

Development Smart Parking System for Royal Hospital Using IoT

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ABSTRACT

The term "Internet of Things" (IoT) refers to a network of physical objects, or "things," that have sensors, software, and other technologies built into them to connect to and exchange data with other systems and devices over the internet. These gadgets can be simple domestic items or highly developed industrial tools. Car parking is one of the most vulnerable issues for all hospitals, as Royal Hospital has large structures and patients, workers, and visitors from throughout the nation. Parking congestion is a major issue at Royal Hospital because it is a large hospital that provides higher-quality healthcare. While there are parking lots at the hospital, they are far away. Also, there is no system for finding parking spaces, which makes the appointment late because of the search procedure. This research aimed to create a smart parking system for Royal Hospital to manage the traffic using IoT connected to mobile App, it saves time spent finding an available parking slot. This framework comprises of the distance estimating gadgets (sensors) associated with the regulator gadget having Wi-Fi. Additionally, it is a component of cloud services and a mobile application that provides the individual with the information necessary to locate an empty parking space. This research will propose a Smart parking system for Royal Hospital, which links to smart parking applications. This research using the dynamic system development method is a novel approach to creating projects or systems. In DSDM, project duration is fixed but functionality is flexible. This new model advances in an ordered manner and provides quick, high-quality solutions for projects. It provides a sound strategy for the project's success, flawlessly depicts the company, stimulates collaboration between parties, and clearly illustrates the prototype system within the team.

Introduction

In recent years, the Internet of Things (IoT) has become more and more well-known. The infrastructure of hardware, software, and services that link actual things to a computer network is included in this paradigm. It entails linking different real-world devices and/or items, referred to as things, so that they may communicate with other things and applications with the aim of working together to accomplish various activities or to give users useful services and information. As the usage of automobiles is increasing gradually, it turns out to be problematic to classify appropriate places to park space for each automobile. Smart Parking System deals with the progress of mobile applications, which is beneficial for consumers to enter full data about car park space and manage it efficiently in parking lot. Smart Parking System uses Image Processing method to classify recording plate of an automobile and likewise affords independent door opening and closing process every time it notices an automobile at the entry of a parking portion. This paper discusses how the development of smart parking is progressing and why it is important, and it is about the idea of installing sensors on parking.

The IoT architecture typically consists of three levels, according to [Aazam et al. 2014]: The various IoT objects that measure and provide information about the environment (sensors) and perform tasks (actuators) that, in response to sensed data, will change the environment in which they are inserted are included in the sensing layer; the network layer manages communication between devices and applications; and the application layer is where the

applications use the data and/or functionalities provided by the device. Although the IoT paradigm is fascinating to use in many instances, connecting such devices requires overcoming obstacles at various stages.

The ThingSpeak1 platform's suitability as a development environment for Internet of Things applications is assessed in this paper. Due to its usability and usefulness in the creation of apps that produce significant amounts of data, Thing Speak was chosen. However, Thing Speak was far more conducive to the quick creation of these applications. Other platforms, such as FIWARE and Kaa, were also considered.

Reviewing Literature

Smart Parking is a car park resolution that can comprise earth sensors, cameras or calculating sensors. These devices are typically entrenched into parking spots or located following to them to notice whether parking bays are open or busy. My project is concentrating on applying a smart parking system at Royal hospital parking to make it easy for patients to find a place to park their cars fast. There are many topics that discuss the problem of finding a car parking and focused on the smart parking system as the best solution for this problem, and some of the most published articles about smart parking system topic are:

(Smart parking systems and sensors: A survey, by IEEE, 05 April 2012), that is specifying the idea of the smart parking system and their types, also the categorizations of numerous current systems are clarified in the article. Besides, they discover the idea of the smart parking system and their classes. The categorizations of numerous current systems are clarified. The parking system handles numerous technologies, and the groups of those methods are set. The purposes of the nodes in wireless sensor networks are also categorized in the article.

