

RESCUE OF CHILDREN MISTAKENLY LOCKED IN THE CAR

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree In Electronics and Communication
Engineering

by

K.Aravind Reddy (37130181)



**DEPARTMENT OF ELECTRONICS AND
COMMUNICATON ENGINEERIG
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

April – 2021

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONA FIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of K.Aravind Reddy (37130181), who carried out the project entitled "RESCUE OF CHILDREN MISTAKENLY LOCKED IN THE CAR" Under our supervision from September 2020 to April 2021

Internal Guide

Dr.E.Anna Devi, ME,Ph.D

Head of the Department

Dr.T.RAVI, ME,Ph.D

Submitted for Viva voce Examination held on_____

Internal Examiner
(Name in Capital letters
with Signature)

External Examiner
(Name in Capital letters
with signature)

DECLARATION

I K.Aravind Reddy(37130181) hereby declare that the Project Report entitled RESCUE OF CHILDREN MISTAKENLY LOCKED IN THE CAR done by me under the guidance of Dr.E.Anna Devi, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree Electronics and communication engineering.

DATE:

**PLACE:
CANDIDATE**

SIGNATURE OF THE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to Dr. N.M.NANDITHA,Ph.D. Dean, School of Electronics and Communication engineering and Dr.T.RAVI,ME., Ph.D.Head of the Department, Dept. of Electronics and Communication Engineering for providing me necessary **support and details at the right time during the progressive reviews.**

I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr. E.ANNADEVI** for her valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Electronics and Communication Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

According to the safety organization Kids and Cars, in US, an average of 38 children die each year in hot cars, seemingly forgotten by a distracted parent. This study describes an innovative complete car control system against children abandonment in unattended vehicles. Existing car seat alarm designs either compromise people's privacy (camera -based designs), or fail to distinguish children sitting in the back from heavy stuff put on rear seats, and keep sending false alerts (pressure sensor-based designs).

The proposed system implements a force sensing resistor, infrared sensors, a carbon dioxide sensor, a temperature/humidity sensor. These acquisition devices are connected to a microcontroller board that is able to combine all acquired data for detecting the alarm scenario and consequently acting some warning procedures, and sends alert messages to users with GSM module.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	V
	LIST OF FIGURES	VIII
	LIST OF TABLES	VIII
1	INTRODUCTION	1
	1.1 Embedded System	2
	1.2 Embedded System Hardware	3
	1.3 Embedded System Software	5
	1.4 Embedded Firmware	6
2	LITERATURE SURVEY	
	2.1 In-Vehicle Occupancy Detection And Classification	7
	2.2 Analysis On The Design Of Child Safety Seats In Vehicle	8
	2.3 Effect Of Rear Seat Structure On Child Occupant Safety	9

3	MATERIALS AND METHODS	
3.1	Existing System	10
3.2	Block Diagram	11
3.2.1	Actually Arduino	12
3.2.2	Hardware and software	15
3.3	Proposed System	16
3.4	Different Types of IR Sensors	17
3.5	HARDWARE DESCRIPTION	18
3.5.1	Gas Analyser	18
3.5.2	IR Imaging Device	19
3.5.3	Gas Sensor	23
3.5.4	Electrochemical	24
3.5.5	GSM	33
3.5.6	DC Motor	41
4	SOFTWARE REQUIREMENTS	
4.1	Arduino IDE	46
4.2	Embedded C	49
4.3	PHP	51
5	CONCLUSION	54
	REFERENCES	55

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1.1	EMBEDDED SYSTEM	2
1.2	COMPUTER ARCHITECTURE	3
3.1	BUILDING BLOCKS OF PROJECT	11
3.2	ARDUINO BOARD	13
3.3	ARDUINO UNO WITH DIGITAL I/O	14
3.4	PIN DIAGRAM OF ARDUINO UNO	15
3.5	IR SENSOR CIRCUIT DIAGRAM	16
3.6	IR CIRCUIT	17
3.7	GAS ANALIZER	19
3.8	IR IMAGING DEVICES	20
3.9	GAS SENSOR	24
3.10	CATALYTIC BEAD	26
3.11	TEMPERATURE MEASUREMENT	30
3.12	BIMETALLIC THERMOSTAT	32
3.13	GSM MODEM	34
3.14	GSM MODEM CIRCUIT	34
3.15	INTERNET OF THINGS	38
3.16	CLOUD COMPUTING	39
3.17	EXAMPLES OF IOT SYSTEM	39
3.18	DC MOTOR	42
3.19	MOTOR TESTING	43
3.20	DETAILS OF MOTOR	44

LIST OF TABLES

TABLE NUMBER	TABLE TITLE	PAGE NO.
3.1	TECHNICAL SPECIFICATIONS	29

CHAPTER 1

INTRODUCTION

Every summer, there are some children who have been forgotten in the car and died due to heatstroke. Some careless parents have forgotten to take the children out, and finally the irreparable tragedy happened. Just in the United States, 52 children died in 2018 and 43 children died in 2017 because of heatstroke in vehicle, and the majority of these in-car heatstroke deaths are accidents that are preventable. In recent years, the number of heatstroke deaths of children in vehicles is still increasing. How to remind these careless parents is an urgent problem to solve. An effective solution to these preventable tragedies is to effectively detect rear seat children, and send a prompt and accurate alert to their parents. There exist some techniques in the market or in the literature to remind parents of the children left in the rear seat. The most common way is to install a pressure sensor under the car seat, but it cannot distinguish between heavy stuff (e.g., grocery items) and the child in the rear seat. Thus, it may send annoying false alarms. Another option is to install a 2-D surveillance camera in the vehicle. According to the image captured by the camera, it can easily analyze whether the children are left unattended in a parked car or not. Even though with high accuracy for alerts, all of the activities in the car will be exposed to the camera, which may lead to the privacy leakage of the driver and passengers. Some other works try to detect the baby by using the infrared cameras. However, it cannot detect the baby when the interior environment is already heated in hot summer. Recently, DeWald et al. in propose an RF-based baby detection system, but additional expensive devices such as CW-radar are needed.

1.1 EMBEDDED SYSTEM

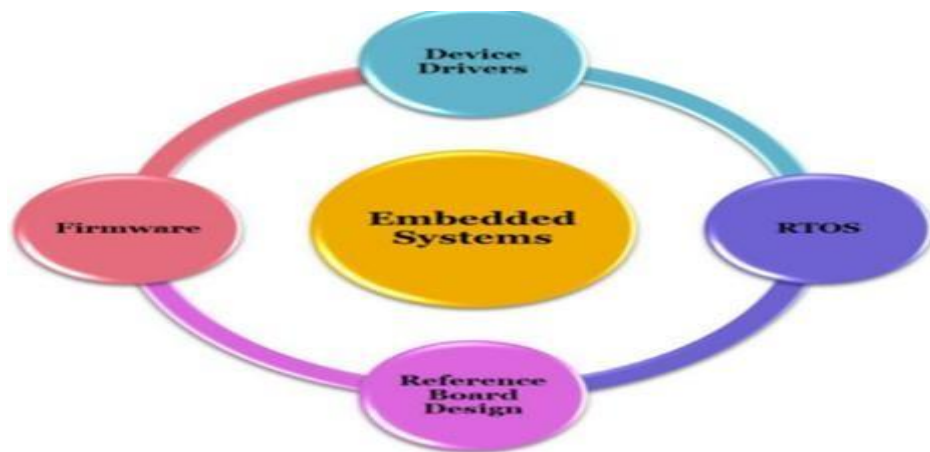
An embedded system is a combination of computer hardware and software, either fixed in capability or programmable, designed for a specific function or functions within a larger system. Industrial machines, agricultural and process industry devices,

automobiles, medical equipment, cameras, household appliances, airplanes, vending machines and toys, as well as mobile devices, are possible locations for an embedded system.

Embedded systems are computing systems, but they can range from having no user interface (UI) -- for example, on devices in which the system is designed to perform a single task -- to complex graphical user interfaces (GUIs), such as in mobile devices. User interfaces can include buttons, LEDs, touchscreen sensing and more. Some systems use remote user interfaces as well.

1.2 Embedded system hardware (microprocessor-based, microcontroller-based)

Embedded system hardware can be microprocessor- or microcontroller-based. In either case, an integrated circuit is at the heart of the product that is generally designed to carry out computation for real-time operations. Microprocessors are visually indistinguishable from microcontrollers, but while the microprocessor only implements a central processing unit (CPU) and, thus, requires the addition of other components such as memory chips, microcontrollers are designed as self-contained systems.



1.1.Embedded system

Microcontrollers include not only a CPU, but also memory and peripherals such

as flash memory, RAM or serial communication ports. Because microcontrollers tend to implement full (if relatively low computer power) systems, they are frequently put to use on more complex tasks. For example, microcontrollers are used in the operations of vehicles, robots, medical devices and home appliances, among others. At the higher end of microcontroller capability, the term system on a chip (SoC) is often used, although there's no exact delineation in terms of RAM, clock speed and so on.

The embedded market was estimated to be in excess of \$140 billion in 2013, with many analysts projecting a market larger than \$20 billion by 2020. Manufacturers of chips for embedded systems include many mainstays of the computer world, such as Apple, IBM, Intel and Texas Instruments, as well as numerous other companies less familiar to those outside the field. Arm has been a highly influential vendor in this space. The company began as an outgrowth of Acorn, a U.K. maker of early PCs. Arm chips, produced under license by other companies, are based on the reduced instruction set computer (RISC) architecture and are often used in mobile phones; they remain the most widely deployed SoC in the embedded world, with billions of units fielded.



1.2 Computer architecture

1.3 Embedded system software

A typical industrial microcontroller is unsophisticated compared to the typical enterprise desktop computer and generally depends on a simpler, less-memory-intensive program environment. The simplest devices run on bare metal and are programmed directly using the chip CPU's machine code language.

Often, embedded systems use operating systems or language platforms tailored to embedded use, particularly where real-time operating environments must be served. At higher levels of chip capability, such as those found in SoCs, designers have increasingly decided the systems are generally fast enough and the tasks tolerant of slight variations in reaction time that near-real-time approaches are suitable. In these instances, stripped-down versions of the Linux operating system are commonly deployed, although other operating systems have been pared down to run on embedded systems, including Embedded Java and Windows IoT (formerly Windows Embedded).

Generally, storage of programs and operating systems on embedded devices make use of either flash or rewritable flash memory.

1.4 Embedded firmware

The firmware on embedded systems, referred to as embedded firmware, is specific software written into the memory of a device that serves the purpose of ROM, but can be updated more easily. Firmware can be stored in non-volatile memory devices including ROM, programmable ROM, erasable PROM or flash memory. Embedded firmware is used to control various device and system functions, for example, telling the device how to communicate with other devices, perform specific functions and provide input and output functionality.

The delineation between the terms *embedded firmware* and *embedded software* are blurring, but embedded software often refers to the only code running on a

piece of hardware, while firmware can also refer to the chip that houses a device's basic input/output system (BIOS) or Unified Extensible Firmware Interface (UEFI), which connect software and a system's operating system.

Embedded systems vs. VLSI

Very-large-scale integration, or VLSI, is a term that describes the complexity of an integrated circuit. VLSI is the process of embedding hundreds of thousands of transistors into a chip, whereas LSI (large-scale integration) microchips contain thousands of transistors, MSI (medium-scale integration) contain hundreds of transistors, and SSI (small-scale integration) contain tens of transistors. ULSI, or ultra-large-scale integration, refers to placing millions of transistors on a chip.

