

REAL TIME SEAT VACANCY USING IoT

A Project Report Phase – II

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in Electronics and Communication Engineering

by

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INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

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BONA FIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **RISHASRI.H** (39130374) and **SUKANYA.D** (39130448) who carried out the project entitled **"REAL TIME SEAT VACANCY USING IoT"** under our supervision from November 2022 to April 2023.

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We, **RISHASRI.H** (39130374) and **SUKANYA.D** (39130448) hereby declare that the project report entitled “**REAL TIME SEAT VACANCY USING IoT**” done by us under the guidance of **Dr. A. SAHAYA ANSELIN NISHA M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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ABSTRACT

Nowadays, Internet of Things is impacting every aspect of human life and its environment. IoT paradigm focuses on the connection of everything to the Internet, and has been adopted in all fields of study. It presents the design and implementation of a solution combining hardware and web application that allows passengers to verify bus seat occupants and occupancy status of the seats. This can be done either with their connected devices or with connected display systems at the bus entrance. The prototype system successfully curtails seat hog practice, time wastage in search of unoccupied seats in the bus. This research involves the development of a prototype system, made of pressure (force-sensing resistor) and Arduino uno module for bus seats, which sends real time seat utilization status to the web application.

During this pandemic situation each and every passenger have to book a ticket for travelling. With more people having access to utilities, the world has improved. Technologies in this development make it easier to survive. The term “Internet of Things” refers to a networked environment where physical objects with integrated electronics, sensors, software, etc. are used to transmit data to the appropriate parties. IoT provides new innovations for the growth of smart cities, transportation, and industries. The proposed system is used in the transportation industry to manage open seats, particularly on buses. Currently, most seat assignments are made online for passengers, but when a seat is available, the ticket checker must make a manual assignment. The system's objective is to employ sensors to ascertain whether all reserved seats are occupied or not. The signal is then instantly sent to a centralized server to open up that particular seat for few bookings. The system also allows users to reserve an available seat in advance. This also provides an efficient and accurate way to manage the seating capacity and ensures smooth seating occupancy. In order for passengers who made last-minute travel plans to be able to purchase tickets online from the forthcoming boarding stations. This also provides more efficient way for people to find available seating and reduce the time spent on waiting.

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LIST OF ABBREVIATIONS

IOT	Internet of Things
PHP Server	Personal Home Page Server
IEEE	Institute of Electrical and Electronics Engineers
GPS	Global Positioning System
GSM	Global System for Mobile Communication
RFID	Radio Frequency Identification
IDE	Integrated Development Environment
USB	Universal Serial Bus
SRAM	Static Random Access Memory
AREF	Analog Reference
LED	Light Emitting Diode
SPI	Serial Peripheral Interface
IOREF	Input / Output Reference
TWI	Two Wire Interface
LCD	Liquid Crystal Display
CRT	Cathode Ray Tube
I2C	Inter Integrated Circuit
DTR	Dynamic thermal Rating
UART	Universal Asynchronous Receiver Transmitter
PIR Sensor	Passive Infrared Sensor
GPIO Pins	General Purpose Input / Output pins
CGRAM	Character Generator Random Access Memory
ASCII	American Standard Code for Information Interchange
HTML	Hyper Text Markup Language

CHAPTER 1

INTRODUCTION

Mobility is one of the most important concerns in cities. The current state of urban traffic congestion causes a number of health issues due to pollution, noise, and, obviously, the high level of stress experienced by drivers who must wait in traffic for several hours in order to get somewhere. Devices in the Internet of Things (IoT) also reveal user data and patterns, creating an altogether new ecosystem with a new sort of data being generated. The usage of IoT in the bus seat-finding system has been a process of change and a shift from an older, more passive system to a new, more active system. With regard to self-servicing, monitoring, and seat tracking on the Bus, the integration of these technologies into the seat finding system reduces management difficulties. Smart transportation systems have been established in a number of developed cities as fresh remedies to this issue.

The creation of a city's software and hardware infrastructure is required for the implementation of systems of this kind. These industrialized nations have produced real-time bus location information systems for passengers and a number of mobile apps that deliver this information directly to passengers' cellphones. The use of private vehicles like cars and bikes has evolved far beyond what one can conceive in today's lightning-fast technology environment. However, due to traffic congestion and daily increases in gas prices, the majority of individuals choose to choose public transportation over driving their own cars. Everyone rushes into the buses in this crowded place without checking whether there are any seats available and instead opts to sit on the footboard. Nothing gets done despite the government proposing several laws and rules. For the convenience of their clients, many public institutions created a system that shows the position of the passenger car, but it does not provide the number of open seats. In response to COVID-19, the government originally started providing intra- district bus services, and in line with the instructions it provided, public buses started operating at 50% capacity. The government's regulations are disregarded during this period, though, if a bus driver takes on more people than the vehicle is capable of holding. We developed an automated approach

for public transportation vehicles that continuously monitors seat availability in order to resolve this issue. The effects of COVID-19 are now clearly seen in several public sectors. Governments have taken steps to reduce the danger of contamination from crowding, including limiting public spaces, imposing travel restrictions, and promoting home offices.

A post-lockdown period will see some activity return, which will raise passenger demand. Operators of public transportation will be compelled to take physical precautions to prevent the spread of the virus as a result. These alternatives include controlling the limited capacity, reorganizing public transportation, and crowd control. This will enable us to control the number of seats in public transportation.

1.1 EMBEDDED SYSTEM

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, and store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic control systems, etc.

1.2 MOTIVATION

During the lockdown in May 2020 due to COVID-19, the government first started the intra-district bus services, and as per the guidelines issued by the government, public buses started to run with 50-percent capacity. But during this period, if any bus attendant allows more passengers than capacity, this leads to the breach of the guidelines provided by the government. In order to get rid of this

situation, the automated solution for public transport buses which provides the continuous monitoring of seat availability.

The impact of COVID-19 is now a days visible in many public sectors. Governments implemented measures to reduce the risk of contamination by crowding, for example, shutting down public sectors, implementing travel restrictions or supporting home offices. This change in the world heavily affects public transport services.

In a post-lockdown period, some activities will resume and will result in an increase in passenger demand. This will force public transport operators to use physical distancing measures to reduce the virus transmission risk. These options are managing the limited capacity, redesigning public transportation services, crowd management.

Here the aim of the project is to give the solution for this issue is to introduce a ticketing system proposed to identify the passenger using IR sensor and predict and update available vacancy which can be further used for booking.

1.3 OBJECTIVES

- In emergencies, people who prefer to travel in a bus for long distances will be suffering a lot due to the unavailability of seats.
- Especially the aged people and the children will be affected as they may not get a chair for their entire journey.
- To avoid the problem in public transport for the people who are suffering during their journey.
- This system helps the people know the vacant seats of buses in advance just five minutes before the bus arrival time
- So that the people accordingly plan to take the buses for their peaceful journey.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE SURVEY

Lavanya R et.al, (2017) proposed a system based on **crowd density estimation and bus location prediction using IR sensors, a GPS module interfaced with Arduino UNO**. The advantage is that the crowd inside the bus can be known and the time between nearby bus stops [8]. The major disadvantage is number of available seats is ambiguous and uncertain and only a predefined value is obtained.

Priti Shende et.al, (2016) proposed a system on a **bus tracking system using the RF module, Ethernet module, and LCD**. With the help of the local IP address configured to the router, the data which is received is displayed on the website and LCD module in bus stops [10]. The disadvantage of the system is still we don't have any information regarding the availability of the number of seats in the bus.

Jafrul Islam Sojol et.al, (2018) proposed a system with **automated passenger counting system using pressure pad developed by them**, Bluetooth HC-05 and touch screen display interfaced with Arduino UNO [6]. The major disadvantage is the values obtained from pressure pad will be inaccurate as it will also detect bags/trolleys if unknowingly placed by the travellers.

Baburao Kodavati et.al, (2011) has proposed a system for **Vehicle tracking based on GPS and GSM**. In this, they have GSM for sending the details to the mobile phones. But in this case, there are chances of information not reaching the persons due to improper signal strength and not all mobile numbers of the people travelling inside the bus can be tracked [15]. Hence, GSM is difficult to implement in the buses which run in rural area.

Bhat Apoorva et.al, (2018) proposed a system for **real time monitoring of bus arrival and ticket booking facility through GPS, RFID tags, and sensors** [7]. The practical feasibility and implementation difficulties are not discussed.

Faizan Ahmad et al, (2015) has proposed a methodology for **face recognition based on information theory approach of coding and decoding the face image** is discussed in [Sarala A. Dabhade & Mrunal S. Bewoor, 2012] proposed methodology is connection of two stages – Face detection using Haar Based Cascade classifier and recognition using principle component analysis. Various face detection and recognition methods have been evaluated.