(A new Smart Parking System Infrastructure and Implementation, by Yanfeng Geng and Christos Cassandras, 4 October 2012), that has information and review about the outline and distribution process of the smart parking systems. Also, the writers say that they have suggested a new smart parking system for the city environment. The system allocates and assets an ideal parking spot for a car driver based on the consumer's necessities that are association nearness to terminus and parking price, whereas likewise guaranteeing that the general parking volume is professionally used. Their method resolves a Mixed Integer Linear Program difficulty at every choice point in a period driven order. The solution of every MILP is an ideal distribution based on present state data and topic to change proceedings, for instance new customer applications or parking spaces becoming obtainable. The distribution is simplified at the next choice point guaranteeing that there is no source reservation clash, and that no user is eternally allocated a resource with advance than the present price purpose rate. Application matters counting parking discovery, booking assurance and Vehicle-to-Infrastructure or Infrastructure-to-Vehicle communication are decided in the project of them. Our system can save car driver period, petroleum, and expenditure, while decreasing the road traffic jamming and environment contamination.

(Smart Parking System, by mafiha, 2018), that is talking about a general idea about how to start a smart parking system project. The author specifies Dhaka city to find a solution for the traffic caused from not finding a spot to park a car, so she decided to take smart parking system as a best solution for this problem. She said finding a free parking spot in a jammed town like Dhaka is hard. And as if anybody needs to go outdoor from house with private car main thing derives in his awareness is around parking as where he will park his car, and best of the circumstances, publics go to a parking location and discover that parking space are filled and then he must do exploration for additional parking spot. Consequently, it is a great annoyance and countless individuals remain in terror around parking of his car when he goes out with his car. Also, she said that she understood that, to appreciate an improved transportation an enhanced parking system is essential particularly in a jammed town like Dhaka. Consequently, she was thinking how this case can be resolved and lastly, she was successful in creating a cloud founded based on a smart parking system and she was hopeful that applying the system could eliminate the parking problematic of her town. Furthermore, the author thinks ARTIK Cloud is a good and suitable platform for this work. By using this system, a consumer will be capable of discovering an obtainable parking spot simply by either using a mobile or web application from any place. She likewise used Intel Edison with a show that might be located numerous significant positions of

the town or road from anywhere it will be likely to discover free parking spot. This system notifies parking information each 30 seconds. In her project she is willing to display to us in what way we can simply shape like this smart system. She is also willing to use ARTIK Cloud platform, a calm IoT cloud platform.

(Smart parking system with pre & post reservation, billing and traffic app, by Gayatri N. Hainalkar and Mousami S. Vanjale, 11 January 2018), this topic is discussing that a smart parking system built on IoT that not only lets the car driver to reserve a specific parking spot nonetheless too assistances in involuntary cashless promoting, Hacking suggestion, post trip reservation is projected. The authors said that moving in the direction of smart city growth, many smart apps like smart home, healthcare, irrigation, street lighting, parking system, waste management system and many more are part of it. One of these apps is the smart parking system that is an imperative portion of the so named smart city. Smart parking system permits preserving the parking space in improvement, which assists in discount of period in looking for the parking space, decrease in traffic jamming, decrease in contamination, decrease in prevention of car driver and so on. In their project the offered system delivers wholly the features vital for advancement of the excellence of life of an individual in respects to smart city.

(Designing and Managing a Smart Parking System Using Wireless Sensor Networks, by Adil Hilmani, Abderrahim Maizate and Larbi Hassouni, 6 June 2018), it is detailing technologies have been formed to prepare car parks with smart devices to assistance road users classify the nearby car park that has an open space. at this articles the authors said that with the alteration of the worldwide economy and contemporary existence, the Information and Communication Technologies division has practiced an energetic hastening in its procedure, to acclimatize at such alteration. Nowadays, publics devote greatest of their time outdoor of their family surroundings, they go every day to work, and they often go spending centers then magnetisms, deprived of overlooking the movements to the center of the town. This certainly produced an inequity in the regular mobility that directed to the growth of parking facilities to escape needless driving from place to place in the town center to just to find for a parking space this, on the one hand, reasons extra carbon dioxide issues and recompenses the environment of the town's ecosystem. Conversely, it raises drivers' prevention and traffic mobbing in the town, which will surely reason in circulation coincidences. Altogether these damagess the practice of the contemporary town's ecosystem and has developed a main test in the growth of upcoming smart parking systems.

(Car Park System: A Review of Smart Parking System and its Technology, by Zaidi Razak, 2019), which is reviewing the evaluation of car detection technology and how to manage car parking systems. The writer said in his article that in line for the propagation in the amount of the cars in the road, road traffic problems are certain to be, this is in line for the statistic that the present transference substructure and car park ability advanced are incapable to manage with the arrival of the cars in the road, and to manage this problem the use of smart parking system is important since it help users to find parking easily ,likewise the writer mentioned the sensors implementation in the system and how they are important foe a great smart parking system.

