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A Survey On Car Parking System Using Iot

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Abstract:

Even though parking is usually thought of as being easy, traditional parking systems' inefficiencies can make the task difficult. These systems rely heavily on manpower for management, requiring users to manually search for parking spaces. This paper introduces a Smart Parking system with an energy management solution designed for organized environments like multi-story office parking areas. To create a better organized parking systems, the system combines sophisticated Honeywell sensors and controllers with cutting-edge IoT technology. Lights are installed to indicate where parking spaces are available, saving people from having to search far and wide. Occupied spaces are recorded in the cloud, enabling the central system to direct incoming vehicles to open spots.

Additionally, the system optimizes energy usage by automatically adjusting lighting, enhancing both energy efficiency and user visibility in parking spaces. This automated system reduces the need for manual intervention, enhancing the overall aesthetics and efficiency in parking area usage. The aim of this paper is to enhance user convenience and time efficiency within parking systems.

Keywords: Parking Management, Sensors, Wireless Sensor Networks (WSN), Time Optimization, Internet Connectivity.

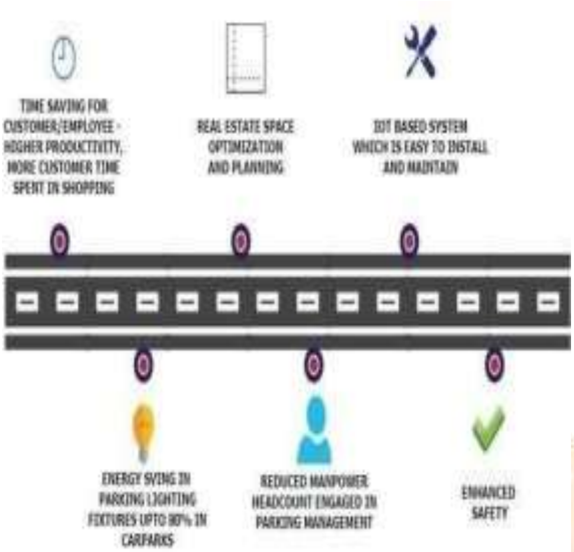
I. Introduction

Parking management in large commercial areas like malls, hospitals, city centers, and residential societies is increasingly challenging due to the growing number of vehicles. Multi-storied parking systems are commonly implemented but lead to inconveniences such as during peak hours, users have to deal with crowded entry areas, noise and pollution, and waste their time searching for a spot to park.

Additionally, these systems demand substantial resources like lighting, ventilation, and manpower, escalating electricity costs and energy wastage, to address space limitations and the increasing number of vehicles on the road, an inventive parking service is desperately needed. utilizing a smart parking system. IoT and wireless sensor networks (WSN) technology develop as a sustainable option that offers advantages for energy and time savings.

Users are efficiently directed to available parking spots, eliminating manual search efforts. This system assures accurate positioning, monitoring, and remote control while being cost-effective and user-friendly. Existing WSNs in parking systems focus on space booking, allocation, and online payment integration using IoT platforms. However, this paper proposes a comprehensive solution catering to larger parking spaces and considers various implementation aspects, including security concerns for users vehicles.

The system uses a dispersed sensor network with Dual Technology Ultrasonic and Passive Infrared sensors to identify approaching cars and turn on aisle lights. Through an interface, these sensors send occupancy data to the Wireless Parking Controller, allowing exterior indicator lights to show the status of open parking slots. Secure data transmission inside the system is made easier using zigbee technology.



The process entails designating parking spots as "Occupied" in the system GUI and turning on parking lights when users park. Sensors detect human presence, keeping lights on, and reducing illumination after a set time to save energy. Upon user return, normal illumination is restored until departure, marking the space as vacant and dimming lights. For multi-storied parking, display panels at entrances show available spaces on each level, aiding users in choosing a level and saving time.

