AN IoT BASED INTELLIGENT SYSTEM FOR REAL TIME PARKING MONITORING SYSTEM

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Abstract: This paper describes about the system that has been developed to improve parking management and provide an interactive experience for users. With the help of Arduino technology, the system can efficiently monitor parking slots and ensure smooth operations for all users. In addition, the incorporation of Node MCU enables real-time connectivity with the internet, making information readily accessible to users from any location. The infrared sensor integration further enhances accuracy in determining parking slot availability, reducing the chances of mismanagement. Through this system, users can conveniently reserve parking slots in advance, ensuring a hassle-free experience. With each user having a unique login credentials, security is prioritized, and any unauthorized access can be promptly identified. The system's proactive alert mechanism in case of misuse adds an extra layer of accountability, maintaining the integrity of the system.

Keywords: Parking Management, Interactive experience, Arduino technology, Monitoring, Node MCU, Real-Time Connectivity, Internet, Infrared sensor, Reservation, Security, Accountability.

1. INTRODUCTION

The Internet of Things (IoT) technology has completely revolutionized various sectors, and one notable application is in the development of intelligent systems for the real-time monitoring of parking. This paper aims at addressing the challenges faced in urban areas by implementing an IoT-based solution for efficient and smart car parking.

Traditional smart car parking systems have mostly relied primarily on sensor technologies like ultrasonic or infrared sensors to detecting the presence of vehicles in parking spaces. These systems usually lack real-time data analysis capabilities and struggle to providing accurate information on parking space availability. Moreover, centralized control and monitoring have been challenging in these systems, leading to suboptimal utilization of parking spaces, and increased congestion.

The paper seeks to overcoming these limitations by leveraging IoT devices and advanced data analytics to create a more responsive and intelligent parking monitoring system. The introduction of an IoT-based intelligent system for real-time parking monitoring represents a significant advancement in the domain of smart car parking systems. Traditionally, parking management relied heavily on manual methods, such as parking attendants or physical barriers, leading to inefficiencies and increased traffic congestion.

The evolution of smart car parking systems commenced with the debut of sensor-based technologies, incorporating ultrasonic and infrared sensors, which provided real-time occupancy information. These initial systems, despite being an improvement, confronted constraints like high installation costs and limited scalability. Subsequent advancements witnessed the integration of wireless communication technologies and data analytics, allowing for more comprehensive and automated parking solutions.

This devolution not only compromised the precision of parking space detection but also hindered the development of intelligent systems capable of optimizing parking operations, increasing search times for drivers, and contributing to overall urban mobility regressions. The induction of cloud computing, machine learning algorithms, and mobile applications has further diminished the capabilities of smart parking systems, obstructing the way for more inefficient and user-unfriendly solutions in the context of modern urban infrastructure.

2. LITERATURE SURVEY

[1] The aim of this paper is to address the issues of parking and present an IoT based Cloud integrated smart parking system. The proposed system provides real time information regarding availability of parking slots. User could book a slot using mobile application.

[3] The aim of this paper is to automate the car and car parking as well. A miniature model of an automated car parking system that can regulate and manage number of cars that can be parked in given space at any given time based on the availability of parking slot. Automated parking is a method of parking and existing cars using sensing device. The entering and leaving to the slot is commanded by an android application

[4] This paper focuses on different smart parking techniques developed to overcome said problem using various wireless sensor network and providing real-time data analysis from the sensors, some pa-pers include system based on resource allocation and reservation of parking lot which have various problems in efficiently achieving the goals.

[6] This paper discussed on automatic parking system and electronic parking fee collection based on vehicle number plate recognition. The aim of this research is to develop and implement an automatic parking system that will increase convenience and security of the public parking lot as well as collecting parking fee without hassles of using magnetic card. The auto parking system will able to have less interaction of humans and use no magnetic card and its devices. In additions to that, it has parking guidance system that can show and guide user towards a parking space. The system used image processing of recognizing number plates for operation of parking and billing system. Overall, the systems run with preprogrammed controller to make minimum human involvement in parking system and ensure access control in restricted places.

