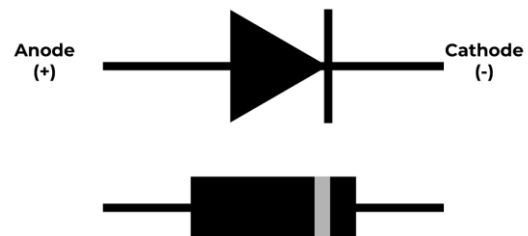


Figure 19 Diodes

vacuum tube or thermionic diode is a vacuum tube with two electrodes, a heated cathode and a plate, in which electrons can flow in only one direction, from cathode to plate. A semiconductor diode, the most common type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals. Semiconductor diodes were the first semiconductor electronic devices. Today, most diodes are made of silicon, but other materials such as gallium arsenide and germanium are used.

The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction), while blocking it in the opposite

direction (the reverse direction). As such, the diode can be viewed as an electronic version of a check valve.

PCB – Printed Circuit Board

A printed circuit board (PCB) mechanically supports and electrically connects electronic components or electrical components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate.



Figure 20 Printed Circuit Board

Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it. Printed circuit boards are used in all but the simplest electronic products. They are also used in some electrical products, such as passive switch boxes. Alternatives to PCBs include wire wrap and point-to-point construction, both once popular but now rarely used. PCBs require additional design effort to lay out the circuit, but manufacturing and assembly can be automated. Specialized CAD software is available to do much of the work of layout. Mass-producing circuits with PCBs is cheaper and faster than with other wiring methods, as components are mounted and wired in one operation. Large numbers of PCBs can be fabricated at the same time, and the layout only has to be done once. PCBs can also be made manually in small quantities, with reduced benefits.

Transformer & Adapters

A transformer is a static electrical device that transfers electrical energy between two or more circuits. A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force or "voltage" across a second coil wound around the same core.



Figure 21 Transformer

An AC adapter, AC/DC adapter, or AC/DC converter is a type of external power supply, often enclosed in a case similar to an AC plug. Other common names include plug pack, plug-in adapter, adapter block, domestic mains adapter, line power adapter, wall wart, power brick, and power adapter.



Figure 22 AC adapter

4.2 PROTOTYPE DESIGN AND TESTING



Figure 23 Prototype AC controller with IOT module



Figure 24 Inside view of AC controller

Output display



Figure 25 AC controller switched ON



Figure 26 LCD Display showing all OK in Area- 2



Figure 27 AC compressor switches ON after 3 minutes

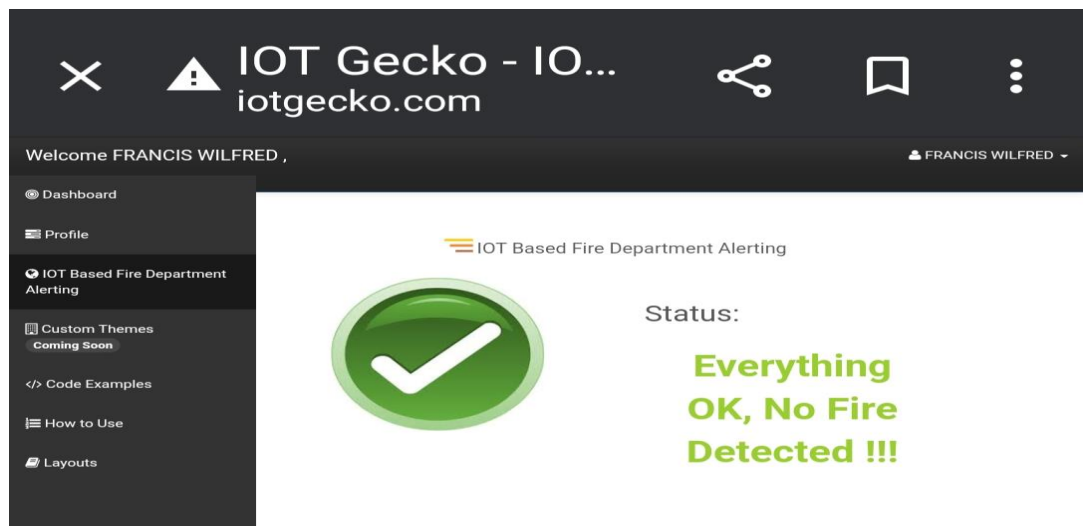


Figure 28 Data sent to mobile through Wifi module using IOT before FIRE



Figure 29 Fire sensor activated by naked fire



Figure 30 LCD shows fire detected in IOT module

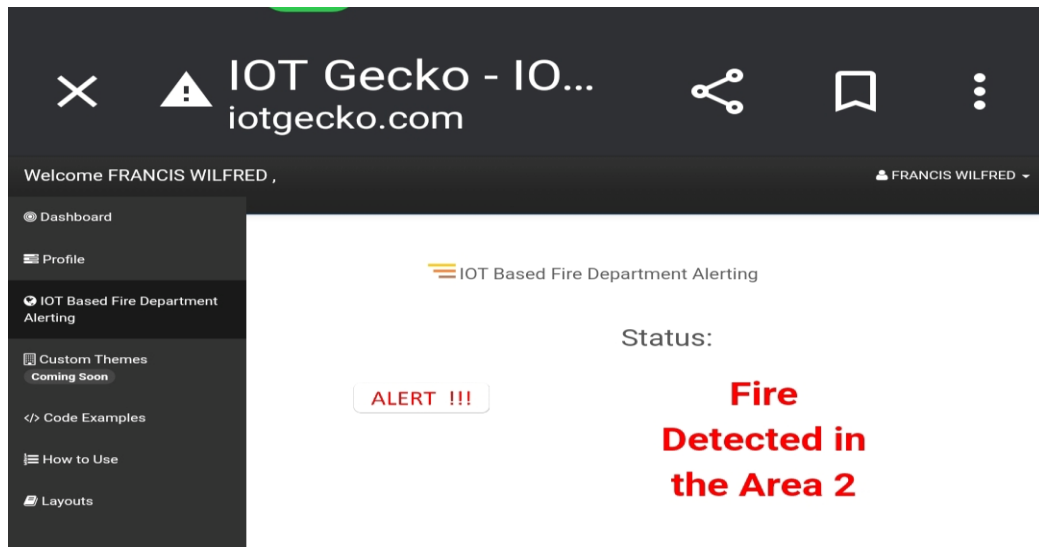


Figure 31 Data sent to mobile through Wifi module using IOT after FIRE

CHAPTER -5

5.1 CONCLUSION

Day by day AC fire accidents are raising in the society and at the same time air conditioning demands also increases steeply. It is necessary to implement these modifications for safe operation of the Air conditioners in order to prevent fire and to save human lives & their belongings. It will be an excellent societal application with respect to safety aspects with additional cost.

REFERENCES

Shreya Gosrani,Abhishek Jadhav,Krutika Lekhak,Devesh Chheda. “Fire detection, monitoring and alerting system based on IoT, International Journal of Research in Engineering, Science and management Volume-2, Issue, April 2019

IEEMA Journal- Feb 2023-Causalities due to fire in air conditioners

V.Rathnakumar, C.Chandran .Control circuit modification in room air-conditioners for safe operation during 4th National Conference on Refrigeration and Air Conditioning (NCRAC-2015) held at Rajalakshmi Engineering College, Chennai, 28th to 30th October 2015.