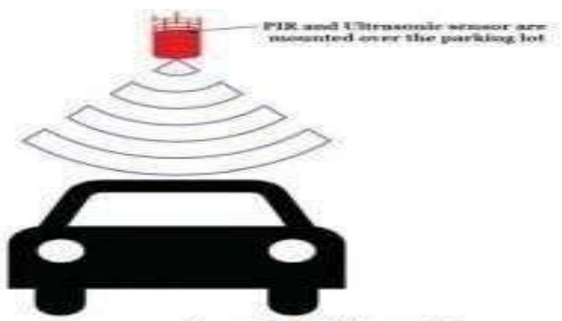


Figure 2: Wall mounted sensor

Overall, this smart parking system optimizes user experience, reduces energy consumption, and streamlines parking management, offering a significant improvement over conventional systems.

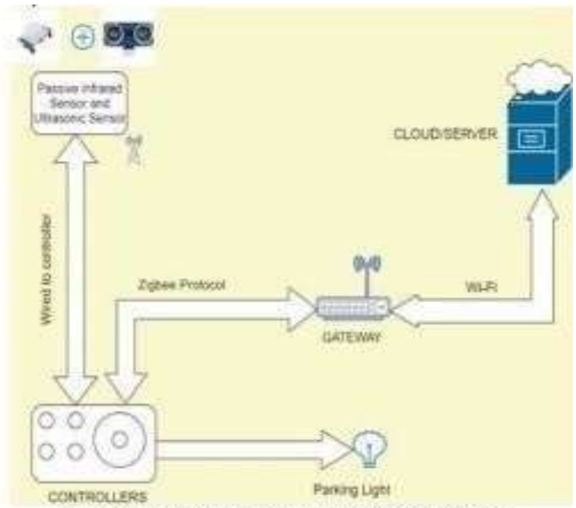


Figure 3: Schematic diagram of Wireless Parking.

II. SOFTWARE MODEL AND FRAMEWORK FOR AN IOT-BASED ENERGY MANAGEMENT SYSTEM

The architecture depicted in figure 3 is an Internet of Things (IoT) energy management system that integrates intelligent edge computing through the use of a DRL (Deep Reinforcement Learning) network. Energy devices, energy-edge-servers, and energy-cloud servers are the three main parts of this structure.

A. Power Source

Any entity is represented by the energy gadget, energy device or user within the network involved in either supplying or requiring energy. These devices are capable of collecting, or generating energy data based on their specific functionalities and types

B. Energy Edge Configuration

Deployed at strategic points like network gateways or base stations, the energy-edge connection operates within local area networks for tasks such as computing, caching, and delivering energy-related data. It interfaces with energy devices through diverse communication Wi-Fi, VANET (Vehicular Ad Hoc Network), and 5G technologies, among others. The local energy network activities are also managed by the energy-edge-server according to analytical results.

C. Cloud Server for Energy

Cloud server for energy is connected to the central controller in the system for energy management and has two purposes. Assisting servers with their processing demands, it does analysis and computations for energy devices in real-time. In this design, data processing is handled by the energy- edge connection, which then uses the core network to send the processed data to the cloud server. The cloud server and the edge-server employ DRL agents. An energy device sends a task to a nearby edge-server, where the edge DRL agent is in charge of carrying it out, when the task involves computational processing.

III. SOFTWARE MODEL

Here, we suggest a model that outlines an IoT-centered energy management system withintelligent computing, as shown in Fig. 3. The four separate layers of this model are the cognition layer, application layer, sensor layer,and network layer.

1. The Layer of Sensing

Within the layer of sensing, devices are tasked with generating or detecting energy-related information within the connected network. Management of device connections falls under the duty of the energy-edge server, ensuring reliable communication links. An integral feature of this software model involves querying data, a fundamental aspect essential for intelligent edge computing services. Considering the diverse nature of energy data in cities, the edge-server organizes and categorizes collected energy data for classified processing.

2. Network Layer

The IoT-based energy management solution that is being suggested emphasizes data transmission for seamless transfer betweenenergy devices, the Energy-Edge server, and task delegation between the Edge and Cloud servers.

Various communication technologies like PLC, 5G, LTE, and Wi-Fi facilitate this data transmission.