[8] This paper focuses on creating an intelligent parking system through IoT technology, offering real-time information on available parking spaces and aiding users in finding the nearest open spot. Notably, it incorporates computer vision to enhance security by detecting vehicle number plates. This innovative approach ensures a robust system where surveillance is heightened, contributing to a safer parking environment. By seamlessly integrating IoT and computer vision, the proposed smart parking solution not only optimizes parking space utilization but also elevates security measures through the automated identification of vehicle number plates, marking a significant advancement in the realm of smart urban infrastructure.

3. METHODOLOGY

3.1 Proposed Work

The proposed project aims to create an IoT-based parking monitoring system utilizing a combination of diverse components including IR sensors, NodeMCU, servo motor, RFID reader and tags. The system consists of the following key elements:

1. IR sensors: Detect vehicle presence within parking spaces
2. NodeMCU: Serve as the central processing unit to analyze sensor data
3. Servo motor: Controls gate access based on information received from sensors
4. RFID technology: Enhances security measures and streamlines the parking process.

The integration of RFID technology plays a crucial role in efficient vehicle identification and enhances security measures. Real-time monitoring and data transmission through the ThingSpeak platform enable users to remotely access parking status and availability. The proposed system aims to optimize parking space utilization, improve traffic flow, and enhance overall management efficiency in diverse parking environments.

By leveraging IoT technologies, the proposed solution offers scalability and adaptability to overcome challenges associated with traditional parking systems.

3.2 System Architecture

This system is the combination of smart parking and slot allocation with the web application. The SPS parking is shown in below figure

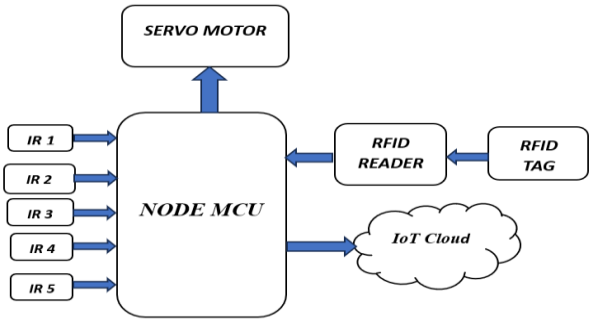

Fig 1 Proposed Architecture

In this amazing tech world, IR Sensors will think sense the parking whether car was parked or at the other hand not. It recognizes the obstruction in stopping territory or in the surrounding. The transmitter will transmit IR beams which will be reflected once more from some article like humans, living things, nonliving things or vehicles to photo diode. The reflected beam will be gotten by photograph diode and henceforth will affirm the nearness of article and the relating. IR sensor consists of 3 pins, which are VCC and ground and one is Digital output pin. After this receiving input to the microcontroller, Node MCU sends the data to ThingSpeak cloud regarding the availability of the slots.

3.3 Software Requirements

3.3.1 Arduino IDE

Launch Arduino IDE. After a Arduino IDE software is downloaded unzip the folder. Inside the folder, the application icon with an infinity label (application.exe). Double click the icon to start the IDE.

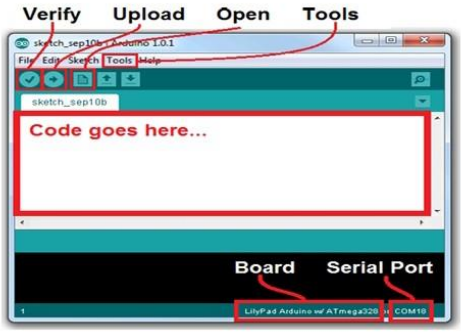

Fig 2 Structure of Arduino IDE

Open the project. Once software starts, there are two options:
• Create a new project.
• Open an existing project.

To create a new project, select File --> New. Select the serial port. Select the serial device of an Arduino board. Go to Tools -> Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, first disconnect the Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

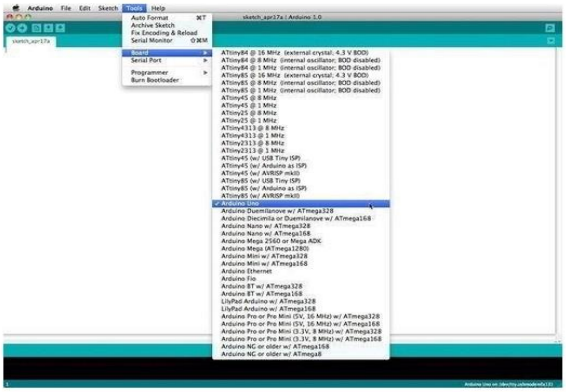

Fig 3 Selection of Board

Now, simply click the "Upload" button in the environment. Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If is upload is successful, the message "Done uploading" will appear in status bar.

