INTELLIGENT PAY PARK - RASPI-BASED SMART PARKING MANAGEMENT SYSTEM

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1. Introduction:

Urbanization and the increasing number of cars on the road have made traditional parking arrangements more difficult to manage, which has resulted in several enduring problems like traffic jams, waste of time, and pollution of the environment. The goal of this project is to use Internet of Things (IoT) technology to construct a Smart Parking Management System to address these issues. The aim is to mitigate current parking system issues, optimize overall efficacy, and furnish urban dwellers and commuters with a seamless and eco-friendly parking encounter.

2. Abstract:

The need for effective parking management systems has increased because of urbanization and an increase in the number of automobiles. Conventional parking arrangements frequently lead to traffic jams, wasted time, and pollution of the environment. To solve these issues and improve the overall parking experience, this Project offers a Smart Parking Management System that is based on the Internet of Things (IoT).

The suggested method makes use of Internet of Things technology to build an intelligent and dynamic parking management system. Parking spots with sensors, a centralized data processing unit, and an intuitive mobile application are essential elements. Real-time occupancy status monitoring is continuously monitored by sensors that are installed into each parking space.

3. Background of study

An inventive answer to the problems associated with urban parking is provided by IoT-based Smart Parking Management Systems. The system maximizes parking space use, minimizes environmental effect, and improves the general efficiency of urban transportation networks by utilizing the power of the Internet of Things. Urban parking management is made smarter, more sustainable, and user-centric by combining real-time data analytics with intuitive interfaces.

The central processing unit, the user's mobile device, and the parking spaces are all seamlessly connected thanks to the Internet of Things architecture. After processing the sensor data, data analytics algorithms provide insights into parking trends, peak usage hours, and overall occupancy rates. Authorities may make well-informed decisions about parking policy modifications and infrastructure design thanks to this data-driven method.

 Additionally, the system has smart payment features that let users pay for parking using a smartphone application. It also features real-time messages and alerts to let users know when their parking permits expire, ensuring that parking laws are followed.

4. Review of Literature:

The review of relevant literature comprising of research articles published by Indian and international authors in national and international journals, conferences proceedings and theses conducted and presented in the following table. The literature review is conducted to find the answers to the following question.

1. What are the Issues with Traditional Parking System?
2. What are the advantages while transitioning from traditional vehicle parking systems to technology-based parking systems?
3. What are the major tools and techniques Proposed for Technology based Parking System?

1. **Adi Alee Saleem et. al.** This paper delves into the transformative impact of IoT on smart parking solutions, specifically examining research conducted between 2018 and 2019. Cities worldwide, aspiring to transition into smart cities, are embracing IoT to tackle issues like traffic congestion, limited parking facilities, and road safety. The reviewed research papers showcase various models enriched with sensors, cloud integration, and mobile applications. These models collectively contribute to the development of smart parking systems, offering tangible benefits such as time savings, energy conservation, reduced fuel consumption, and a consequent decrease in carbon footprint [1].

2. **Waheeb A Jabbar et. al** This paper introduces an innovative solution, the IoT Raspberry Pi-based Parking Management System (IoT-PiPMS), designed to empower staff and students to easily locate available parking spots in real-time through a smartphone application. The system comprises essential components, including the Raspberry Pi 4 B+ (RPi) embedded computer, Pi camera module, GPS sensor, and ultrasonic sensors. [2]

3. **Thorat S. S. et. al** This research paper aims to address this concern by developing a reliable system that automates the identification of available parking slots and maintains systematic records of parked vehicles. The system significantly reduces human effort at the parking area, eliminating the need for drivers to search for free slots and simplifying the payment calculation process. [3].

4. **Supriya Shinde et.al** To improve travel ease, this research study introduces an IoT-based parking system. The system makes use of intuitive Android applications as interfaces and harnesses the power of the Internet of Things to deliver efficient parking solutions. This innovation's mainstay is Google Maps, a crucial component that not only lets customers find vacant parking spots but also gives them directions to get there. In addition to guiding users to their destinations and emphasizing effective parking places, the system promises to lower pollution and accident rates and improve traveler comfort. [4].