(Smart parking systems: comprehensive review based on various aspects, May 2021, by Abrar Fahim, Mehedi Hasan and Muhtasim Alam Chowdhury), it gives a general review about smart parking system. Here the writers say that the contemporary world is altering quickly which is powered by technical detections and technological creations that enable the formation of several smart devices, applications, and systems. These smart devices, applications, and systems contain home apparatus, smart cars and transport systems, robotics, smart sensor networks, communication systems, and numerous additional implements. Over these technological consecrations, human life has become more manageable, supple, and relaxed. These days, numerous human life features are whichever completely or incompletely affected by contemporary technology and its consecrations. And they mentioned that the solution of smart parking system is one of the technological blessings in our life mentioning it's important to us.

(WHAT IS A SMART PARKING SYSTEM? FUNCTIONALITIES AND BENEFITS, August 17, 2021, by Lucía Burbano), it describes smart parking and what it is it meaning, and why it is important. The author said if there is one movement that pressures car drivers, it will be observing a parking spot in the city. This is altering with the application of smart resolutions, for that applying smart technology to simplify this mission will resolve this problematic, improving working effectiveness, make simpler the movement of city road traffic and offering car drivers

a more pleasant and time saving capability. It too decreases the damaging effects of jamming meanwhile less cars traveling associates to fewer greenhouse gas releases.

(10 best parking apps to find a spot and your car, by Joe Hinde, on March 31, 2022) it discusses some of the important applications for smart parking. at this article the writer says that there are two kinds of parking applications. The first assists us to discover a parking space in a congested city. The second assists us in finding our car in a big parking area. And she said that appreciatively their list comprises composed of all sorts of applications. Applications like these are particularly cooperative when we are in huge spaces like cities, enjoyment parks, shopping mall and centers, and numerous additional zones. Parking is an actual discomfort in the mostgested cities greatest of the time. And with a bit of luck, these applications assisted and then she mentioned the most famous application for smart parking by listing them into two divisions. The first five applications assisted us in the discovery of our car afterward we parked. In the meantime, the second set of applications which assistance us in discovering an authentic parking space for our car.

(Design and Development of a Smart Parking System, by Mohammed Omar Ba Sabbea, Muhammed Irfan, Saeed Karama ALtamimi, Saeed Mabkhot Saeed, A. H. M., 2, December 2018), it highlights that the obtainable technology in parking systems has boundaries to offer a parking admission to legal cars, also the parking charge payment mechanism. The authors say that in the previous few years there have been many studies that are objective to decrease the car parking difficulties and make it additional effortlessly and human fewer. Faiz Shaikh has offered an evaluation on smart parking system. They pay attention to operative smart parking technologies established to overcome the exiting problems through using of wireless radar network and provided that actual time data investigation forms the sensor. Also, Yashomati R. Dhumal has offered an android-founded smart car parking system. The system uses an android application to make the consumers reserve places inside the car park, later creation the registering and offer data like car license plate number, phone number and many more. The system defines the period that the consumer wants to park his car at the parking lot. It uses a plate acknowledgment technology at the parking's arrival to let the official car driver go into it. To sum up, the smart parking system can be comprehended as revenues to resolve parking matters together in the existing age and in the coming years. Also, IoT allowing methods essential to be assumed full consideration, guaranteeing that they are at the middle of scheduling smart parking systems. In line with this, numerous replacements occur to the appliance of updating the arrangement of parking lots and to the application of smart functionality. There are those that can be professionally connected and there are those that are fairly stimulating. Irrespective, the application must permit car drivers to obtain real data on parking available and residual parking spaces. The city's parking procedure must be addressed in an effective, actual, and cost-operative method.

Methodology

Methodology is the logical outline inside which the study is shown or the basis upon which the study is founded. There are many types of methodologies such as:

DSDM officially known as Dynamic System Development Method that is an agile method which focuses on the complete project lifecycle, it was created in 1994, after project managers using the Rapid Application Development required more authority and discipline to this new iterative method of working. The DSDM have many strength and weakness points which are:

The basic product functionality can be carried quickly, Inventors have easy access to the end-users, and Projects are dependably finished on time

As strength points of it and:

Comparatively high block to entry can signify a dramatic and troublesome alteration in company philosophy, Expensive to be applied, not perfect for minor organizations. As weak points.

