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IOT Based Smart Parking System

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Abstract - The main goal of the SMART PARKING SYSTEM using IOT project is to lessen traffic congestion caused by parking spaces being unavailable on highways, in multi-story buildings, and in shopping centers. If there are any available empty slots in relation to the user's location, the project shows them. Utilizing parking spaces effectively is the goal of our proposal. We keep track of open spots in the parking lot and allocate them to the user. The previously mentioned smart parking system can result in an error-free, dependable, safe, and quick management system. The idea of "smart cities" has been very popular recently. Now that the Internet of Things has advanced, the concept of a smart city appears to be feasible. IOT professionals are working tirelessly to increase the dependability and productivity of urban infrastructure. IOT is addressing issues including traffic congestion, a lack of parking spaces, and road safety. The IOT module for the proposed smart parking system is deployed on-site and is used to track and indicate the availability of each individual parking space. Additionally, a mobile application is offered, enabling users to check for parking availability and reserve a spot in accordance with that availability. An overview of the system architecture at a high level is also described in the article. The paper concludes with a discussion of the system's operation in the form of a use case that validates the accuracy of the suggested model.

Key Words: Smart Parking, IOT, Parking,

I. INTRODUCTION

The goal of the smart parking system project is to provide users with management of all parking facilities. Because of the market's low prices and the economy's recent expansion ,even the typical middle-class person can now buy a car, which is fantastic. However, there are drawbacks to owning a car, including high traffic, pollution, a lack of roads, and parking spaces. The issue of parking such cars is one of the major worries that accounting needs to consider. Even yet, if there is room for parking, a lot of time is wasted trying to find the right spot, which increases fuel consumption and is not environmentally good. If we can figure out a way for the parking structure to tell us the exact location of a free spot, it will be very beneficial for both the environment and the vehicles. The LCD initially shows the number of empty and filled spots as the user approaches the location. When the user's car approaches the parking detect sensor, a notification on their mobile app indicates the parking slot number, where they should park their car.

A. Relevance of Project

The primary advantage of a smart parking system is in its cutting-edge technology. It adheres to the newest ideas and technology to guarantee successful results. Supervising and managing the design and implementation of smart parking is really simple. Because of its well-organized structure, staff members can simply handle this system.

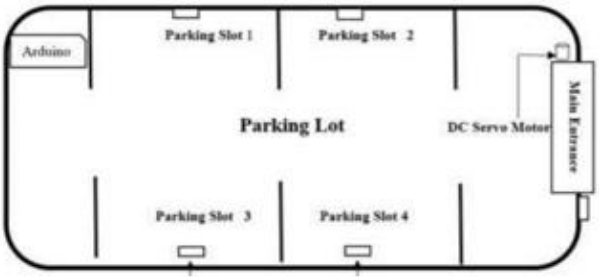

Fig: 1 Block Diagram Of Smart Parking System

i. Problem Statement

Recent studies conducted in large cities have examined the parking management issue from a number of perspectives, including the high car density on the highways. Because it is so difficult to find a parking space, this causes drivers to have bothersome problems when trying to park their cars. Drivers typically squander time and energy searching for a spot, ending up parking their cars on the street, which exacerbates the traffic jam. In the worst situation, people are unable to locate a parking spot, particularly during holidays and busy times.

ii. Objective

Low-cost sensors, real-time data, and applications that let users track open and closed parking spaces are all part of smart parking. The intention is to reduce the amount of time spent manually looking for the best parking lot, floor, and spot by automating the process. Some systems will include an entire range of services, like notifications about parking times, online payments, and even the ability to search for cars on very big lots. The user and the owner of the lot can both profit substantially from a parking solution Optimized parking - allows users to save time, money, and effort by selecting the greatest place available. The parking lot fills up quickly, and businesses and corporations can make good use of the available space.

Decreased traffic - As fewer cars are needed to travel about looking for an open parking place, traffic flow increases.

Decreased pollution - Every day, the search for parking burns around a million barrels of oil. The amount of time spent driving will be greatly reduced by an ideal parking solution, which will also reduce daily vehicle emissions and the environmental impact on the planet.
Enhanced Safety - Security personnel and parking lot workers have access to real-time lot information that can help stop suspicious activities and parking infractions. Cameras that recognize license plates can capture relevant video. Additionally, fewer people doing spot searches on the streets can lessen the number of accidents brought on by the diversion of looking for parking.
Reduced Management Costs - Labor costs and resource fatigue are reduced by increasing automation and decreasing manual labor.
Improved User Experience - A smart parking system will combine all user interactions into a single, cohesive process. The driver's payment, location search, site identification, and time notifications are all integrated into the destination arriving procedure.