VLSI circuits are common features of embedded systems. Many ICs in embedded systems are VLSI, and the use of the VLSI acronym has largely fallen out of favor.

Debugging embedded systems

One area where embedded systems part ways with the operating systems and development environments of other, larger-scale computers is in the area of debugging. While programmers working with desktop computer environments have systems that can run both the code being developed and separate debugger applications that monitor the actions of the development code as it is executed, embedded system programmers generally cannot.

Some programming languages run on microcontrollers with enough efficiency that rudimentary interactive debugging is available directly on the chip. Additionally, processors often have CPU debuggers that can be controlled -- and, thus, control program execution -- via a JTAG or similar debugging port.

In many instances, however, programmers of embedded systems need tools that attach a separate debugging system to the target system via a serial or other port. In this

scenario, the programmer can see the source code on the screen of a conventional personal computer just as would be the case in the debugging of software on a desktop computer. A separate, frequently used approach is to run software on a PC that emulates the physical chip in software, thus making it possible to debug the performance of the software as if it were running on an actual, physical chip.

Broadly speaking, embedded systems have received more attention to testing and debugging because a great number of devices using embedded controls are designed for use in situations where safety and reliability are top priorities.

The internet of things builds on an embedded systems base

While some embedded systems can be relatively simple, a growing number either supplant human decision-making or offer capabilities beyond what a human could provide. For instance, some aviation systems, including those used in drones, are able to integrate sensor data and act upon that information faster than a human could, permitting new kinds of operating features.

CHAPTER 2

LITERATURE SURVEY

2.1 IN-VEHICLE OCCUPANCY DETECTION AND CLASSIFICATION

Occupancy detection is a difficult problem. There are several mechanisms exists for occupancy detection in vehicles, particularly in Automobiles. Now, safety has become an important and necessary aspect of the automobile industry. Airbag became a basic and important safety measure in cars. Even though airbag is a vehicle safety device, it can kill children below 12 years due to its rapid action by the exerting lot of force. This project explains about detecting the number of passengers sitting in the car and then classifying each person whether he/she is a child or an adult by processing the image taken from the camera. So that the deployment of airbags can be avoided near children. Each time car speeds from 0 Km/h to 20 Km/h, occupancy of the car is determined and each one is classified again. We are using widely used technique haar Cascades, for detection. First, we detect faces and then classify each occupant adult or child.

IMPLEMENTATION OF REAL-TIME PASSENGER SAFETY ALERT SYSTEM

Car accidents are a common event in all modernized society. However, as vehicles become more autonomous, car accidents will slowly begin to decrease. Even with the decrease in accidents, mistakes will still be made that cause damage to both property and persons. In an effort to reduce the damage caused by these mistakes, the system described in this paper uses sensors to measure features such as height and weight in order to distinguish between adult and small child. Once the system has made the distinction, it will inform the driver of potentially dangerous travel accommodations and recommend the proper safety seat or harness. This paper describes the process of designing, constructing, and testing the prototype of the system.

CLOUD BASED SYSTEM FOR DETECTING CHILDREN IN AUTOMOBILES

Children and infants being left in cars on hot summer days is a major public health issue across the world. With modern sensor and connectivity technology, it should be possible to detect these scenarios by uploading raw data to the cloud. In the cloud,

systems will be able to respond to this data and make judgements to notify proper response personnel. In this paper, we explore cloud technology to process updates from a sensor system and how it could be used to send notifications to prevent these tragic occurrences.

2.2 ANALYSIS ON THE DESIGN OF CHILD SAFETY SEATS IN VEHICLE

When cars come into more and more families, it is increasingly long time for children to stay in the vehicle. It is gradually arousing people's attention that there are many child casualties' problems caused by vehicle accidents. Thus, child seat become the most effective and general products just because it can resolve those problems. The article analyzed the importance of the design of child seat for vehicle, at the same time, it proposed the basic design principles and design approach to improve the comfort and security of children. Finally, it further analyzed of the design of child safety seats through outstanding examples. It is increasingly long time for children to stay in the vehicle when cars come into more and more families. It is gradually arousing people's attention that there are many child casualties problems caused by vehicle accidents. The rate of children casualties is much higher than adults', if children do not have any passengers bound measures to protect the event of a crash. The experiments show that when the speed reach 50 km/h, a child of 40 kg weight is equal to the moving object which power is 1 t.

AN INTEGRATED CHILD SAFETY SEAT COOLING SYSTEM—MODEL AND TEST

Vehicle safety remains a prominent automotive issue for engineers, consumers, and government regulators. One area that merits attention is the safety issue of when a child is left alone in a parked vehicle during the summer months when the ambient air temperatures are warmer. Injuries and deaths of infants, young children, and elderly adults have occurred due to elevated body temperatures for prolonged time periods. One proposed solution is the design of a car safety seat that offers temporary thermal protection to the occupant. This seat features thermoelectric cooling and forced air convection to maintain the body temperature within acceptable ranges for a limited time. In this paper, a system thermal model and experimental results are presented to validate the effectiveness of the thermoelectric-based safety system. The experimental system

demonstrates the capability of maintaining localized cabin air temperatures below critical survivability thresholds in a closed parked vehicle for up to 95 minutes. This represents an 85% increase over standard child seating units, in cabin temperatures up to 69°C, for an emulated 7 kg infant.

2.3 EFFECT OF REAR SEAT STRUCTURE ON CHILD OCCUPANT SAFETY

This paper aims to study the effect of the rear seat structure on child occupant protection. According to GB15083-2006 standard, a finite element model of luggage cabin and rear-row seat was developed in LS-DYNA and validated via test results. The model was used in analysis of the safety performance of rear seat structure under luggage impact in car frontal crashes, in order to minimize the risk of child occupant injury. A 3 years old child seat was simulated with fixing on the rear seat. Four optimization schemes were designed in order to reduce the intrusion and acceleration of the rear seat structure, comparing to the original model.

CHAPTER 3

MATERIALS AND METHODS

3.1 EXISTING SYSTEM:

- In existing system, they used WIFI signals to detect the persons in car.
- In existing systems, they use camera to detect the persons, but it will affect the user's privacy.

DISADVANTAGES:

- Users privacy will affect if we use camera.
- Systems based on motion detection using an infrared sensor (PIR) may not always be effective

PROPOSED SYSTEM:

- In proposed system, we can use force sensing resistor sensor, temperature sensor, IR sensor and gas sensor to detect the conditions.
- We can use GSM module to send the alert to user.
- By using IoT we can monitor the data in cloud.

ADVANTAGES:

- Force sensing resistive sensors are more reliable.
- We can able to monitor the car environment data because of the sensors we used in it.

3.2 BLOCK DIAGRAM:

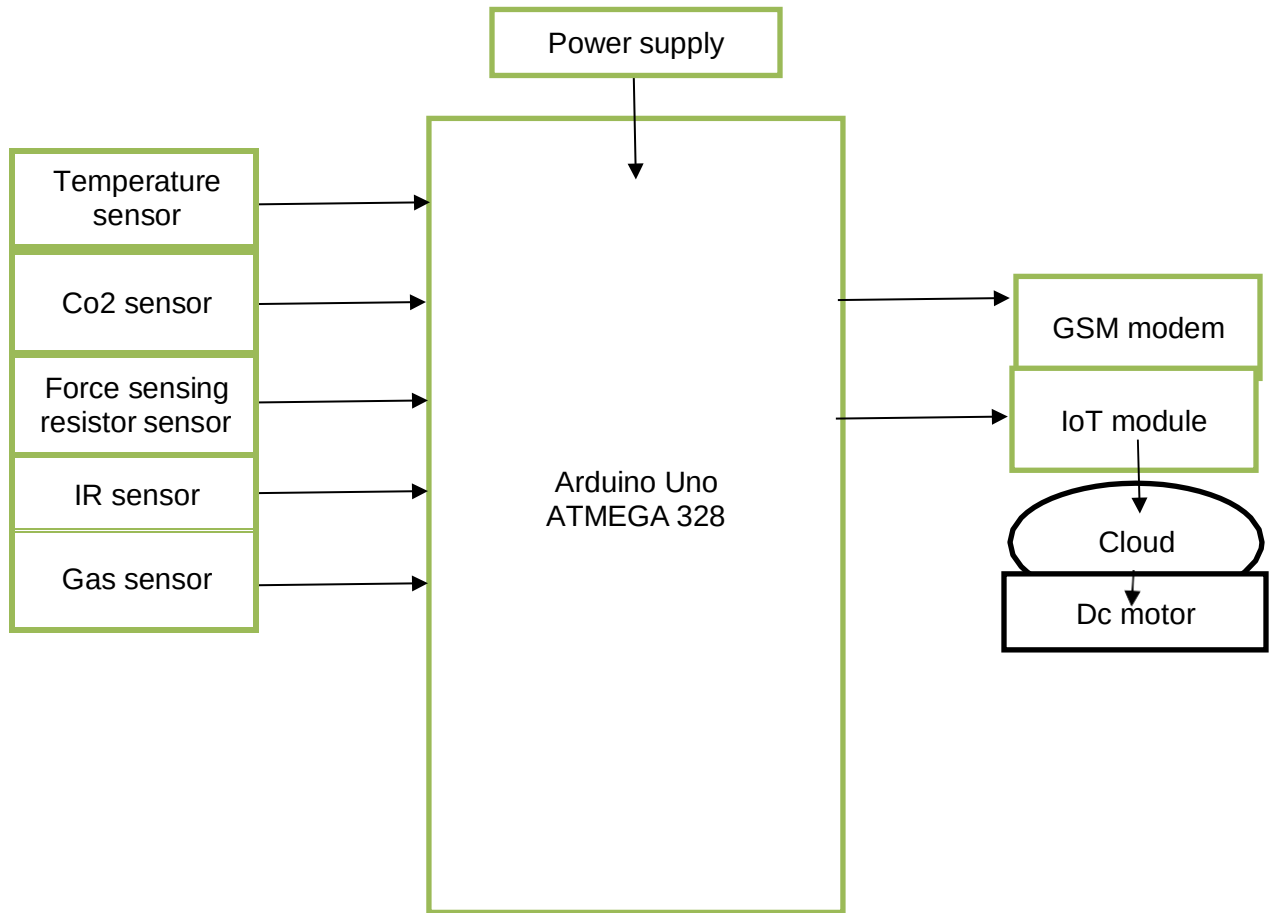


Fig 3.1 Building blocks of project

HARDWARE REQUIREMENTS:

- Arduino Uno
- IR sensor
- FSR sensor
- Gas sensor
- Co2 sensor
- Temperature and humidity sensor
- GSM modem
- IOT module

- DC motor

SOFTWARE REQUIREMENTS:

- Arduino IDE
- Embedded C
- PHP

3.2.1 ARDUINO UNO

The UNO is that the best board to urge started with electronics and coding. If this is often your first experience tinkering with the platform, the UNO is that the most robust board you'll start twiddling with . The UNO is that the most used and documented board of the entire Arduino family.

Arduino Uno may be a microcontroller board supported the ATmega328P (datasheet). It has 14 digital input/output pins(of which 6 are often used as PWM outputs), 6 analog inputs, a 16 MHz quartz , a USB connection, an influence jack,an ICSP header and a reset button.

