Semester-2 Project

Hardware Workshop SeatSense

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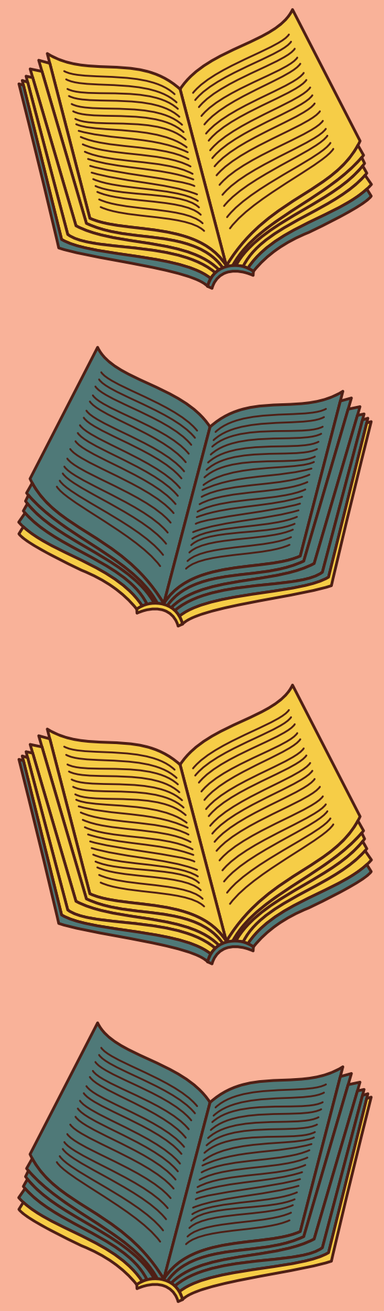
SeatSense

Smart Bus Seat Monitoring System

Objective: The Smart Bus Seat Monitoring System aims to enhance the commuting experience for passengers by providing real-time information about seat availability within a bus. This project addresses the common issue of uncertainty regarding seat availability, allowing passengers to make informed decisions before entering the bus and improving overall transportation efficiency.



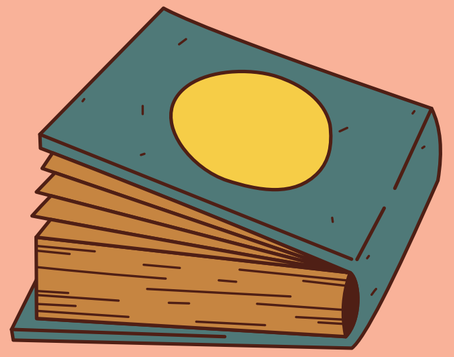
Vision and Sight:

Enhanced Efficiency	Cost Savings	Enhanced Passenger Experience
Real-time data collection and analysis for optimized resource allocation. Streamlined operations leading to improved service reliability and punctuality.	Reduction in manual labor costs associated with traditional counting methods. Increased revenue potential through improved capacity utilization and fare optimization.	Reduced overcrowding and improved onboard comfort. Tailored services based on accurate passenger demographics and preferences.

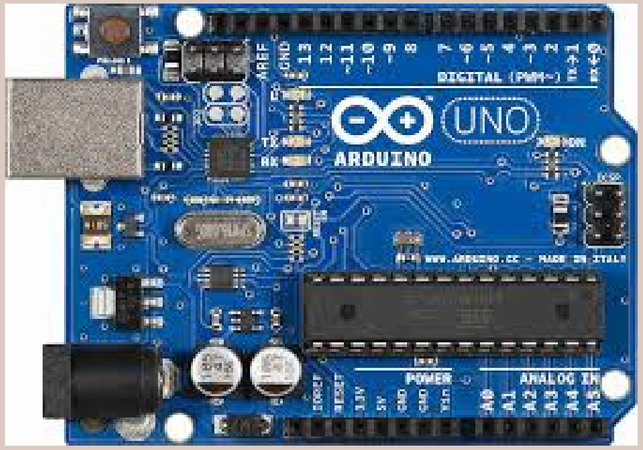
Components

Creating a device that senses the number of vacant seats in a bus involves combining various technologies to achieve accurate and reliable seat occupancy detection.

1. IR sensors
2. Arduino Uno
3. (16*2) LCD DISPLAY
4. Esp8266 wifi module



Arduino Uno



- Arduino UNO SMD ATmega328

- Datasheet

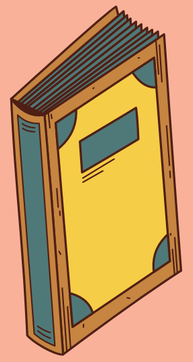
1. Microcontroller ATmega328P-AU
2. Operating Voltage 5V
3. Input Voltage (recommended) 7-12V
4. Input Voltage (limits) 6-20V
5. Digital I/O Pins 14 (of which 6 provide PWM output)
6. Analog Input Pins 6
7. DC Current per I/O Pin 40 mA
8. DC Current for 3.3V Pin 50 mA
9. Flash Memory 32 KB of which 0.5 KB used by bootloader
10. SRAM 2 KB EEPROM 1 KB
11. Clock Speed 16 MHz

