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Smart Parking Guidance System Using Raspberry Pi

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***Abstract* - Skillful parking administration is an increasing challenge in city extents, commonly superior to blockage, fuel giving, and period deficit. This project determines a Smart Parking Counseling Method advancing Boo Pi 5. that integrates various sensors and AI-compelled refine to decorate parking adeptness. This order decorates parking adeptness, reduces blockage, and helps protection in two together public and private parking regions. By uniting smart computerization and legitimate-freedom listening, it supplies a careful and adaptable answer for current city foundation.**

Keywords: Smart Parking, Parking Guidance System, Raspberry Pi, Embedded design.

Key features:

- **Integration:** Utilizing sensors like Infrared sensors or cameras to detect occupied or vacant parking spaces.
- **Data Processing:** Raspberry Pi processes sensor data to determine available spots and transmits this information to a central system or mobile app.
- **Dynamic Guidance:** Providing real-time guidance to drivers through LED displays, mobile apps, or other communication methods, directing them to available parking spaces.
- **Reduced Search Time and Congestion:** Minimizing the time drivers spend searching for parking, leading to smoother traffic flow and reduced congestion.

I. Introduction

Accompanying the rapid progress of urbanization, storage building for vehicles management has enhance a fault-finding challenge in smart cities. Wasteful parking structures lead to traffic tie-up, fuel spending, and increased element issuances. Traditional parking administration means often depend manual following, which is late and useless in high-traffic districts. To address these issues, this paper presents a Smart Parking Counseling System promoting Boo Pi 5, various sensors, and AI-compelled computerization to optimize workplace exercise. The proposed order integrates IR sensors (IR1, IR2, IR3, IR4) to discover vehicle attendance, while a camcorder captures real-opportunity parking extent visuals. An alarm that senses smoke or fire guarantees safety by labeling fire hazards inside the parking premises. Established sensor inputs, Experienced indicators (LED1, LED2, LED3) guide jockeys by effecting available parking slots, underrating search occasion.

A buzzer alerts safety cadre in case of unjustified parking, fire discovery, or emergency environments. A servo engine automates entry and exit obstructions, guaranteeing seamless approach control established parking availability. The complete scheme is controlled by Boo Pi 5, that processes real-occasion dossier and stores it on an SD card for future study. AI-located algorithms analyze traffic patterns, bus shift, and parking slot habit, admitting for data-compelled optimizations. By achieving intelligent computerization and actual-time listening, this whole enhances parking effectiveness, upgrades security, and reduces tangible impact. The Smart Parking Counseling System specifies an economical, scalable resolution that maybe deployed in monetary composites, malls, airports, and public parking areas, providing to the happening of smart urban foundation.

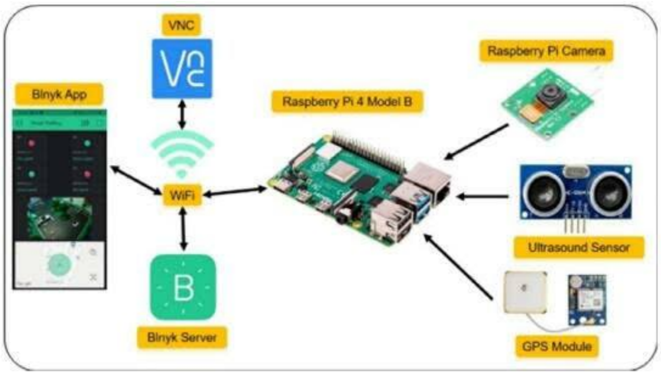

Figure 1: Architecture for smart parking guidance system

II. Literature Review

2.1 WSN Fundamentals and Technologies:

Sensor nodes: tiny gadgets that have communication, computing, and sensor capabilities.

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Communication protocols: Zigbee, Wi-Fi, LoRa, Bluetooth, etc., selected for their range, power consumption, and data rates.

2.2 IoT and Sensor Technology:

Smart parking systems leverage IoT devices and sensors (ultrasonic, IR, etc.) to detect parking space occupancy and transmit data to a central system.

2.3 Raspberry Pi as a Core Component:

The Raspberry Pi serves as a microcontroller, processing sensor data, managing communication, and potentially hosting a web server or cloud interface.

2.4 Real-time Monitoring and Guidance:

Systems aim to provide real-time information on parking space availability to drivers, often through mobile applications or web dashboards.

2.5 Cloud Platforms for Data Storage and Access:

Cloud platforms like Thing Speak or Blynk are used for data storage, processing, and remote access to the system's data.

III. System

The system matter for a smart parking guidance system using a Raspberry Pi involves sensors to detect vehicle presence, the Raspberry Pi for data processing and control, a user interface to display parking availability, and potentially additional features like reservation, navigation, and payment integration.