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power, it with a AC•to•DC adapter or battery to urge started.

There are many versions of Arduino boards introduced within the market like Arduino Uno, Arduino Due, Arduino.Leonardo, Arduino Mega, however, commonest versions are Arduino Uno and Arduino Mega. If you're getting to create,a project concerning digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the,simplest , easy and most economical option.



Fig 3.2: Arduino Board

ARDUINO BOARD

There are various types of Arduino boards in which many of them were third-party compatible versions. The most official versions available are the Arduino Uno R3 and the Arduino Nano V3. Both of these run a 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB of flash RAM 14 digital I/O and six analogue I/O and the 32KB will not sound like as if running Windows. Arduino projects can be stand-alone or they can communicate with software on running on a computer. For e.g. Flash, Processing, Max/MSP). The board is clocked by a 16 MHz ceramic resonator and has a USB connection for power and communication. You can easily add micro SD/SD card storage for bigger tasks.

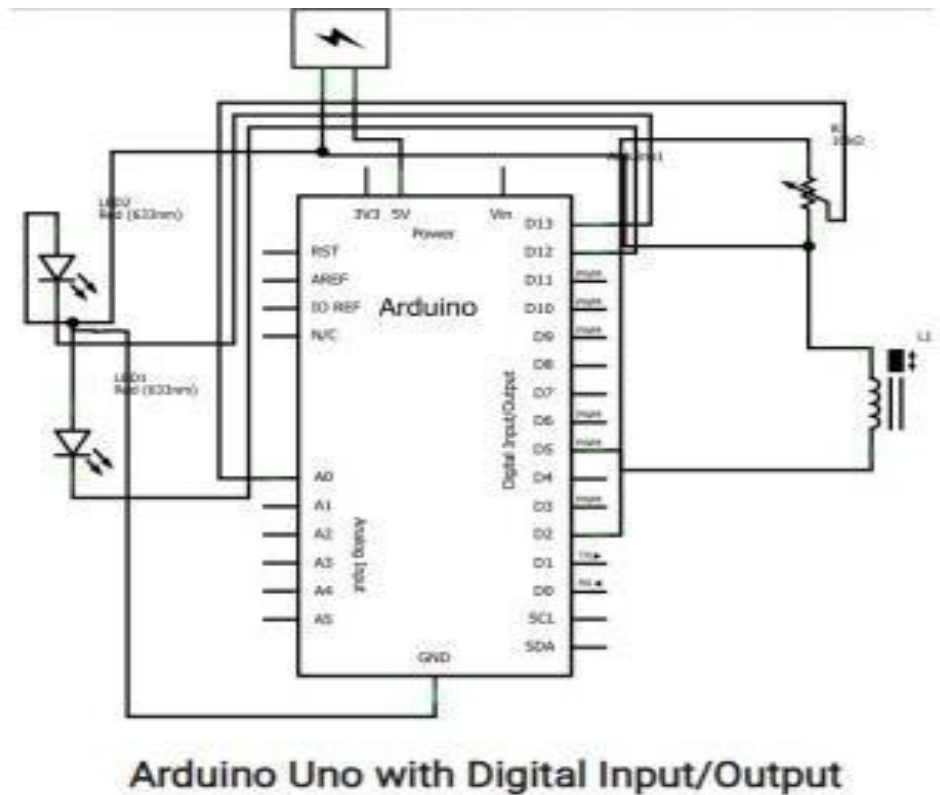


Fig 3.3: Arduino uno with digital i/o

FEATURES OF ARDUINO:

- It is an easy USB interface. This allows interface with USB as this is like a serial device.
- The chip on the board plugs straight into your USB port and supports on your computer as a virtual serial port. The benefit of this setup is that serial communication is an extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.
- It is easy-to-find the microcontroller brain which is the ATmega328 chip. It has more number of hardware features like timers, external and internal interrupts, PWM pins and multiple sleep modes.



Fig 3.4: Pin diagram of arduino uno

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware.

3.2.2 HARDWARE AND SOFTWARE

IR SENSOR:

An infrared sensor is an device , that emits so as to sense some aspects of the environment . An IR sensor can measure the warmth of an object also as detects the motion. These sorts of sensors measures only infrared , instead of emitting it that's called as a passive IR sensor. Usually within the spectrum , all the objects radiate some sort of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is just an IR LED (Light Emitting Diode) and therefore the detector is just an IR photodiode which is sensitive to IR light of an equivalent wavelength as that emitted by the IR LED. When IR light falls on the photodiode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received.

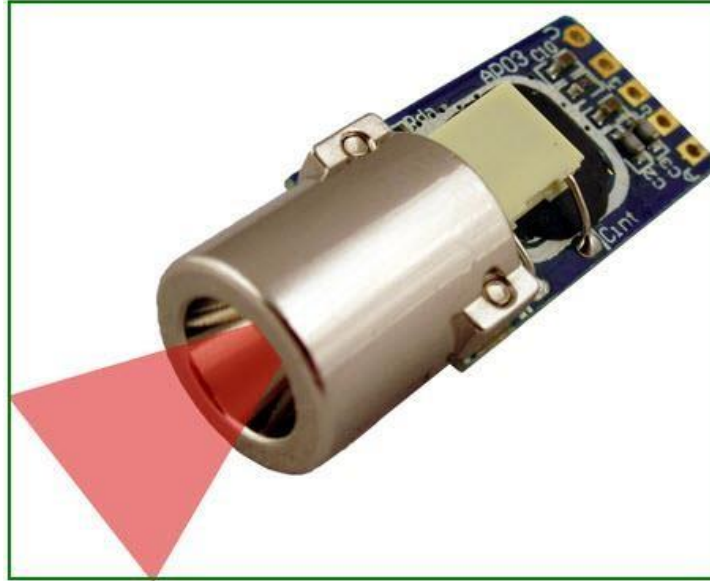


Fig 3.5 : IR sensor

IR Sensor Circuit Diagram and Working Principle

An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components

- LM358 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo ohms.
- Variable resistors.
- LED (Light Emitting Diode).

3.3 PROPOSED SYSTEM

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

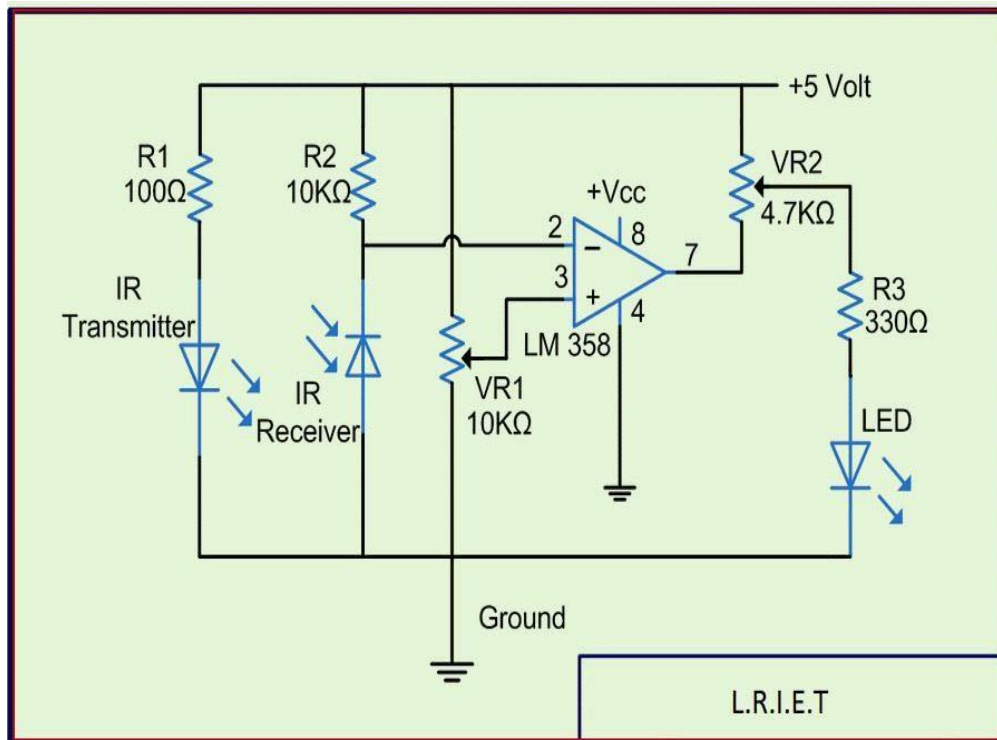


Fig 3.6 : IR sensor circuit diagram

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100 Ω), R2 (10k Ω) and R3 (330 Ω) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k Ω) is used to adjust the output terminals. Resistor VR1 (preset=10k Ω) is used to set the sensitivity of the circuit Diagram. Read more about IR sensors.

3.4 Different Types of IR Sensors and Their Applications

IR sensors are classified into differing types counting on the applications. Some of the standard applications of various sorts of sensors are The speed sensor is employed for synchronizing the speed of multiple motors. The temperature sensor is employed for industri

al temperature control. PIR sensor is employed for automatic door opening system and Ultrasonic sensor are used for distance measurement. IR Sensor Applications IR sensors are utilized in various Sensor based projects and also in various electronic devices which measures the temperature that are discussed within the below. Radiation

Thermometers IR sensors are utilized in radiation thermometers to live the temperature depend on the temperature and therefore the material of the thing and these thermometers have a number of the subsequent features – Measurement without direct contact with the object – Faster response – Easy pattern measurements Flame Monitors These sorts of devices are used for detecting the sunshine emitted from the flames and to watch how the flames are burning. The Light emitted from flames extend from UV to I R region types. PbS, PbSe, Two-color detector, pyro electric detector are a number of the commonly employed detector utilized in flame monitors.

Moisture Analyzers Moisture analyzers use wavelengths which are absorbed by the moisture within the IR region. Objects are irradiated with light having these wavelengths (1.1 μm , 1.4 μm , 1.9 μm , and 2.7 μm) and also with reference wavelengths. The Lights reflected from the objects depend on the moisture content and is detected by analyzer to live moisture (ratio of reflected light at these wavelengths to the reflected light at reference wavelength).

In GaAs PIN photodiodes, PbS photoconductive detectors are employed in moisture analyzer circuits. Gas Analyzers IR sensors are utilized in gas analyzers which use absorption characteristics of gases within the IR region. Two sorts of methods are wont to measure the density of gas like dispersive and non dispersive.

3.5 HARDWARE DESCRIPTION

3.5.1 GAS ANALIZER:

Dispersive: An Emitted light is spectroscopically divided and their absorption characteristics are used to analyze the gas ingredients and the sample quantity.



Fig 4.7: Gas analyzer

Non dispersive: It is most commonly used method and it uses absorption characteristics without dividing the emitted light. Non dispersive types use discrete optical band pass filters, similar to sunglasses that are used for eye protection to filter out unwanted UV radiation.

This type of configuration is commonly referred to as non dispersive infrared (NDIR) technology. This type of analyzer is used for carbonated drinks, whereas non dispersive analyzer is used in most of the commercial IR instruments, for an automobile exhaust gas fuel leakages.

3.5.2 IR Imaging Devices

IR image device is one of the major applications of IR waves, primarily by virtue of its property that is not visible. It is used for thermal imagers, night vision devices, etc.

