

REAL TIME CAR PARKING AUTOMATION AND SLOT RESERVATION FOR URBAN MOBILITY

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering in Electronics and Communication Engineering

By

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION
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SATHYABAMA

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

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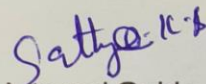
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **E.DEEPAK NAIDU(40130054)**, **E.THARUN CHANDRA(40130053)** who carried out the project entitled "**REAL TIME CAR PARKING AUTOMATION AND SLOT RESERVATION FOR URBAN MOBILITY**" under our supervision from Nov 2023 to April 2024.


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DECLARATION

We, **E. DEEPAK NAIDU** (40130054) and **E.THARUN CHANDRA** (40130053) hereby declare that the Project Report entitled "**REAL TIME CAR PARKING AUTOMATION AND SLOT RESERVATION FOR URBAN MOILITY**" done by me under the guidance of **Dr. K.B.Sathya, Ph.D**, at Sathyabama Institute of science and Technology is submitted in partial fulfillment of the requirements for the award of a Bachelor of Engineering degree in Electronics and Communication Engineering

DATE: 18-04-2024

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ABSTRACT

In today's busy urban landscapes, efficient car parking management is crucial for enhancing mobility and reducing congestion. This paper proposes a real-time car parking automation system utilizing RFID technology, IR sensors, and LED lights to streamline the process of slot reservation and optimize parking space utilization. The system employs RFID tags embedded in vehicles to enable seamless identification and communication with the parking infrastructure. Upon entering the parking facility, IR sensors detect the presence of vehicles and relay this information to a centralized control system. LED lights strategically placed throughout the parking lot indicate the availability of slots, guiding drivers to vacant spaces. Through an intuitive mobile application or web interface, users can reserve parking slots in advance, minimizing the time spent searching for a spot and enhancing convenience. The system dynamically updates slot availability in real-time, ensuring accurate and efficient utilization of parking resources. Furthermore, the integration of RFID technology enables automated payment processing, eliminating the need for physical tickets or cash transactions. This not only enhances the user experience but also reduces operational costs for parking management authorities. Additionally, the system can be configured to provide insights and analytics on parking patterns and utilization trends, facilitating informed decision-making for urban planners and policymakers. By leveraging RFID, IR sensors, and LED lights, this innovative parking automation solution offers a scalable and adaptable approach to addressing the challenges of urban mobility, ultimately contributing to a more sustainable and efficient urban transportation ecosystem.

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CHAPTER-1

INTRODUCTION

1.1 GENERAL

The introduction of the Real Time Car Parking Automation Mechanism marks a pivotal advancement in urban infrastructure ,responding to the escalating challenges of parking congestion in modern cities. As urbanization surges, the demand for efficient and automated parking solutions becomes imperative. This innovative system seamlessly integrates cutting-edge technologies such as advanced sensors, artificial intelligence, and automation to revolutionize the conventional parking paradigm.

Traditional parking management often suffers from inefficiencies, leading to traffic bottlenecks, wasted time, and increased pollution. The Real-Time Automatic Car Parking Mechanism aims to address these issues by providing a dynamic and intelligent approach to parking. By deploying sensors that detect and relay real-time data on available parking spaces, the system optimally allocates parking slots using sophisticated machine-learning algorithms. This not only maximizes the utilization of parking spaces but also minimizes the time spent by drivers searching for suitable spots.

Furthermore, the integration of a centralized control system facilitates seamless communication between parking sensors and the user interface. Drivers are empowered with real-time information on parking availability, enabling them to make informed decisions swiftly. This introduction sets the stage for a discussion on the operational intricacies, benefits, and the transformative impact that the Real-Time Automatic Car Parking Mechanism promises in alleviating urban parking challenges.

Urban mobility faces significant challenges, including traffic congestion and parking shortages To address these issues, real-time car parking automation and slot reservation systems offer innovative solutions. By integrating Arduino Nano

microcontrollers, RFID technology, IR sensors, and LED lights, we can create an efficient and user-friendly parking management system.

This system aims to streamline the parking process by allowing drivers to reserve parking slots in advance, reducing the time spent searching for available spaces. Additionally, it enhances safety and convenience through automation, guiding drivers to their designated parking spots using LED indicators.

In this project, we will explore the design, implementation, and benefits of such a system, highlighting its potential to revolutionize urban mobility and improve the overall parking experience for both drivers and city residents.

1.2 EMBEDDED SYSTEMS

A system is something that maintains its existence and functions as a whole through the interaction of its parts. E.g. Body, Mankind, Access Control, etc A system is a part of the world that a person or group of persons during some time interval and for some purpose choose to regard as a whole, consisting of interrelated components, each component characterized by properties that are selected as being relevant to the purpose.

- Embedded System is a combination of hardware and software used to achieve a single specific task.
- Embedded systems are computer systems that monitor, respond to, or control an external environment.
- Environment connected to systems through sensors, actuators and other I/O interfaces.
- Embedded system must meet timing & other constraints imposed on it by environment.

An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, nor a traditional business or scientific application. High-end embedded & lower-end embedded systems. High-end embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistants and Mobile phones etc. Lower-end embedded systems -

Generally, 8,16 16-bit controllers are used with a minimal operating system and hardware layout designed for the specific purpose.

Applications

Embedded systems find applications across a wide range of domains, including:

Consumer Electronics: From smartphones and smartwatches to smart home devices and entertainment systems, embedded systems enhance the functionality and connectivity of consumer electronics.

Automotive Industry: Embedded systems control numerous functions in modern vehicles, including engine management, infotainment systems, safety features, and autonomous driving technologies.

Industrial Automation: Embedded systems enable process control, monitoring, and automation in manufacturing, robotics, and industrial machinery, improving efficiency and productivity.

Healthcare: Medical devices, wearable health monitors, and diagnostic equipment utilize embedded systems for patient monitoring, data collection, and treatment delivery.

IoT (Internet of Things): Embedded systems form the backbone of IoT devices, facilitating communication, data processing, and interaction with the physical world in smart cities, agriculture, healthcare, and more.

Aerospace and Defense: Embedded systems are critical for avionics, spacecraft control, navigation systems, weapon systems, and surveillance applications in the aerospace and defense sectors.