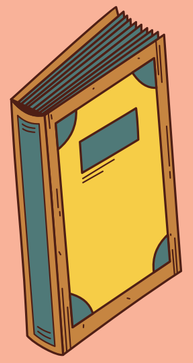
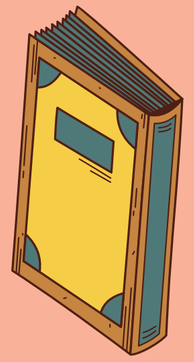
Arduino Uno

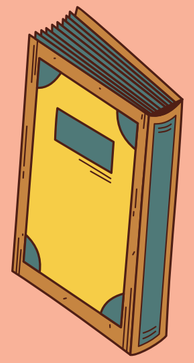
It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Programming Arduino

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno w/ ATmega328" from the Tools > Board menu (according to the microcontroller on your board).
The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header.



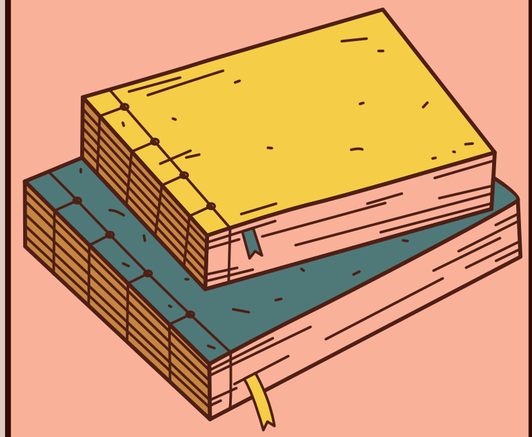


Specifications for Arduino

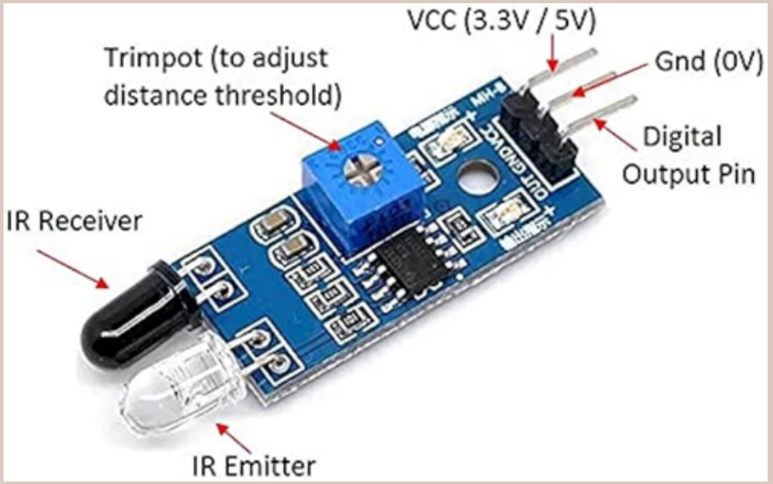
Memory

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the bootloader); It has also 2 KB of SRAM and 1 KB of EEPROM

Microcontroller	ATmega328
Digital I/O Pins	14
Analog Inputs	6
Crystal Oscillator Frequency	16MHz
Operating Voltage	6-20V
Dimensions	7 x 5 x 1cms
Weight	10 grams