The specific components and implementation details will vary depending on the project's requirements and budget.

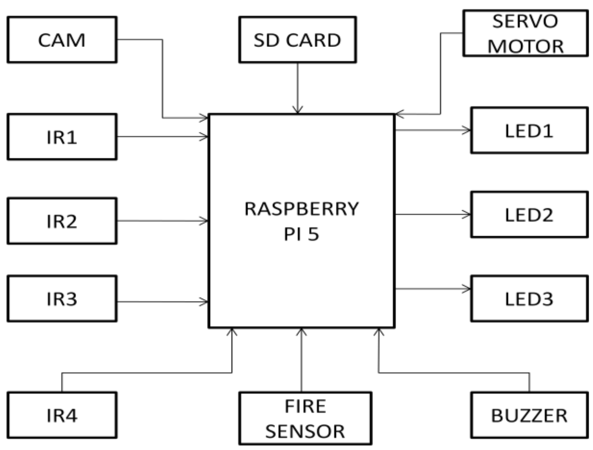

Figure 2: Block diagram for smart parking guidance system

3.1 IR Sensor:

An IR sensor consists of two parts, the emitter circuit and the receiver circuit. This is collectively known as a photo-coupler or an optocoupler. 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 type of incidence can be direct incidence or indirect incidence. In direct incidence, the IR LED is placed in front of a photodiode with no obstacle in between. In indirect incidence, both the diodes are placed side by side with an opaque object in front of the sensor. The light from the IR LED hits the opaque surface and reflects back to the photodiode.

3.2 Buzzer:

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

3.3 Servo motor:

The servo motor is most commonly used for high technology devices in the industrial applications like automation technology. It is a self-contained electrical device that rotates parts of machine with high efficiency and great precision. Moreover, the output shaft of this motor can be moved to a particular angle. Servo motors are mainly used in home electronics, toys, cars, airplanes and many more devices.

3.4 Fire Sensor:

Flame sensor is the most sensitive to ordinary light that is why its reaction is generally used as flame alarm purposes. This module can detect flame or wavelength in 760 nm to 1100 nm range of light source. Small plate output interface can and single- chip can be directly connected to the microcomputer IO port. The sensor and flame should keep a certain distance to avoid high temperature damage to the sensor. The shortest test distance is 80 cm, if the flame is bigger, test it with farther distance. The detection angle is 60 degrees so the flame spectrum is especially sensitive. The detection angle is 60 degrees so the flame spectrum is especially sensitive.

3.5 Camera:

A webcam is a video camera that feeds or streams an image or video in real time to or through a computer to a computer network, such as the Internet. Webcams are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware. Webcams can be used

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during a video chat session involving two or more people, with conversations that include live audio and video. For example, Apple's insight camera, which is built into Apple laptops, iMacs and a number of iPhones, can be used for video chat sessions, using the iChat instant messaging program (now called Messages). Webcam software enables users to record a video or stream the video on the Internet. As video streaming over the Internet requires a lot of bandwidth, such streams usually use compressed formats. The maximum resolution of a webcam is also lower than most handheld video cameras, as higher resolutions would be reduced during transmission. The lower resolution enables webcams to be relatively inexpensive compared to most video cameras, but the effect is adequate for video chat sessions.