1.3 DESIGN OF EMBEDDED SYSTEM

Like every other system development design cycle embedded system too have a design cycle. The flow of the system will be like as given below

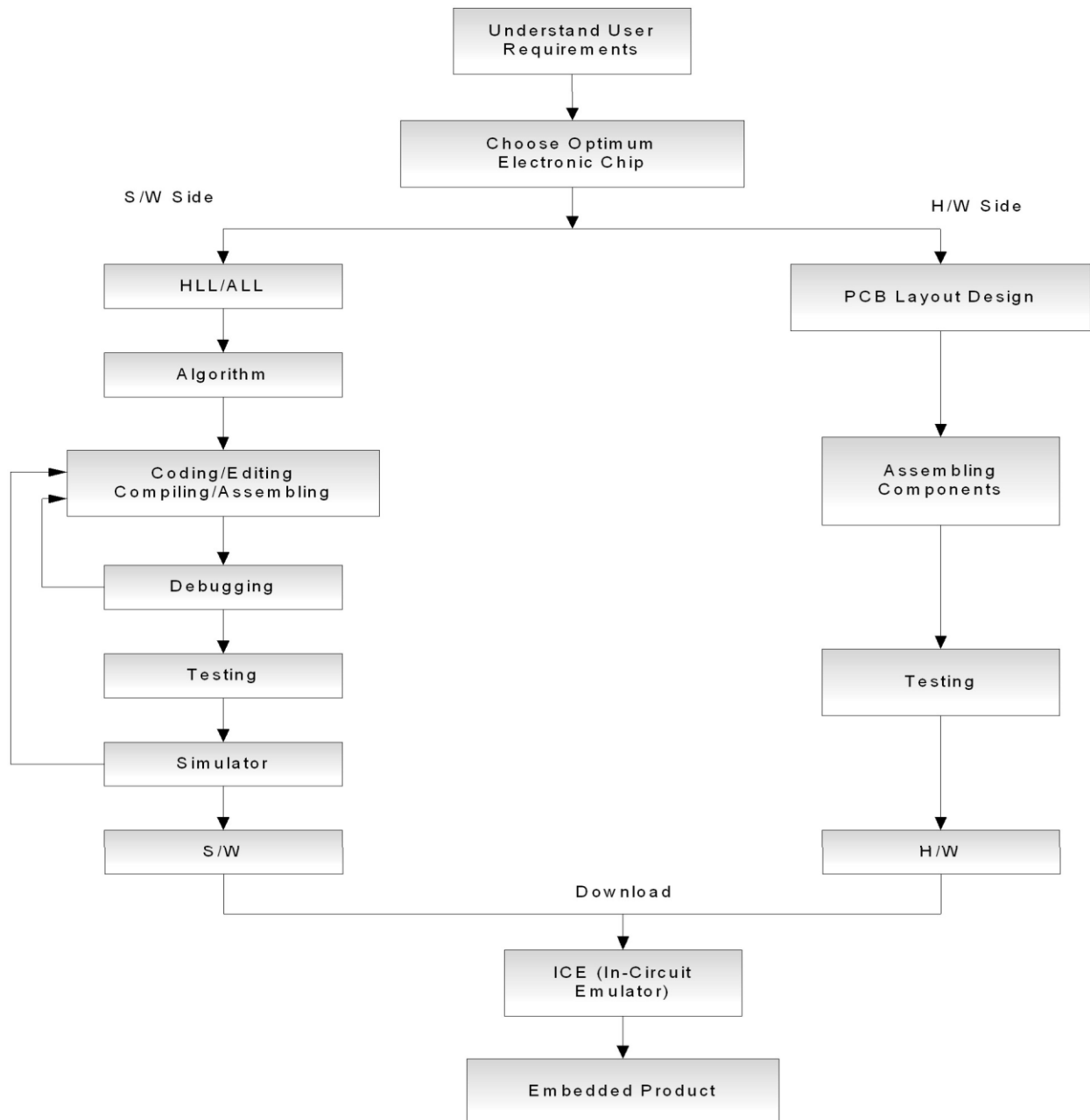


Fig 1.1 Embedded Product Development Life Cycle

From the initial state of the project to the final fabrication the design considerations will be taken like the software consideration and the hardware components, sensor, input and output. The electronics usually uses either a microprocessor or a microcontroller. Some large or old systems use general-purpose mainframe computers or minicomputers.

1.4 CLASSIFICATION

- Real-Time Systems.
- RTS has to respond to events within a specified deadline.
- A right answer after the deadline is a wrong answer
- RTS classification
 - Hard Real-time Systems
 - Soft Real-Time System

Hard Real-time Systems

- "Hard" real-time systems have very narrow response time.
- Example: Nuclear power system, Cardiac pacemaker.

Soft Real-Time System

- "Soft" real-time systems have reduced constraints on "lateness" but still must operate very quickly and repeatably.
- Example: Railway reservation system – takes a few extra seconds the data remains valid.

CHAPTER-2

LITERATURE SURVEY

2.1 “A cloud-based smart parking system based on IoT technologies “, Journal of Critical Reviews,Z.Mukadam and R.Logeswaran (2020)

In contemporary urban landscapes, the scarcity of parking spaces poses a significant challenge, prompting the development of various Smart Parking systems (SPS). This paper undertakes a comprehensive examination, comparison, and in-depth analysis of SPSs, delving into technological modalities, sensor types, networking methodologies, user interfaces, computational strategies, and the services they render. Additionally, it addresses a research void by offering insights into the adaptability of SPSs across diverse environmental conditions, elucidating their merits and demerits. Through a meticulous comparison of multiple facets of SPSs, the paper equips researchers, designers, and policymakers with the tools to discern the most suitable SPS while staying abreast of current trends in this dynamic sector.

Chemical and biological sensors based on graphene, such as temperature sensors, biological sensors and gas sensors, were reviewed. It was shown that graphene had a great potential in the optical fiber sensing technology. Furthermore, the deficiencies and challenges of the graphene in the applications of optical fiber sensors were analyzed. In a whole, the unique advantages of graphene have present their versatility and importance in the application fields of optical fiber sensors.

2.2 “Internet of Intelligent Things : injection of Intelligence into IoT devices” S.P Singh, A.Solanki,T.Singh and A.Tayal (2021)

The paper by S. P. Singh, A. Solanki, T. Singh, and A. Tayal titled "Internet of Intelligent Things: Injection of Intelligence into IoT Devices," explores the infusion of intelligence into Internet of Things (IoT) devices. Published in 2021, it is a part of the book "Artificial Intelligence to Solve Pervasive Internet of Things Issues." The abstract encapsulates a journey into enhancing IoT with intelligent capabilities. It

discusses advancements in injecting intelligence, potentially revolutionizing IoT functionalities. Within a limited framework, the authors delve into the critical nexus of AI and IoT, paving the way for a more nuanced understanding of the synergies between intelligent technologies. The paper contributes to the discourse on evolving technologies, providing a foundation for researchers and practitioners navigating the landscape of intelligent IoT solutions.

2.3 “Park King : an IoT based Smart Parking System”, C.Ajchariyavanich, T.Limpisthira and N.Chanjarasvichai (2019)

People in Urban regions face a daily problem finding parking slot for their vehicles. So, this study develops a network architecture based on Internet of Things platform. A system improves the efficiency of the current cloud-based smart-parking system. This study suggested a system that assists users in automatically finding a free parking space at the lowest cost. With an application, a user can request to reserve a parking slot. The application moves a driver directly into the free slot in a garage. Also, it utilizes the distance and total number of free spaces in each garage to determine the user nearest parking slot and cost. The garage slot cost will be charged by user credit once the user entered the garage or reserved a parking slot through the application. The system proposed a novel system which picks up a parking slot, reserves, and pays for it through mobile application. The proposed system can easily be deployed in the actual world.