IR SENSOR

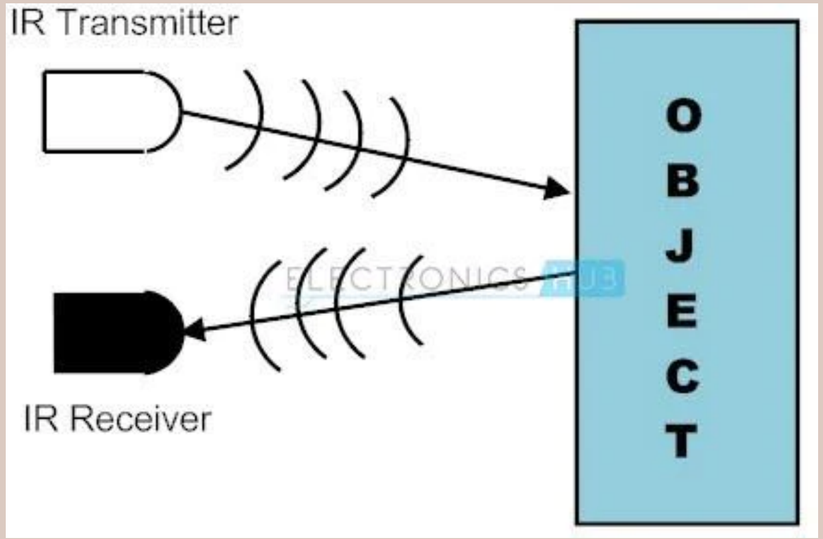


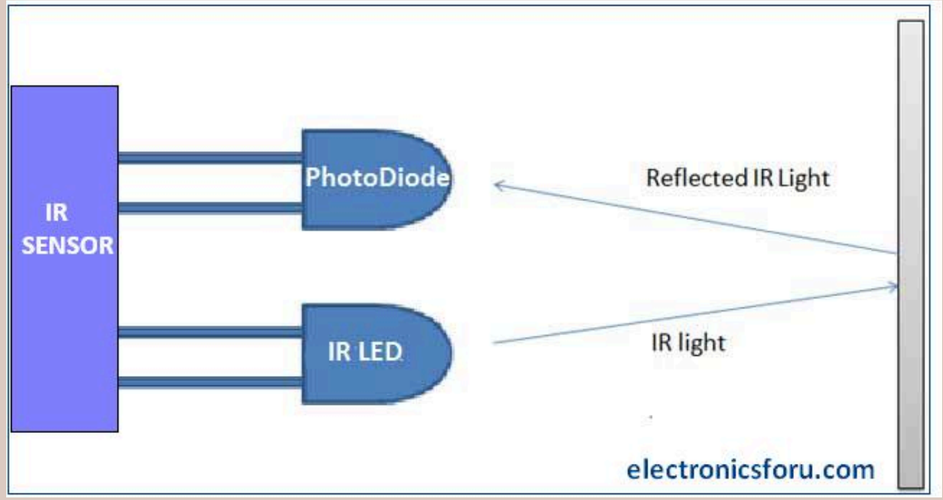
FEATURES:

- Easy to assemble and use
- Onboard detection indication
- The effective distance range of 2cm to 30cm
- A preset knob to fine-tune distance range
- If there is an obstacle, the indicator lights on the circuit board.

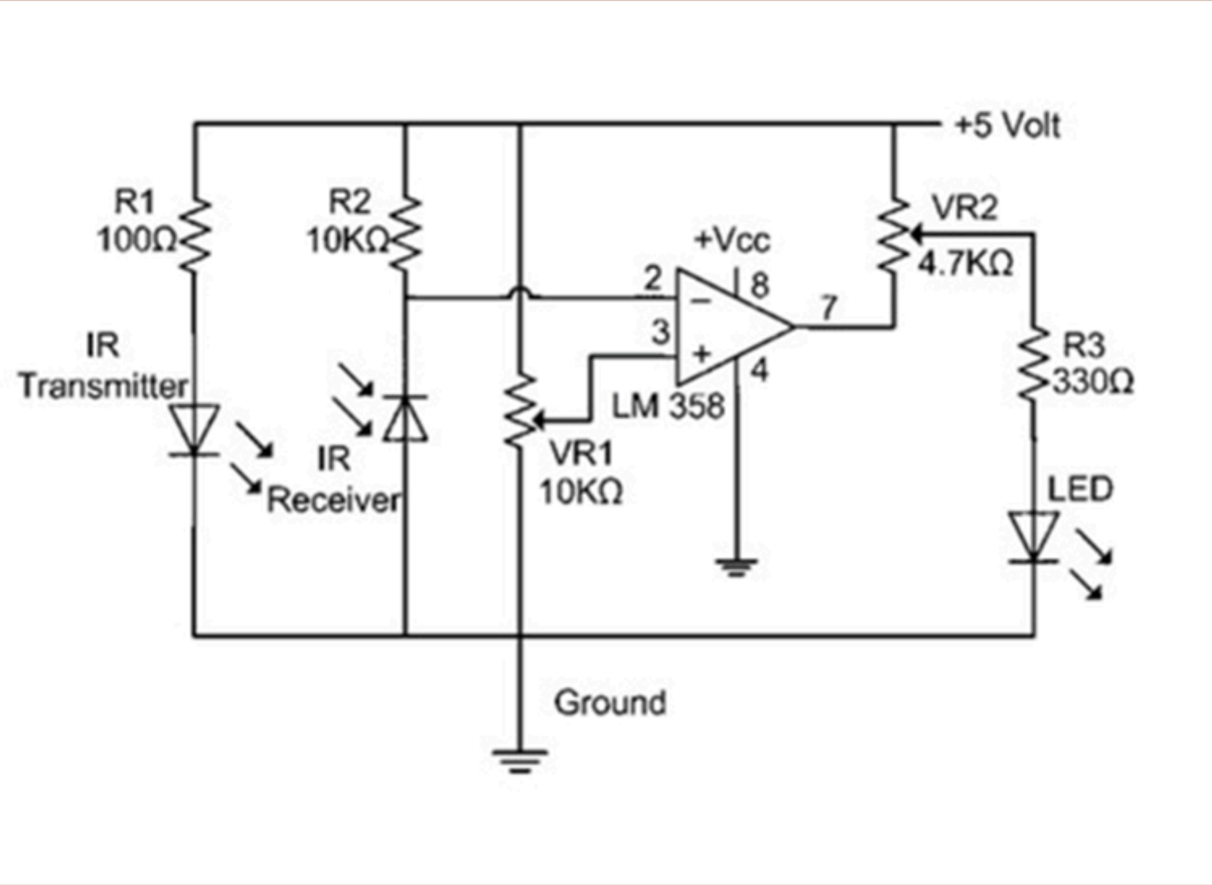
WORKING PRINCIPLE:

IR proximity sensors are devices that use invisible light to sense things. They have a part that sends out light and a part that receives light. When something comes close to them, it bounces light back to the receiver. The sensor looks at the reflected light to see if there's an object nearby and how far it is. If it detects something, it sends a signal to indicate it's active. This signal can trigger actions like sound alerts, moving machine parts, or altering a robot's path.