IR IMAGING DEVICES:



Fig 3.8 : IR imaging devices

For examples Water, rocks, soil, vegetation, an atmosphere, and human tissue all features emit IR radiation. The Thermal infrared detectors measure these radiations in IR range and map the spatial temperature distributions of the object/area on an image. Thermal imagers usually composed of a Sb (indium antimonite), Gd Hg (mercury-doped germanium), Hg Cd Te (mercury-cadmium-telluride) sensors.

An electronic detector is cooled to low temperatures using liquid helium or liquid nitrogen's. Then the Cooling the detectors ensures that the radiant energy (photons) recorded by the detectors comes from the terrain and not from the ambient temperature of objects within the scanner itself an IR imaging electronic devices.

Thus, this is all about IR sensor circuit with working and applications. These sensors are used in many sensor based electronics projects.

FORCE RESISTIVE SENSOR

Resistor is one among the foremost typically used passive components in electrical and electronics circuits. Resistors are often defined as a circuit element used for reducing current flow and also lower voltage levels in circuits. There are differing types of resistors classified supported various criteria like fixed value resistors, variable resistors, wire wound resistors, metal film resistors and special resistors. The special purpose resistors are often listed as pencil resistors, light dependent resistors, force sensing resistors then on. Force sensing resistors are often defined as a special sort of resistor whose resistance are often varied by varying the force or pressure applied thereto. The FSR sensor technology was invented & patented by Franklin Eventoff in 1977. The FSR sensors are made of conductive polymer which has a property of changing its resistance based on the force applied to its surface. Hence, these are termed as FSR sensors, force sensing resistor is a combination of resistor and sensor technology. The force sensing resistor is usually supplied as a polymer sheet or ink which is applied as screen printing. Both the electrically conducting and non-conducting particles are present on this sensing film. These particles are generally submicrometer sizes which are formulated for reducing the temperature dependence and also for improving mechanical properties, increasing surface durability.

Force Sensing Resistor Layers

If force is applied to a surface of sensing film, then the particles touches the conducting electrodes and thus resistance of the film changes. There are several resistive based sensors but force sensing resistors operate satisfactorily in difficult environments and also requires an easy interface compared to other resistive based sensors. Even though there various types of force sensors, the force sensing resistors are having several advantages such as thin size (less than 0.5mm), very low cost and also good shock resistance. The only disadvantage of FSR sensors is low precision, there will be approximately 10% or more difference in measurement results.

Force Sensing Resistors

Force sensing resistors are called as (PTF) polymer thick film devices. The resistance of FSR sensors decreases with increase in pressure applied to its surface.

4•Simple Steps

to design Force Sensing Resistor

Force sensing resistor are often designed by following the four simple steps shown below:

1. Gathering

2. Force Sensing Resistor Components

Gathering the required materials for designing FSR sensors. The materials used for FSR sensor are electrical & electronic components– PCB, conductive foam, wires, solder, hot glue, tools• soldering iron, hot glue gun, cutter.

3. 2. Sizing

4. Sizing of Plates & Foam for FSR Sensor

The size of FSR sensors varies based on application requirements, consider a PCB is cut into two identical square plates and solder plates with red and black wires as shown in the figure. Then, cut the conducting foam into an equivalent shape and size of the plate.

5. 3. Connecting

Now, connect the 2 plates and conducting foam by outline glue such, confirm it conducts well.

6. 4. Testing

Force Sensing Resistor Testing Thus, the FSR sensor can be tested using a multimeter. Connect the wires of FSR sensor to multimeter without applying any force on surface of the force sensing resistor the resistance will be very high. If force is applied to its surface, then the resistance starts decreasing.

7. Applications of Force Sensing Resistor

There are numerous applications for force sensing resistors in various fields like foot pronation systems, automobiles like car sensors, resistive touchpads, musical instruments, keypads, portable electronics, and so on.

Touch Controlled Load Switch

Touch Control Load Switch by www.edgefxkits.com

The touch controlled load switch project is designed for controlling any load by touch sensitive switch. The project uses a 555 timer, relay, diodes, resistors, capacitors

tors, and cargo (lamp) which are connected as shown within the diagram .Touch Control Load Switch Block Diagram by www.edgefxkits.comThe 555 timer is connected in monostable mode to drive relay based on triggering signal received from touch plate. The triggering pin of the 555 timer is connected to touch the plate. If the touch plate is triggered, then the 555 timer output drives relay for a fixed time duration. The time duration can be changed by an RC time constant of timer and after a fixed time duration the load automatically turns OFF. The human body induced supply is used for developing voltage on touch plate.

Are you curious about developing innovative electronics projects like scary spider , crazy hat, etc., on your own? Feel free to approach us by posting your comments, ideas, queries and suggestions in the comments section below.

3.5.3 GAS SENSOR:

A gas detector could also be a tool that detects the presence of gases during a neighborhood , often as a neighborhood of a security system. This type of kit is employed to detect a gas leak or other emissions and may interface with an impact system so a process are often automatically pack up .

A gas detector can sound an alarm to operators within the area where the leak is happening , giving them the chance to go away . This type of device is vital because there are many gases which will be harmful to organic life, like humans or animals. Gas detectors are often wont to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is employed widely in industry and may be found in locations, like on oil rigs, to watch manufacture processes and emerging technologies like photovoltaic.

They may be used firefighting. Gas leak detection is that the process of identifying potentially hazardous gas leaks sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Exposure to toxic gases also can occur in operations like painting, fumigation, fuel filling, c

onstruction, excavation of contaminated soils, landfill operations, entering confined spaces, etc. Common sensors include combustible gas sensors, photoionization detectors, infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and semiconductor sensors. More recently, infrared imaging sensors have inherited use. ills, aircraft and shipbuilding facilities, hazmat operations, wastewater treatment facilities, vehicles.



Fig. 4.9: Gas sensor

3.5.4 Electrochemical

Electrochemical gas detectors work by allowing gases to diffuse through a porous membrane to an electrode where it is either chemically oxidized or reduced. The amount of current produced is determined by how much of the gas is oxidized at the electrode,^[3] indicating the concentration of the gas. Manufacturers can customize electrochemical gas detectors by changing the porous barrier to allow for the detection of a certain gas concentration range. Also, since the diffusion barrier is a physical/mechanical barrier, the detector tended to be more stable and reliable over the sensor's duration and thus required less maintenance than other early detector technologies.

However, the sensors are subject to corrosive elements or chemical contamination and may last only 1–2 years before a replacement is required.^[4] Electrochemical gas detectors are used in a wide variety of environments such as refineries, gas turbines, chemical plants, underground gas storage facilities, and more.

Catalytic bead (pellistor)

Catalytic bead sensors are commonly used to measure combustible gases that present an explosion hazard when concentrations are between the lower explosion limit (LEL) and upper explosion limit (UEL). Active and reference beads containing platinum wire coils are situated on opposite arms of a Wheatstone bridge circuit and electrically heated, up to a few hundred degrees C. The active bead contains a catalyst that allows combustible compounds to oxidize, thereby heating the bead even further and changing its electrical resistance. The resulting voltage difference between the active and passive beads is proportional to the concentration of all combustible gases and vapors present. The sampled gas enters the sensor through a sintered metal frit, which provides a barrier to prevent an explosion when the instrument is carried into an atmosphere containing combustible gases. Pellistors measure essentially all combustible gases, but they are more sensitive to smaller molecules that diffuse through the sinter more quickly. The measureable concentration ranges are typically from a few hundred ppm to a few volume percent. Such sensors are inexpensive and robust, but require a minimum of a few percent oxygen in the atmosphere to be tested and they can be poisoned or inhibited by compounds such as silicones, mineral acids, chlorinated organic compounds, and sulfur compounds.

Photoionization

Photoionization detectors (PIDs) use a high-photon-energy UV Light to ionize chemicals within the sampled gas. If the compound has an ionization energy below that of the lamp photons, an electron is going to be ejected, and therefore the resulting current is proportional to the concentration of the compound. Common lamp photon energies include 10.0 eV, 10.6 eV and 11.7 eV; the quality 10.6 eV lamp lasts for years, while the 11.7 eV lamp typically last only a few months and is employed only no other option is out there . A broad range of compounds are often detected at levels starting from a couple of ppb to many thousand ppm. Detectable compound classes so as of lowlevel sensitivity include: aromatics and alkyl iodides; olefins, sulfur compounds, amines, ketones, ethers, alkyl bromides and silicate esters; organic esters, alcohols, aldehydes and alkanes; H₂S,

NH₃, PH₃ and organic acids. There is no response to plain components of air or to mineral acids.

Major advantages of PIDs are their excellent sensitivity and ease of use; the most limitation is that measurements aren't compound-specific. Recently PIDs with pre-filter tubes are introduced that enhance the specificity for such compounds as benzene or butadiene. Fixed, hand-held and miniature clothing-clipped PIDs are widely used for industrial neatness, hazmat, and environmental monitoring.

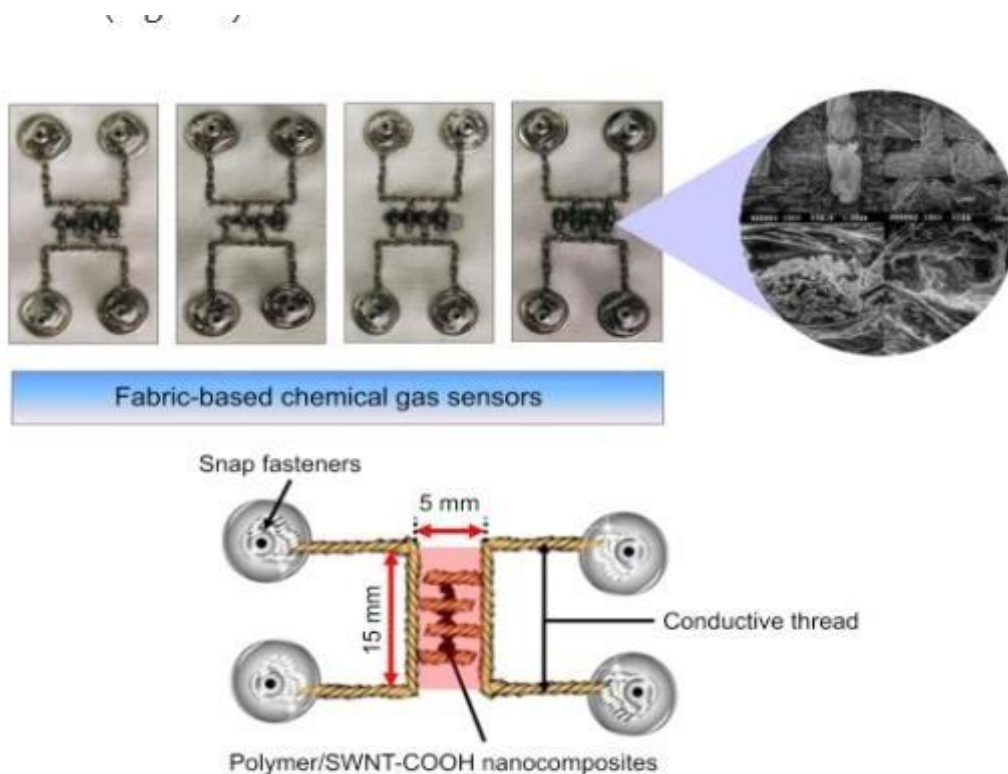


Fig.3.10 Catalytic bead

Infrared point

Infrared (IR) point sensors use radiation passing through a known volume of gas; energy from the sensor beam is absorbed at certain wavelengths, counting on the properties of the precise gas. For example, carbon monoxide gas absorbs wavelengths of about 4.2-

4.5 μm . [5] The energy during this wavelength is compared to a wavelength outside of the absorption range; the difference in energy between these two wavelengths is proportional to the concentration of gas present. [5]

This type of sensor is advantageous because it doesn't need to be placed into the gas to detect it and may be used for remote sensing. Infrared point sensors are often used to detect hydrocarbons and other infrared active gases like water vapour and CO_2 .