2.4 “Real-Time Location Based Shared Smart Parking system”, Pragati Kanchan , Chhaya Mhaske, Reena Pagare and Nikhil Kumar B. Shadoor (2020)

With the growth in population, traffic congestion and parking have become a serious problem. There is the explosive growth of the per capita amount of vehicles. In this paper, a Location-Based Shared Smart Parking System is proposed to solve the parking problem. This system is designed for both private and public parking areas. This system helps the user to find the nearest possible parking area and gives the information related to the availability of parking slots in that respective parking area. The main focus of this system is to reduce the time for finding the parking slot and also avoids unnecessary travelling through occupied parking slots in a parking area. The proposed system is designed using IoT technology, WSN (IR

sensors), QR code and RFID technology. IR sensors are used to detect the presence of the car in the parking slot and QR code is used to authenticate the user in the public parking area, RFID technology is used to authenticate the user in private parking area. The system is expected to reduce traffic problems, fuel consumption which results in reduces carbon footprints in an atmosphere.

2.5 “A Smart Real-Time Parking Control and Monitoring System “,Abdelrahman Osman Elfaki , Wassim Messoudi,Anas Bushnag,Shakour Abuzneid and Tareq Alhmiedat(2023)

Smart parking is an artificial intelligence-based solution to solve the challenges of inefficient utilization of parking slots, wasting time, congestion producing high CO2 emission levels, inflexible payment methods, and protecting parked vehicles from theft and vandalism. Nothing is worse than parking congestion caused by drivers looking for open spaces. This is common in large parking lots, underground garages, and multi-story car parks, where visibility is limited and signage can be confusing or difficult to read, so drivers have no idea where available parking spaces are. In this paper, a smart real-time parking management system has been introduced. The developed system can deal with the aforementioned challenges by providing dynamic allocation for parking slots while taking into consideration the overall parking situation, providing a mechanism for booking a specific parking slot by using our Artificial Intelligence (AI)-based application, and providing a mechanism to ensure that the car is parked in its correct place. For the sake of providing cost flexibility, we have provided two technical solutions with cost varying. The first solution is developed based on a motion sensor and the second solution is based on a range-finder sensor. A plate detection and recognition system has been used to detect the vehicle's license plate by capturing the image using an IoT device. The system will recognize the extracted English alphabet and Hindu-Arabic Numerals. The proposed solution was built and field-tested to prove the applicability of the proposed smart parking solution. We have measured and analyzed keen data such as vehicle plate detection accuracy, vehicle plate recognition accuracy, transmission delay time, and processing delay time.

CHAPTER-3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM

The aim of the real time car parking automation and slot reservation for urban mobility is to optimize parking space utilization enhance convenience for drivers, and streamline the overall parking process in urban areas. By integrating RFID technology, Arduino Nano microcontrollers, and IR sensors, the project aims to create a seamless solution for both parking operators and vehicle owners.

The system will allow drivers to reserve parking slots in advance through a mobile app or website, reducing the time spent searching for available spaces and minimizing traffic congestion. Upon arrival, RFID tags installed in vehicles will be detected by IR sensors at the entrance, automatically opening the gate and allocating the pre-booked parking slot. Real-time monitoring of parking occupancy will enable efficient management of available spaces, ensuring maximum utilization and minimizing instances of overcapacity.

Additionally, the system will provide insights into parking patterns and trends, enabling authorities to make data-driven decisions for future infrastructure planning and traffic management. Overall, the project aims to revolutionize urban mobility by providing a smart, automated solution that optimizes parking resources, reduces environmental impact, and improves the overall urban experience for residents and visitors alike

3.2 SCOPE OF THE PROJECT

3.2.1 TECHNOLOGICAL INTEGRATION

RFID Technology: Utilize RFID tags or cards for vehicle identification and access control at parking entrances/exits.

Arduino Nano: Implement Arduino Nano microcontrollers to manage sensor data,

control barriers/gates, and communicate with the central system.

IR Sensors: Deploy IR sensors for detecting vehicle presence in parking slots to facilitate real-time monitoring and slot availability updates.

Wireless Communication: Integrate wireless communication protocols like Bluetooth or Wi-Fi for data exchange between Arduino controllers and the central server.

Database Management: Implement a database system to store and manage information regarding available parking slots, reservations, and user profiles.

Mobile Application: Develop a user-friendly mobile app for slot reservation, payment processing, and navigation to available parking spaces.

3.2.2 DESIGN CONSEDARATIONS

Scalability: Design the system to accommodate varying numbers of parking spaces and user demands in urban areas.

Reliability: Ensure robust hardware and software components to minimize system downtime and maintenance requirements.

Security: Implement encryption and authentication mechanisms to secure communication channels and prevent unauthorized access to parking facilities.

User Experience: Prioritize intuitive interfaces and seamless interactions for both drivers and parking administrators.

Energy Efficiency: Optimize power consumption of sensor nodes and controllers for prolonged operation using battery or solar power sources.

Adaptability: Consider future advancements in technology and urban infrastructure to ensure the system remains relevant and adaptable to evolving need

CHAPTER- 4

EXPERIMENTAL METHODS

4.1 EXISTING SYSTEM

The Existing system of car parking management typically relies on manual process, which can often lead to inefficiencies and frustrations for both parking operators and users. In traditional setups, drivers must physically search for available parking spots, leading to congestion and wasted time. Moreover, payment methods are often outdated, requiring cash transactions or manual ticket validation. These systems lack real-time monitoring capabilities, making it difficult to manage occupancy levels effectively. Additionally, without automated reservation systems, users have limited visibility into parking availability, leading to uncertainty and inconvenience. Overall, the current approach to urban parking lacks the efficiency and convenience that modern technology can offer

4.2 PROPOSED SYSTEM

The proposed real-time car parking automation and slot reservation system aims to address the challenges of urban mobility by leveraging Arduino Nano, RFID technology, IR sensors, and LED lights. In today's congested urban landscapes, finding parking spots efficiently is a major concern for both drivers and city planners. By implementing this innovative system, we can streamline the parking process, reduce traffic congestion, and enhance overall urban mobility.

At the heart of the system lies the Arduino Nano microcontroller, a versatile and cost-effective platform capable of interfacing with various sensors and actuators. The Arduino Nano serves as the central processing unit, orchestrating the interaction between RFID readers, IR sensors, LED lights, and the reservation database.