5. **GX Li et. al** An orderly and appropriate vehicle parking infraction notice system was devised by researchers in order to control this non-standard parked behavior and to guide and regulate owners in developing excellent parking habits. The article describes a system that records vehicle information on illegal parking. The way this system operates is that a wireless MMS image terminal takes pictures of illegal vehicles, then uses the GPRS network to send those pictures in real time to the school's Data Center Computer in the Security Department. This ensures that information about illegal vehicles is promptly recorded and alerted. Illegal cars will be restricted or cautioned not to reenter the campus in the interim [5].

4.1 Analysis of the review of literature

All things considered, these studies emphasize the necessity of comprehensive and integrated approaches that consider environmental, technological, and regulatory factors to address the problems associated with parking in metropolitan area.

1. **Integration with Transportation Planning:** For sustainable urban development, a number of studies highlight the integration of parking regulations with more comprehensive transportation planning.
2. **Technology Solutions:** Two studies address the application of technology. One focuses on modern parking solutions, while the other examines the use of an automated system to monitor and control illegal parking.
3. **Environmental Impact:** A number of studies take the environment into account, bringing attention to problems like noise pollution and poor air quality as a result of insufficient parking management.
4. **Impact of unlawful Parking:** Two studies especially address the effect of unlawful parking; the first one focuses on the time it takes for commercial trips, while the second one suggests a mechanism for regulation and enforcement.

5. The objectives of the study:
Establishing specific goals at the outset of an IoT-Based Smart Parking Management System is necessary to direct its execution and guarantee its success. These are important goals to think about:
1. **Maximize Parking Space Utilization**: Make sure that parking spots are used effectively by putting in place a system that gives real-time information on available spots.
2. **Boost Operational Efficiency:** Automating the processes of monitoring, payment, and enforcement will streamline parking lot operations and increase overall efficiency.
3. **Encourage Cost Savings for consumers:** By giving consumers the resources they need to locate parking spots fast and making convenient payment options available, you may help them save time and money.
4. **Enhance Revenue Generation:** To make the system financially sustainable and possibly defray installation costs, investigate revenue-generating alternatives such partnerships and smart pricing structures.