IR sensors are commonly found in waste-water treatment facilities, refineries, gas turbines, chemical plants, and other facilities where flammable gases are present and therefore the possibility of an explosion exists. The remote sensing capability allows large volumes of space to be monitored.

Engine emissions are another area where IR sensors are being researched. The sensor would detect high levels of carbon monoxide gas or other abnormal gases in vehicle exhaust and even be integrated with vehicle electronic systems to notify drivers.

Infrared imaging

Infrared image sensors include active and passive systems. For active sensing, IR imaging sensors typically scan a laser across the sector of view of a scene and appearance for backscattered light at the absorption line wavelength of a specific target gas. Passive IR imaging sensors measure spectral changes at each pixel in a picture and appearance for specific spectral signatures that indicate the presence of target gases. [7] the kinds of compounds which will be imaged are an equivalent as people who are often detected with infrared point detectors, but the pictures could also be helpful in identifying the source of a gas.

Semiconductor

Semiconductor sensors detect gases by a reaction that takes place when the gas comes in direct contact with the sensor. Tin dioxide is the commonest material utilized in semiconductor sensors, [8] and therefore the electric resistance within the sensor is

decreased when it comes in touch with the monitored gas. The resistance of the tin dioxide is usually around 50 kΩ in air but can drop to around 3.5 kΩ within the presence of 1% methane. This change in resistance is employed to calculate the gas concentration. Semiconductor sensors are commonly wont to detect hydrogen, oxygen, alcohol vapor, and harmful gases like carbon monoxide gas . One of the foremost common uses for semiconductor sensors is in carbon monoxide gas sensors. They are also used in breathalyzers. Because the sensor must are available contact with the gas to detect it, semiconductor sensors beat a smaller distance than infrared point or ultrasonic detectors.

Ultrasonic

Ultrasonic gas leak detectors aren't gas detectors intrinsically . They detect the acoustic emission created when a pressured gas expands during a low area through alittle orifice (the leak). They use acoustic sensors to detect changes within the ground noise of its environment. Since most high-pressure gas leaks generate sound within the ultrasonic range of 25 kHz to 10 MHz, the sensors are ready to easily distinguish these frequencies from background acoustic noise which occurs within the audible range of 20 Hz to twenty kHz.

The ultrasonic gas leak detector then produces an alarm when there's an ultrasonic deviation from the traditional condition of ground noise . Ultrasonic gas leak detectors cannot measure gas concentration, but the device is in a position to work out the leak rate of an escaping gas because the ultrasonic sound level depends on the pressure and size of the leak.

Ultrasonic gas detectors are mainly used for remote sensing in outdoor environments where weather can easily dissipate escaping gas before allowing it to succeed in leak detectors that need contact with the gas to detect it and sound an alarm. These detectors are commonly found on offshore and onshore oil/gas platforms, gas compressor and metering stations, turbine power plants, and other facilities that house plenty of outside pipeline.

Holographic

Holographic gas sensors use light reflection to detect changes during a polymer film matrix containing a hologram. Since holograms reflect light at certain wavelengths, a change in their composition can generate a colourful reflection indicating the presence of a gas molecule.[12] However, holographic sensors require illumination sources like white light or lasers, and an observer or CCD detector.

TEMPERATURE SENSOR:

‘The earth is getting warmer day by day.’ This sentence has started to crop up every second and then in our day to day lives. But seldom do we wonder what it meant. What is warmer? How warm is warm? Is it hotter than hot, or just hotter than cold? To our human senses, temperature is only a subjective evaluation. For an objective and reproducible measuring, we need to quantify the temperature digit, and to do that, a suitable measurement device is required.

Table3.1: 5.1 Technical specifications

Range	0°...100°C
Accuracy	< 0,1°C + NTC-spread over 0°...70°C
Resolution	2 m°C@30°C and 25 m°C@100°C
Linearity	see table
No. Sensors	1....30
Type	5 kOhm NTC-resistors Max. wire resistance 3,3 Ohm
Conditioner	Wheatstone-bridge with +15 Bits ADC
Calibration	at 0°C and 100°C _ 0,1°C
Drift	1 m°C/°C with periodic calibration and 5 m°C/°C without calibration
Scanfreq.	default max. 10 meas./s
Amb.temp	0°...60°
Control	Micro-Wire™ 5 (Di, Do, Clk en CS)
Levels	0 and 5 Volt
Power	+12 Volt 3,5 mAmp (+5,5 +20 Volt) -5 Volt 1 mAmp (-4,5 -8 Volt)
Dimensions	224 x 120 x 60 + 40 mm

Temperature and its Measurement

Simply speaking, temperature is that the degree of hotness of the body which may be a measure of the warmth content within the body. The matter to quantify the warmth content of the body on a scale didn't arise until the invention of the external-combustion engine . The curiosity of scientists to know the behavior of water at different levels of warmth contents gave rise to a proper and better laid out study. one among the primary references for 'temperature' dates back to 1760, when Black declared that applying an equivalent heat to different materials resulted in several temperatures.

Years of rigorous scientific study led to several theories starting from the straightforward 'Caloric' concept, which treated heat as a cloth substance which is exchanged among materials, to Carnot's description of warmth as a sort of energy (which laid the inspiration of the primary law of thermodynamics). However, no one of them satisfactorily told the concept of temperature. it had been Maxwell's theory which offered good reasoning into it. He finalised temperature of a body as is its thermal property which provides information about the energy content of the system. it's the measure of the standard K.E. (energy by virtue of motion) of the molecules of the substance and signifies a heat potential because of which heat flows from higher temperature to lower temperature

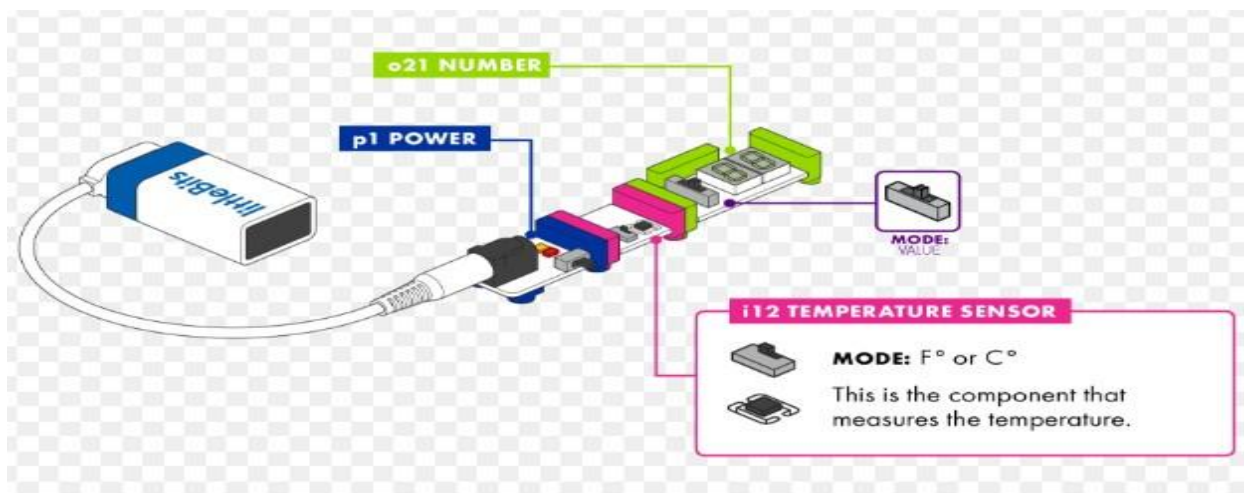


Fig.3.11 Temperature measurement

There are many various sorts of Temperature Sensor available and every one have different characteristics depending upon their actual application. A temperature sensor contains of two basic physical types:

- Contact Temperature Sensor Types – These designs of temperature sensor are required to be in physical contact with the object being sensed and use conduction to monitor changes in temperature. They can be wont to detect solids, liquids or gases over a good range of temperatures.
- Non-contact Temperature Sensor Types – These sorts of temperature sensor use convection and radiation to watch changes in temperature. They can be used to detect water substances and gases that emit radiant energy as heat rises and cold settles to the bottom in convection currents or detect the radiant energy being transmitted from an object within the sort of infra-red radiation (the sun).

The two basic sorts of contact or maybe non-contact temperature sensors also can be sub-divided into the subsequent three groups of

- sensors,
- Electro-mechanical,
- Resistive and Electronic .

The Thermostat may be a contact type electro-mechanical temperature sensor or switch, that basically consists of two different metals like nickel, copper, tungsten or aluminium etc, that are bonded together to form a Bi-metallic strip. The different linear expansion rates of the 2 dissimilar metals produces a mechanical bending movement when the strip is subjected to heat.

The bi-metallic strip are often used itself as an switch or as a mechanical way of operating an switch in thermostatic controls and are used extensively to regulate hot water heating elements in boilers, furnaces, predicament storage tanks also as in vehicle radiator cooling systems.

The Bi-metallic Thermostat

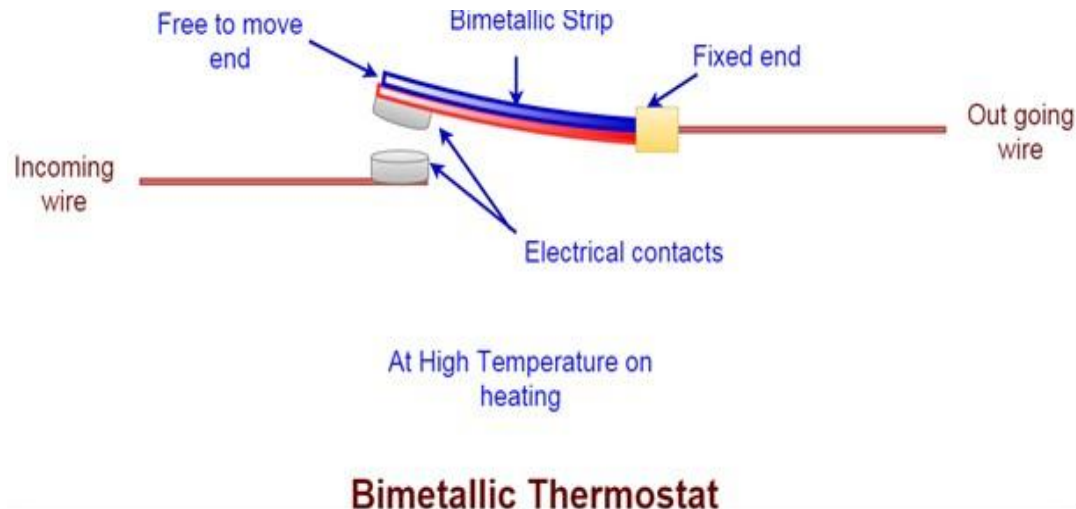


Fig.4.12: Bimettalic thermostat

The thermostat contains of two thermally different metals stuck together back to back. When it's cold the contacts are shut down and current passes through the thermostat. When it gets hot, one metal expands quite the opposite and therefore the bonded bi-metallic strip bends up (or down) opening the contacts preventing the present from flowing.