RFID technology plays a pivotal role in enabling seamless slot reservation for parking spaces. Each vehicle is equipped with an RFID tag containing unique identification information. As a vehicle approaches the parking lot, the RFID reader

scans the tag, allowing the system to identify the vehicle and check its reservation status in real-time. If a reservation is confirmed, the corresponding parking slot is automatically allocated, and the LED indicator above the slot turns green, guiding the driver to the designated spot.

In addition to RFID, IR sensors are strategically deployed throughout the parking lot to monitor the occupancy status of individual parking spaces. These sensors detect the presence of vehicles within each slot, providing real-time data on parking availability. The Arduino Nano processes this information and updates the reservation database accordingly, ensuring accurate and up-to-date slot availability information for users.

LED lights integrated into the parking lot infrastructure serve as visual indicators, conveying crucial information to drivers at a glance. Green lights indicate available parking spaces, guiding drivers to vacant slots with ease. Conversely, red lights signify occupied spaces, allowing drivers to bypass filled slots and proceed to areas with availability. This intuitive visual feedback mechanism enhances the user experience and minimizes the time spent searching for parking.

Moreover, the system incorporates a user-friendly interface accessible via a mobile application or a dedicated web portal. Through this interface, users can conveniently reserve parking slots in advance, select preferred time slots, and manage their reservations effortlessly. The reservation database syncs in real-time with the Arduino Nano, ensuring seamless communication between the backend system and end-user

Advantages

1. **Efficient Space Utilization:** The system can optimize parking space allocation, ensuring that each spot is utilized effectively, reducing congestion and maximizing availability.
2. **Time Savings:** Drivers can reserve parking slots in advance, saving time searching for available spaces and reducing traffic congestion around parking areas.
3. **Convenience:** With RFID technology, drivers can access parking facilities seamlessly without the need for physical tickets or cash transactions, enhancing

overall convenience.

4. **Real-time Monitoring:** Operators can monitor parking occupancy levels in real-time, allowing for dynamic adjustments to optimize space allocation and improve overall management efficiency.

5. **Improved Security:** RFID technology enhances security by providing secure access control to parking facilities, reducing the risk of unauthorized parking or vehicle theft.

6. **Cost-effectiveness:** By automating the parking process and reducing the need for manual intervention, the system can potentially lower operational costs for parking facility operators.

7. **Environmental Benefits:** Efficient parking management can help reduce traffic congestion and emissions associated with vehicles searching for parking, contributing to environmental sustainability efforts in urban areas.

8. **User Experience:** LED lights can be integrated into the system to provide visual cues, guiding drivers to available parking spots quickly and enhancing the overall user experience.

9. **Scalability:** The modular design of the system allows for scalability, enabling easy expansion to accommodate growing parking demands in urban areas.

4.3 IEEE STANDARDS

IEEE 802.11(Wi-Fi)

Utilize Wi-Fi for communication between the Arduino Nano system and a central server or cloud platform for real-time data exchange, reservation management, and system control.

IEEE 802.15.4(Zigbee)

Employ Zigbee protocol for short-range wireless communication between the Arduino Nano units, enabling seamless coordination among different components within the parking system.

IEEE 802.3(Ethernet)

Implement Ethernet connectivity for wired communication between the parking system and the central server, providing an alternative or complementary means of data transfer.

ISO 18000-6C

This standard specifies the air interface protocol for RFID systems operating at 860 MHz to 960 MHz.

ISO 15693

This standard specifies the air interface protocol for RFID systems operating at 13.56 MHz.

IEEE 1609

Consider IEEE 1609 standards for communication between vehicles and infrastructure, enhancing the functionality of the parking system for smart urban mobility applications.

4.4 CONSTRAINTS

Hardware Limitations

Arduino Nano has limited processing power and memory, so optimize code and avoid resource-intensive operations.

Power-Constraints

Consider power requirements for the entire system and ensure it can be powered adequately, especially if using LED lights.

Cost Constraints

Balance the cost of components with functionality and performance requirements to ensure the system remains affordable.

Space Constraints

Arduino Nano's compact size is beneficial, but ensure all components fit within the available space in the parking system.

4.5 TRADE-OFFS

Speed vs Accuracy

Balancing the speed of detection with the accuracy of sensor readings can be crucial, especially in high-traffic areas.

Complexity vs Reliability

A more complex system may offer advanced features but could be prone to more failures. Simplifying the system may enhance reliability.

Integration vs Customization

Integrating off-the-shelf components can save time and effort but may limit customization options. Developing custom solutions offers more flexibility but requires more resources.

User Experience vs Cost

Providing a seamless user experience may require additional features or higher-quality components, which can increase costs.

4.6 ARCHITECTURE DIAGRAM

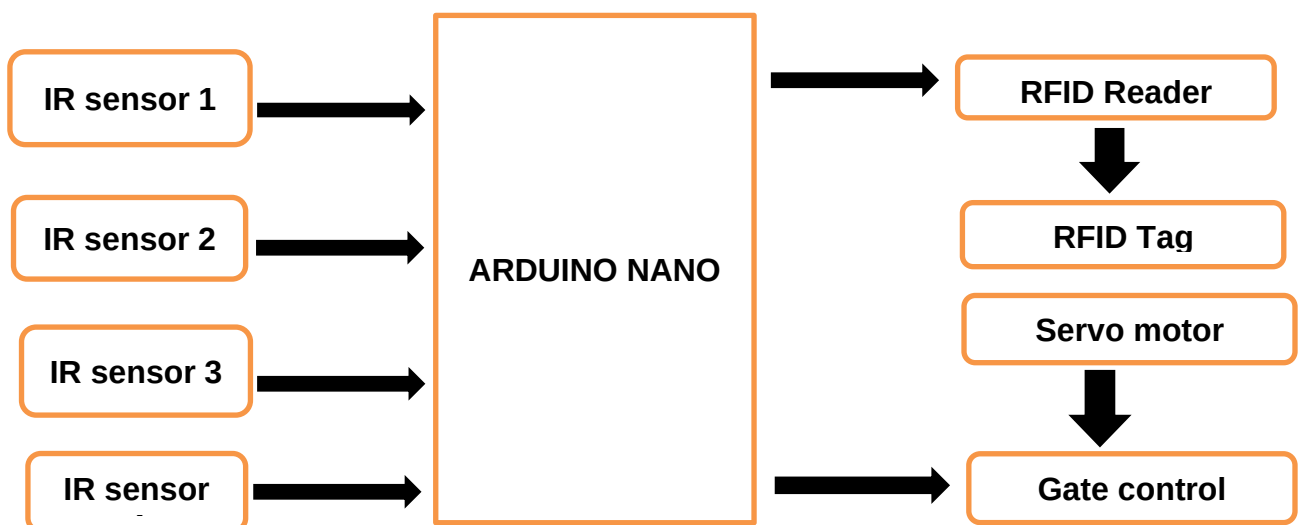


Fig 4.1 Architecture Diagram

4.7 HARDWARE REQUIREMENT

4.7.1 ARDUINO NANO

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free.