Sharma H and Saurav S and Singh S and Saini AK and Saini R (2015) has proposed a system **Analyzing Impact of Image Scaling Algorithms on Viola – Jones Face Detection Framework**, this exploration studies the Viola–Jones algorithm about the problem from low quality of the image and discovery the improve solution from Viola–Jones algorithm. The system usages two approaches to scaled image that are window scaling and image scaling. The image scaling has 5 techniques that is Nearest Neighbor, Bi-Linear, Bi-Cubic, Extended Linear, and Piece-Wise Extended Linear. The system usages 5 difference face database for relating the presentation of 5 different image scaling techniques. The system was established by using C++, Visual studio 2010, and Opensource Computer Vision (OpenCV). They used confusion matrix that compose of True Positive, False Positive, and False Negative to calculate the performance of each technique. From the result, they found that the analysis in set-up of the window scaling is improved than image scaling.

Paul Viola and Michael Jones (2017) has proposed a system for **Face Detection Using Combination of Skin Color Pixel Detection and Viola-Jones Face Detector**”, This examination studies the detection of the human skin [9]. It uses a grouping of two techniques that are a novel hybrid color models and Viola – Jones algorithms. Its determination is to recognize the object is human or not. The system is planned in MATLAB and usage ECU face and skin database to calculate the

correctness. From the result, this method has great performance more than another. When usage this method with Viola – Jones face detector, it will be more capable must be indented.

Myunghoon et.al, (2014) used **Active shape model (ASM)** to remove 77 facial points. Active Shape Model is widespread geometric based style in which detected image is iteratively deformed to fit shape model and extract facial points later contrast with shape model.

Kamlesh et.al, (2014) used combination of **Active Appearance Model (AAM)** and **Local Binary Pattern (LBP)** as an example of hybrid attitude, removed 68 facial points, in which AAM is geometric based method and LBP is presence-based method. Subsequently extractions of features, unlike classifiers are used for the classification of emotions.

M. A. Hannan et.al, (2012) devised a system on **Bus monitoring system using GPS, GPRS, GIS, and RFID** [12] helps to track the transit vehicle but does not provide information about the number of persons inside the bus or seat availability.

Thiyagarajan Manihatty Bojan et.al, (2014) devised a **transportation system based on IoT using GPS, GSM interfaced with Arduino UNO and MEGA with Atmega328**, Atmega2560 for tracking the location,[11] NFC technology, and CCTV for capturing and monitoring their travel and LCD with internet connection for displaying in the bus stops.

Marcus Handte et.al (2012) proposed a system about **navigation system for urban bus riders using IoT**. They have used the Wi-Fi connection to track the passenger details using the MAC address [13] and display the tracking details in the mobile application. The major drawback of this, all people may not access the wi-fi every time and in some cases, there are chances of people travelling without mobile phones.

Tiago Dias Camacho et.al (2012) has proposed on **Advanced Public Transport Systems (APTS)**. They have implemented a magnetic card or smart card for automatic ticket collecting system. [14] Though they are easy to carry and convenient for people, there are some chances of losing it and forgetting during travel. Hence, this system will not be preferable in rural areas.

2.2 SUMMARY

Currently, the field of IoT has many new technologies coming up. IoT Technology is undergoing unprecedented growth. Many exciting new technologies such as Image Processing, IoT Devices like Raspberry pi etc. are in existence. But all these technologies have their drawbacks such as limited line of sight, excessive power consumption, high cost.

This development is to provide a low cost as well as easy to use. Identification of seat vacancy in vehicle using Arduino UNO. During this pandemic situation all are preferred to travel with a social distance in public or private transport. This is very useful for them to see the number of vacancy seats in vehicle so that they can book a ticket at last moment.

2.3 PROBLEM STATEMENT

Many public institutes developed a system for customers convenience, which displays the passenger vehicle position, but the number of vacant seats is not implemented. The project helps them to book a seat by knowing the vacancy seats in a vehicle by using IR sensor, Arduino UNO, Node MCU and PHP server.

CHAPTER 3

METHODOLOGY

3.1 STANDARDS

IEEE has a number of existing standards (current and under development), activities, and events that are directly related to creating the environment needed for a vibrant IoT, recognizing the value of the IoT to industry and the benefits this technology innovation brings to the public. Some key standards activities are:

- **Architectural framework:** The focus of IEEE P2413-2019 is to develop a standard for the architectural framework for the Internet of Things, which includes descriptions of various IoT domains, definitions of IoT domain abstractions, and identification of commonalities between different IoT domains. The architectural framework defined in this standard will promote cross domain interaction, aid system interoperability and functional compatibility.
- **Harmonization and security of IoT:** The IEEE 1451-99 is focused on developing a standard for harmonization of Internet of Things (IoT) devices and systems. This standard defines a method for data sharing, interoperability, and security of messages over a network, where sensors, actuators and other devices can interoperate, regardless of underlying communication technology.
- **Sensor Performance and Quality:** Sensors are fundamental to IoT ecosystem with large volume of different sensors integrated into a complex framework. IEEE 2700 proposes a common framework for sensor performance specification terminology, units, conditions and limits is provided. IEEE P2510 defines quality measures, controls, parameters and definitions for sensor data related to Internet of Things (IoT) implementations.

3.2 CONSTRAINTS

Most of the people prefer using public buses instead of their private vehicles because of the day-by-day increments in gasoline prices and traffic jams. This system help them to book a ticket by seeing vacancy seats in mobile app but IR sensor will not work during darkness or night time.

3.3 EXISTING SYSTEM

There are various methods that are proposed with seat vacancy and bus ticketing system. The GPS [3] and GSM system gives the tracking of bus continuously which is a cloud based and android based system. The main disadvantage of this system is it is mainly accessible to PC or laptop.

There is a method called Transit smart card system is although used to collect the fares among the passengers. This is implemented to know the starting point of the traveler and a time-consuming process. The automatic fare collection system also be implemented but they may not be reliable in some cases due its different methodology.

Later, the RFID technology also played a vital role in public transport system. The papers are proposed using this technology for bus ticketing and monitoring the seat vacancy. Basically, it consists of different parts like RFID Tag, Middleware, and Reader to read the RFID tag which completely depends on the database where the information regarding the passenger is stored. The tag reader here is responsible for communicating with the tag provided to the user. The system is designed for the ticketing system while passenger boarding into the bus but not the seat vacancy. Cashless ticketing system is providing a secure and cash free travel which eradicates the use of coins for change purpose. The RFID is mainly used in this system the tag is provided with a specific code which contains the information regarding the payment details the fare is deducted and the passenger is allowed to board the bus. They also

studied on the security of the individual data. The RFID cards are generally used for public transportation system where the data of the user is shown as if they required or for security purpose.

Data manipulation can be encouraged if proper server is not used to read the tag also all common passenger details are very difficult to enter into the database. The further researches are done which are based on seat vacancy monitoring. An automated passenger counting system is involved in the implementation of vacancy of seat vacancy and also incorporate the corruption. The Nifty system is further implemented to check the availability of seats and track the bus it uses GSM and GPS technology and automatic ticket vending machine to issue the ticket. An android application is developed to access the booking of seat which is a separate cloud-based algorithm is used. Image processing technology is further implemented to detect the images. There is also a system proposed which is used to detect the seat vacancy using image processing technique. Morphological technique is used to change the shape or geometry of the image which enables to capture the image properly. The algorithm proposed in this system is used to detect the seat vacancy information for the passengers but not the ticketing system. There should be dynamically proposed a system which includes both seat vacancy and bus ticketing system.

In the existing system Raspberry Pi is used to implement the system, along with Quick response code (QR-code). The QR- code is a machine-readable barcode which contains the information of a product or data regarding a person stored in a database. The algorithm used here is different which includes the both uses of system. The Raspberry Pi is a small computer which holds the working of CPU. The open CV is used for image processing technique to track the seat vacancy. This system consumes more cost.

3.4 PROPOSED SYSTEM

- The proposed system is mainly designed to provide the number of vacancy seats present in each of the different buses so as to avoid the passenger overloading in different buses.
- The IR sensor is used to count the number of passengers entering the bus and also count the number of passengers leaving the bus.
- Here we use the Arduino as a controller unit and Node MCU (ESP8266) as a Wi-fi module which sends the data to the web server. Arduino transmits the passenger count to Node MCU.
- Node MCU receives the passenger and that data will upload to PHP Server.
- Then the passenger can check the availability of seats in web server.