Moreover, as for the advantages and disadvantages of DSDM, they are as followed:

Advantages

Develops group effort: as it can benefit to improve communication efforts crossways numerous teams and sections, which helps to reduce misperception. Supports fast deliverables: as it lets product groups issue their deliverables quickly, reducing postponements and presence to a sensible timeline, which helps groups, rise effectiveness meet customer requirements and accomplish a launch preferably. Supports response: as it inspires groups to stay near communication with attentive parties to get recurrent response and proposals. Improves project group: as when applying the DSDM technique, there are a diversity of tools and plans they can use to assist improved manage the complete process. Sets perfect rules: as it can, assistance groups manage their efforts to guarantee they meet time limits and stay within the financial plan.

Disadvantages

Needs assets: as it can be expensive to appliance. Though it needs an asset to appliance, it might as well save group money through inspiring groups to work professionally and decreasing time-to-market for produces.

Reduces creativeness: as it inspires creators to work rapidly, it might limit risk-taking.

Demands construction: as it works greatest when groups have a dependable construction, filled support from management and capable project managers to lead the project life cycle.

Furthermore, a numeral of opportunities and threats related to DSDM methodologies are registered such as:

Opportunities

The opportunities recognized are as itemized below:

1- Methodology Engineering: It has been experiential that a single methodology is not appropriate for all circumstances. Therefore, Methodology Engineering has been suggested to improve, familiarize, and arrange methodologies.

2- Light Analysis and Design: as only the most elementary and vital models are used throughout analysis and design. Certain Agile processes like ASD and FDD previously contain such perform, thus curing the chronic model-phobia by which elder agile methodologies were distressed.

3- Skilled people Guidance: By skilled people view in dissimilar circumstances is an opportunity that must be place to extreme use. This not only mentions to growth specialists, who are intricate lengthily in Agile groups, nonetheless too comprises domain technology and overhead all methodology specialists, who can assistance adjust the methodology to be suitable to the project at hand.

4- Distributed Software Development Strategies and Techniques: as the regular growth of the Internet and the continuous rise in its rapidity has made distributed software development a contemporary movement.

5- Reverse Engineering: as it is frequently the circumstance that the applied classes are dissimilar from the ones that were initially planned. This dissimilarity can be in terms of class qualities and approaches, or even just as an unwanted rise in the number of the classes.

Threats facing DSDM procedures in the software world are mostly limited to circumstances where these practices express violent competition or cynicism. One such significant example is:

Shortage of Interest in the use of DSDM methodologies in traditional administrations, as appropriately specified in Agile methodologies have not been received well in traditional organizations, mostly due to problems in organizing traditional and Agile procedures or human resources, and troubles in following the principles for example CMM

Design and Discussion

This chapter discusses the critical design of the project on the Internet of things for Development Smart Parking System for (Royal Hospital) using mobile Application, and the design is clarified in a detailed and perfect way for the project so that it shows the functions used in the project such as sensors, microcontrollers, and others.