The Arduino Nano is a compact yet powerful microcontroller board that is part of the Arduino family. It's based on the ATmega328P microcontroller, offering a wide range of functionalities for various projects. With its small size and versatility, the Nano is suitable for both beginners and experienced makers alike.

At its core, the Nano provides 14 digital input/output pins, 8 analog inputs, and a 16 MHz crystal oscillator. It also features a mini-USB port for programming and power, as well as a reset button for easy debugging. Despite its diminutive size, it packs a punch in terms of capabilities, making it ideal for prototyping, experimenting,

and creating interactive electronic projects. This is what the Arduino board looks like.



Fig 4.2 Arduino Board

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

One of the key advantages of the Arduino Nano is its compatibility with the Arduino IDE, which simplifies the coding process for users of all skill levels. Whether you're writing your first lines of code or implementing complex algorithms, the Nano's intuitive programming environment makes it accessible to everyone.

Furthermore, the Nano supports a wide range of sensors, actuators, and communication modules, allowing for endless possibilities in project development. From building simple LED blinkers to crafting sophisticated IoT devices, the Nano provides the flexibility and scalability needed to bring your ideas to life.

In summary, the Arduino Nano is a versatile and compact microcontroller board that offers a wealth of features and functionalities. Whether you're a hobbyist, student, or professional, the Nano provides an excellent platform for innovation and creativity in the world of electronics and programming

Summary

- Microcontroller ATmega328P
- Operating Voltage 5V

- Input Voltage (recommended) 7-12V
- Analog Input Pins 8
- Digital I/O pins : 14 (6 optional PWM outputs)
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB (ATmega328P) of which 2KB used by bootloader
- SRAM 2 KB
- EEPROM 1 KB
- Clock Speed 16 MHz

Pin Configuration

The Arduino Nano is a popular microcontroller board with a set of digital and analog input/output pins that can be used for various purposes, including interfacing with sensors, displays, and other electronic components. Here is the pin configuration for the Arduino Nano:

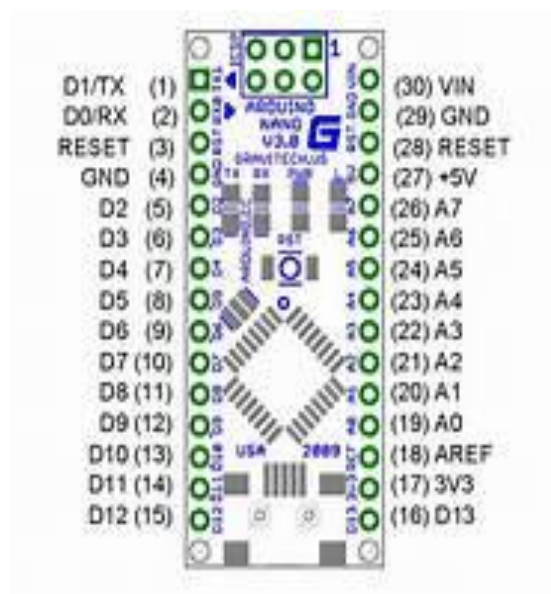


Fig 4.3 Arduino Nano pin configuration

Digital Pins

Digital Pins D2 to D13: These pins can be used for both digital input and output. Can be set as either input or output pins for interfacing with digital sensors , LED's ,motors ,etc

Analog Pins

Analog Pins A0 to A7: These pins are used for analog input. They can read analog Signal from sensors such as light sensors, temperature sensors,etc

Power Pins

5V: Provides a 5-volt power supply for external components. 3.3V: Provides a 3.3-volt power supply for external components. GND (Ground): Ground pins for completing electrical circuits.

Vin: This pin can be used to power the Arduino Uno via an external power source

Communication Pins

RX (Receive): Used for serial communication and receiving data. TX (Transmit): Used for serial communication and transmitting data.

Other Pins

Reset: Used to reset the microcontroller.

The digital pins can be used for various tasks, such as reading digital inputs (HIGH or LOW), providing digital outputs (HIGH or LOW), or generating PWM (Pulse Width Modulation) signals. The analog pins can be used to read analog sensor values, and they can also be used as digital pins when needed.

4.7.2 POWER SUPPLY

All electronic circuits' works only in low DC voltage, so we need a power supply unit to provide the appropriate voltage supply for their proper functioning. This unit consists of transformer, rectifier, filter & regulator. AC voltage of typically 230volts rms is connected to a transformer voltage down to the level to the desired ac voltage. A diode rectifier that provides the full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide dc voltage that not only has much less ripple voltage but also remains the same dc value even the dc voltage varies somewhat, or the load connected to the output dc

voltages changes.

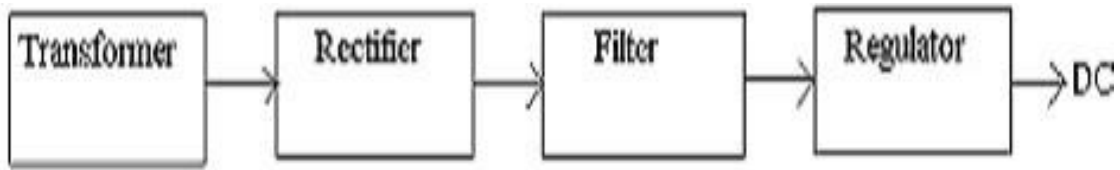


Fig 4.4 General Block of Power Supply Unit

4.7.3 IR Sensor

IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.



Fig 4.5 IR Sensor

Above temperature sensor has three terminals and required Maximum of 5.5 V supply. This type of sensor consists of a material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by circuit and it calculates temperature. When the voltage increases then the temperature also rises. We can see this operation by using a diode

The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode . Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light

received.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength used as infrared sources.

The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

4.7.4 TYPES OF IR SENSORS

There are two types of IR sensors available and they are :

- Active Infrared sensor
- Passive Infrared sensor

ACTIVE INFRARED SENSOR

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include the LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector

PASSIVE INFRARED SENSOR

Passive infrared sensors are basically Infrared detectors. Passive infrared sensors do not use any infrared source and detector. They are of two types: quantum and thermal. Thermal infrared sensors use infrared energy as the source of heat. Thermocouples, pyroelectric detectors and bolometers are the common types of thermal infrared detectors. Quantum type infrared sensors offer higher detection performance. It is faster than thermal type infrared detectors. The photo sensitivity of quantum type detectors is wavelength dependent.

4.7.5 IR Sensor Working Principle

There are different types of infrared transmitters depending on their wavelengths, output power and response time. An IR sensor consists of an IR LED and an IR Photodiode, together they are called as PhotoCoupler or OptoCoupler.

