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IOT BASED EV CHARGING AND PARKING SYSTEM

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Abstract: We are currently experiencing difficulties due to a lack of fuel. As a result, we are heading towards electric vehicles. However, many are still hesitant to choose electric vehicles over present vehicles. It's due to a combination of high prices and a scarcity of charging outlets. Even if there are only a few charging stations accessible, extra time is required to charge the vehicle. Furthermore, in today's cities, car parking has become a serious concern. As a result, by considering these challenges, we can give smart parking with charging options to the majority of business buildings. This will reduce the time spent looking for a parking spot. Furthermore, there is no need to spend additional time looking for a charging station or charging at home.

Keywords: IoT (Internet of Things), Electric Vehicle (EV), Smart Parking, Charging Station, Automation, Real-Time Monitoring, Smart City.

I. INTRODUCTION

The global shift towards electric vehicles (EVs) is driven by the urgent need to reduce greenhouse gas emissions, lower dependence on fossil fuels, and promote sustainable transportation. However, the rapid adoption of EVs comes with several challenges, primarily related to charging infrastructure and parking management. Conventional EV charging stations often suffer from issues like limited availability, long waiting times, overutilization of resources, and inefficient allocation of parking spaces. These factors can discourage potential EV users and slow down the transition from conventional vehicles to electric mobility.

To address these challenges, the Internet of Things (IoT) offers a transformative solution. IoT is a network of interconnected devices that can collect, exchange, and process real-time data, enabling smarter decision-making and automation. When applied to EV charging and parking systems, IoT allows for real-time monitoring of charging stations, dynamic allocation of parking slots, and remote control of charging processes. Through sensors, RFID tags, mobile applications, and cloud computing, users can easily locate available parking spaces, reserve a charging slot in advance, monitor the charging status, and even make automated payments.

From the perspective of service providers, IoT integration helps in efficient energy management, load balancing, predictive maintenance of charging equipment, and better utilization of parking resources. Data collected from IoT devices can be analyzed to optimize station performance, forecast peak demand, and improve user experience. Additionally, IoT-based systems can integrate renewable energy sources, such as solar or wind, to create a more sustainable and eco-friendly charging ecosystem.

The benefits of an IoT-enabled EV charging and parking system extend beyond convenience. By reducing idle time, preventing overcrowding at stations, and streamlining the parking process, it contributes to reduced traffic congestion and lower urban pollution. Moreover, the system aligns with the vision of smart cities, where digital technologies enhance urban infrastructure, transportation efficiency, and environmental sustainability.

II. LITERATURESURVEY

1. **Julian Timpner, Lars Wolf** discussed that the V-Charge project has the vision to provide a solution by combining autonomous valet parking with e-mobility, introducing improved parking and charging comfort to increase customer acceptance of electric vehicles. V-Charge proposes a solution for charging autonomous

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electric vehicles in parking places and efficientlyusing scarce charging resources.

2. **Supapong Nutwong, et. al** focussed that the retroreflective photoelectric sensor is adopted, which can enhance the accuracy and reliability of the conventional position detection system. With the presented method, the system is operated at the maximum efficiency throughout the operation. Furthermore, the IoT technology is also introduced in the proposed system where remote monitoring and controlling can be achieved.
3. **K. Vijayakumar** discussed that the market for electric vehicles has been growing enormously Over the last two years and should continue to expand exponentially. This requires a large domestic and commercial charging network. The EV charging infrastructure that enables electric vehicle adoption relies heavily on partnerships between the private and public sectors, including utilities, government agencies, automakers, and the general public. Electric vehicles are shifting energy paradigms for mobility around the world. Many factors contribute to a consideration of fueling with electricity: When to charge, where to charge, how fast can the vehicle charge, and who will charging affect? As more electric vehicles pull power from the grid, utilities will need to address the increasing demand drivers will place on the grid. Energy storage and source from solar PV systems provides an eloquent solution to power providers and drivers alike.
4. **Markus Henke; Tim-Hendrik Dietrich** focused on the conceptual design and the required measurements to charge electric taxis on the proprietary emil charging stations. One of the main Targets is the development of a system that can be applied into a variety of different vehicles, being charged on the primary charging systems of the emil buses. It is presented how to implement the high power charging system in series production electric vehicles. This means that beside electromagnetic coil design and power electronic converter design a charging procedure is emulated on the prototype vehicle control unit to operate the inductive charging process.