IR Proximity Sensor Circuit Diagram:



The IR proximity sensor circuit consists of the following components:

- LM358 IC
- Resistors in the kilo-ohm range
- 2 pairs of IR transmitter and receiver
- LED
- Variable resistors

Limitations of Infrared sensor :

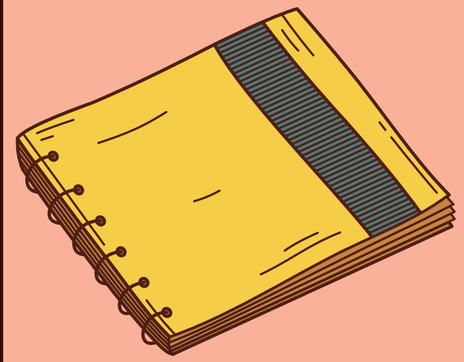
Following are the limitations of Infrared sensor :

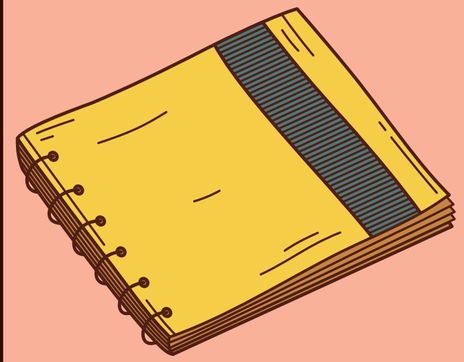
• Infrared frequencies are influenced by hard articles (for example dividers, entryways), smoke, dust, haze, daylight and so on Thus it doesn't work through dividers or entryways.

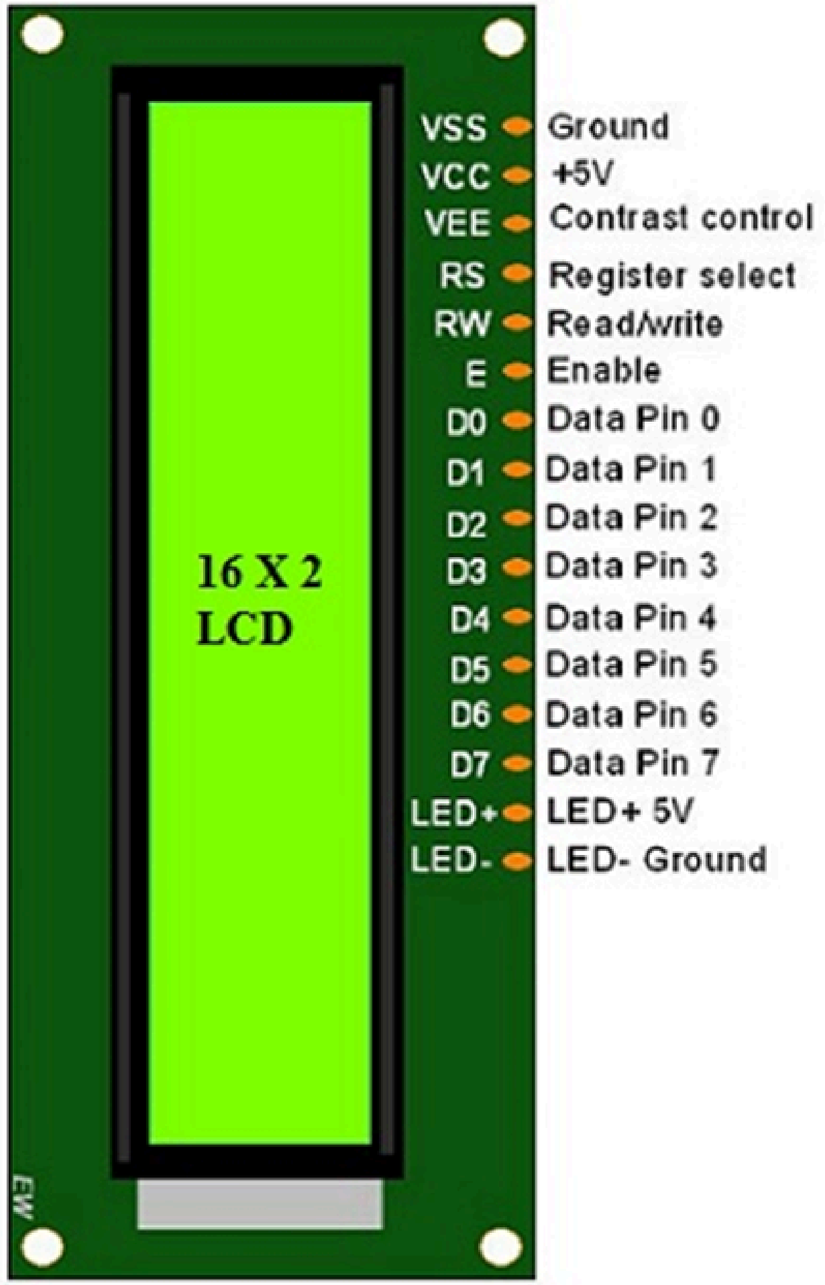
• Infrared waves at high force can harm eyes.