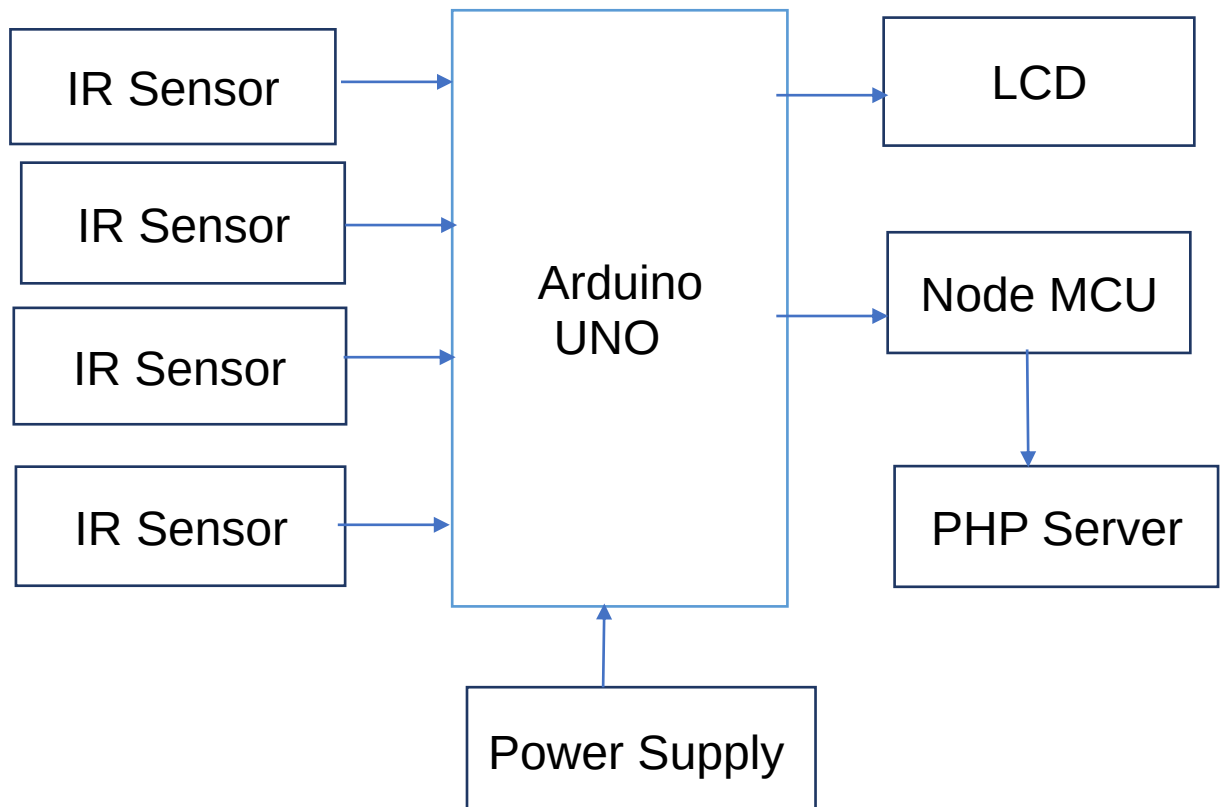


Fig 3.1: BLOCK DIAGRAM

3.5 COMPONENTS REQUIRED

- Arduino UNO Microcontroller
 - IR sensor
 - LCD
 - Node MCU
 - Power Supply
- Arduino IDE
 - Embedded C

3.6 EXISTING BLOCK DIAGRAM

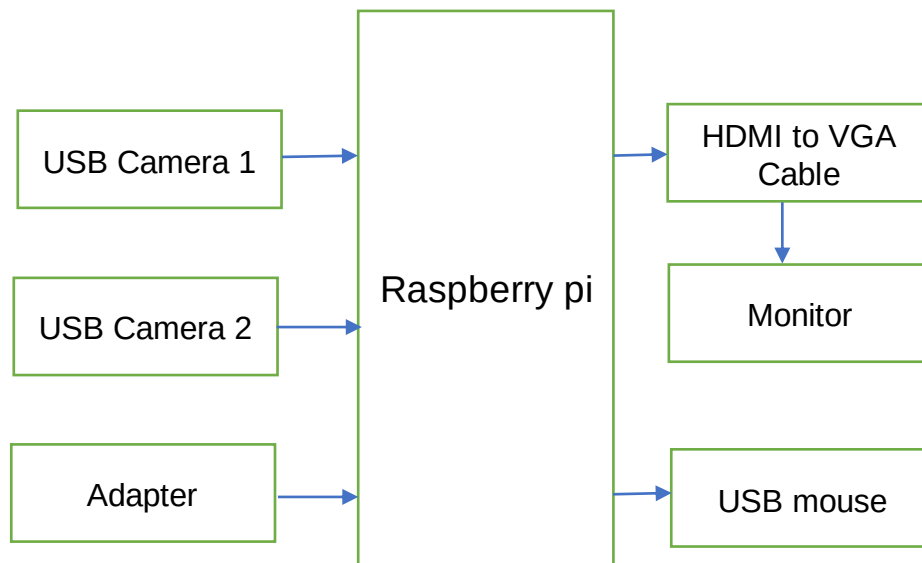


Fig 3.2: EXISTING BLOCK DIAGRAM

CHAPTER 4

HARDWARE DESCRIPTION

4.1 INTRODUCTION

This chapter mainly deals with the hardware of the project. This chapter consists of various components used in the system. It also consists of its working, and other attributes of the components. The important peripherals of the system are the various sensors and the Node MCU. The sensors used in the system give us outputs from the bus and the node MCU is used to give the live data of the bus to the PHP sever.

4.2 ARDUINO UNO BOARD

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power 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 an AC-to-DC adapter or batter to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards and the reference model for the Arduino platform.



Fig 4.1 Arduino Uno Board

4.2.1 TECHNICAL SPECIFICATION

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12 V
Input Voltage (limit)	6-20 V
Digital I / O Pins	14 (of which 6 provide PWM output)
PWM Digital I / O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 Ma
DC Current for 3.3 V Pin	50 Ma
Flash Memory	32 KB (ATmega328P)
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

TABLE 4.1: Technical Specifications of Arduino Uno

There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, the most common versions are Arduino Uno and Arduino Mega. If we are planning to create a project relating to digital electronics, embedded systems, robotics or IoT, then the best using boards is Arduino Uno because it is easy and most economical option.

4.2.2 INTRODUCTION TO ARDUINO

Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller ATmega328. First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartielles and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world.

The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 input / output digital ports that are used to connect with external electronics circuits. Out of 14 input / output ports, 6 pins can be used for PWM output. It allows the designers to control and sense the external electronic devices in the real world.

This board comes with all the features required to run the controller and can be directly connected to the computer through USB cable that is used to transfer the code to the controller using IDE (Integrated Development Environment) software, mainly developed to program Arduino. IDE is equally compatible with Windows, MAC or Linux systems however, Windows is preferable to use. Programming languages like C and C++ are used in IDE. Apart from USB battery or AC to DC adapter can also be used to power the board.

Arduino Uno boards are quite similar to other boards in Arduino family in terms of use and functionality, however, Uno boards don't come with FTDI USB to Serial driver chip.

There are many versions of Uno boards available however, Arduino Nano V3 and Arduino Uno are the most official versions that come with ATmega328 8-bit AVR Atmel microcontroller where RAM memory is 32KB.

When nature and functionality of the task go complex SD card can be added in the boards to make them store more information.

4.2.3 FEATURES OF ARDUINO

- Arduino Uno comes with USB interface i.e. USB port is added on the board to develop serial communication with the computer.
- ATmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions per cycle.
- It is an open-source platform where anyone can modify and optimize the board based on the number of instructions and task, they want them to achieve.
- This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device.
- Reset pin added in the board that resets the whole board and takes the running program in the initial stage. This pin is useful when the board hangs up in the middle of the running program; pushing this pin will clear everything up in the program and starts the program right from the beginning.
- There are 14 input / output digital pins and 6 analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins. There is no hard and fast interface required to connect the devices to the board. Simply plug the external device into the pins of the board that are laid out on the board in the form of the header.

- The 6 analog pins are marked as A0 to A5 and come with a resolution of 10 bits. These pins measure from 0 to 5V, however, they can be configured to the high range using analog reference () function and AREF pin.
- 13 KB of flash memory is used to store the number of instructions in the form of code.
- Only 5V is required to turn the board on, which can be achieved directly using USB port or external adapter, however, it can support external power source up to 12V which can be regulated and limit to 5V or 3.3V based on the requirement of the project.
- Arduino Uno is based on AVR microcontroller called ATmega328.
- This controller comes with 2KB SRAM, 32KB of flash memory, 1KB of EEPROM. Arduino Board comes with 14 digital pins and 6 analog pins. ON-chip ADC is used to sample these pins. A 16MHz frequency crystal oscillator is equipped on the board.

4.2.4 PIN DESCRIPTION

There are several input / output digital pins and analog pins placed on the board which operates at 5V. These pins come with standard operating ratings ranging between 20mA to 40mA. Internal pull-up resistors are used in the board that limits the current makes these resistors useless and damages the device.

- **LED:** Arduino Uno comes with built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON and LOW will turn it OFF.
- **Vin:** It is the input voltage provided to the Arduino Board. It is different than 5V supplied through a USB port. This pin is used to supply voltage. If a voltage is provided through a USB port. This pin is used to supply voltage. If a voltage is provided through power jack, it can be accessed through this pin.
- **5V:** This board comes with the ability to provide voltage regulation. 5V pin is

used to provide output regulated voltage. The board is powered up using three ways i.e. USB, Vin pin of the board or DC power jack. USB supports voltage around 5V while Vin and Power Jack support a voltage ranges between 7V to 20V. It is recommended to operate the board on 5V. It is important to note that, if a voltage is supplied through 5V or 3.3V pins, they result in bypassing the voltage regulation that can damage the board if voltage surpasses from its limit.