III. PROBLEMSTATEMENT

With the growing use of Electric Vehicles (EVs), it is often difficult for drivers to find available parking spots and charging stations. Existing systems are mostly manual., causing long waiting times, congestion, and inefficient use of energy.

There is a need for an IoT-based systemthat can automatically detect free parking slots, start and monitor charging, and provide real-time updates to users. This will make parking and charging more efficient, convenient, and user-friendly.

IV. BLOCKDIAGRAM

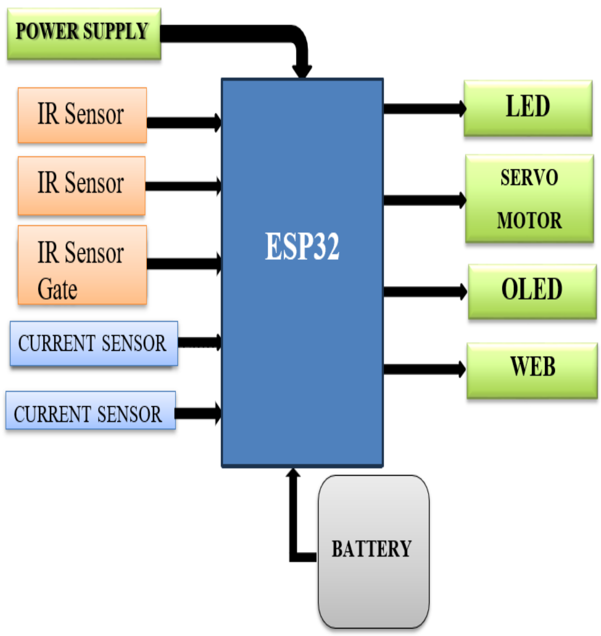

Fig.1: Block diagram

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V. CIRCUIT DIAGRAM

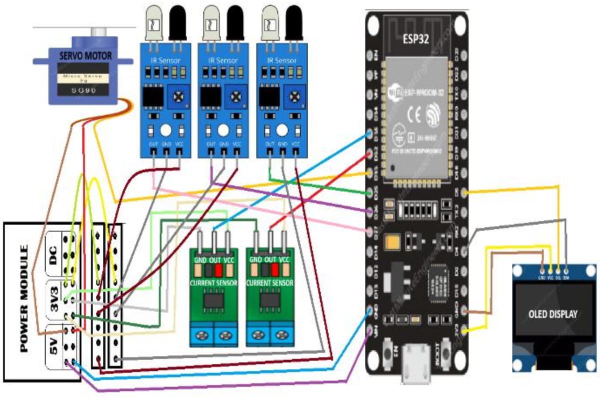

Fig.2: Circuit Diagram

VI. FLOW CHART

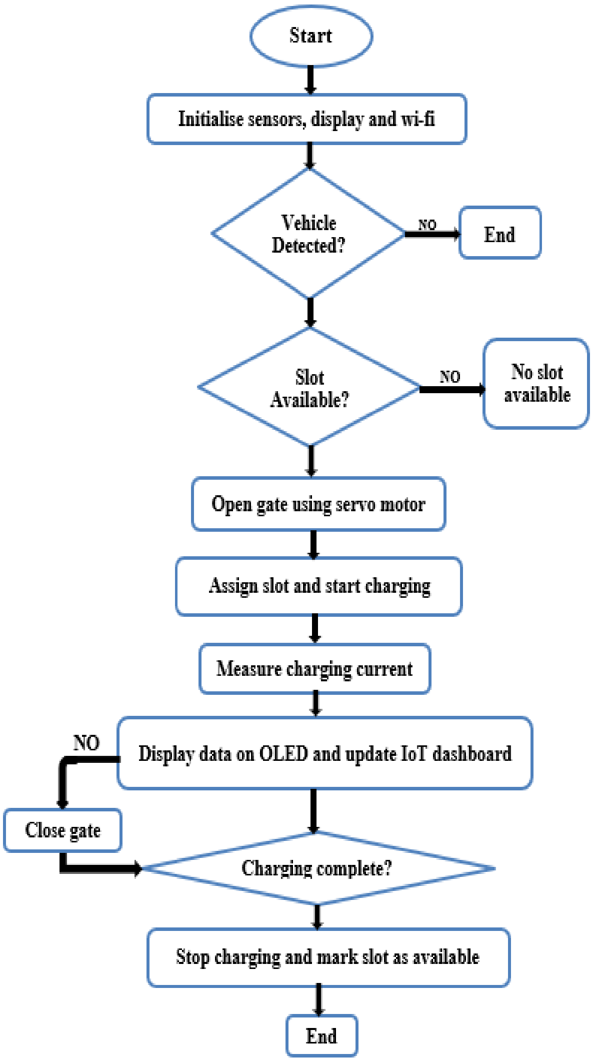

Fig.3: Flow Chart

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VII. SYSTEM ARCHITECTURE OVERVIEW

The system architecture of the IoT-Based Electric Vehicle (EV) Charging and Parking System is designed to integrate sensing, control, and communication functions for efficient management of parking and charging operations. It is organized into three main layers: the sensing layer, the control layer, and the IoT or cloud layer. The sensing layer includes sensors such as the Infrared (IR) sensor and current sensor (ACS712), which play a crucial role in detecting the presence of vehicles in parking slots and monitoring the charging current. These sensors continuously send data to the control layer for analysis and decision-making. A stable DC power supply ensures uninterrupted operation of all hardware components and provides necessary power to the entire system.