• In screen and control application, it can control just a single gadget at one time. Additionally it is hard to control things which are not in LOS (Line of Sight). It requires view among transmitter and collector to convey.

·It underpins more limited reach and consequently it execution corrupts with longer distances.
·It upholds lower information rate transmission contrast with wired transmission.



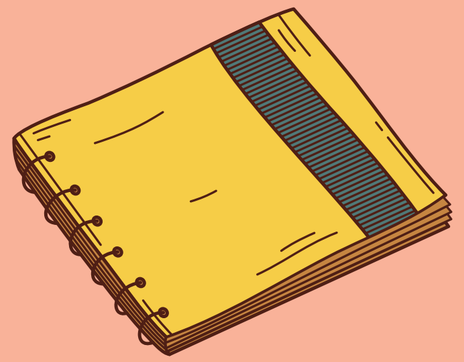




LCD DISPLAY

Features of LCD16x2

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters



Registers of LCD

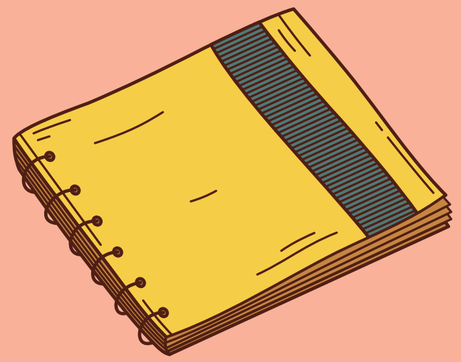
A 16×2 LCD has two registers like data register and command register. The RS (register select) is mainly used to change from one register to another. When the register set is ‘0’, then it is known as command register. Similarly, when the register set is ‘1’, then it is known as data register.

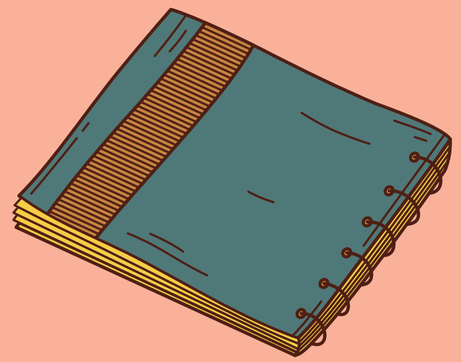
Command Register:

The main function of the command register is to store the instructions of command which are given to the display. So that predefined tasks can be performed such as clearing the display, initializing, set the cursor place, and display control. Here commands processing can occur within the register.

Data Register:

The main function of the data register is to store the information which is to be exhibited on the LCD screen. Here, the ASCII value of the character is the information which is to be exhibited on the screen of LCD. Whenever we send the information to LCD, it transmits to the data register, and then the process will be starting there. When register set =1, then the data register will be selected.





Principal LCD Advantages:

1. Sharpness

Image is perfectly sharp at the native resolution of the panel. LCDs using an analog input require careful adjustment of pixel tracking/phase (see Interference, below).

2. Geometric Distortion

Zero geometric distortion at the native resolution of the panel. Minor distortion for other resolutions because the images must be rescaled.

3. Brightness

High peak intensity produces very bright images. Best for brightly lit environments.

4. Screen Shape

Screens are perfectly flat.

5. Physical

Thin, with a small footprint. Consume little electricity and produce little heat.

Principal LCD Disadvantages:

1. Resolution

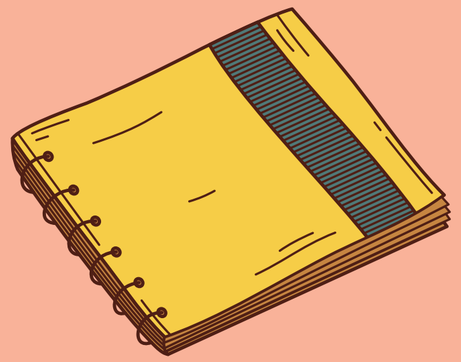
Each panel has a fixed pixel resolution format determined at the time of manufacture that can not be changed. All other image resolutions require rescaling, which generally results in significant image degradation, particularly for fine text and graphics. For most applications should only be used at the native resolution of the panel. If you need fine text and graphics at more than one resolution do not get an LCD display.

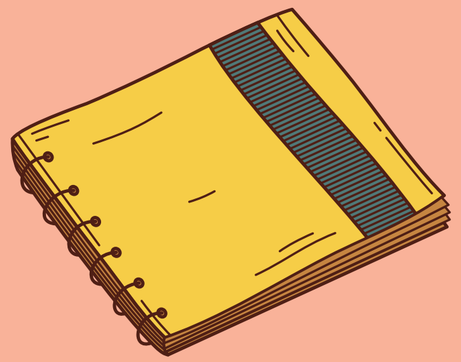
2. Viewing Angle

Limited viewing angle. Brightness, contrast, gamma and color mixtures vary with the viewing angle. Can lead to contrast and color reversal at large angles. Need to be viewed as close to straight ahead as possible.