- **GND:** These are ground pins. More than one ground pins are provided on the board which can be used as per the requirement.
- **RESET:** This pin is incorporated on the board which resets the program running on the board. Instead of physical reset on the board, IDE comes with a feature of resetting the board through programming.
- **IOREF:** This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then select the proper power source.
- **PWM:** PWM is provided by 3, 5, 6, 9, 10, 11 pins. These pins are configured to provide 8-bit output PWM.
- **SPI:** It is known as Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library.
- **AREF:** It is called Analog Reference. This pin is used for providing a reference voltage to the analog inputs.
- **TWI:** it is called Two-wire Interface. TWI communication is accessed through Wire Library. A4 and A5 pins are used for this purpose.
- **SERIAL COMMUNICATION:** Serial communication is carried out through two pins called Pin 0 (Rx) and Pin 1 (Tx). Rx pin is used to receive data while Tx pin is used to transmit data.
- **EXTERNAL INTERRUPTS:** Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

4.2.5 COMMUNICATION AND PROGRAMMING

Arduino Uno comes with an ability of interfacing with other Arduino boards, microcontroller and computer. The ATmega328 placed on the board provides serial communication using pins Rx and Tx.

The ATmega16U2 incorporated on the board provides serial communication using USB com drivers. Serial monitor is provided on the IDE software which is used to send or receive text data from the board. If LEDs placed on the Rx and Tx pins will flash, they indicate the transmission of data.

Arduino Uno is programmed using Arduino Software which a cross-platform application called IDE is written in Java. The AVR microcontroller ATmega328 laid out on the base comes with built-in boot loader that sets you free using a separate burner to upload the program on the board.

4.2.6 AUTOMATIC (SOFTWARE) DOWNLOAD

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2 is connected to the reset line of the ATmega328 via a 100 nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running MacOS X or Linux, it resets each time a connection is made to it from the software (via USB). For the following half-second or so, the boot loader is running on the Uno.

While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives a one-time configuration or other data when it first starts, makes sure that the software with which it communicates waits for a second after opening the connection and before sending this data. The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It is labelled as “RESER-EN”. It is also able to disable the auto-reset by connecting a 110ohm resistor from 5V to the reset line.

4.2.7 USB OVERCURRENT PROTECTION

The Arduino Uno has a built-in overcurrent protection mechanism to prevent damage to the board and the connected devices from excessive current flow through the USB port. This protection is provided by a resettable fuse, which is also known as a poly-fuse.

The poly-fuse is a small, surface-mount device located near the USB connector on the Arduino Uno board. It is designed to limit the current that flows through the USB port to a safe level. In case of a short-circuit or excessive current draw, the poly-fuse will limit the current flow to a safe level by increasing its resistance, and once the fault condition is removed, it will return to its normal state.

It is important to note that some USB devices may draw more than 500mA of current, and in such cases, an external power supply may be required to power the Arduino and connected devices. It is recommended to always use a power supply that is within the rated specifications of the Arduino board and the connected devices to

avoid triggering the overcurrent mechanism. It is important to ensure that the USB cable used to connect the Arduino board to the computer or power supply is good quality and capable of handling the required current without causing any voltage drop or other issues.

4.2.8 PHYSICAL CHARACTERISTICS

Some of the physical characteristics of Arduino Uno board are:

- **SIZE:** The Arduino Uno board measures 68.6 mm x 53.4 mm (2.7 inches x 2.1 inches), making it compact and portable device.
- **SHAPE:** The Arduino Uno board has a rectangular shape with rounded corners, and it has mounting holes at each corner to attach it to a project or enclosure.
- **COLOR:** The Arduino Uno board is typically blue in color, with white silk-screened markings that indicate the pinouts, labels and other important information.
- **COMPONENTS:** The Arduino Uno board consists of several components including the microcontroller, voltage regulator, USB port, power jack, reset button and various pins and connectors.
- **WEIGHT:** The weight of the Arduino Uno board is typically around 25 grams, which makes it easy to handle and manipulate.
- **MATERIAL:** The Arduino Uno board is made from a combination of high-quality components such as Atmel ATmega328P microcontroller and a printed circuit board (PCB) made of fiberglass or other high-quality materials.
- **INPUT VOLTAGE:** The Arduino Uno can be powered using a USB cable or an external power source, with an input voltage range from 7V to 20V DC.
- **OPERATING TEMPERATURE:** The Arduino Uno can operate in a wide range of temperatures from -40°C to 85°C, making it suitable for use in a variety of environments.

4.2.9 APPLICATIONS

Arduino Uno comes with a wide range of applications. A larger number of people are using Arduino boards for developing sensors and instruments that are used in scientific research.

Following are some of the main applications of the board. They are:

- ❖ Embedded system
- ❖ Security and Defense system
- ❖ Digital Electronics and Robotics
- ❖ Parking Lot Counter
- ❖ Weighing Machines
- ❖ Traffic Light Count Down Timer
- ❖ Medical Instrument
- ❖ Emergency Light for Railways
- ❖ Home Automation
- ❖ Industrial Automation

There are a lot of other microcontrollers available in the market that are more powerful and cheap as compared to Arduino board.

Arduino comes with a big community that is developing and sharing the knowledge with a wide range of audience. Quick support is available pertaining to technical aspects of any electronic project. When you decide Arduino board over other controllers, you don't need to arrange extra peripherals and devices as most of the functions are readily available on the board that makes the project economical in nature and free from a lot of technical expertise.

4.3 IR SENSOR

An infrared sensor is an electronic device that detects and measure infrared radiation. Infrared radiation is a type of electromagnetic radiation that has a wavelength longer than that of visible light and is invisible to the human eye. IR sensors are used in a

variety of applications including temperature sensing, motion detection and remote - control systems. These types of sensors measure only infrared radiation, rather than emitting it. These types of sensors are known as passive IR sensors. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that is 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.

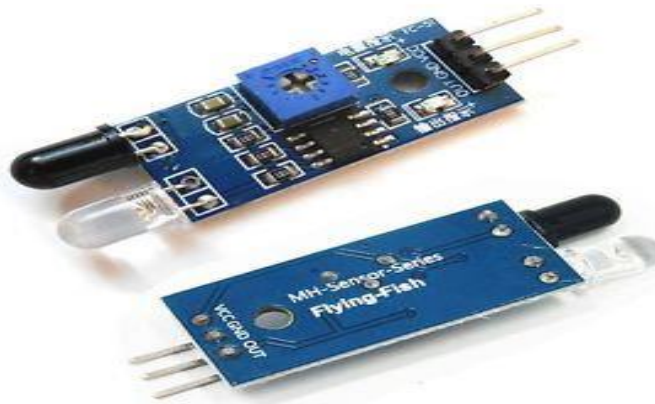


Fig 4.2 IR Sensor

4.3.1 TYPES OF IR SENSOR

IR sensors are classified into different types depending on the applications. There are different types of IR sensors, but most operate by detecting the amount of infrared radiation emitted by an object. There are several types of IR sensors, including thermophile sensors, pyroelectric sensors, photodiode sensors etc.

- **Thermophile sensors:** It measures the temperature of an object by detecting the amount of infrared radiation emitted from it. These sensors consist of several thermocouples connected in series, and when infrared radiation is absorbed by the thermophile, it generates a voltage that can be measured.
- **Pyroelectric sensors:** It works by detecting changes in the electric field generated by a material in response to changes in temperature. These sensors

are sensitive to rapid changes in temperature and are commonly used in motion detectors and burglar alarms.

- **Photodiode sensors:** It converts infrared radiation into an electrical current. These sensors are commonly used in remote controls, where they receive signals from the infrared emitter and convert them into electrical signals that can be processed by the device.
- **PIR sensors:** These sensors are used for automatic door opening system and security alarms.
- **Ultrasonic sensors:** These sensors are widely used in cars as parking sensors to aid the driver in reversing into parking spaces. It uses sound rather than light for detection.

4.3.2 WORKING PRINCIPLE OF IR SENSOR

Infrared sensors work on three fundamental Physics laws:

- **Planck's Radiation Law:** Any object whose temperature is not equal to absolute Zero (0 Kelvin) emits radiation.
- **Stephan Boltzmann Law:** The total energy emitted at all wavelengths by a black body is related to the absolute temperature.
- **Wein's Displacement Law:** Objects of different temperature emit spectra that peak at different wavelengths that is inversely proportional to Temperature.

4.3.3 IR TRANSMITTER

IR Transmitter acts as source for IR radiation. According to Plank's Radiation Law, every object is a source of IR radiation at temp T above 0 Kelvin. In most cases black body radiators, tungsten lamps, silicon carbide, infrared lasers, LEDs of infrared wavelength are used as sources.

4.3.4 TRANSMISSION MEDIUM

As the name suggests, Transmission Medium provides passage for the radiation to reach from IR Transmitter to IR Receiver. Vacuum, atmosphere and optical fibres are used as medium.