Logical Design

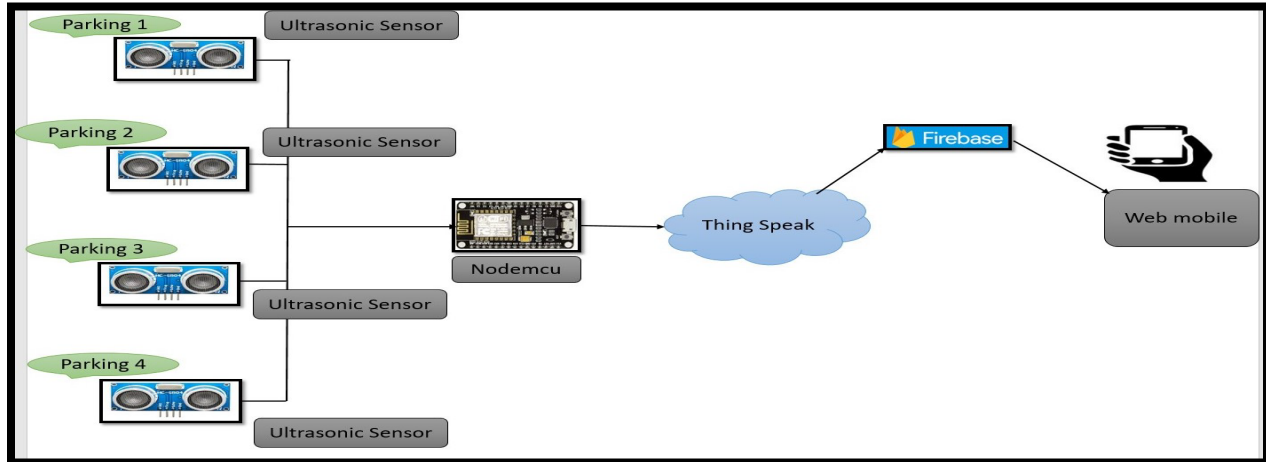


Figure1 Logical Design

The above system design shows the design of the system of IoT smart parking that uses three of main components all IoT systems should consider which are: the sensitive devices, connectivity or Wi-Fi models devices and the interfaces (the application or web site). This intelligent system for car parking needs to first have sensitive devices which are called ultrasonic sensors to measure the distance between the car and the parking. Each parking slot should be equipped with one ultrasonic sensor boundary or any other obstacle. These sensors are connected to a microcontroller called (nodeMCU) that sends the signals from these sensors to the network.

The last part shows smart parking mobile applications. All the data that the sensors send to thing speak through microcontroller are saved in the database server. Mobile phone system application interfaces read the data from firebase and show it in the app which is installed on devices or web mobile. So, the users can easily find the empty parking through their mobile phones

Physical Design

The physical design represents the external and internal entities that flow data to and from the system. During the design process, material design outputs and insertion systems are considered. It refers to how input data is displayed and how output data is processed. Also, physical design works in various ways, including data design, user interface design, and process design. Physically and logically, the design is successful and efficient. This image shows, based on what we explained in Chapter 2, how this system of sensors works so that the reader can reach the phone or computer