Flowchart
(A) Sensor Module
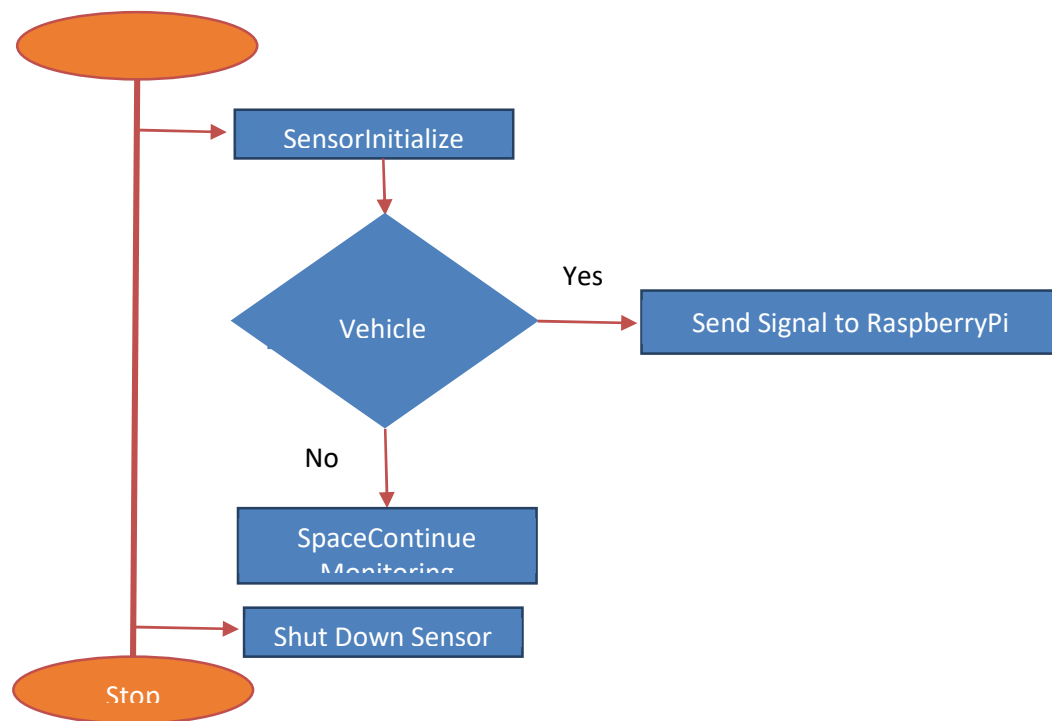
(B) Raspberry Pi Integration Module
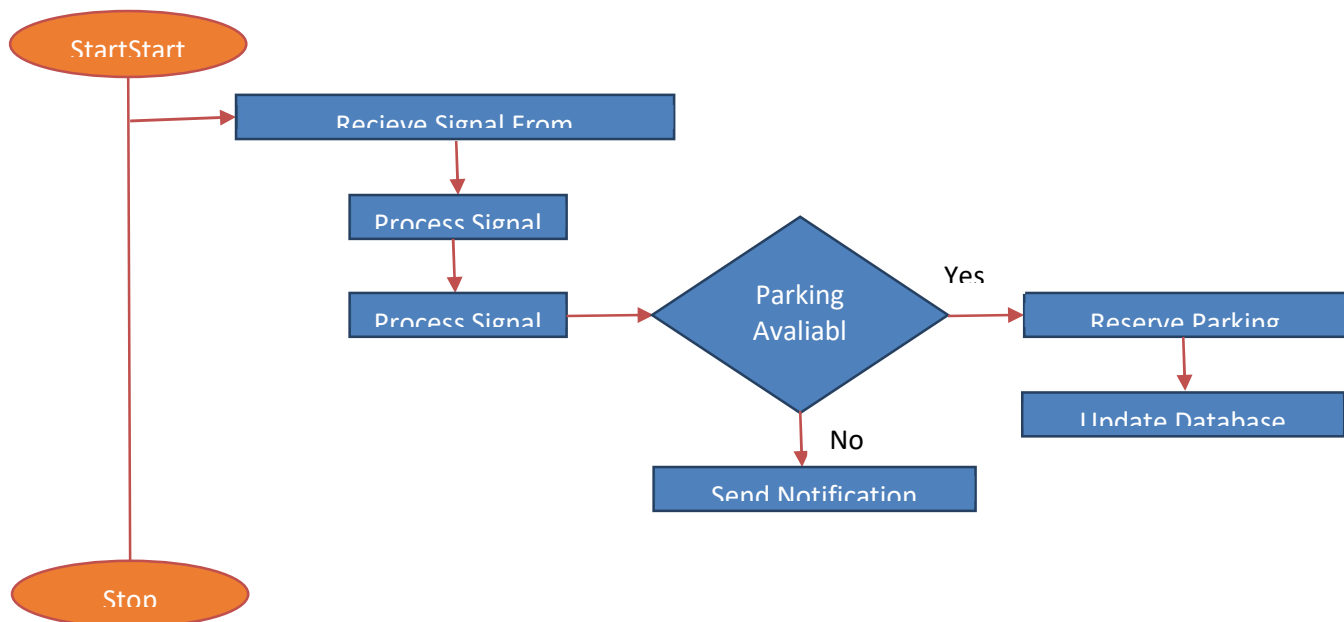
6. Significance of Study:

Technology plays a vital role in addressing parking challenges. Modern parking solutions leverage technological advancements to improve efficiency, accessibility, and enforcement. Automated systems, as described in one study, enhance the monitoring and control of parking, providing a more systematic and proactive approach to managing parking.

The experience gained will enable the researcher to carry out other studies of better quality in terms of methodology used and how the results are presented and analyzed. It will also provide a strong basis

for further research in related areas of study. The research study should contribute to fundamental knowledge or provide solutions to real world problems. The information obtained would be used as a springboard for Implementing new areas related to it. Thus, it is used as Complete Solution. Furthermore, the study will become an integral part of vehicle parking in daily routine.

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