4.3.5 IR RECEIVER

IR receivers are photo diode and photo transistors. They are capable of detecting infrared radiation. Hence IR receiver is also called as IR detector. Variety of receivers are available based on wavelength, voltage and package.

IR Transmitter and Receivers are selected with matching parameters. Some of deciding specifications of receivers are photosensitivity or responsivity, noise equivalent power and detectivity.

4.3.6 WORKING OF IR SENSOR

An Infrared Sensor works in the following sequence:

- IR source (transmitter) is used to emit radiation of required wavelength.
- This radiation reaches the object and is reflected back.
- The reflected radiation is detected by the IR receiver.
- The IR Receiver detected radiation is then further processed based on its intensity. Generally, IR Receiver output is small and amplifiers are used to amplify the detected signal.
- Typical working of IR sensor detection system can be understood by figure below.

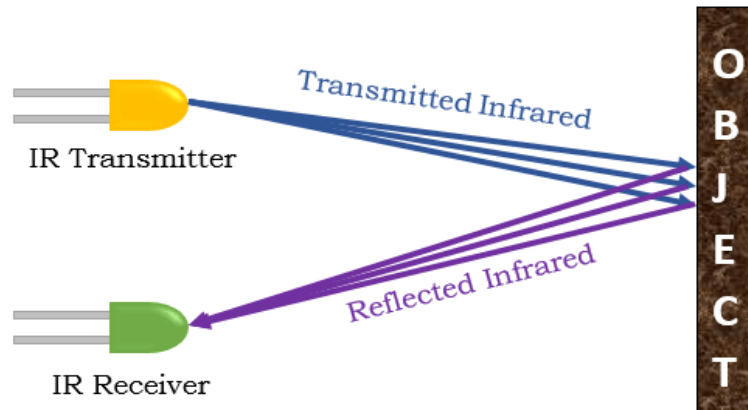


Fig 4.3 Working of IR Sensor

Incidence in an IR Detection System may be direct or indirect. In case of Direct Incidence, there is no hindrance in between transmitter and receiver. Whereas, in Indirect Incidence IR Transmitter and Receiver are kept side by side and the object is in front of them.

IR sensors can be classified into two types based on presence of IR source. They are:

Active IR sensor

Passive IR sensor [1]

4.4 NODE MCU

Node MCU is an open-source firmware and development kit that plays a vital role in designing your own IoT product using a few Lua script lines. Multiple GPIO pins on the board allow you to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications.

The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module [2].

The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a language that connects you with a well-known developer community.

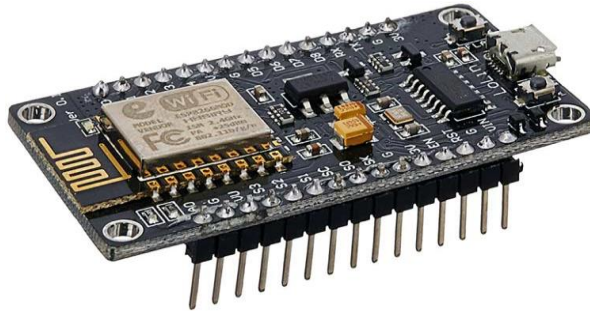


Fig 4.4 Node MCU

An opensource firmware gives you the flexibility to edit, modify and rebuilt the existing module and keep changing the entire interface until you succeed in optimizing the module as per your requirements.

- USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication.
- Instead of the regular USB port, Micro USB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board.
- The board incorporates status LED that blinks and turns off immediately, giving you the current status of the module if it is running properly when connected with the computer.

The ability of module to establish a flawless Wi-Fi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry Pi.

4.4.1 NODE MCU PINOUT

Node MCU comes with a number of GPIO Pins. Following figure shows the Pinout of the board. There is a candid difference between VIN and VU where former is the regulated voltage that may stand somewhere between 7 to 12 V while later is the power voltage for USB that must be kept around 5 V.

4.4.2 FEATURES OF NODE MCU

- Open-source
- Arduino-like hardware
- Status LED
- Micro USB port
- Reset/Flash buttons
- Interactive and Programmable
- Low cost
- ESP8266 with inbuilt Wi-Fi
- USB to UART converter
- GPIO pins

As mentioned above, a cable supporting USB port is used to connect the board. As you connect the board with a computer, LED will flash. You may need some drivers to be installed on your computer if it fails to detect the Node MCU board.

We use Arduino IDE software for programming this module. It is important to note that the pin configuration appearing on the board is different from the configuration we use to program the board on the software i.e. when we write code for targeting pin 16 on the Arduino IDE, it will actually help is laying out the communication with the D0 pin on the module. There are five ground pins and three 3V3 pins on the board. The board can be powered up using the following three ways.

USB Power. It proves to an ideal choice for loading programs unless the project you aim to design requires separate interface i.e. disconnected from the computer.

Provide 3.3V. This is another great option to power up the module. If you have your own off-board regulator, you can generate an instant power source for your development kit.

Power Vin. This is a voltage regulator that comes with the ability to support up to 800 mA. It can handle somewhere between 7 to 12 V. You cannot power the devices operating at 3.3 V, as this regulator unable to generate as low as 3.3V.

4.4.3 APPLICATIONS

Node MCU V3 is mainly used in the Wi-Fi Applications which most of the other embedded modules fail to process unless incorporated with some external Wi-Fi protocol. Following are some major applications used for Node MCU V3.

- Internet Smoked Alarm
- VR Tracker
- Octopod
- Serial Port Monitor
- ESP Lamp
- Incubator Controller
- IoT home automation
- Security Alarms

4.5 LCD

LCD (Liquid Crystal Display) is the innovation utilized in scratch pad shows and other littler PCs. Like innovation for light-producing diode (LED) and gas-plasma, LCDs permit presentations to be a lot more than innovation for cathode ray tube (CRT). LCDs expend considerably less power than LED shows and gas shows since they work as opposed to emanating it on the guideline of blocking light.

LCD is either made with a uninvolved lattice or a showcase network for dynamic framework show. Likewise alluded to as a meager film transistor (TFT) show is the dynamic framework LCD. The uninvolved LCD lattice has a matrix of conductors at every crossing point of the network with pixels. Two conductors on the lattice send a current to control the light for any pixel. A functioning framework has a transistor situated at every pixel crossing point, requiring less current to control the luminance of a pixel.

Some aloof network LCD's have double filtering, which implies they examine the matrix twice with current in the meantime as the first innovation took one sweep. Dynamic lattice, be that as it may, is as yet a higher innovation.

A 16x2 LCD show is an essential module that is generally utilized in various gadgets and circuits. These modules more than seven sections and other multi fragment LEDs are liked. The reasons being: LCDs are affordable; effectively programmable; have no restriction of showing exceptional and even custom characters (not at all like in seven fragments), movements, etc.

A 16x2 LCD implies 16 characters can be shown per line and 2 such lines exist. Each character is shown in a lattice of 5x7 pixels in this LCD. There are two registers in this LCD, in particular Command and Data.

The directions given to the LCD are put away by the order register. An order is a direction given to LCD to play out a predefined assignment, for example, introducing it, clearing its screen, setting the situation of the cursor, controlling presentation, and so forth. The information register will store the information that will be shown on the LCD. The information is the character's ASCII incentive to show on the LCD.

4.5.1 EXECUTION OF LCD

Now that was all about the signals and the hardware. Let us come to data, signals and execution.

Two types of signals are accepted by LCD, one is data and one is control. The LCD module recognizes these signals from the RS pin status. By pulling the R / W pin

high, data can now also be read from the LCD display. Once the E pin has been pulsed, the LCD display reads and executes data at the falling edge of the pulse, the same for the transmission case.

It takes 39-43 μ S for the LCD display to place a character or execute a command. It takes 1.53ms to 1.64ms except for clearing display and searching for cursor to the home position.

Any attempt to send data before this interval may result in failure in some devices to read data or execute the current data. Some devices compensate for the speed by storing some temporary registers with incoming data.

There are two RAMs for LCD displays, namely DDRAM and CGRAM. DDRAM registers the position in which the character would be displayed in the ASCII chart. Each DDRAM byte represents every single position on the display of the LCD.

The DDRAM information is read by the LCD controller and displayed on the LCD screen. CGRAM enables users to define their personalized characters. Address space is reserved for users for the first 16 ASCII characters.

Users can easily display their custom characters on the LCD screen after CGRAM has been set up to display characters.



Fig 4.5 LCD

4.5.2 PIN DESCRIPTION:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	V _{CC}
3	Contrast adjustment; through a variable resistor	V _{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V _{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Table 4.2 Pin description of LCD

4.5.3 RS (Register select)

A 16X2 LCD has two order and information registers. The determination of the register is utilized to change starting with one register then onto the next. RS=0 for the register of directions, while RS=1 for the register of information.

4.5.4 COMMAND REGISTER

The guidelines given to the LCD are put away by the direction register. An order is a direction given to LCD to play out a predefined assignment, for example, instating it, clearing its screen, setting the situation of the cursor, controlling showcase, and so on. Order preparing happens in the direction register.