Integration of data storage across energy cloud servers, energy servers, and devices forms a unified network storage, constituting a "data-pool." This virtual repository allows access to heterogeneous data, enabling examination of historical data to develop control policies. The registry keeps a record of device entries and exits within the IoT-based energy network, aiding in network configuration management.

3. Third Layer of Consciousness

This produces intelligent insights in the centre of the suggested system architecture into the energy environment.Configuration, optimization, and DRL processing are the three main practical modules thatmake this layer. The DRL processing module, which is installed on cloud and edge- servers, captures user requests and present conditions. calculating rewards based on past actions.

Leveraging a robust DNN, it makes informed decisions, offering accurate estimations and predictions. An ideal timetable is sought after through optimization. for edge server usage, minimizing energy consumption. Configuration, performed in the cloud-server or edge-server, governs operations, balancing centralized and decentralized approaches.

4. Layer of Applications

A bunch of tools is provided by the application layer to process data from underlying layers and set up the suggested IoT infrastructure. Energy management forms the core function, facilitating comprehensive control and scheduling without delving into the down layer intricacies. Control over topology manages device entry/exit decisions. Web-based and mobility applications foster interoperability among diverse devices and technologies, enriching the IoT-based energy management system.

RECOMMENDED DESIGN FOR PARKING MANAGEMENT SYSTEM

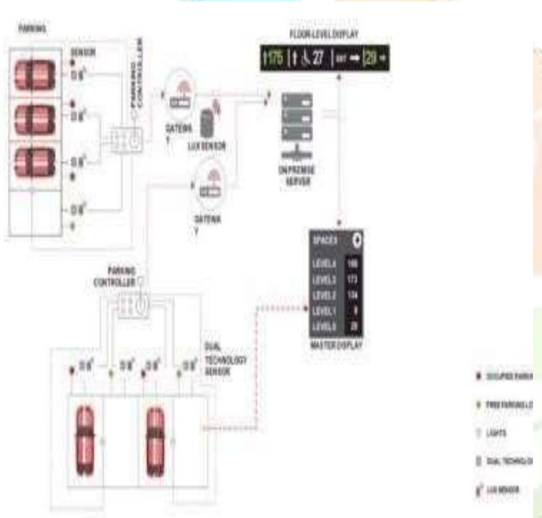


Figure 4: Architecture of proposed model

A. Time Savings:

In traditional parking setups, the layout is often disorganized or poorly managed, leading users to take a long hunt for an available parking spot. Through a probabilistic mathematical model, it's been projected When traffic is at its busiest, this quest takes approximately24 minutes, while in idle periods, it averages around 17 minutes. Contrastingly, in a system, the area for parking is efficiently organized, providing users with advance information regarding available spots through heads on display on various levels and floor sections. Dual-color indicator lights signify the vacancy status of parking slots, aiding users in swiftly locating empty spaces.

During the parking of a car, it takes about 11 minutes, reducing to 9 minutes during idle periods. This translates to are markable54.16% reduction in user time. This time efficiency effectively mitigates common frustrations associated with hunting for parking spaces, allowing this saved time to be utilized productively, whether for office employees or shoppers in a mall parking lot. Broadly speaking, every 13 minutes saved per user equates to a collective 585 hours saved among 2700car park users.

Equation (1) operates under the postulation that the probability (P(E)) of finding an unoccupied space for parking linearly increases as users ascend from the ground to the top floor within the multi storied parking system.

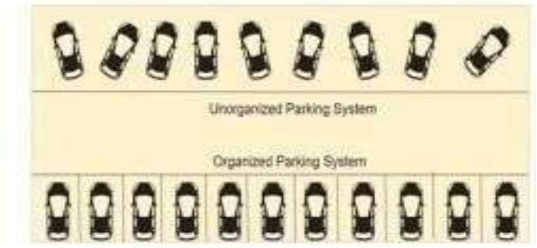
$$\text{Time Saving}=\frac{S\times D\times\sum_{i=1}^{n} P(E_i)}{n}$$

Where:

S=Average car speed on each floor.