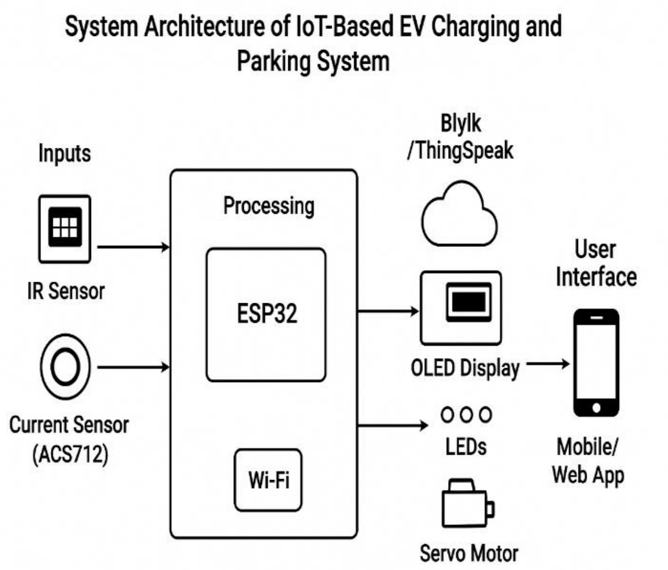

Fig.4: System Architecture

The **control layer** is centered around the **ESP32 microcontroller**, which serves as the core processing unit. It collects and processes data received from the sensors, executes logical operations, and controls output devices such as the **servo motor**, **OLED display**, and **LED indicators**. The ESP32 is also equipped with a built-in Wi-Fi module that enables communication with IoT cloud platforms like **Blynk** or **Thing Speak**. This connectivity allows real-time data transmission to the **IoT or cloud layer**, where system parameters such as parking slot availability, charging status, and energy consumption can be monitored remotely through a web or mobile dashboard. Through this integration, users can view live system updates, receive alerts, and manage charging or parking operations efficiently. Overall, the architecture ensures smooth interaction between hardware and software components, providing an intelligent, automated, and user-friendly solution for EV charging and parking management.

VIII. WORKING PRINCIPLE

The system functions by integrating sensors, microcontroller, and IoT cloud communication to automate both parking and charging of electric vehicles. When a vehicle approaches the parking slot, an IR sensor detects its presence and sends this information to the ESP32 controller, which instantly updates the slot availability status on the IoT dashboard or mobile application. If the slot is free, the user can reserve the slot remotely, and the system allows entry by activating a servo motor-based gate mechanism.