4.5.5 DATA REGISTER

The information register will store the information that will be shown on the LCD. The information is the character's ASCII incentive to show on the LCD. It goes to the information register and is prepared there when we send information to the LCD. While choosing RS=1, the information register.

4.5.6 READ AND WRITE MODE OF LCD

As stated, the LCD itself comprises of an interface IC. This interface IC can be perused or composed by the MCU. A large portion of the occasions we're simply going to keep in touch with the IC since perusing will make it increasingly perplexing and situations like that are exceptionally uncommon Information such as cursor position, status completion interrupts, etc. can be read if necessary

4.5.7 LCD COMMANDS

There are some preset commands in the LCD that we need to send to the LCD via some microcontroller. The following are some important command instructions:

Sr. No.	Hex Code	Command to LCD instruction Register
1	01	Clear display screen
2	02	Return home
3	04	Decrement cursor (shift cursor to left)
4	06	Increment cursor (shift cursor to right)
5	05	Shift display right

6	07	Shift display left
7	08	Display off, cursor off
8	0A	Display off, cursor on
9	0C	Display on, cursor off
10	0E	Display on, cursor blinking
11	0F	Display on, cursor blinking
12	10	Shift cursor position to left
13	14	Shift cursor position to right
14	18	Shift the entire display to the left
15	1C	Shift the entire display to the right
16	80	Force cursor to beginning (1st line)
17	C0	Force cursor to beginning (2nd line)
18	38	2 lines and 5×7 matrix

Table 4.3 Command codes for LCD

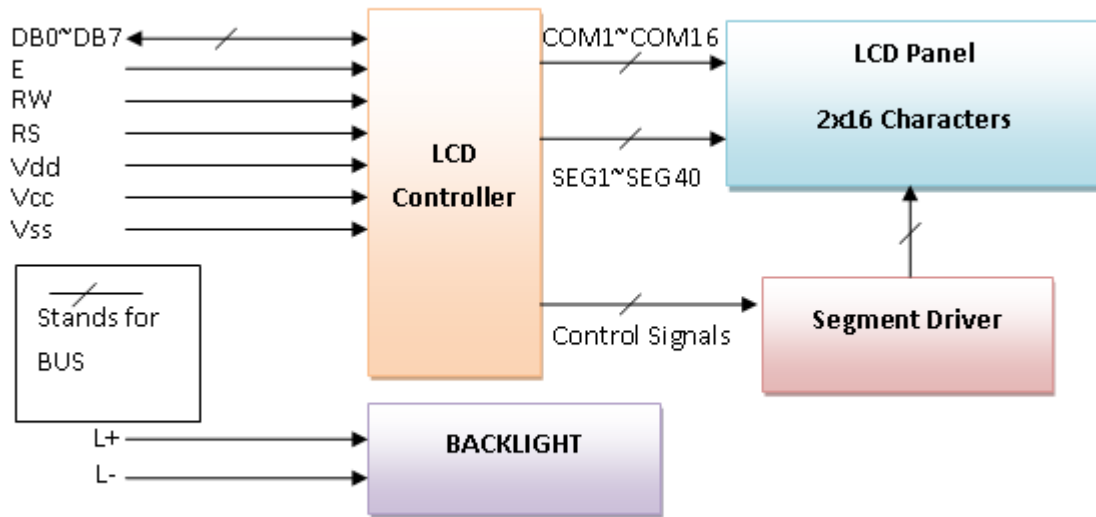


Fig 4.6 Block diagram of LCD display

Instruction	Instruction Code										Instruction Description	Code	Execution time
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Read Data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM		1.53-1.64ms
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)		1.53-1.64ms
Busy flag & Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Busy flag (BF: 1→ LCD Busy) and contents of address counter in bits AC6-AC0.		39 μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.		39 μs

Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM Address in address counter.	39 μ s
Function Set	0	0	0	0	1	DL	N	F	X	X	Set interface data length (DL: 4bit/8bit), Numbers of display line (N: 1-line/2-line) display font type (F:0 $\rightarrow$ 5 $\times$ 8 dots, F:1 $\rightarrow$ 5 $\times$ 11 dots)	39 μ s
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	X	X	Set cursor moving and display shift control bit, and the direction without changing DDRAM data	39 μ s
Display & Cursor On/Off	0	0	0	0	0	0	1	D	C	B	Set Display(D),Cursor(C) and cursor blink(b) on/off control	39 μ s
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable shift entire display.	0 μ s
Return Home	0	0	0	0	0	0	0	0	1	X	Set DDRAM Address to “00H” from AC and return cursor to its original position if shifted.	43 μ s
Clear Display	0	0	0	0	0	0	0	0	0	1	Write “20H” to DDRAM and set DDRAM Address to “00H” from AC	43 μ s

Table 4.4 Control and display commands

4.5.8 4-BIT AND 8-BIT MODE OF LCD:

The LCD can work in two striking modes, the 4-bit m ode and the 8-bit mode. We

send the information snack through snack in 4-bit mode, first upper chomp, by then lower snack. For those of you who don't have the foggiest idea what a goody is: a chomp is a four-piece gathering, so a byte's lower four bits (D0-D3) are the lower snack, while a byte's upper four bits (D4-D7) are the higher snack. This enables us to send 8-bit data. This connects with us to send 8-bit data. Whereas in 8-bit mode we can send the 8-bit information truly in one stroke since we utilize all the 8 information lines. You need to get it now; yes 8-bit mode is quicker and immaculate than 4-bit mode. In any case, the fundamental shortcoming is that it needs 8 microcontroller-related information lines. This will result in our MCU coming up short on I/O pins, so 4-bit mode is extensively utilized. To set these modes, no control pins are used.

4.6 POWER SUPPLY

A power supply is a component that provides at least one electrical charge with power. It typically converts one type of electrical power to another, but it can also convert a different Energy form in electrical energy, such as solar, mechanical, or chemical.

A power supply provides electrical power to components the term refers to devices built into the powered component. Computer power supplies, for example, convert AC current to DC current and are generally located along with at least one fan at the back of the computer case.

Most computer power supplies also have an input voltage switch that, depending on the geographic location, can be set to 110v/115v or 220v/240v. Due to the different power voltages supplied by power outlets in different countries, this switch position is crucial.

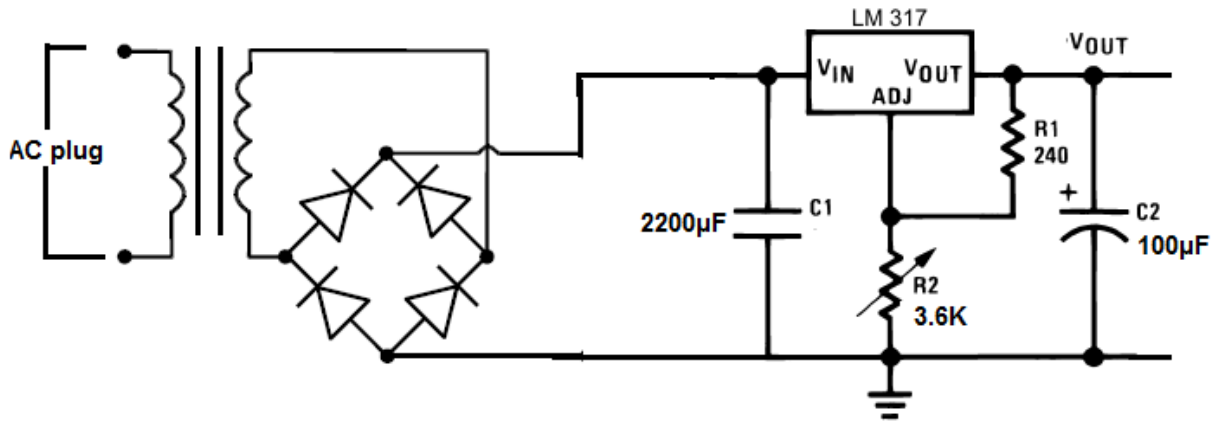


Fig 4.7 Power supply diagram

4.6.1 TRANSFORMER

A transformer is a static electrical gadget that exchanges control between at least two circuits. A fluctuating current creates a changing attractive motion in one transformer curl, which thus actuates a differing electromotive power over a second loop twisted around a similar center.

Without a metallic association between the two circuits, electrical vitality can be exchanged between the two loops. The enlistment law of Faraday found in 1831 portrayed the impact of prompted voltage in any curl because of the changing attractive flux surrounded by the coil.

4.6.2 RECTIFIER

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it "straightens" the direction of current.

Rectifiers have many uses, but are often found to serve as components of DC power supplies and direct power transmission systems with high voltage. Rectification can be used in roles other than direct current generation for use as a power source.

4.6.3 CAPACITORS

Capacitors are used to attain from the connector the immaculate and smoothest DC voltage in which the rectifier is used to obtain throbbing DC voltage which is used as part of the light of the present identity. Capacitors are used to acquire square DC from the current AC experience of the current channels so that they can be used as a touch of parallel yield.