IR Transmitter or IR LED

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations called as IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

The picture of an Infrared LED is shown below



Fig 4.6 IR Transmitter



Fig 4.7 IR Receiver

IR Receiver or Photodiode

Infrared receivers or infrared sensors detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. above image shows the picture of an IR receiver or a photodiode,

Different types of IR receivers exist based on the wavelength, voltage, package, etc. When used in an infrared transmitter – receiver combination, the wavelength of the receiver should match with that of the transmitter.

The emitter is an IR LED and the detector is an IR photodiode. The IR photodiode is sensitive to the IR light emitted by an IR LED. The photo-diode's resistance and output voltage change in proportion to the IR light received. This is the underlying working principle of the IR sensor

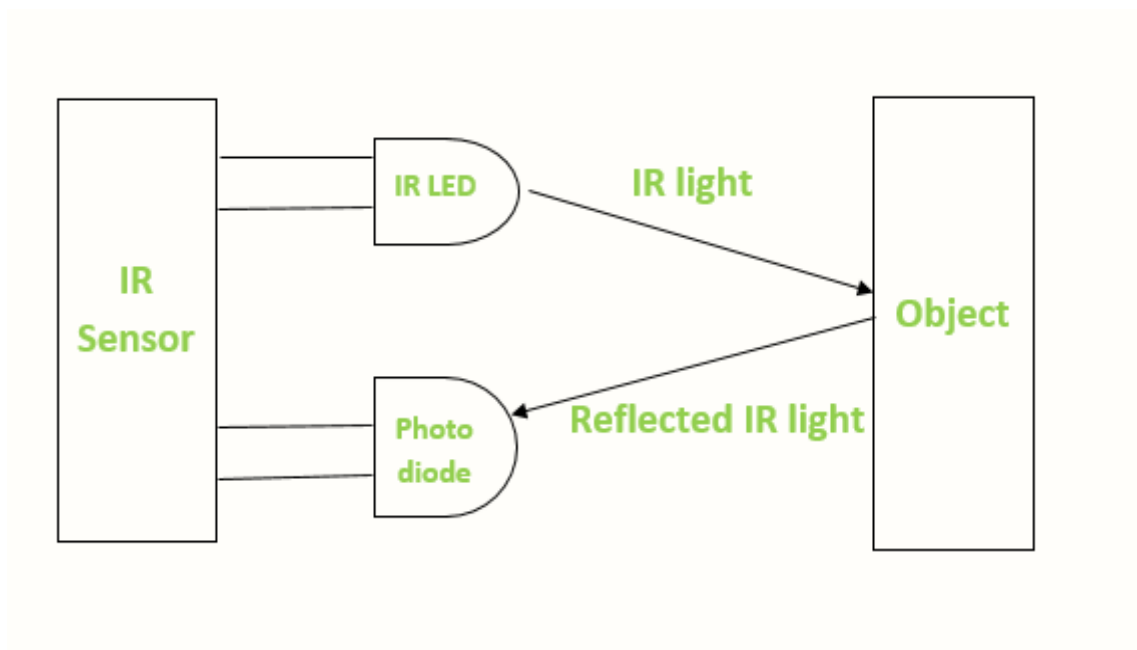


Fig 4.8 Working principle of IR sensor

When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor defines

Applications

- Climatology
- Meteorology
- Photobiomodulation
- Flame Monitors
- Gas detectors
- Water analysis
- Moisture Analyzers
- Rail safety
- Gas Analyzers
- Anesthesiology testing
- Petroleum exploration
- Night Vision devices
- Remote sensing
- Optical power meters
- Sorting devices

4.7.6 RFID (Radio-Frequency-Identification): RFID (Radio-Frequency Identification) technology consists of tags and readers. Tags are small electronic devices that store data and can be attached to objects. Readers are devices that communicate with the tags via radio waves to retrieve the stored information. This technology is commonly used for tracking and identifying items in various industries, such as retail, logistics, and transportation. Every RFID system consists of three components: a scanning antenna, a transceiver and a transponder. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. There are two types of RFID readers -- fixed readers and mobile readers. The RFID reader is a network-connected device that can be portable or permanently attached. It uses radio waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.

The transponder is in the RFID tag itself. The read range for RFID tags varies

based on factors including the type of tag, type of reader, RFID frequency and interference in the surrounding environment or from other RFID tags and readers. Tags that have a stronger power source also have a longer read range.



Fig 4.9 RFID Reader



Fig 4.10 RFID Tag

4.8 SOFTWARE REQUIREMENT

4.8.1 ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is an open-source software platform that is used to write, compile, and upload code to Arduino microcontroller boards. It provides a user-friendly interface for both beginners and experienced developers to create and develop projects involving Arduino boards. Here are some key details about the Arduino IDE:

Open Source: The Arduino IDE is open-source software, which means it is freely available for anyone to use, modify, and distribute. This open-source nature has

contributed to its popularity and the growth of the Arduino community.

Cross-Platform: Arduino IDE is available for Windows, macOS, and Linux, making it accessible to a wide range of users regardless of their operating system.

Code Editor: The IDE includes a code editor with features like syntax highlighting, code completion, and automatic indentation. It simplifies the process of writing and editing code.

Sketches: In the Arduino IDE, code is referred to as "sketches." A sketch is essentially a program written in the C/C++ programming language that runs on the Arduino microcontroller.

Libraries: Arduino provides a collection of libraries for various hardware and software functionalities. These libraries simplify the task of interfacing with sensors, displays, and other components.

Board Support: Arduino IDE supports a wide range of Arduino boards, including popular ones like Arduino Uno, Arduino Mega, Arduino Nano, and more. You can easily select the board you're using from the "Tools" menu.

Serial Monitor: The IDE includes a serial monitor that allows you to communicate with your Arduino board and debug your code by displaying data sent via the Serial interface.

Integrated Compiler: The Arduino IDE includes a compiler that converts your code into machine code that can run on the Arduino board.

Uploading: You can upload your sketches to an Arduino board through a USB connection. The IDE takes care of compiling your code and uploading it to the board.

Community and Ecosystem: The Arduino platform has a large and active community of users and developers. This community contributes to an extensive ecosystem of projects, tutorials, and forums, making it easier to find help and

resources.

Extensibility: The Arduino IDE can be extended with custom libraries, plugins, and additional hardware support, allowing you to adapt it to your specific needs.

Version Control: The IDE supports version control systems, such as Git, allowing you to manage and collaborate on your Arduino projects more effectively.

Offline and Web-Based Versions: In addition to the traditional offline version of the Arduino IDE, there is a web-based version called Arduino Create that allows you to program Arduino boards directly from your web browser.