iii. Scope of Project

Currently, there are portals in several nations where users can access online information regarding parking lots. Users can use this system to get information on parking spaces, but it cannot tell them which parking spaces are occupied or vacant. Thus, such a system is unable to solve the problem ingeniously. Car lifts come equipped with an automated robotic system that, as soon as the vehicle arrives on a platform, parks it automatically in a designated position. Movie theaters and medium-sized commercial centers cannot implement this system because it will be extremely expensive for them. In a majority of public spaces, the system can simply display availability; it cannot display the precise time slot or the route to that time slot. Finding a clever route to the open area is therefore necessary.

iv. Methodology

Servo motors, IR sensors, and Node MCU are the components of this project. Two IR sensors are utilized to determine whether a parking space is available, while one IR sensor is used at the entry and exit gates to detect the car. The gates are opened and closed by servo motors in response to sensor values. An open source IOT platform is called Node MCU .It consists of hardware built around the ESP-12 module and firmware running on ESP if Systems' ESP8266 Wi-Fi SOC. By default, the firmware is referred to as "Node MCU" rather than the development kits. The scripting language Lua is used by the firmware. The ESP8266 is a low-cost microchip with full TCP/IP stack and microcontroller functionality that is equipped with WIFI. Node MCU has a CPU core, quicker WIFI, additional GPIOs, and low-power Bluetooth 4.2 capability. The Node MCU will receive a signal from the IR sensors indicating the existence of a car in front of the entry, prompting it to determine whether a vacant slot is present inside the parking lot. The main entrance will open when the DC servo motor receives a signal from Node MCU indicating that there is one or more empty slots. However, the gate will not open if a Node MCU detects that there are no available spaces when a car tries to enter. Furthermore, a webpage connected to the Node MCU board will display the quantity of capability.
The basic concept underlying our approach is this: consumers typically waste a lot of time and gasoline searching for a vacant parking space, which increases fuel consumption. We devised a novel approach in which we furnish the consumer with an unoccupied slot number so that he can park his car without squandering time looking for one. In a similar vein, we aim to show the start and end times so that the user may determine how long he has parked his car.

II. LITERATURE SURVEY

1. Developing a Smart Parking Management System Using the Internet of Things

Parking searches result in enormous time and energy waste as well as major financial consequences. This is especially true for those who experience constant pressure to arrive on time. Smart cities use a wide range of contemporary technologies to efficiently manage and improve resources. Urban parking structures are among the most important assets that need to be maintained. As a cutting-edge approach to parking management that saves consumers money, time, and effort, we created the smart parking management system (SPMS). Modern living has made it necessary to enhance techniques for finding parking spaces that are available and reduce traffic at the parking entrance. A better option than looking for parking at a lot when there's a chance you won't find any is to search for or reserve available parking online in advance. Our smart parking management system was created with the following goals in mind:
• Effectively manage parking and use technology to solve issues;
• Use technological advancements to further the idea of smart cities.
Numerous technologies are used by the suggested system to assist with parking management. For users, it offers necessary services including parking search, booking, and payment. It is expanded to include more sophisticated capabilities like tracking parking conditions, receiving notifications, and data. The apparatus is linked to sensors for occupancy detection and an automated number plate recognition (ANPR) camera for access control.

2. IOT-based E-Parking System for Smart Cities

In addition to causing parking-related issues, the massive growth in the number of vehicles on the road and poor management of existing parking spaces have worsened traffic congestion in urban areas. Therefore, the creation of an automated smart parking management system is necessary in order to lessen air pollution and fuel consumption while also assisting drivers in finding a parking spot that is appropriate for their car. It has been shown that a driver must spend about fifteen minutes looking for a suitable parking space, which adds to vehicle fuel consumption, traffic jams, and air pollution. There is a substantial body of study on the creation and design of smart parking systems. Different aspects of smart parking system:
• Parking lot reservation and space availability inquiries;
• Real-time parking navigation and route guidance;
• Vehicle occupancy detection and parking lot management.

The majority of smart parking systems (SPS) that have been put out in the literature in recent years offer solutions for issues including real-time navigation inside parking facilities, occupancy detection and administration of parking lots, parking availability information systems, and parking reservation systems. Nevertheless, very few studies have focused on the automatic collection of parking fees and the real-time detection of improper parking. In order to overcome these challenges, this paper provides an internet-of-things (IOT) based E-parking system that uses an integrated component known as a parking meter (PM).
• Improper parking detection in real time
• An estimate of how long each car will be parked
• Automated parking fee collection
Parking meter (PM) based E-parking (PM-EP), the E-parking system suggested in this article, offers a parking lot reservation system and information on parking facility availability, together with a citywide smart parking management solution.