4.6.4 VOLTAGE CONTROLLERS

The 78XX voltage controller is mainly used for voltage controllers as a whole. The XX speaks to the voltage delivered to the specific gadget by the voltage controller as the yield. 7805 will supply and control 5v yield voltage and 12v yield voltage will be created by 7812.

The voltage controllers are that their yield voltage as information requires no less than 2 volts. For example, 7805 as sources of information will require no less than 7V, and 7812, no less than 14 volts. This voltage is called Dropout Voltage, which should be given to voltage controllers.

4.7 SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded C

4.7.1 ARDUINO IDE

Arduino IDE (Integrated Development Environment) is the software for Arduino. It is a text editor like a notepad with different features. It is used for writing code, compiling the code to check if any errors are there and uploading the code to the Arduino. It is a

cross- platform software which is available for every Operating System like Windows, Linux, macOS. It supports C/C++ language. It is open-source software, where the user can use the software as they want it to. They can also make their own modules/functions and add them to the software. It supports every available Arduino board including Arduino mega, Arduino Leonardo, Arduino Ethernet and more. A Word file is called a Document similarly, an Arduino file is called a Sketch where the user writes code. The format of Arduino is saved as.ino

When a user writes code and compiles, the IDE will generate a Hex file for the code

(Hex files are Hexa Decimal files which are understood by Arduino) and then sent to the board using a USB cable. Every Arduino board is integrated with a microcontroller; the microcontroller will receive the hex file and run as per the code written.

Arduino IDE consists of different sections

1. Window Bar
2. Menu Bar
3. Shortcut Buttons
4. Text Editor
5. Output Panel

Window Bar:

The window bar consists the name of File and the Arduino IDE software version

Menu Bar:

The menu bar consists of

- File
- Edit
- Sketch
- Tools

- Help

4.7.2 FILE

- New

It creates a new File (Ctrl + N)

- Open

It is used to open the file which was saved before (Ctrl + O)

- Open Recent

It shows the shortlist of recently opened programs

- Sketchbook

Shows the current sketches which is used for the project

- Close

Closes the main screen window (Ctrl + W)

- Save

It is used to save the current sketch (Ctrl + S)

- Save as...

Allows saving the current sketch with a different name (Ctrl + Shift + S)

- Page Setup

Page settings for modifying the page (Text) (Ctrl + Shift + P)

- Print

Used to print the current program (Ctrl + P)

- Preferences

Settings of the IDE software can be changed here (Ctrl + ,)

- Quit

Closes all IDE windows (Ctrl + Q)

4.7.3 EDIT

- Undo / Redo

Goes back to one or more steps you did while editing

- Cut

Cuts the selected text from the editor

- Copy

Copies the selected text from the editor

- Copy for Forum

It copies and changes the style of code suitable for the forum

- Copy as HTML

It copies and changes the style of code suitable for the Html

- Paste

It pastes the text from the copied text

- Select All

Select's all the content from the editor

- Comment / Uncomment

It is used to comment and uncomment selected lines of code

- Increase / Decrease Indent

Adds or removes a space at the beginning of each selected line

- Find

Finds the typed text in the editor

- Find Next

Finds the next position of the searching word

- Find Previous

Finds the previous position of the searching word

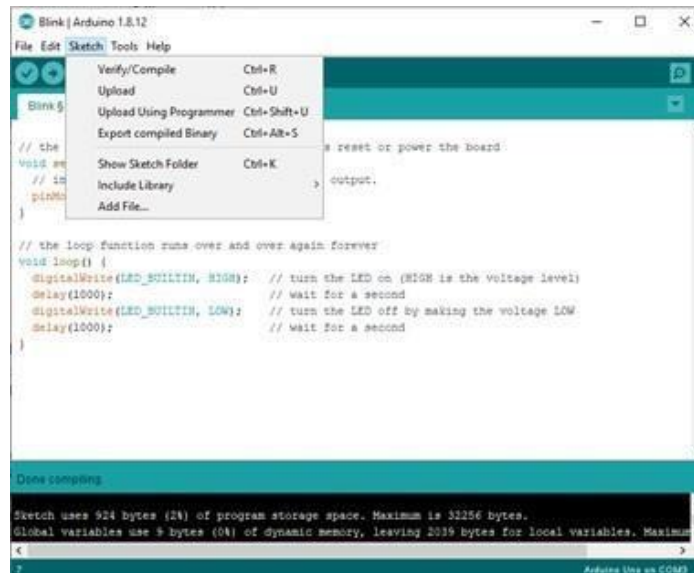


Fig 4.8 Sketch

- Verify / Compile

Checks or verifies your program if any error is there, and displays in the output / panel.

- Upload

It compiles and also uploads the code to the Arduino board

- Upload using Programmer

Uploads code using programmer which is available in Tools tab

- Export Compiled binary

Saves a .hex file in the system

- Shows Sketch Folder

Open the current sketch folder

- Include library

Adds a library to your sketch by inserting #include statements at the start of your code

- Adds File

Adds a file to the sketch and the new file appears in a new tab in the window.

4.7.4 TOOLS

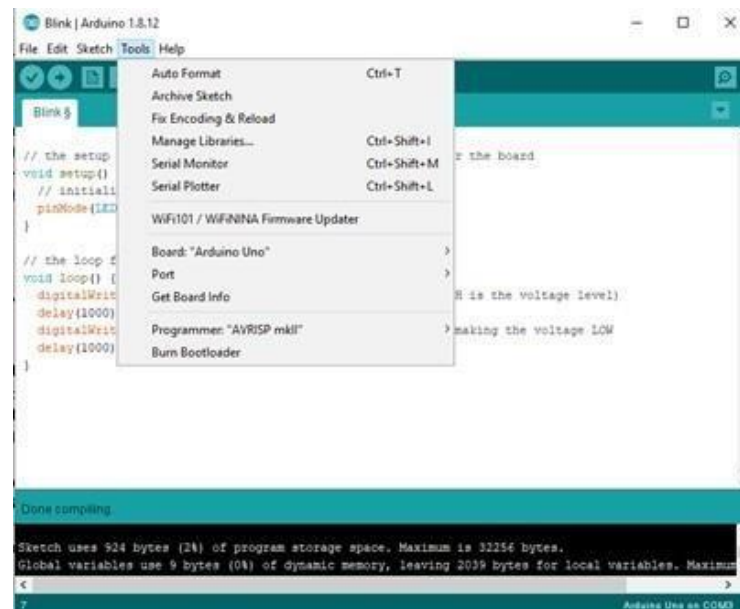


Fig 4.9 Tools

- Auto Format

This option formats your code to a nice format so everyone can understand

- Archive Sketch

Copies the code into winrar format (.zip)

- Fix Encoding & Reload

Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

- Serial Monitor

Serial monitor shows the visual communication by sending and receiving data

- Board

To select the type of Arduino Board

- Port

To select the port where you have connected the Arduino

- Programmer

For selecting a hardware programmer when programming a board or chip and not using the USB type of communication.

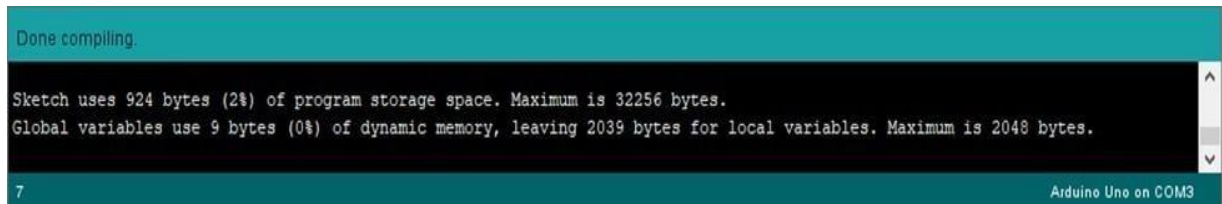


Fig 4.10 Output Panel

This output panel is used to give comments about the code

- if the code is successfully compiled or any error occurs.
- If the code has been successfully uploaded to the board.

4.7.5 EMBEDDED C

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems. Embedded C programming typically requires nonstandard extensions to the C language in order to support enhanced microprocessor features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address such capabilities by providing a common standard for all implementations to adhere to.

It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., `main()` function, variable definition, data type declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

A Technical Report was published in 2004 and a second revision in 2006.

CHAPTER 5

RESULTS AND DISCUSSIONS

IoT technology is used more effectively to identify innovations in current systems. It increases the demand for necessities in every industry. IoT systems assist in enhancing efficiency and effectiveness for all user needs during long-distance travel. In this rapidly expanding world, another type of development is the digitalization of seat vacancy checking in vehicles. The proposed system uses sensors mounted on some IoT devices to identify vacant seats in moving vehicles.

The use of private vehicles like cars and bikes has increased in a way that is far more advanced than one can imagine in today's lightning-fast technological world. However, due to the daily increases in gas prices and traffic congestion, the majority of people choose to use public transportation instead of their private vehicles. Everyone rushes into the buses in this busy world without checking whether any seats are available and instead chooses to sit on the footboard.