3. Black-Level, Contrast and Color Saturation

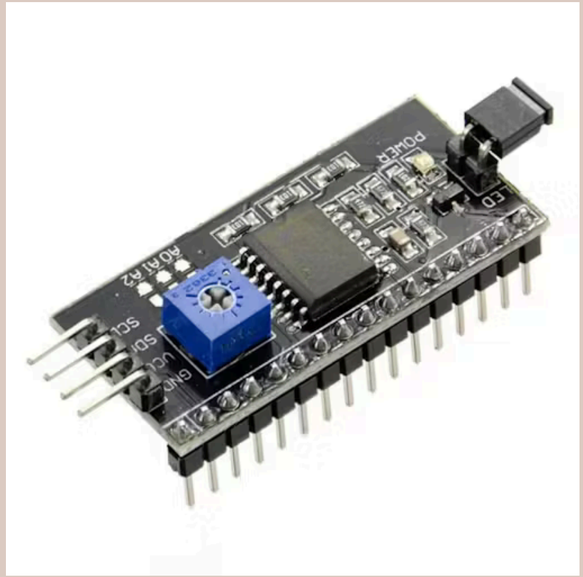
LCDs have difficulty producing black and very dark grays. As a result they generally have lower contrast than CRTs and the color saturation for low intensity colors is also reduced. Not suitable for use in dimly lit and dark environments.





16x2 LCD I2C Interface Adapter

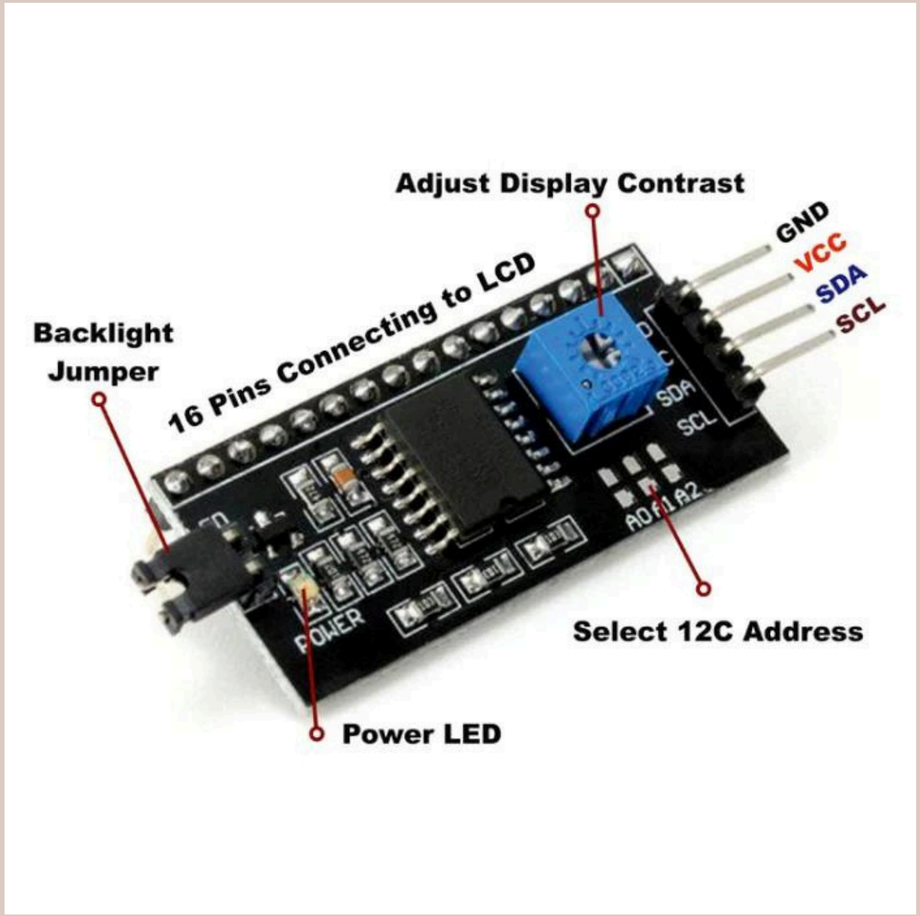
FEATURES:

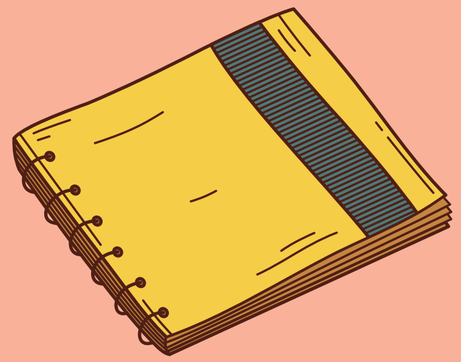


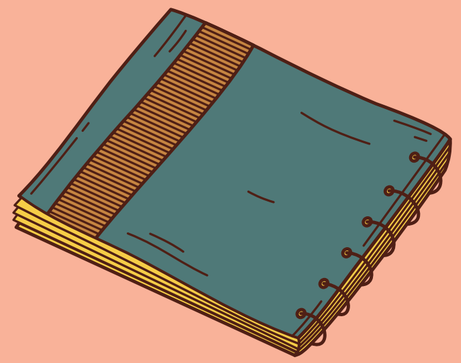
- Serial I2C control of LCD display using PCF8574.
- Backlight can be enabled or disabled via a jumper on the board.
- Contrast control via a potentiometer
- RoHS-compliant I2C Serial LCD Daughter board.
- You can connect 16x4 and 20x4 LCD display with I2C interface.
- Supports 4-bit mode, which Character Modules widely support.
- Utilizes a PCF8574 I2C chip to convert I2C serial data to parallel data for the LCD.
- The default I2C address is 0x3F, but it can be changed via 3 solder jumpers provided on the board.
- Allows control of up to 3 LCDs via a single I2C bus, each with its address.
- Enhances project efficiency and simplicity with its I2C communication protocol.

Applications:

- Various applications in electronics and DIY projects.
- Ideal for use with Arduino and other microcontroller-based systems.
- Suitable for hobbyists and professionals alike.
- Versatile usage in robotics, automation, and
- DIY endeavors.

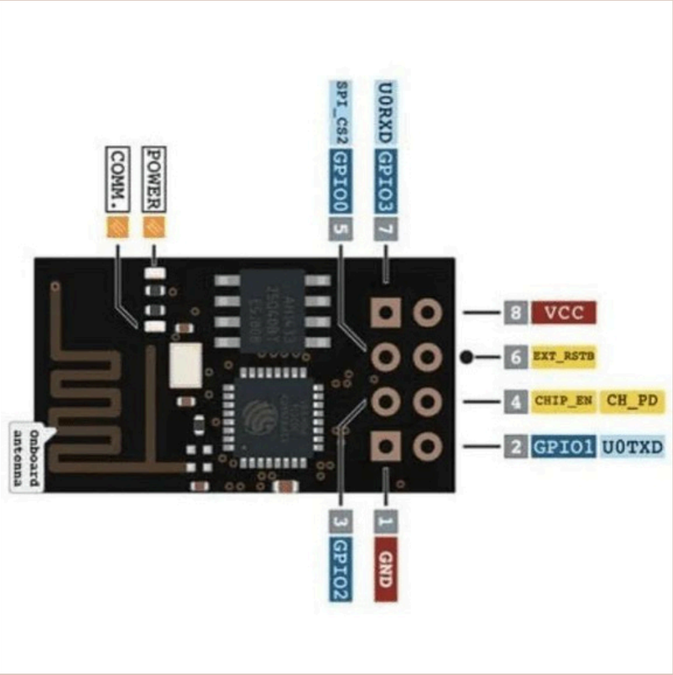






ESP01 ESP8266 Wireless Transceiver Module

- The ESP 01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.



- When getting to know and use this device, the best approach is to use a USB to 3.3V TTL converter and a 3.3v power supply. Avoid working with any devices that require or output 5V levels

Applications:

- A wireless location-sensing device
- Wireless positioning system beacon
- Smart socket/intelligent light
- Mesh Network
- Industrial wireless control devices

Operating Voltage	3.3VDC
Wifi	802.11 b/g/n
Flash Memory	1mb
Interface	SDIO 1.1 / 2.0, SPI, UART
Dimensions	25 x 15 x 11 mm
Weight	5 grams

Methodology of making the project

Placement of IR Sensors

A single IR sensor strategically placed at the bus entrance/exit accurately detects passenger movement, ensuring unobstructed monitoring.

Arduino Uno

Processes sensor data and controls the system, is centrally located within the bus. The placement ensures easy access for maintenance and troubleshooting

WiFi ESP8266

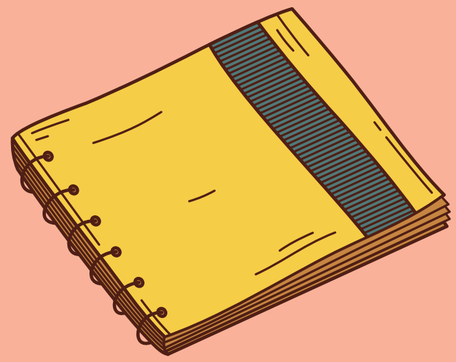
Situated near the Arduino, ensuring a stable connection and optimal signal strength. Connected with IR sensors for application integration.

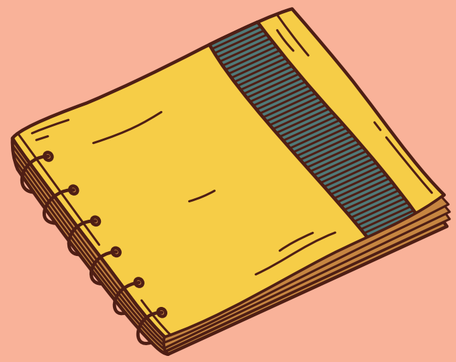
Project Design and Implementation

LCD Display
The LCD display, offering real-time seat occupancy updates, is positioned visibly within the bus. Typically, it's mounted near the entrance or above the driver's compartment, ensuring easy visibility for passengers and staff at eye level.