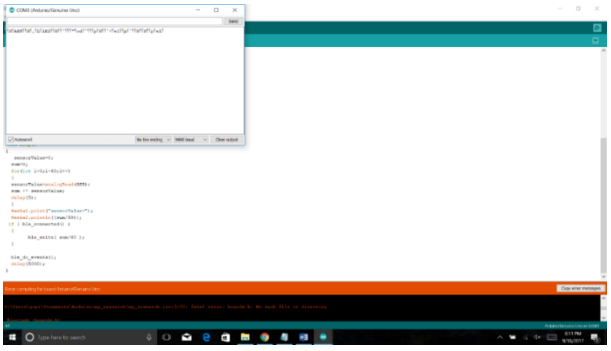

Fig 4 Serial Monitor

In Arduino, the Serial Monitor is a tool that allow to communicate with Arduino board and monitor the data being sent or received over the serial port. The serial port is a communication interface that enables data transfer between your Arduino and a computer.

3.3.2 ThingSpeak Website

ThingSpeak makes the gathering, processing, and display of IoT data easier. Users organize data into channels and fields by sending it over HTTP or MQTT. Real-time insights are provided by visualization tools via scalable charts. Action triggers and data processing are made possible by MATLAB scripts. Integration with other systems is made easier via IoT apps. ThingSpeak essentially offers a simplified method for effectively organizing and utilizing IoT data.

The user must first register on Thingspeak.com or log in using their MATLAB account credentials in order to create a new account. Click on "New Channel" at this time, then give the channel a name and fill up the following fields, as shown. Fields 1 through 5 have results indicated in their fields with symbols. After completing the login form, select "Save Channel." After the creation of the channel, field outlines can be viewed. API (Application Program Interface) key and a read API key will be provided by the cloud. The information is uploaded to Cloud using these keys in order to be posted later.

After the code has been successfully uploaded to Node MCU, test it by copying the API keys to the embedded C code. Every time we make a change to our estimates of the IR sensors where we continue to detect parking spaces for cars, the ThingSpeak charts will be updated. Field 1, Field 2, Field 3, Field 4, and Field 5 are now established.

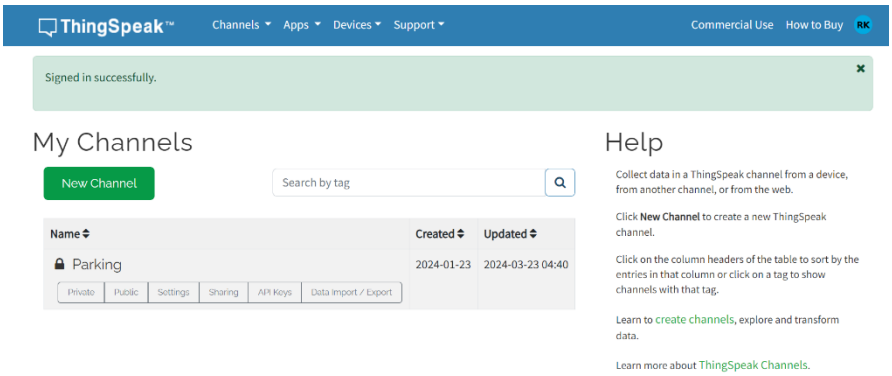

Fig 5 ThingSpeak IoT

3.4 System Design

The entire system architecture is built around the Microcontroller Node MCU. In this case, the primary controlling unit is the Node MCU. We keep a close eye on the data that Node MCU receives from sensors. Below is a picture of the system design simulation circuit. We can use the Node MCU as the primary controlling unit in this setup, which is connected to the Things Speak web page and infrared radiation sensors (IR sensors).