Despite the government planning a number of rules and regulations, nothing is accomplished. For the convenience of their customers, many public institutions developed a system that shows the position of the passenger vehicle, but it does not take into account the number of open seats.

It represents an automated system for sitting service bus passenger counting. The proposed project offers an effective and creative way to give the authority total access, flexibility, and satisfaction. It will function as a virtual assistant. Our system may mark a turning point in the fight against corruption in India's public transportation system. Real-time applications can be implemented in a quick and effective manner.

The hardware components are connected as per the instructions given. The image of hardware circuit connection is shown in the below figure 5.1.

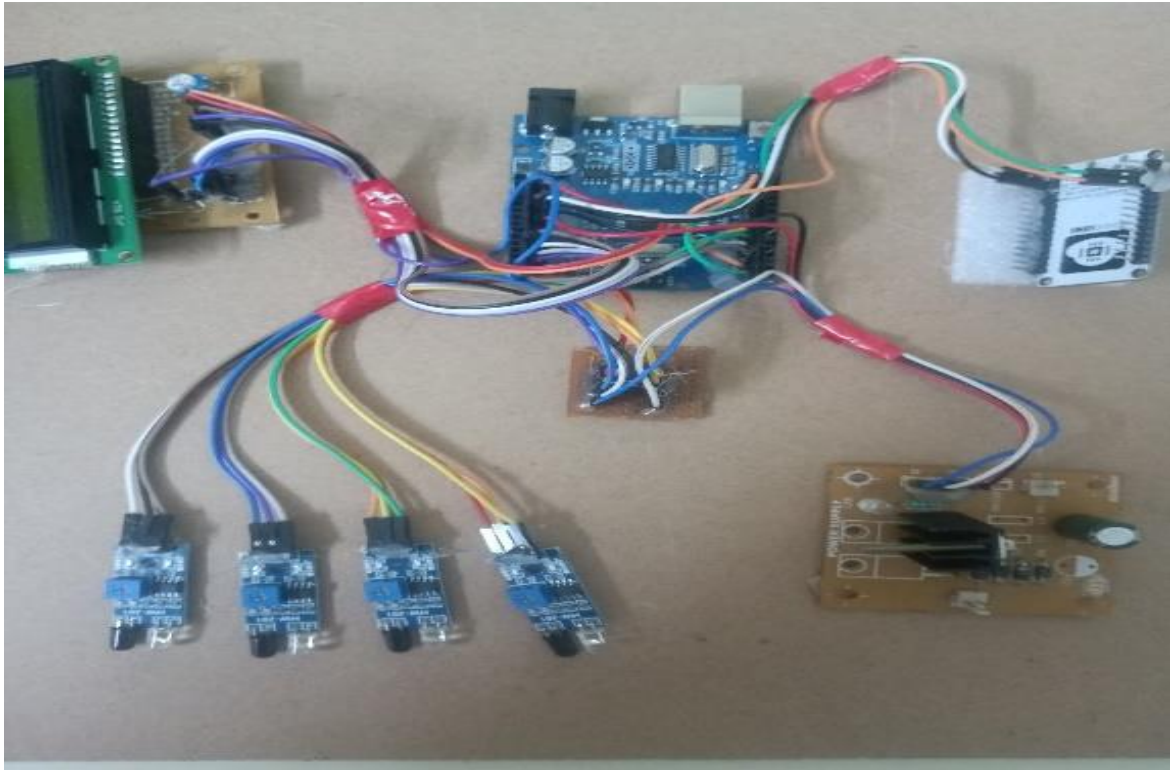


Fig 5.1 Hardware component connection

The above figure 5.1 represents the hardware connection. The main hardware component is Arduino Uno which is used to connect the other hardware components. The Arduino Uno is connected to various components like Node MCU, IR Sensor, LCD display board and power supply. The components are connected with jumper wires. The Node MCU is a Wi-Fi module, since it is a Wi-Fi module it will be easy to access using Wi-Fi. The IR sensors play an important role here as this detects the motion of the person. The power supply is used to connect all the hardware components and this makes the whole hardware system to work. The information gathered from Arduino and Node MCU is given to a PHP server. The output can be seen in personal laptops.

5.1 OUTPUT

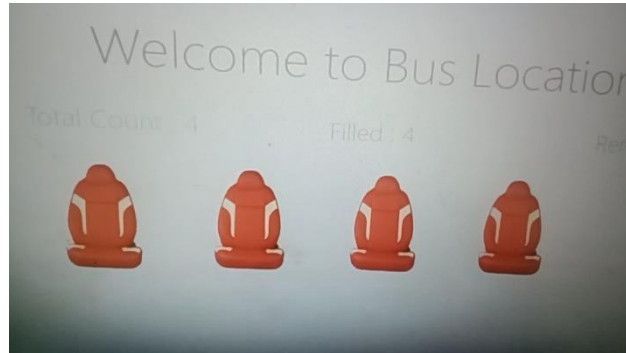


Fig 5.2 All seats are filled

The figure 5.2 represents that all the seats in bus are filled. The people cannot occupy the seats as the seats are completely filled. The mechanism involved here is, when a person is moving the IR sensor detects the motion. If the IR sensor detects motion i.e. if the person occupy the seat the seat in the above figure shows red and if the seat is empty it will be green in colour.



Fig 5.3 Two seats are filled

The figure 5.3 represents that only two seats are filled and remaining two seats are vacant for the people to occupy. The mechanism involved here is, when a person is moving the IR sensor detects the motion. If the IR sensor detects motion i.e. if the person occupy the seat the seat in the above figure shows red and if the seat is empty it will be green in colour.

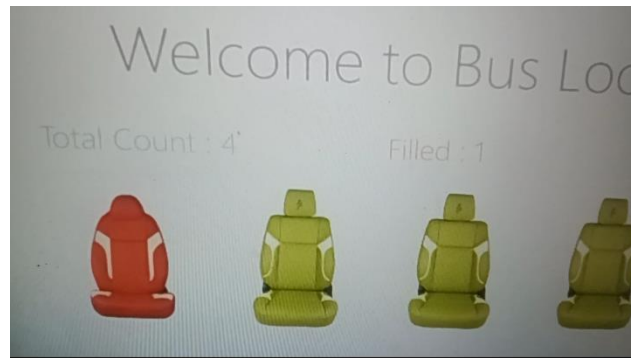


Fig 5.4 One seat is filled

The figure 5.4 represents that only seat is filled and remaining three seats are vacant. These seats can be occupied by the people as they are vacant. The mechanism involved here is, when a person is moving the IR sensor detects the motion. If the IR sensor detects motion i.e. if the person occupy the seat the seat in the above figure shows red and if the seat is empty it will be green in colour.

The information gathered from Arduino and Node MCU is given to a PHP server. The output can be seen in personal laptops.

CHAPTER 6

CONCLUSION

In this super-fast technological world, the usage of private vehicles like cars, bikes have been increased in a much-advanced way than one can imagine. But most of the people prefer using public buses instead of their private vehicles because of the day-by-day increments in gasoline prices and traffic jams. In this hectic world, everyone rushes into the buses without prior knowledge of the vacancy of seats and prefers to go on the footboard. Though the government is scheduling a number of rules and regulations, all goes in vain. Many public institutes developed a system for customers convenience, which displays the passenger vehicle position, but the number of vacant seats is not implemented. Therefore, customers time will be wasted searching for buses having accessible seats, which troubles them in managing their activities. If both the passenger vehicle's position and the availability of free spaces are known, customers can use this time in other activities instead of waiting for the buses. Thus, the travel can be planned in a much better way by the customers.

IoT technology is used in better way to find the innovations in the existing systems. It improves the need of essentials in every field. In long distance travel, IoT system helps to increase the efficiency and effective process on every need of the user. Digitalization of seat vacancy checking in the vehicles is also a kind of development in this fast -growing world. The proposed system is designed to detect the seat vacancies in the vehicles using the sensors mounted with some IoT devices.

Here, an automated system for passenger counting in sitting service bus is presented. The proposed project provides efficient and innovative way to give complete access, flexibility and satisfaction to the authority. It will work like a virtual helper. Our system can be a milestone to reduce the corruption in public transport system in India. It is an easy and efficient way to implement in real-time applications.

6.1 FUTURE WORK

- **Improved Passenger Experience:** The passenger experience will be greatly improved by real-time seat availability information, which will lessen annoyance and increase the allure of using public transit.
- **Increased Efficiency:** Transport authorities will be able to more effectively manage the transportation system and distribute resources thanks to the system's data-sharing capabilities.
- **Cost Savings:** The technology can aid in resource optimization, lowering operating expenses for transportation companies.
- **Enhanced Safety:** The device may be utilized to keep an eye on the vehicle's occupancy and make sure that no one is packing the car to capacity, which could compromise safety.
- **Potential for Expansion:** The technology utilized in this research is transferable to other fields outside public transit, such the restaurant sector, where real-time data on available tables can be helpful.
- **Environmental Sustainability:** Real-time seat availability data can promote the use of public transit over private automobiles, therefore easing traffic and cutting emissions.

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