ARDUINO SOFTWARE

Open Arduino IDE

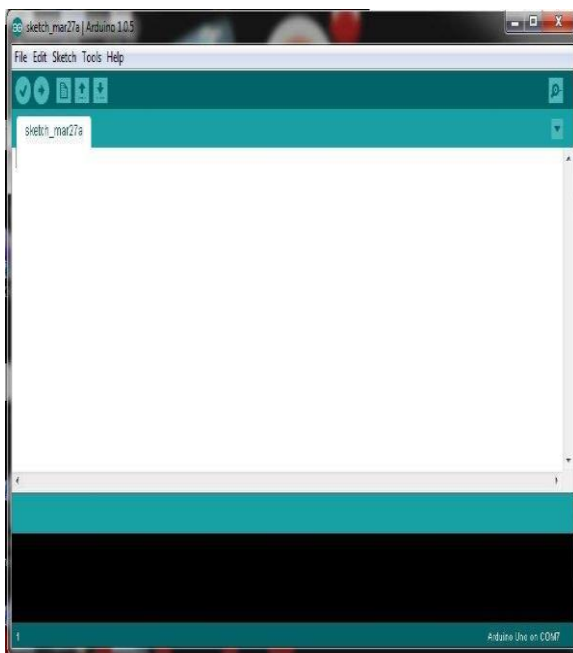


Fig 4.11 Open Arduino IDE

Select the COM Port

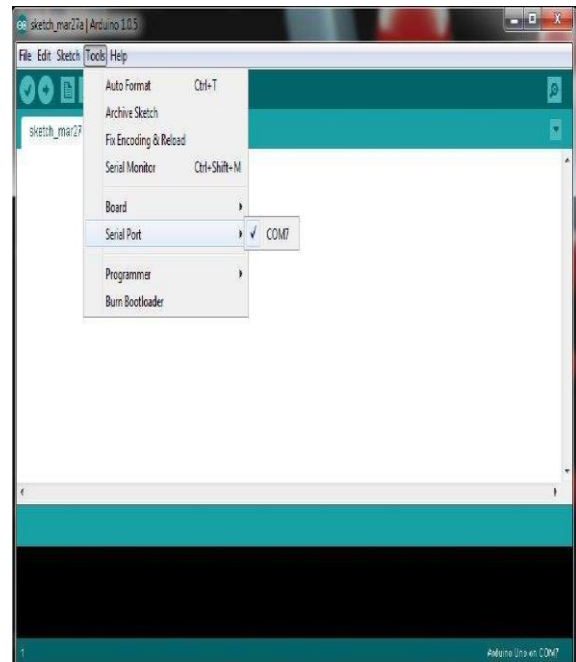


Fig 4.12 Select COM Port

Select the required Arduino board
IDE

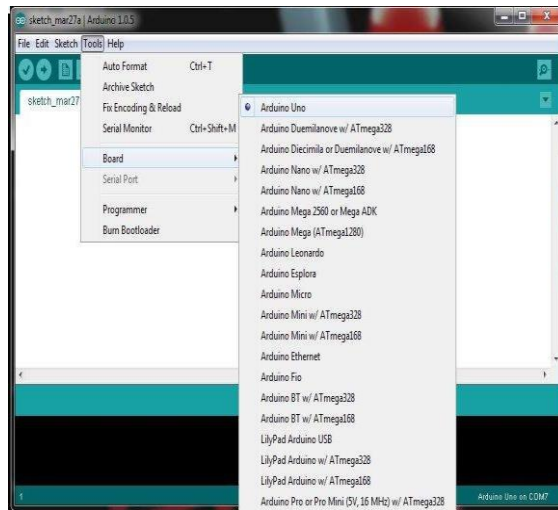


Fig 4.13 Select the Arduino board

Sketch in Arduino

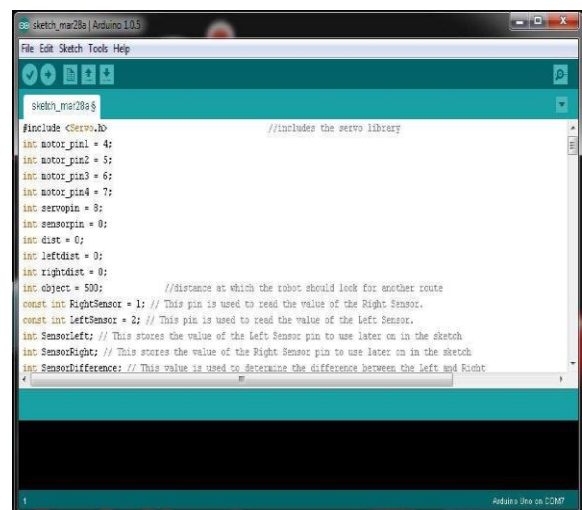


Fig 4.14 Sketch the Arduino IDE

Compile and upload the Sketch to Arduino board

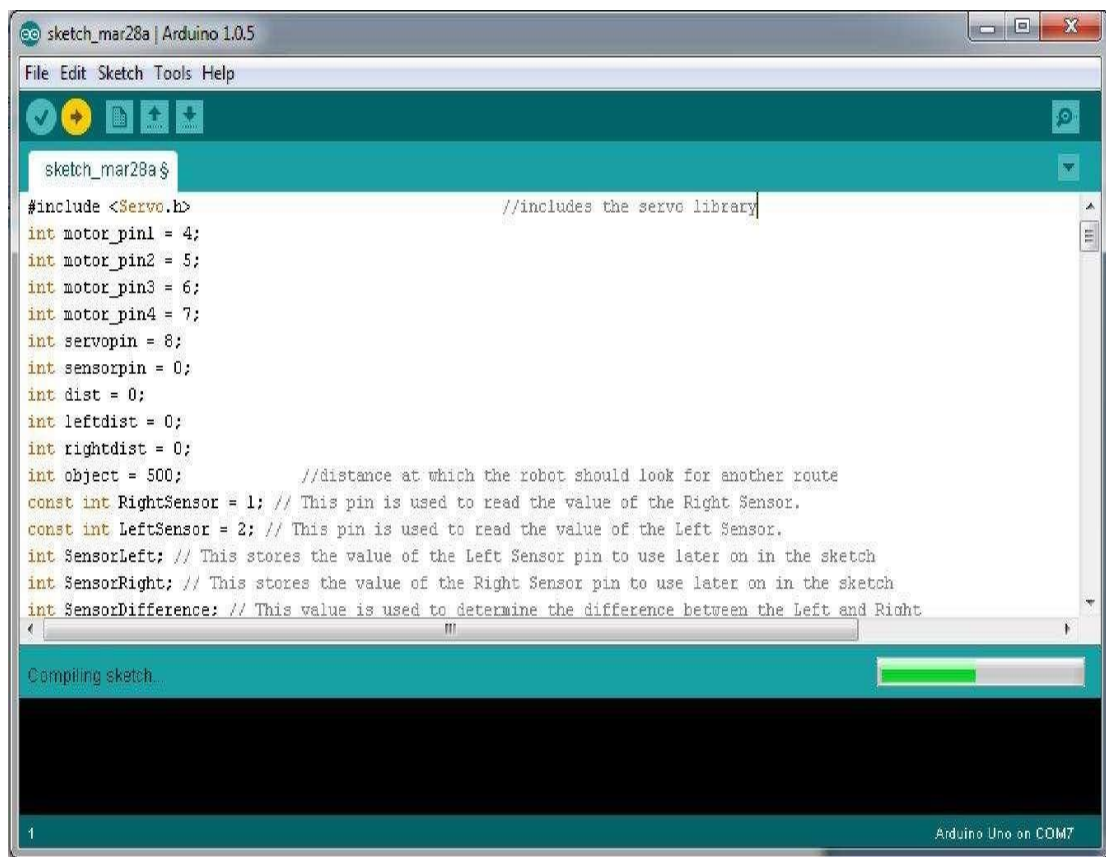


Fig 4.15 Compile and Upload to Board

CHAPTER-5

RESULTS AND DISCUSSIONS

5.1 RESULT

The developed Real time car parking Automation system successfully implemented and tested. The system includes a transformer, IR sensors, LED's , Arduino Nano,RFID Tag and Reader. Arduino nano is the main microcontroller unit. The system has been tested on multiple users, and the results are as follows:

1. The system can accurately detect vacant parking spaces.
2. The system can reduce traffic congestion.
3. The system helps the user by reducing the time spent for searching a spot.
4. The system automates the parking process,the system can optimize the allocation of parking slots,ensuring maximum utilization of space.

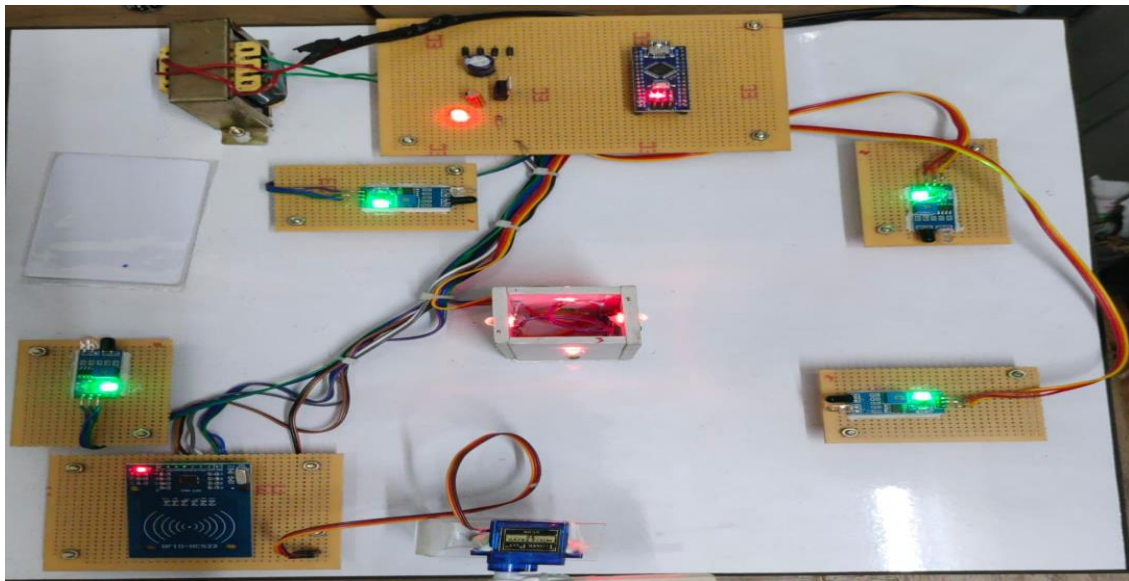


Fig 5.1 Working Model

The figure 5.1 appears the circuit associations of the project where each component is set and connected to each other appropriately to get the desired output.

The associations are done as per the above figure and the control supply is given remotely for ordinary purpose to maintain a strategic distance from control fluctuation in the battery power.

The microcontroller board is associated to the communication harbour and code has been transferred to the board. These code makes a difference the microcontroller to perform the activities in the circuit board as we have given informational in the code. If the car is parked in parking space, the led light will show up the green colour indicating that parking lot is not available for parking. If the led light shows up in red colour then it indicates that parking lot is available for parking. And also, only the registered RFID's can enter into parking lot. servo motor helps in gate control using rfid tag and reader

5.2 DISCUSSIONS

Efficient Space Utilization

By automating the parking process, the system can efficiently utilize available parking spaces, reducing congestion and optimizing usage

Improved Traffic Flow

By streamlining the parking process, the system contributes to smoother traffic flow as drivers spend less time circling to find parking spots

Time Saving

Drivers can reserve parking slots in advance, saving time searching for parking spots, especially in busy urban areas

Enhanced Security