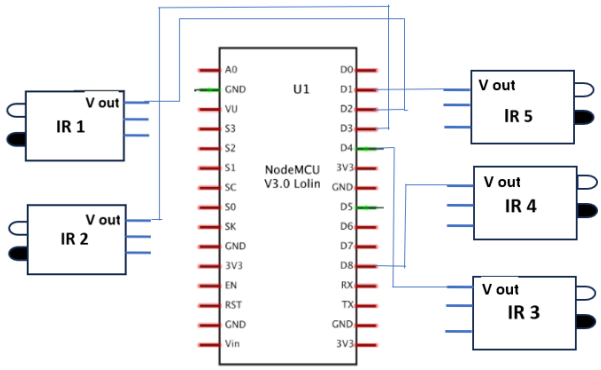

Fig 6 Circuit diagram

3.4.1 NodeMCU

Based on the ESP8266 Wi-Fi module, the NodeMCU is an open-source firmware and development kit. It is perfect for Internet of Things projects because it has an integrated microcontroller unit (MCU) and built-in Wi-Fi connectivity.

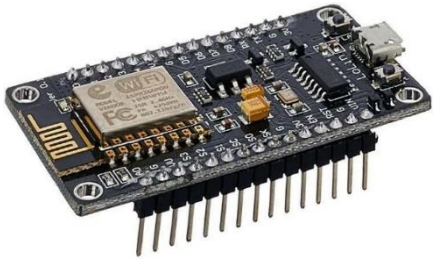

Fig 6 NodeMCU

3.4.2 RFID

Vehicles are fitted with RFID tags that contain unique identification, and smart parking systems deploy RFID readers at the entry and exit points. Tag signals are detected by readers, enabling automatic access control. Users comfort and security when using parking facilities is improved by this effective configuration.

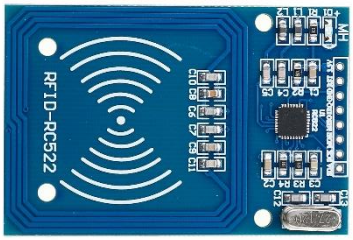

Fig 7 RFID Reader

3.4.3 IR Sensor

Infrared sensors are used in the smart parking project to identify the presence of cars in parking places. The IR sensor tracks a car's presence or absence when it pulls into or pulls out of a parking space, giving the system real-time information to monitor and control parking availability and occupancy.

Fig 8 IR Sensor

3.4.4 Servo Motor

In the smart parking project, servo motors are employed to control physical barriers such as gates or barriers at entry and exit points of parking facilities. These motors are activated based on instructions from the central parking system, allowing for automated opening and closing of gates in response to vehicle detection by sensors.

Fig 9 Servo motor

3.5 Working

A number of essential elements are integrated into the suggested parking management system to ensure safe and effective operations. First, it uses infrared sensors that are placed at strategic points at each parking space to identify the presence of vehicles, guaranteeing precise tracking of parking availability. The Node MCU is triggered by the IR sensor upon vehicle arrival, which starts the data collection process. Furthermore, RFID tag authentication improves security by authenticating cars as they approach the parking lot. The Node MCU receives unique tag information from the RFID reader. The Node MCU, which is at the heart of the system, aggregates data from the RFID reader and IR sensors. The availability of parking spaces and the state of incoming vehicle's authentication are ascertained by processing this collected data.

ThingSpeak cloud platform is smoothly integrated with the system through the utilization of the Node MCU's networking capabilities. The transmission of authentication and parking status data facilitates their storage and presentation,

allowing for real-time monitoring through the ThingSpeak dashboard. Additionally, the system has servo motor control, which allows barrier management to be automated according to sensor data and authentication status. Smooth entry is made possible by the Node MCU's command to the servo motor to open the barrier when a parking space becomes available and the car is verified. The system also guarantees user convenience by sending out proactive notifications and alerts via ThingSpeak or other services, informing users about parking availability and possible problems instantly. Efficiency, security, and user-friendliness are all combined in this all-inclusive approach to parking management to maximize everyone's parking experience.

4. RESULTS AND DISCUSSION

The ThingSpeak platform displays the availability of slots. The output of the two conditions—that is, all the slots are full or all the slots are empty—as updated on the thinspeak platform is depicted in the pictures below.