On/Off Thermostat

There are two ideal kinds of bi-metallic strips depends mainly upon their movement when subjected to temperature changes. There are the “snap-action” types that prepare an instant “ON/OFF” or “OFF/ON” type action on the electrical contacts at a group temperature point, and therefore the slower “creep-action” types that gradually move their position as the temperature changes.

Snap-action type thermostats are commonly utilized in our homes for controlling the temperature point of ovens, irons, immersion predicament tanks and that they also can be found on walls to control the domestic heating system.

Creeper types generally contains a bi-metallic coil or spiral that slowly unwinds or coils-up because the temperature changes. Generally, creeper type bi-metallic strips are more sensitive to temperature changes than the quality snap ON/OFF types because the strip is longer and thinner making them ideal to be used in temperature gauges and dials etc.

Although rock bottom and are available over a good operating range, one main disadvantage of the quality snap-action type thermostats when used as a temperature sensor, is that they need a bulk hysteresis range from when the electrical contacts open until once they close again. For example, it's going to be set to 20oC but might not open until 22oC or close again until 18oC.

So the range of temperature swing are often quite high. Commercially available bi-metallic thermostats for home use do have temperature adjustment screws that leave a more precise desired temperature set-point and hysteresis level to be pre-set.

3.5.5.GSM

GSM may be a mobile communication modem; it's stands for global system for mobile communication (GSM). The idea of GSM was famoused at Bell Laboratories in 1970. It is widely used mobile communication system within the world. GSM is an open and digitalized cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was popularised as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the info , then sends it down through a channel with two different streams of client data, each in its own particular slot . The digital system has a capability to hold 64 kbps to 120 Mbps of knowledge rates.



Fig.4.13 GSM Modem

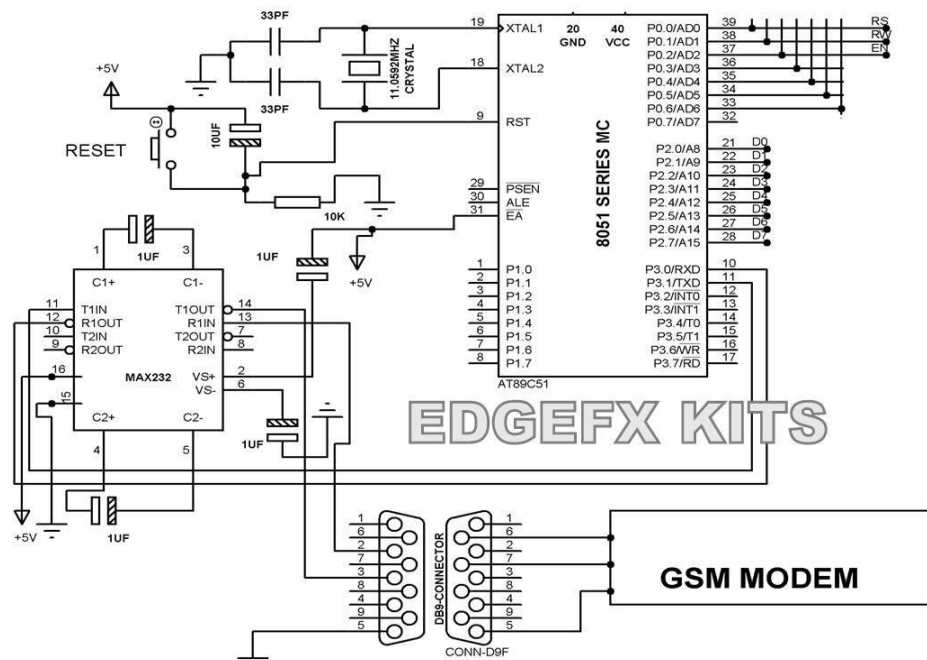


Fig.4.14 GMS Modem Circuit

There are various cell shape during a GSM system like macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell shape during a GSM network macro, micro, pico and umbrella cells. The coverage width of every cell varies consistent with the implementation environment.

Time Division Multiple Access

TDMA technique relies on assigning different time slots to every user on an equivalent frequency. It can easily adapt to data transmission and speech and may carry 64kbps to 120Mbps of knowledge rate.

GSM Architecture

A GSM network consists of the following components:

- A Mobile Station: it's the mobile which consists of the transceiver, the display and therefore the processor and is controlled by a SIM card operating over the network.
- Base Station Subsystem: It acts as an connection between the mobile station and therefore the network subsystem. It contains of the down Transceiver Station which contains the radio transceivers and handles the protocols for communication with mobiles. It also consists of the bottom Station Controller which controls the bottom Transceiver station and acts as a interface between the mobile station and mobile switching centre.
- Network Subsystem: It provides the essential network connection to the mobile stations. The basic a material of the Network Subsystem is that the Mobile Service Switching Centre which provides access to different networks like ISDN, PSTN etc. It also consists of the house Location Register and therefore the Visitor Location Register which provides the decision routing and roaming capabilities of GSM. It also consists the Equipment Identity Register which maintains an account of all the mobile equipments wherein each mobile is identified by its own IMEI number. IMEI stands for International Mobile Equipment Identity.

Features of GSM Module:

- Improved spectrum efficiency
- International roaming
- Compatibility with integrated services digital network (ISDN)
- Support for new services.
- SIM phonebook management
- Fixed dialing number (FDN)
- Real time clock with alarm management
- High-quality speech
- Uses encryption to form phone calls safer
- Short message service (SMS)

The security strategies standardized for the GSM system make it the foremost secure

telecommunications standard currently accessible. Although the confidentiality of a call and secrecy of the GSM subscriber is simply ensured on the radio channel, this is often a serious step in achieving end-to-end security.

GSM Modem

A GSM modem may be a device which may be either a mobile or a modem device which may be used to make a computer or the other processor communicate over a network. A GSM modem needs a SIM card to be operated and operates over a network range subscribed by the network operator. It is often connected to a computer through serial, USB or Bluetooth connection.

A GSM modem also can be a typical GSM mobile with the acceptable cable and software driver to attach to a interface or USB port on your computer. GSM modem is typically preferable to a GSM mobile. The GSM modem has wide selection of applications in transaction terminals, supply chain management, security applications, weather stations and GPRS mode remote data logging.

Working of GSM Module:

From the below diagram, a GSM modem duly interfaced to the MC through the external shifter IC Max232. The SIM card mounted GSM modem upon receiving digit command by SMS from any cell phone send that data to the MC through serial communication. While the program is executed, the GSM modem receives command 'STOP' to develop an output at the MC, the contact point of which is used to disable the switch. The command so sent by the user is predicated on an intimation received by him through the GSM modem 'ALERT' a programmed message as long as the input is driven low. The complete operation is displayed over 16×2 LCD display.

Intelligent GSM Device for Automation and Security

In these days, the GSM mobile terminal has become one of the items that are constantly with us. Just like our wallet/purse, keys or watch, the GSM mobile terminal provides us a communication channel that enables us to communicate with the world. The requirement for a person to be reachable or to call anyone at any time is very appealing.

In this project, as the name says project is based on GSM network technology for

transmission of SMS from sender to receiver. SMS sending and receiving is used for ubiquitous access of appliances and allowing breach control at home. The system proposes two sub-systems. Appliance control subsystem enables the user to control home appliances remotely and the security alert subsystem gives the automatic security monitoring.

The system is capable enough to instruct user via SMS from a specific cell number to change the condition of the home appliance according to the user's needs and requirements. The second aspect is that of security alert which is achieved in a way that on the detection of intrusion, the system allows automatic generation of SMS thus alerting the user against security risk.

INTERNET OF THINGS:

- The term Internet of Things generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention. There is, however, no single, universal definition.
- Enabling Technologies: The concept of combining computers, sensors, and networks to monitor and control devices has existed for decades. The recent confluence of several technology market trends, however, is bringing the Internet of Things closer to widespread reality. These include Ubiquitous Connectivity, Widespread Adoption of IP-based Networking, Computing Economics, Miniaturization, Advances in Data
- Connectivity Models: IoT implementations use different technical communications models, each with its own characteristics. Four common communications models described by the Internet Architecture Board include: Device-to-Device, Device-to-Cloud, Device-to-Gateway, and Back-End Data-Sharing. These models highlight the flexibility in the ways that IoT devices can connect and provide value to the user.

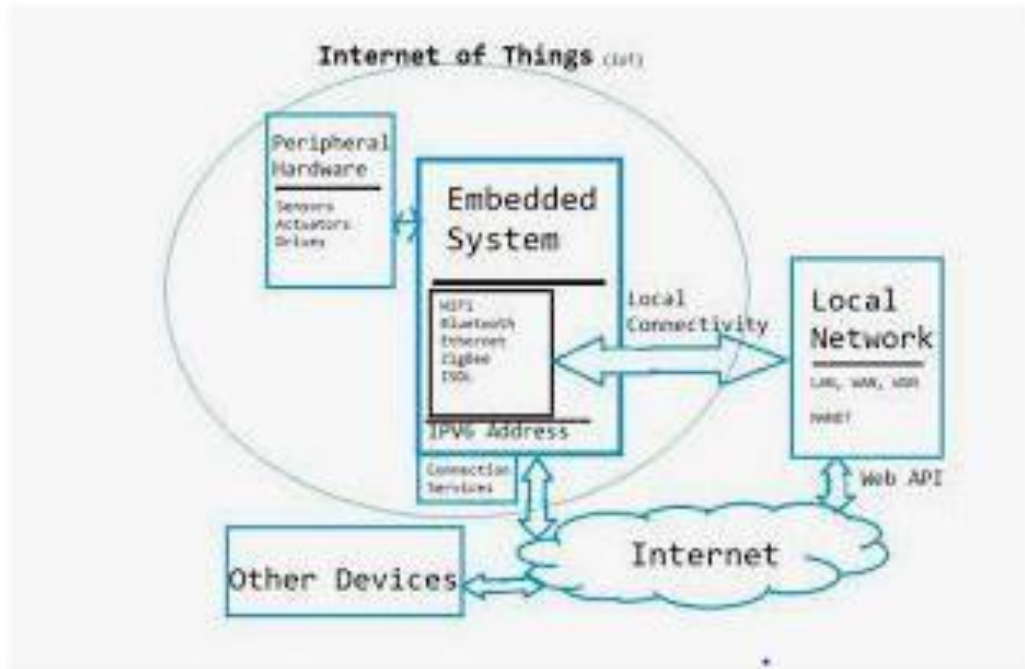


Fig.3.15 Internet of things

IoT devices are implemented using both hardware and software components. Dedicated hardware components are used to implement the interface with the physical world, and to perform tasks which are more computationally complex. Microcontrollers are used to execute software that interprets inputs and controls the system. This module discusses the roles of both the hardware and software components in the system. The functions of common hardware components are described and the interface between the software and hardware through the microcontroller is explained. IoT devices often use an operating system to support the interaction between the software and the microcontroller. We will define

the role of an operating system in an IoT device and how an IoT operating system differs from a standard one.