Wiring and Cable Management
Wiring is simplified with just two sensors, yet careful cable management remains crucial for neatness and interference prevention. Cables from sensors to the Arduino and WiFi module are routed neatly along the bus's interior.

Software integration
We developed the Android application using Android Studio to display seat availability, while setting up a server with WAMP and managing it through PuTTY for storing and processing seat occupancy data.





SeatSense App and Server

Bluetooth integration and user-friendly interface, the app ensures a stress-free journey for users, keeping them informed and optimizing their transportation choices.

App Development:

The "what" of the text.

- User Interface
- Wifi integration
- Data transmission
- Real-time updates
- Notification

Arduino Integration

The "how" of the text.

- Wifi Module
- Sensor integration
- Arduino code
- Power supply
- Simulator testing
- Real-world testing

Challenges Faced

Overcoming hurdles in the development process, we encountered several challenges that shaped our journey towards creating the Smart Bus Seat Monitoring System.

1

Transitioning from ESP01 to ESP8266 for better integration with the application.

2

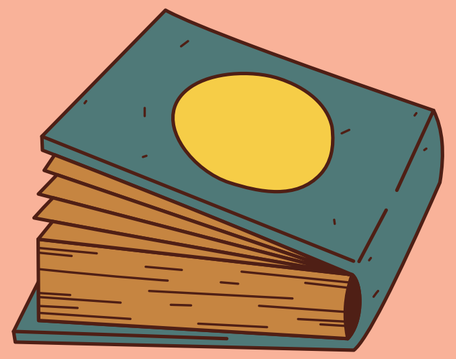
Switching from Blynk to Android Studio due to ESP01 unresponsiveness.

3

Adapting to using four IR sensors instead of two for Arduino and ESP8266 integration.

4

Identifying and rectifying an infinite loop issue in the Arduino and PHP code for website development on WAMP.



Future Scalability

Predictive Analytics Integration: Integrate predictive analytics to forecast seat availability using historical data, optimizing passenger experience.

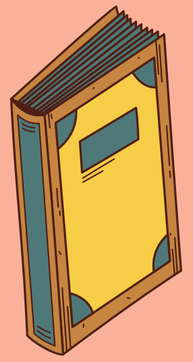
Expansion to Other Transportation Modes: Extend the system to trains, trams, or ferries, broadening its reach and enhancing transportation options.

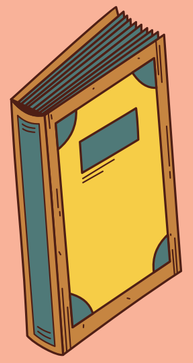
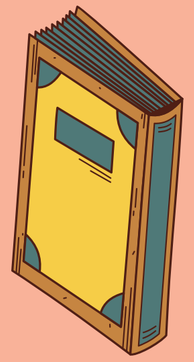
API Development for Third-Party Integration: Develop APIs to allow third-party developers to integrate the seat occupancy data into their applications or services, fostering innovation and collaboration in the transportation sector.

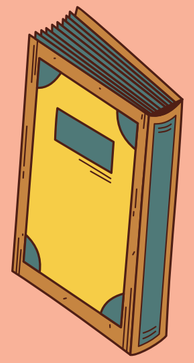
Integration with Smart Payment Systems: Integrate with smart payment methods for seamless fare collection and improved passenger convenience.

Continuous Feedback Loop: Establish a mechanism for collecting feedback from passengers to identify areas for improvement and innovation.

Dynamic Route Optimization: Develop algorithms to dynamically optimize bus routes based on real-time passenger demand and traffic conditions





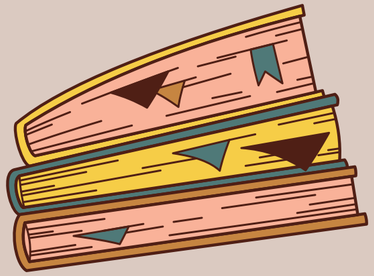
Results and Achievements

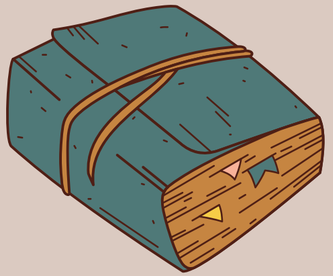
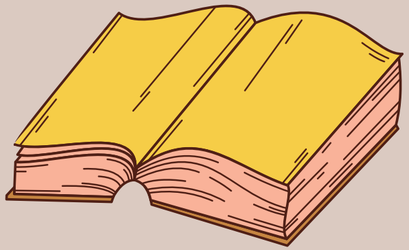
Real-Time Seat Availability: Delivered instant seat availability updates via hardware LCD displays, Android application, and website, enriching the commuting experience.

Seamless Integration: Successfully harmonized hardware and software components, ensuring smooth functioning across all platforms.

Improved Efficiency: Facilitated informed decision-making for passengers through synchronized data presentation on LCD displays, mobile application, and website.

Overcoming Challenges: Triumphed over various obstacles to achieve project completion, ensuring a comprehensive solution for seat monitoring.

Thank You!