- D=Distance travelled by a car in the parking lot.
- $P(E_i)$ = Probability of finding a free parking spot on floor i.
- n = No of floors. In this setup, both types of lights remain continuously illuminated throughout operational hours.

On the other hand, when user possession is not detected, the smart parking system dims the passageway and parking spot lights to 40% of their total power. If one assumes that the user shall be near the automobile for a total of 10 minutes and that passageway lights are used continuously during peak hours, then the overall power consumption savings come to an astounding 84%. This substantial reduction in power ingesting not only diminishes the carbon footprint but also presents a green-solution amidst rising global warming concerns. Moreover, it significantly slashes down electricity bills, reducing yearly expenses exponentially.



The energy consumed in an orthodox system is calculated using the bulb's energy (30W) multiplied by hours divided by 1000 (for 100% illuminance), while the system's energy consumption considers the same bulb energy(30W) multiplied by hours and further multiplied by 0.4, then divided by 1000 (for 40% illuminance).

B. Space Efficiency:

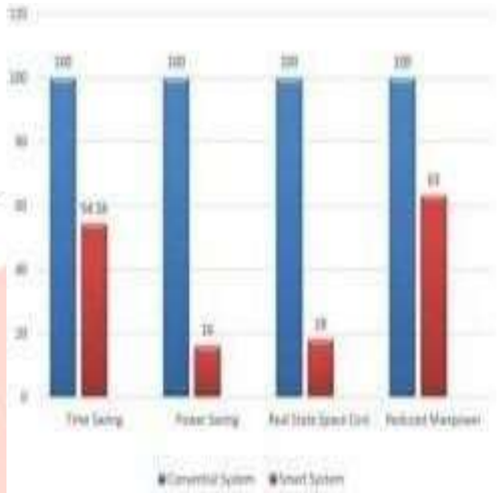
In disorganized parking layouts, vehicle parking tends to be chaotic, leading users in following a pattern set by preceding vehicles. Parallel parking, often used in such scenarios, consumes a significant amount of space.

People often park carelessly, sometimes even taking up two car spaces. The departure to arrival of vehicles ratio affects how the spaces for parking is actually used. An organized multistory parking plan with designated perpendicular parking structures on several sections per level is introduced by the innovative parking system. This layout enhances usage of parking spaces efficiency and saves both real estate costs and users' parking time. Board of display and indicator lights said users in quickly identifying available spaces, contributing to an estimated 18% savings in real estate space.

In conventional parking management, a substantial workforce is required, especially during peak hours, to guide vehicle owners and manage the crowding of vehicles. But in contrast to traditional systems, the parking system drastically lowers this requirement, using just a total of 4 personnel for better security and monitoring, resulting in a staggering 63% reduction in the labour amount.

C. Return on Investment (ROI):

Despite initial investment costs for equipment and construction, the smart parking system yields substantial returns. The solution offers increased user productivity due to parking convenience, significant savings in annual salaries due to reduction in the labour work needed, considerable power savings leading to extended LED life, among other factors. Collectively, the yearly ROI is projected to be around 0.88.



D. Maintenance Based Prediction:

Unlike periodic maintenance in conventional systems, the intelligent parking system integrates strategically positioned light sensors to predict insufficiencies in light and promptly alert maintenance teams. Programmable controllers diagnose faults in sensors or wiring in real time, streamlining the fault-finding process and enhancing system reliability.

E. Safety Augmentation:

Although the IOT based parking system may appear comparatively darker, motion-detecting sensors ensure adequate lighting upon user entry. This setup acts as a theft deterrent while CCTV surveillance further bolsters security measures in parking spots.

IV. CONCLUSION

In addition to outlining the system's architecture and connectivity, this article focuses on an IoT-enabled smart parking system that improves parking management. We propose an IoT frame work where sensor data seamlessly integrates with the controller to enable efficient operations. Apartments, retail- centers and hospitals are some areas where this system can be put into use.

The aim of this IoT-based intellectual system is to address challenges encountered in traditional smart parking systems, including issues related to space, time consumption, labor costs, and productivity. Additionally, this system comes with advantages such as improved privacy and security measures.

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