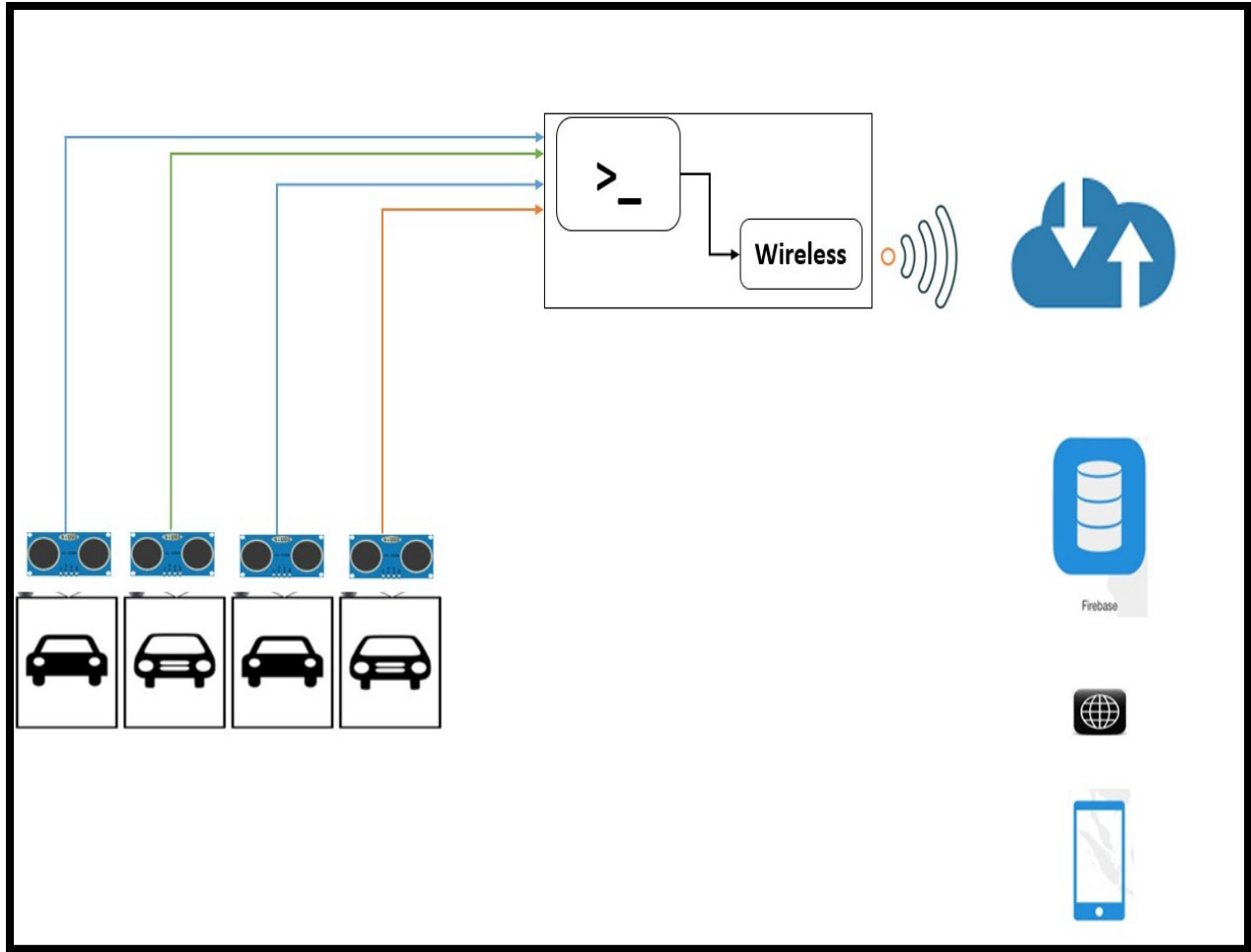


Figure2. Physical Design Framework

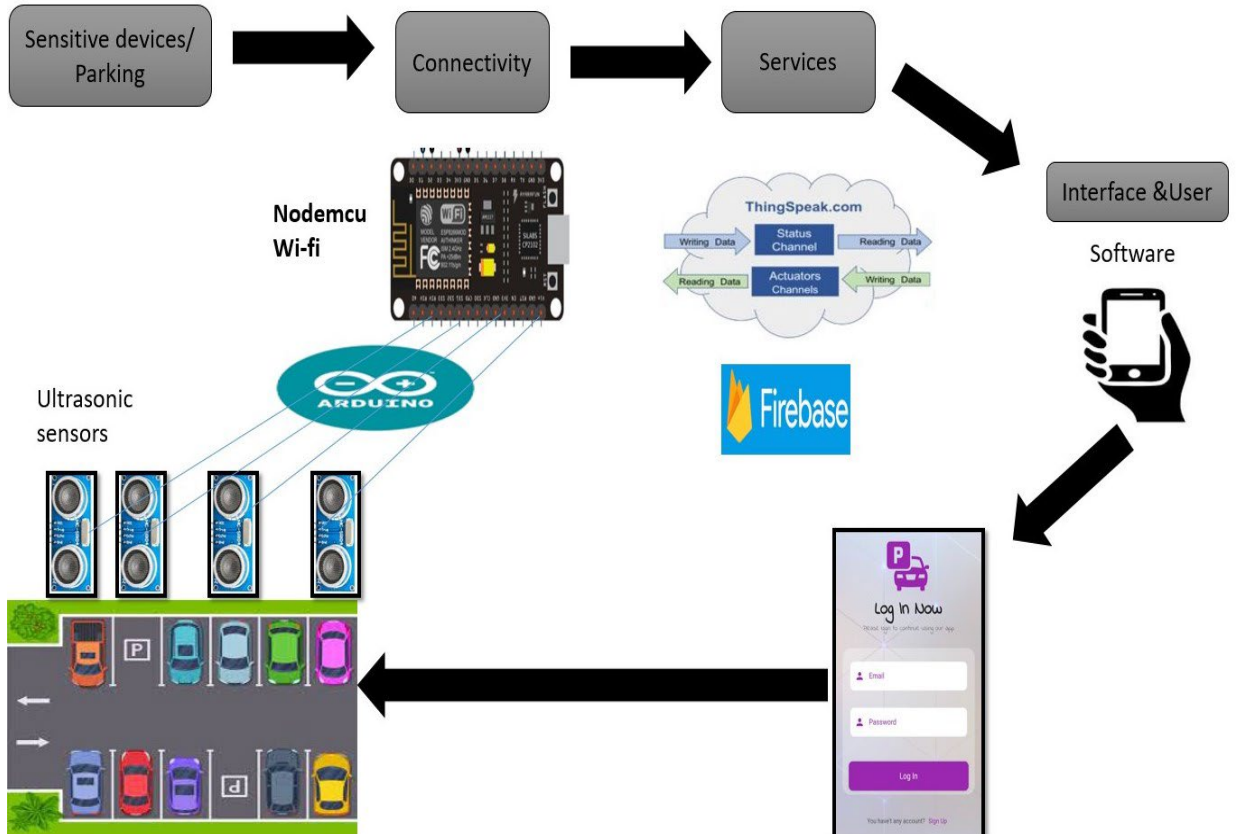


Figure3. Logical Design

The above framework shows the cycle of IoT smart parking system. For the system to function, all these sub-systems need to be connected. First, the sensitive devices (Ultrasonic sensors) located in the car parking slot are programmed using Arduino software used to code the connectivity device and sensor to work with each other. Using a microcontroller (NodeMCU) supports Wi-Fi and enables connectivity through the API key and by using https Protocol to send the signals of sensor to the cloud. The cloud will read this data and send it to application also using https protocol and using API key, since the sensors is sensitive to any movement in the car parking slot, if it is empty or if it is occupied, it will directly this data to send to cloud which will then be shown in the mobile app. The application uses the firebase to store the registration data

NodeMCU ESP8266 is an open-source Lua based firmware and development board specially targeted for IoT based applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware which is based on the ESP-12 module, and like this, it can also be programmed using Arduino IDE and can act as both Wi-Fi Hotspot and can connect to one. It has one Analog Input Pin, 16 Digital I/O pins along with the capability to connect with serial communication protocols like SPI, UART, and I2C. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. Its applications include prototyping for IoT devices, low powered battery-operated applications, and projects requiring I/O interface with Bluetooth and Wi-Fi capabilities.

**Figure 4.png**

The Tower Pro SG90 9g mini servo motor is the most used servo motor in RC applications. The servo motors are used for control applications which require precision control like robot arm positioning, tool position in machining equipment. The servo motors usually provide control over 180° range. This angular position control is performed by PWM technique so by varying its duty cycle you can control the angular position of the motor. This servo motor can lift a maximum of 1.6 kg when suspended at 1cm (about 0.39 in) distance from the shaft. It can also be used in robotic arm, CNC machine, Steering systems on RC cars and other robotic or automation applications as well.

**Figure 5.png**

One of the main concepts of the IoT is in how to connect different devices to the network so that they can send data and receive commands. There are already different technologies for processing the last mile connection, such as Bluetooth, Wi-Fi, NFC, and so on, but most are complex to deploy and often need additional hardware such as appliance or a local control server. Things speak IoT is an open-source