III. SYSTEM REQUIREMENTS SPECIFICATION

a. Functional Requirement

A functional requirement outlines a software system's function and the way it must respond to particular inputs and/or circumstances. These could consist of computations, processing and manipulation of data, and other specialized features. These systems' functional needs are as follows:

• The program must not crash even after a prolonged period of operation. • It must not display inappropriate messages for legitimate conditions.
• The program must process data for all types of input cases and produce the output for each input test case that is supplied.

b. Non functional Requirement

Non-functional requirements are those that have nothing to do with the particular function that the system is supposed to do. Rather of focusing on particular behaviors, they define the standards by which a system's performance can be evaluated. The non-functional needs are as follows:

•Specifications for the product
• Fundamental operating requirements
• Organizational requirements

B. Hardware Specifications

I. Node MCU:

The Node MCU, depicted in Figure 2, has integrated TCP/IP protocol, enabling any microcontroller to connect to a 2.4 GHz Wi-Fi network (802.11 Wi-Fi standards).Node MCU can host an application using the HTTP protocol or connect to an already-existing wireless network. Every Node MCU module has an AT command set firmware pre-programmed into it, so all you have to do is connect it to your Raspberry Pi device and use it as a Wi-Fi shield. We chose Node MCU instead of Arduino UNO because it is more affordable; with Arduino, we need to utilize ethernet shield to provide secure ethernet connectivity, but node mcu has all of these characteristics plus an additional function of wi-fi, where you can use Wi-Fi to connect or power your device.

Fig: 2 Node MCU

II. LCD :

An LCD is an electrical display module that creates a visible image using liquid crystal. One of the most fundamental modules used in DIY projects and circuits is the 16x2 LCD display. The 16x2 corresponds to a display with 16 characters on each of the two lines. Every character in this LCD is shown as a 5 by 7 pixel matrix. The amount of empty and spilled spots is shown on the 16*2 display. Additionally, it is updated on the LCD display when a car parks or unparks.

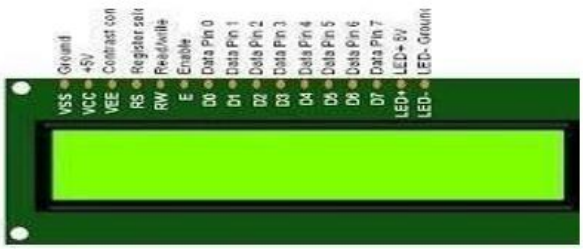

Fig: 3 LCD Display

III. IR Sensor:

An electrical gadget that analyzes and picks up infrared radiation in its surroundings is called an infrared (IR) sensor. William Herchel, an astronomer, made the unintentional discovery of infrared radiation in 1800. He discovered that the temperature was highest just beyond the red light when he measured the temperatures of each color of light (separated by a prism). Despite being within the same electromagnetic spectrum, infrared light has a larger wavelength than visible light, making it invisible to the human eye. Infrared radiation is released by anything that releases heat, or anything with a temperature higher than roughly five degrees Kelvin.
In our project, we're employing three infrared detectors: one to sense whether a car is approaching the parking sensor, and the other two to provide information to the node mcu, our system's brain, on whether a car is parked in that slot or not.

Fig: 4 MIR Sensor

IV. RESULT DISCUSSION

A. Flow chart

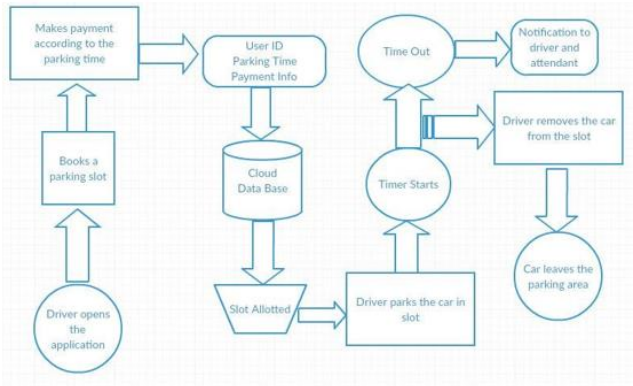

Fig: 5 Flow Chart

B. Advantages

- Optimized Space Utilization
- Time Saving
- Accessibility.

C. Applications

- Smart cities initiatives
- Public transport hubs

V. CONCLUSION

The idea of "smart cities" has long been a human aspiration. Significant progress has been achieved in realizing smart cities in the last few years. There are now more opportunities for smart cities thanks to the development of cloud and Internet of Things technology. The foundation of building smart cities has always been intelligent parking structures and traffic control systems. We approach parking as a problem in this project and introduce an IOT-based, cloud-integrated smart parking solution. Our proposed system offers up-to-date information on parking space availability in a parking area. By using our smartphone application, users who are located in remote areas can reserve a parking space for themselves. The actions taken the goal of this project is to raise the standard of living for city residents by improving parking facilities.

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