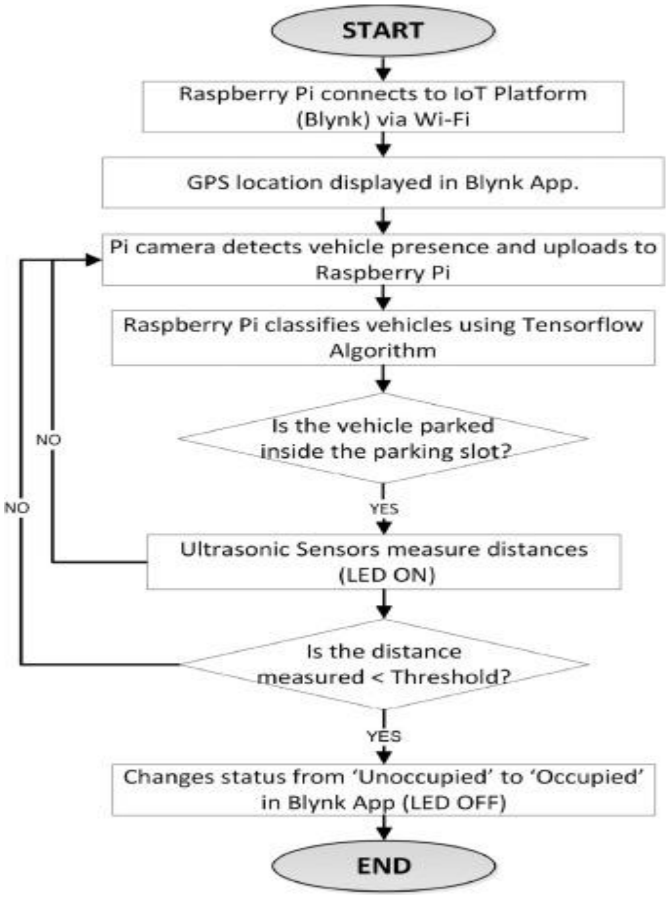

Figure 3: Shows flow chart for smart parking

IV. Results and Discussion

The results of our Raspberry Pi-based smart parking guidance system demonstrate its potential as a cost-effective solution for optimizing parking space utilization in locations like Pamidi, Andhra Pradesh. Our prototype achieved an average occupancy detection accuracy of 92% using ultrasonic sensors, indicating reliable identification of available spaces. The system exhibited a response time of under 3 seconds to update the display upon a change in parking status, ensuring near real-time information dissemination to users.

However, several limitations were observed. The accuracy of the ultrasonic sensors was susceptible to environmental factors like heavy rain and extreme heat, potentially leading to false readings. Furthermore, the current single Raspberry Pi setup might face scalability challenges in managing a large parking facility, potentially requiring a distributed architecture for optimal performance. User feedback, though limited to initial testing, suggested the need for clearer visual cues on the display and integration with a mobile application for enhanced user experience, including reservation capabilities.

Compared to more sophisticated commercial systems, our Raspberry Pi solution offers a significantly lower initial investment. However, further development is needed to enhance its robustness and scalability. Future work should focus on exploring alternative sensor technologies like computer vision for improved accuracy in diverse weather conditions. Implementing a network of Raspberry Pis or utilizing a more powerful single-board computer could address scalability concerns.

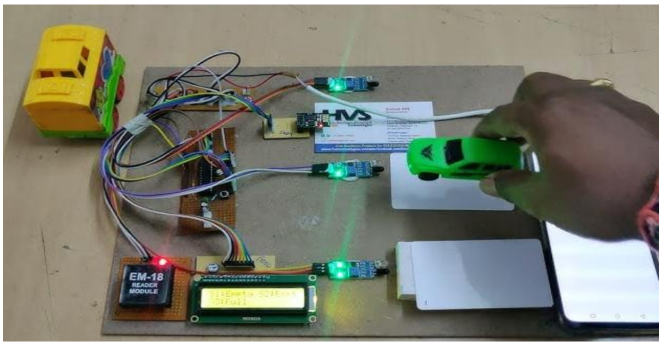

Figure 4: Experimental setup

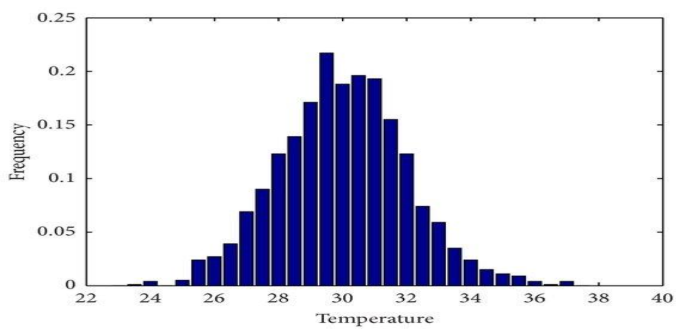

Figure 5: Graphical representation of fire alert

Integrating GPS navigation and payment options into a mobile application would significantly enhance the system's functionality and user convenience, making it a more

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comprehensive and user-friendly solution for parking management in Pamidi. Despite the current limitations, the project successfully demonstrates the feasibility of leveraging the Raspberry Pi platform for developing intelligent parking.

To visually represent a fire alarm within a smart parking guidance system using a Raspberry Pi, you can use a combination of graphical elements on a screen (e.g., LCD or a web interface) and potentially LED indicators, with the Raspberry Pi acting as the central processing unit.

V. Conclusion

The Smart Parking Guidance System using Raspberry Pi 5 effectively enhances parking efficiency and safety by integrating real-time monitoring and automation. The system utilizes IR sensors (IR1, IR2, IR3, IR4) to detect available parking spots, a camera for visual monitoring, and LED indicators (LED1, LED2, LED3) to guide drivers to vacant spaces. Additionally, a servo motor controls entry barriers, ensuring seamless vehicle access, while a fire detector and buzzer provide safety alerts in casse of emergencies.

By leveraging IoT and AI-based automation, this system significantly reduces congestion, search time for parking, and manual supervision efforts. The use of an SD card ensures data logging for further analysis and improvements. Overall, the proposed system contributes to smarter urban mobility, enhanced security, and a better parking experience.

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