software, and it is an API- application programming interface for storing and retrieving the data from objects using HTTP over the Internet or over a LAN- local area network. By using Thing speak, you can create application recording sensors, site tracking applications and social network for applications with updates status. Thing Speak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to Thing Speak from your devices, create instant visualization of live data, and send alerts.

**Figure 6.png**

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android, and Web apps. Firebase provides tools for tracking analytics, reporting, and fixing app crashes, creating marketing and product experiment.



Figure 7.png

Conclusion

Smart cities, smart homes, and other innovative services have all benefited the community in the era of intelligent gadgets and technological advancements like the Internet of Things (IoT). One of these IoT-supported services is the intelligent parking system. For most employees at institutions and businesses worldwide, traffic congestion and automobile jams are a daily annoyance. Therefore, it is crucial to look for ways to lessen this issue. This project is being carried out at the Royal Hospital neighborhood since it is a suitable location with a packed parking lot. Parking congestion is a problem that affects all businesses and institutions in cities and other places, so smart parking solutions improve and effectively increase visibility for patients, employees, and visitors at the royal hospital or any other places that have the same type of issue. Whether a parking space is occupied or available is determined by sensors (Ultrasonic sensors) in the parking area. Using a (esp8266 nodeMCU) microcontroller and the main cloud-based smart parking Platform (Thingspeak), this data is transmitted over the Internet. Thingspeak uses the HTTPS protocol to transmit data from sensor devices to a mobile application in order to display the position and parking status. Users of the program can access Google Maps and track parking using their mobile device. I utilized a variety of programs to put my concept into practice; the Arduino software was used to program each Ultrasonic sensor and nodeMCU. Additionally, I created the firebase-connected application using Android Studio. The database of individuals who access the application, including employees and patients, is kept on Firebase. People who lose time looking for parking are late for work or appointments and cause delays. The implementation of a smart parking system would help people avoid issues with incorrect parking or protracted delays caused by a lack of visibility of available parking spots as well as the problem of congestion in cities of all sizes.

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