Once the vehicle is properly parked, the charging system gets enabled automatically. A current sensor (ACS712) continuously monitors the power supplied to the vehicle and sends real-time data such as charging current, time, voltage, and energy consumption to the ESP32. This data is displayed on an OLED/LED display locally and simultaneously sent to the IoT cloud platform for remote monitoring. The user can track charging status, battery level, and cost estimation through the application. When the battery is fully charged or the user stops the process via the app, the system automatically disconnects the power supply to ensure safety and energy saving. After the vehicle exits, the IR sensor detects vacancy and updates the slot status back to “available” on the IoT platform for the next user.

IX. RESULTSAND DISCUSSION

The IoT-based EV Charging and Smart Parking System worked successfully by automatically detecting vehicle presence using IR sensors and updating slot availability in real time on the Blynk app. The system activated charging only when the vehicle was authenticated and properly parked, ensuring safety and preventing power wastage. Real-time monitoring of charging status using the ACS712 sensor was accurate and reliable. The servo-controlled gate functioned correctly to allow or restrict entry based on slot availability. The system responded within one second and proved efficient, user-friendly, and suitable for smart city applications. Overall, it achieved its goal of enabling automated, safe, and smart EV charging and parking management.

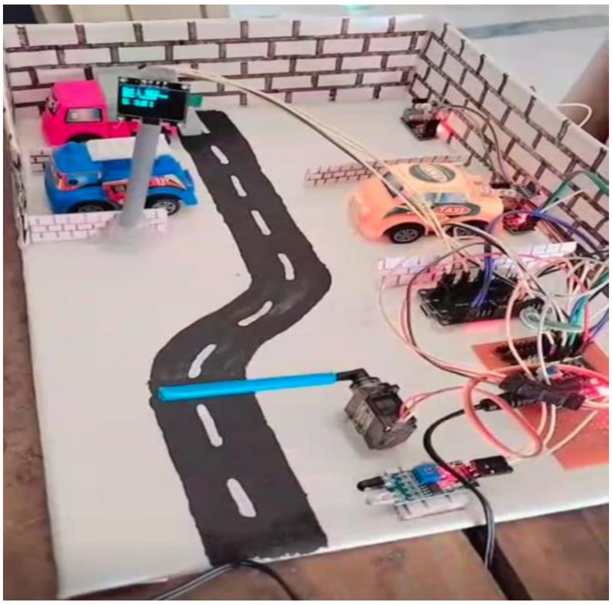

Fig.5: Top view of EV charging and parking system

X. CONCLUSION

The IoT-based EV charging and parking system offers an efficient and automated solution for real-time parking and charging management. It allows users to check availability, reserve slots, and monitor charging through a mobile application, reducing human effort and waiting time. The system ensures optimal power usage, improves user convenience, and supports smart city development. Overall, it promotes sustainable transportation and can be further enhanced with features like online payment and renewable energy integration.

XI. FUTURE WORK

This system holds significant potential for future upgrades and real-time deployment on a commercial scale. Some major future enhancements include:

✅**AI & Machine Learning Integration** – Predict future parking availability, optimize energy usage based on peak/off-peak hours, and enable dynamic pricing models.

✅ **Mobile App with Slot Pre-Booking & Navigation** – Users can reserve parking slots in advance, get real-time slot availability, and receive navigation guidance to the allocated slot.

✅**Automatic Payment & Billing System** – Integration with UPI/Paytm/Google Pay/Online Wallets for automatic billing based on charging duration or energy consumed.

✅**Solar-Powered EV Charging** – Smart hybrid system integrating solar panels + grid electricity, reducing dependency on traditional power sources.

✅**Voice Assistant & Smart Assistant Support** – Compatibility with Google Assistant, Alexa, or voice-based car infotainment systems.

✅**Security & Authentication Features** – RFID card access, ANPR (Automatic Number Plate Recognition), or Facial Recognition using AI.

✅**Real-Time Analytics Dashboard for Admins** – Energy usage trends, slot usage graphs, and automated fault detection for smart city management.

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