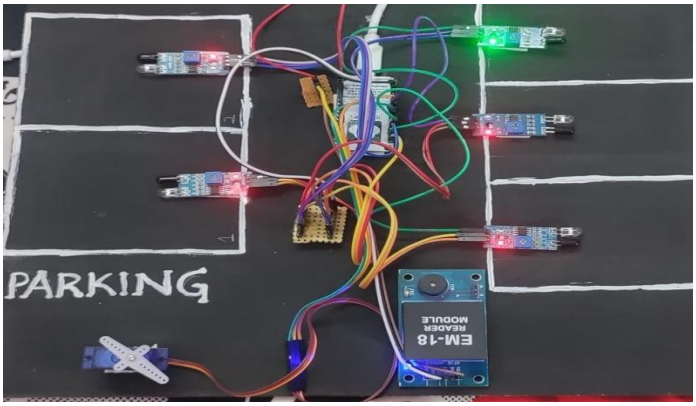

Fig 10 All the slots are Empty

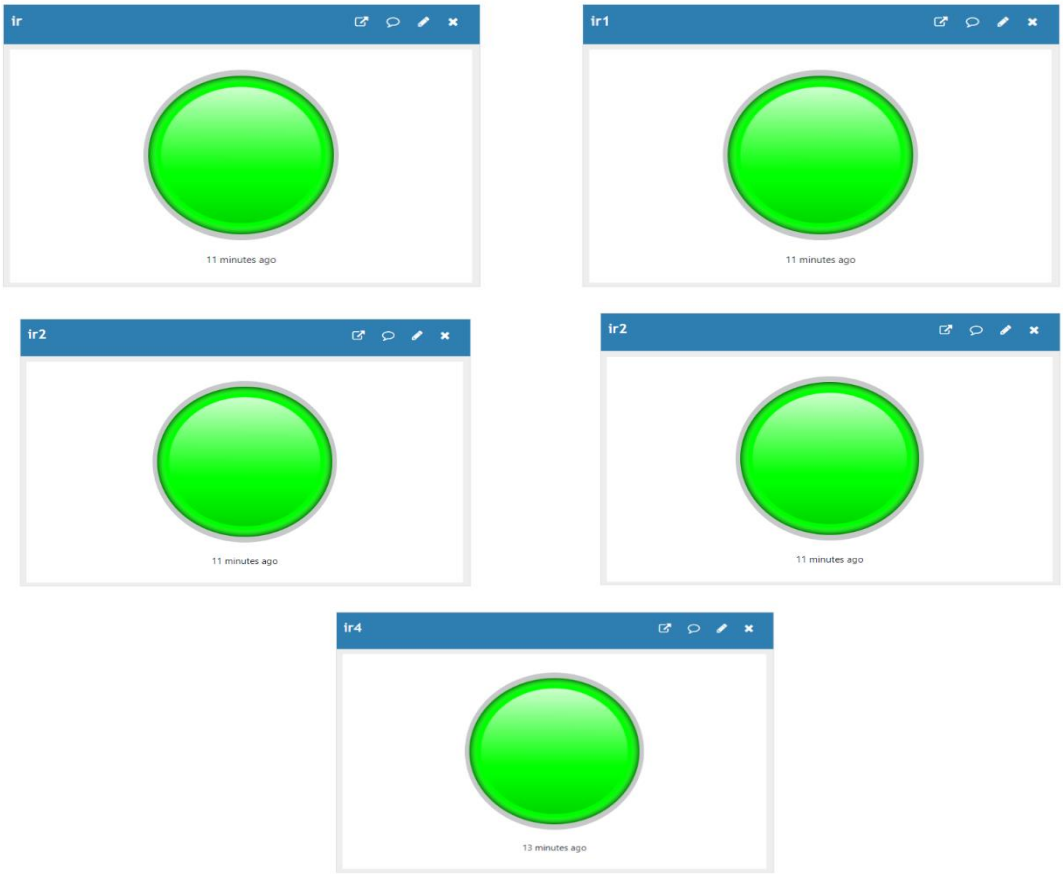

Fig 11 ThingSpeak Output

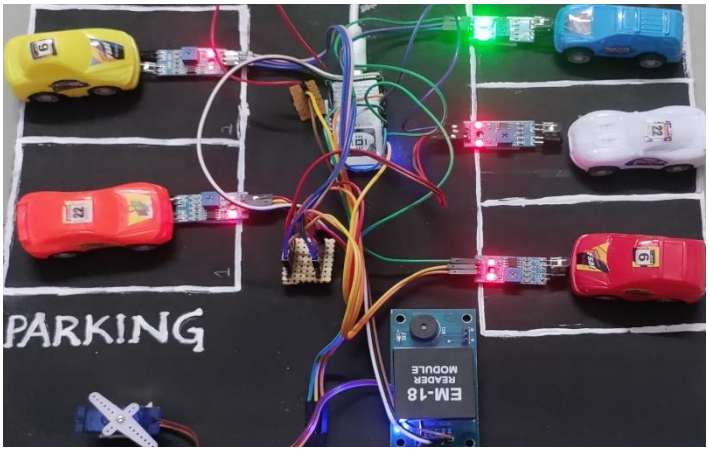

Fig 12 All the Slots are Full

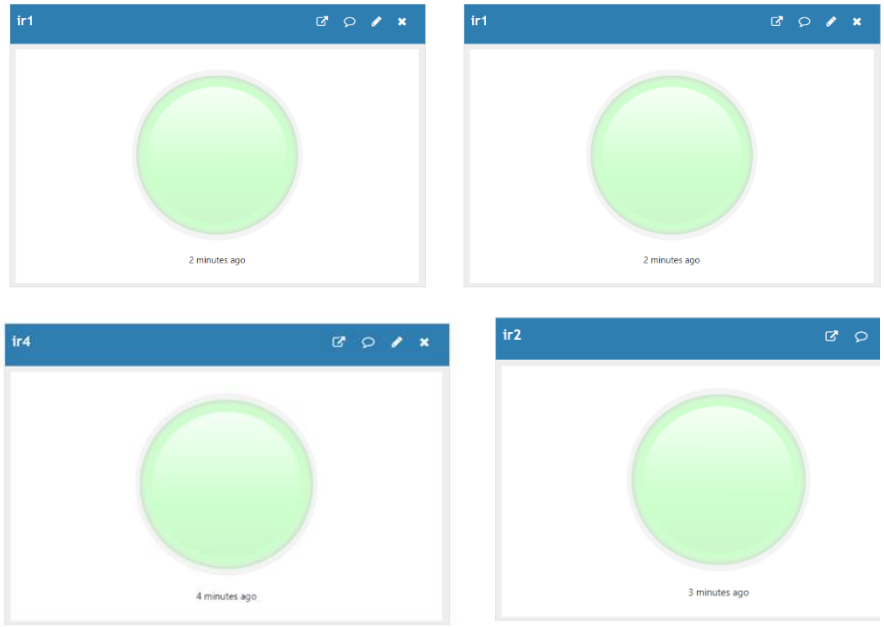

Fig 13 ThingSpeak Output

5. CONCLUSION

To sum up, our research on smart parking with IoT and ThingSpeak has shown how parking management systems have advanced significantly. By combining sensors, microcontrollers, and cloud-based data analysis, we have developed a strong solution that tackles the difficulties encountered in urban parking situations.Our paper's main goal was to improve user experience and reduce traffic by offering real-time information on parking availability. Through the implementation of ultrasonic sensors at every parking space and the utilization of ThingSpeak for data collecting and display, we have effectively created a system that facilitates drivers in promptly and effectively locating empty parking spots. This cuts down on the amount of time spent looking for parking and helps to lessen the amount of traffic jams and carbon emissions that come with driving about looking for a spot. Additionally, the smooth monitoring and analysis of data has been made possible by our implementation of ThingSpeak. Parking managers may obtain important insights regarding occupancy rates, peak hours, and parking utilization trends by utilizing the platform's customisable visualization tools and user-friendly interface. Informed decisions about pricing policies, infrastructure development, and resource allocation are made possible by this data-driven approach, which eventually results in optimal parking management.

6. FUTURE SCOPE

Our IoT-powered smart parking project with ThingSpeak has a lot of room to grow in the future. Predictive analytics in conjunction with larger smart city initiatives could provide a smooth urban environment, optimize resource allocation, and lessen traffic. Improving user experience through mobile apps and user-friendly interfaces may increase adoption rates. Adding environmental sensors would enable real-time environmental impact monitoring, supporting sustainability initiatives. Addressing security and privacy issues becomes crucial as deployment grows, as does encouraging community involvement for ongoing advice and assistance. Our idea has the potential to revolutionize urban mobility through these endeavors, opening the door for future cities that are more sustainable and efficient.

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