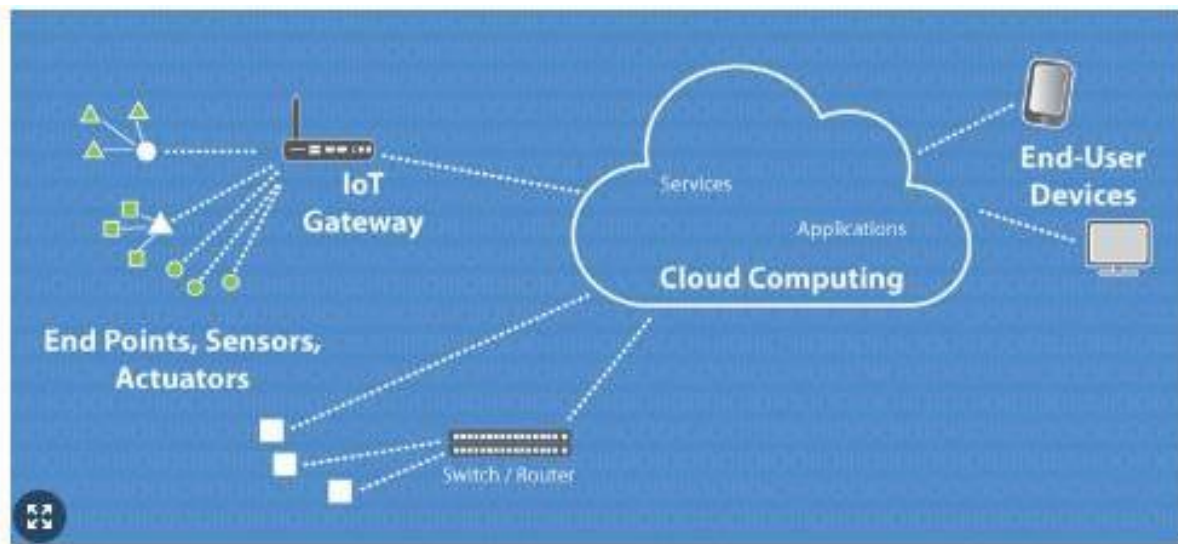


Fig. 3.16 Cloud computing

How IoT works

An IoT ecosystem consists of web-enabled smart devices that use embedded processors, sensors and communication hardware to gather, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by associate to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the knowledge they get from each other. The devices do most of the work without human mediation, although *people can interact with the devices* •• as an example, to line

Example of an IoT system

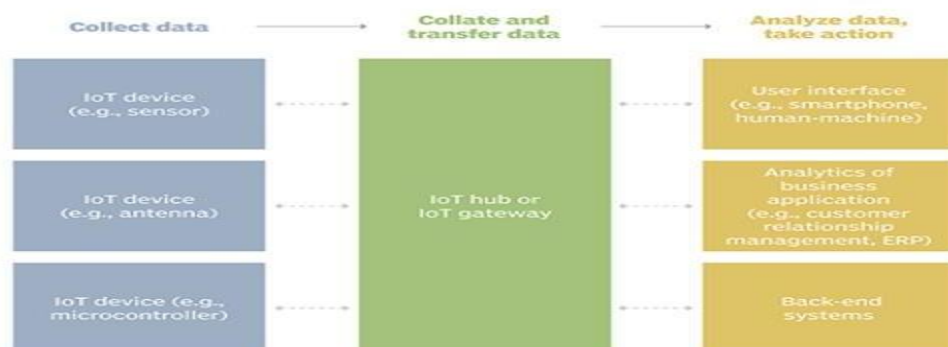


Fig.3.17 Examples of IoT system

them up, give them instructions or access the data. The connectivity, networking and communication protocols used with these web-enabled devices largely depend upon the precise IoT applications deployed.

Benefits of IoT

The internet of things offers variety of advantages to organizations, enabling them to:

- monitor their overall business processes;
- improve the customer experience;
- save time and money;
- enhance employee productivity;
- integrate and adapt business models;
- make better business decisions; and
- generate more revenue.

IoT encourages companies to rethink the ways they approach their businesses, industries and markets and provides them the tools to enhance their business strategies.

Consumer and enterprise IoT applications

There are numerous real-world applications of the web of things, starting from consumer IoT and enterprise IoT to manufacturing and industrial IoT (IIoT). IoT applications period numerous verticals, including automotive, telco, energy and more. In the consumer divide, for example, smart homes that are equipped with smart thermostats, smart appliances and connected heating, lighting and electronic devices can be controlled remotely via computers, smartphones or other mobile devices. Wearable devices with sensors and software can fetch and analyze user data, sending messages to other technologies about the users with the aim of creating users' lives easier and easier. Wearable devices also

are used for public safety •• for instance , improving first responders' response times during emergencies by providing optimized routes to a location or by tracking construction workers' or firefighters' vital signs at life-threatening places. In healthcare, IoT offers many benefits, including the power to watch patients more closely to use the info that's generated and analyze it. Hospitals often use IoT and medical instruments

3.5.6 DC MOTOR:

A DC motor is any of a category of circle electrical machines that converts DC electricity into energy . The most common types believe the forces produced by magnetic fields. Nearly all kinds of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow partially of the motor. DC motors were the primary type widely used, since they might be powered from existing direct-current lighting power distribution systems. A DC motor's speed are often controlled over a good range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are utilized in tools, toys, and appliances. The universal motor can operate DC but may be a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are utilized in propulsion of electrical vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made renewal of DC motors with AC motors possible in many applications.

WORKING:

The DC motor is a machine that transmute electric energy into mechanical energy in form of rotation. Its movement is occasion by the physical behavior of electromagnetism. DC motors meet inductors inside, which produce the magnetic field used to generate movement. But how does this magnetic flux changes if DC current is getting used

An electromagnet, which is a piece of iron wrapped with a wire coil that has voltage applied in its terminals. If two fixed magnets are added in both sides of this electromagnet, the repulsive and attractive forces will produce a torque.

Then, there are two problems to solve: feeding the current to the rotating electromagnet without the wires getting twisted, and changing the direction of the current at the appropriate time. Both of these problems are solved using two devices: a split-ring commutator, and a pair of brushes.

As it can be seen, the commutator has two segments which are connected to each terminal of the electromagnet, besides the two arrows are the brushes which apply electric current to the rotary electromagnet. In real DC motors it can be found three slots instead of two and two brushes.

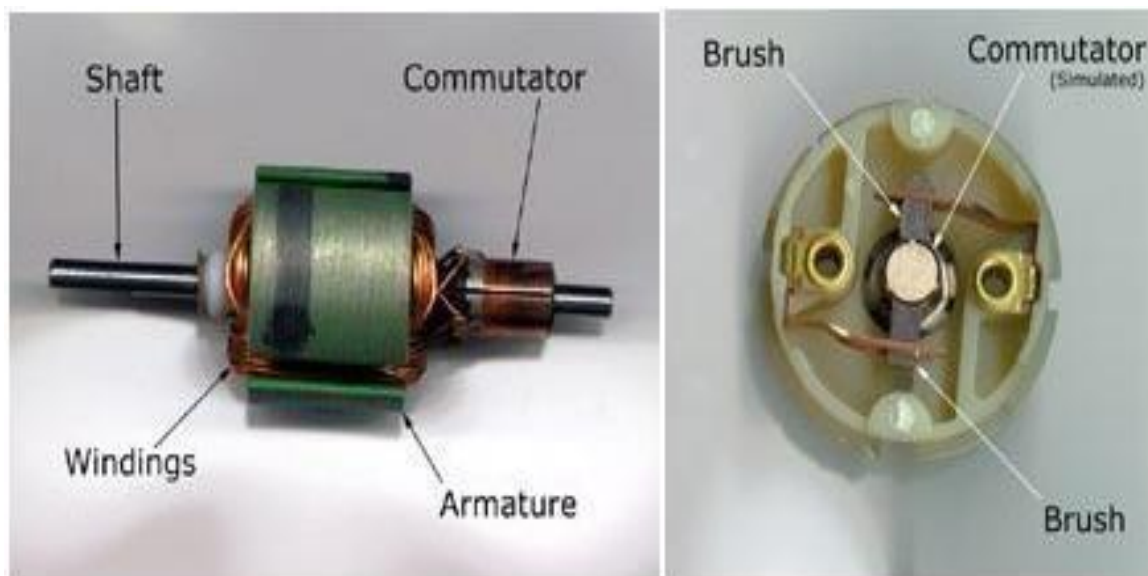


Fig. 3.18 Dc motor

This way, as the electromagnet is moving its polarity is changing and the shaft may keep rotating. Even if it is simple and sounds that it will work great there are some issues which make these motors energy inefficient and mechanically unstable, the principal problem is due to the timing between each polarity inversion. Since polarity in the electromagnet is changed mechanically, at some velocities polarity

is changing too soon, which result in reverse impulses and sometimes in changing too late, generating instantaneous “stops” in rotation. Whatever the case, these issues produce current peaks and mechanical instability.

CONTROL OF DC MOTOR:

DC motors have only two terminals. If you apply a voltage to these terminals the motor will run, if you invert the terminals position the motor will change its direction. If the motor is running and you suddenly disconnect both terminals the motor will keep rotating but slowing down until stopping. Finally if the motor is running and you suddenly short-circuit both terminals the motor will stop. So there is not a third wire to control a DC motor, but knowing the previous behaviors it can be designed a way to control it, and the solution is an H-bridge.

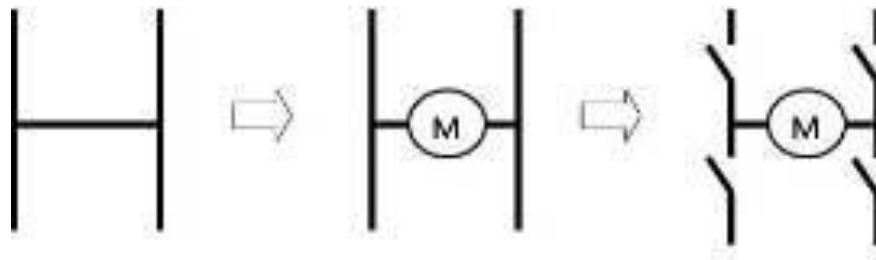


Fig. 3.19 :Motor testing

Look at the last evolution of the DC Motor above, you can observe that there are four gates and a motor connected between them. This is the simplest H-bridge, where the four gates represent for transistors. By manipulating these gates and connecting the upper and lower terminals to a voltage supply, you can control the motor in all the behaviors as below.

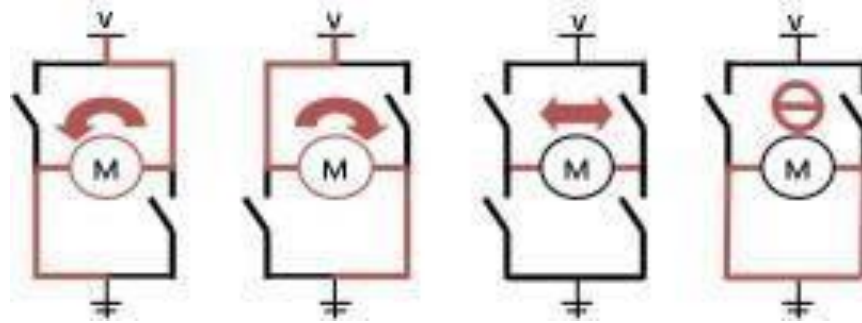


Fig.4.20 Details of motor

Main Types of DC Motors

Understanding the different types of DC motors will also help you understand how they're used for different applications, and which type may apply to your application.