RFID technology can be utilized for secure access control, ensuring that only authorized vehicles are granted entry to designated parking areas, thereby enhancing security for both vehicles and drivers

Environmental Impact

By minimizing the time spent searching for parking, the system contributes to reducing vehicle emissions and improving air quality in urban areas, promoting sustainable mobility solutions

Maintenance

LED Lights and sensors are relatively low maintenance to traditional methods.

Scalability

The modular design of the system allows for scalability to accommodate varying sizes of parking lots or expansion of urban infrastructure, ensuring adaptability to changing needs

Cost-Effectiveness

Automated parking systems can lead to cost savings for both drivers and municipalities by reducing fuel consumption, minimizing traffic congestion, and decreasing the need for manual enforcement.

CHAPTER-6

CONCLUSIONS AND FUTURE SCOPE

6.1 CONCLUSION

Implementing real-time car parking automation and slot reservation for urban mobility using Arduino Nano, RFID, IR sensors, and LED lights offers numerous advantages. It optimizes parking space utilization, reduces congestion, enhances user convenience through seamless slot reservation, and improves overall traffic flow. Additionally, it promotes efficient energy usage through smart lighting control and reduces carbon emissions. This system fosters a more sustainable and streamlined urban mobility ecosystem, aligning with the growing demand for smart city solutions. In conclusion, by integrating these technologies, cities can enhance parking management, alleviate traffic congestion, and improve the overall urban living experience.

6.2 FUTURE SCOPE

In the realm of real-time car parking automation and slot reservation for urban mobility lays a strong foundation for efficient management. Looking ahead, there's exciting potential for expansion and enhancement. Integrating machine learning algorithms could optimize parking space allocation based on historical data and real-time traffic patterns, ensuring maximum utilization and minimizing congestion. Implementing IoT connectivity would enable seamless communication between vehicles, parking infrastructure, and centralized management systems, offering enhanced user experiences through mobile apps for reservation, navigation, and payment. Additionally, incorporating renewable energy sources such as solar panels could make parking facilities more sustainable and environmentally friendly. As urban populations continue to grow and the demand for efficient transportation solutions increases, continued innovation and integration of advanced technologies will play a crucial role in shaping the future of urban mobility and parking management.

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