There are 4 main types of DC motors:

1. Permanent Magnet DC Motors

The permanent magnet motor uses a permanent magnet to create field variability. This type of DC motor provides great starting torque and has good speed regulation, but torque is restricted in order that they are typically found on low horsepower applications.

2. Series DC Motors

In a series DC motor, the sector is wound with a couple of turns of an outsized wire carrying the complete armature current. Typically, series DC motors create an outsized amount of starting torque, but cannot regulate speed and may even be damaged by running with no load. These limitations mean that they're not an honest option for variable speed drive applications.

3. Shunt DC Motors

In shunt DC motors the sector is connected in parallel (shunt) with the armature windings. These motors offer great speed regulation thanks to the very fact that the shunt field are often excited separately from the armature windings, which also offers simplified reversing controls.

4. Compound DC Motors

Compound DC motors, as shunt DC motors, have a separately excited shunt field. Compound DC motors have good establish torque but may experience control problems in variable speed drive applications.

CHAPTER-4

SOFTWARE REQUIREMENTS

4.1 ARDUINO IDE:

The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for many Arduino-based projects. The top menu bar has the standard options, including “File” (new, load save, etc.), “Edit” (font, copy, paste, etc.), “Sketch” (for compiling and programming), “Tools” (useful options for testing projects), and “Help”. The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom department of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used, any errors that were base in the program, and various other useful messages.



4.16 Arduino ide

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a

computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses users who think Arduino is programmed in an “Arduino language.” However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device.

The 6 Buttons

While more advanced projects will take advantage of the built-in tools in the IDE, most projects will rely on the six buttons found below the menu bar.



The button bar

1. The **check mark** is used to verify your code. Click this once you have written your code.
2. The **arrow** uploads your code to the Arduino to run.
3. The **dotted paper** will create a new file.
4. The **upward arrow** is used to open an existing Arduino project.
5. The **downward arrow** is used to save the current file.
6. The far right button is a **serial monitor**, which is useful for sending data from the Arduino to the PC for debugging purposes.



4.22 Button bar

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.^[5] The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses

users who think Arduino is programmed in an “Arduino language.” However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

4.2 EMBEDDED C

Embedded C is one among the foremost popular and most ordinarily used Programming Languages within the development of Embedded Systems. So, in this article, we will see some of the principles of Embedded C Program and the Programming Structure of Embedded C. Embedded C is probably the foremost popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, BASIC, C++ etc. that are often used for developing Embedded Systems but Embedded C remains popular thanks to its efficiency, less development time and portability.

Before digging in to the fundamentals of Embedded C program, we'll first take a glance at what an Embedded System is and therefore the importance of programming language in Embedded Systems.

Programming Embedded Systems As mentioned preliminary, Embedded Systems consists of both Hardware and Software. If we consider an easy Embedded System, the most Hardware Module is that the Processor. The Processor is that the heart of the Embedded System and it are often anything sort of a Microprocessor, Microcontroller, DSP, CPLD (Complex Programmable Logic Device) and FPGA (Field Programmable Gated Array).

All these devices have one thing in common: they're programmable i.e. we can write a

program (which is that the software a part of the Embedded System) to define how the device actually works. Software or Program allow Hardware to monitor external events (Inputs) and control external devices (Outputs) accordingly. During this process, the program for an Embedded System may need to directly manipulate the interior architecture of the Embedded Hardware (usually the processor) like Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports etc.

From the above statement, it's clear that the Software a part of an Embedded System is equally important to the Hardware part. There is no point in having new Hardware Components with poorly written programs (Software).

There are many programming languages that are old for Embedded Systems like Assembly (low-level Programming Language), C, C++, JAVA high level programming languages), Visual Basic, JAVA Script (Application level Programming Languages), etc.

In the process of making a better embedded system, the programming of the system plays a vital role and hence, the selection of the Programming Language is very important.

Factors for Selecting the Programming Language

The following are few factors that are to be considered while selecting the Programming Language for the development of Embedded Systems.

- **Size:** The memory that the program occupies is very important as Embedded Processors like Microcontrollers have a very limited amount of ROM.
- **Speed:** The programs must be very fast i.e. they must run as fast as possible. The hardware should not be slowed down due to a slow running software.
- **Portability:** The same program can be compiled for different processors.
- **Ease of Implementation**
- **Ease of Maintenance**
- **Readability**

Earlier Embedded Systems were developed mainly using Assembly Language. Even though Assembly Language is closest to the actual machine code instructions, the lack of portability and high amount of resources spent on developing the code, made the Assembly Language difficult to work with.

There are other high-level programming languages that offered the above mentioned features but none were close to C Programming Language.

Introduction to Embedded C Programming Language

Before going in to the details of Embedded C Programming Language and basics of Embedded C Program, we will first talk about the C Programming Language.

The C Programming Language, developed by Dennis Ritchie in the late 60's and early 70's, is the most popular and widely used programming language. The C Programming Language provided low level memory access using an uncomplicated compiler (a software that converts programs to machine code) and achieved efficient mapping to machine instructions.

The C Programming Language became so popular that it is used in a wide range of applications ranging from Embedded Systems to Super Computers.

Embedded C Programming Language, which is widely used in the development of Embedded Systems, is an extension of C Program Language. The Embedded C Programming Language uses the same syntax and semantics of the C Programming Language like main function, declaration of datatypes, defining variables, loops, functions, statements, etc.

The extension in Embedded C from standard C Programming Language include I/O Hardware Addressing, fixed point arithmetic operations, accessing address spaces, etc.

4.3 Difference between C and Embedded C

There is even not much difference between C and Embedded C apart from few extensions and the operating environment. Both C and Embedded C are ISO streamer that have almost same syntax, datatypes, functions, etc.

Embedded C is essentially an extension to the quality C programing language with additional features like Addressing I/O, multiple memory addressing and fixed-point arithmetic, etc.

C Programming Language is generally used for developing desktop applications whereas Embedded C is used in the development of Microcontroller based applications.

Basics of Embedded C Program

Now that we've seen a touch bit about Embedded Systems and Programming Languages, we'll dive in to the fundamentals of Embedded C program . We will start with two of the essential features of the Embedded C Program:

Keywords in Embedded C

A Keyword may be a special word with a special aiming to the compiler (a C compiler for instance , may be a software that's wont to convert program written in C to Machine Code). For example, if we take the Keil's Cx51 Compiler (a popular C Compiler for 8051 based Microcontrollers) the following are some of the keywords:

- bit
- sbit
- sfr
- small
- large

These are few of the various keywords related to the Cx51 C compiler along side the quality C Keywords

Data Types in Embedded C

Data Types inside C Programming Language (or any programming language for that matter) help us declaring variables in the program. There are many data types in C Programming Language like signed int, unsigned int, signed char, unsigned char, float, double, etc. In addition to these there are few more data types in Embedded C.

The following are the very data types in Embedded C associated with the Keil's Cx51 Compiler.

- bit
- sbit
- sfr
- sfr16

CHAPTER 5

CONCLUSION

To avoid hot car deaths, we have developed a new sensor-based system with IOT and GSM alert. In this system we implemented a force sensing resistor, infrared sensors, a carbon dioxide sensor, a temperature/humidity sensor. These acquisition devices are connected to a microcontroller board that is able to combine all acquired data for detecting the alarm scenario and consequently acting some warning procedures, and sends alert messages to users with GSM module. We get the expected results in the project and implemented a safety system for children forgotten in cars.

REFERENCES

- [1]. Diwald.A.R, J. Landwehr, D. Tatarinov, P. Di Mario Cola, C. Watgen, C. Mica, M. Lu-Dac, P. Larsen, O. Gomez, and T. Goiva, "Rfbased child occupation etection in the vehicle interior," in 2016 17th International Radar Symposium (IRS), May 2016.
- [2] Gold.E, "Sensorsafe securemax smart infant car seat," <https://www.evenflo.com/gold/>, accessed April 1, 2019.
- [3] Halperin, W. Hu, A. Sheth, and D. Wetherall, "Tool release: Gathering 802.11 traces with channel state information," ACM SIGCOMM Computer Communication Review, vol. 41, no. 1, pp. 53–53, Jan 2011.
- [4] Kids.O and Cars, "Heatstroke deaths of children in vehicles," <https://www.kidsandcars.org/how-kids-get-hurt/heat-stroke/>, accessed April 1, 2019.
- [5] Ma.X, Y. Zhao, L. Zhang, Q. Gao, M. Pan, and J. Wang, "Practical device-free gesture recognition using wifi signals based on metalearning," IEEE Transactions on Industrial Informatics, vol. 16, no. 1, pp. 228–237, Jan 2020.
- [6] Security.B, "Dual view car camera," <https://www.brickhousesecurity.com/car-cameras/>, accessed April 1, 2019.
- [7] Shi.D, J. Ding, S. M. Errapotu, H. Yue, W. Xu, X. Zhou, and M. Pan, "Deep Q-network based route scheduling for transportation network company vehicles," in IEEE Global Communications Conference (GLOBECOM), Abu Dhabi, December 2018.
- [8] Sun, M. Peng, Y. Zhou, Y. Huang, and S. Mao, "Application of machine learning in wireless networks: Key techniques and open issues," IEEE Communications Surveys Tutorials, vol. 21, no. 4, pp. 3072–3108, Fourthquarter 2019.
- [9] Wang, J. Liu, Y. Chen, H. Liu, and Y. Wang, "Towards in-baggage suspicious object detection using commodity wifi," in 2018 IEEE Conference on Communications and Network Security (CNS), May 2018.
- [10] Wang.X, L. Gao, and S. Mao, "Csi phase fingerprinting for indoor localization with a deep learning approach," IEEE Internet of Things Journal, vol. 3, no. 6, pp. 1113–1123, Dec 2016.
- [11] Wang.X, L. Gao, S. Mao, and S. Pandey, "Csi-based fingerprinting for indoor

localization: A deep learning approach,” IEEE Transactions on Vehicular echnology, vol. 66, no. 1, pp. 763–776, Jan 2017.

[12] Wu.C, Z. Yang, Z. Zhou, K. Qian, Y. Liu, and M. Liu, “Phaseu: Realtime los identification with wifi,” in 2015 IEEE Conference on Computer Communications (INFOCOM), April 2015.

[13] Xu, X. Li, C. Lee, M. Pan, and Z. Feng, “Joint sensing duration adaptation, ser matching, and power allocation for cognitive ofdm-noma systems,” IEEE Transactions on Wireless Communications, vol. 17, no. 2, pp. 1269–1282, Feb 2018.

[14] Zhang.D, Y. Hu, and Y. Chen, “Breath status tracking using commodity wifi,” in 2018 IEEE Global Communications Conference (GLOBECOM), Abu Dhabi,ecember 2018.

[15] Zhang.D, Y. Hu, Y. Chen, and B. Zeng, “Breathtrack: Tracking indoor human breath status via commodity wifi,” IEEE Internet of Things Journal, vol. 6, no. 2, pp. 3899–3911, April 2019.



Plagiarism Checker X Originality Report
Similarity Found: 5%

Date: Friday, April 16, 2021

Statistics: 576 words Plagiarized / 11180 Total words

Remarks: Low Plagiarism Detected - Your Document needs Optional Improvement.
