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Information Technologies

USING THE INTERNET OF THINGS, AN ADVANCED SMART CAR PARKING SYSTEM HAS BEEN DEVELOPED

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Master's Thesis

Supervisor

Asst. Prof. Dr. Ayça KURNAZ

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The thesis titled “USING THE INTERNET OF THINGS, AN ADVANCED SMART CAR PARKING SYSTEM HAS BEEN DEVELOPED” prepared by ZAID ALSARRAY and submitted on 17/08/2022 has been **accepted unanimously** for the degree of Master of Science in Information Technologies.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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Signature

DEDICATION

I dedicate this research work and pledge it to my prominent supervisor in guiding me during this entire research journey, as well as to my family, specifically "my mother, my wife and my brother" to always help me in my difficult times, and I hope that this achievement in my academic career will be a mercy and joy for my father while he is in his grave.

ABSTRACT

USING THE INTERNET OF THINGS, AN ADVANCED SMART CAR PARKING SYSTEM HAS BEEN DEVELOPED

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Automobile use has increased dramatically in recent years as a result of the automotive industry's rapid growth and the daily release of more convenient and technologically advanced vehicles to the market. On the other hand, the increasing usage of autos creates additional parking challenges. Throughout the preceding decades, a huge number of researchers have worked on this project. They were striving to get intelligent technology that would assist them in resolving the parking dilemma, and they had devised a system to do so. The Internet of Things (IoT) idea was applied to the development of a smart parking system for autos in this research (IoT). Wireless sensors and the network layer were used in this system to find the vehicle's exam-free parking space, which was determined via the network layer. C++ was chosen as the programming language for the system's software component, which was developed by many researchers. Along with the coding portion of the article, an output window was included. When you come together with other people, you can have a meaningful conversation regarding smart parking systems and the Internet of Things.

Keywords: Android, Smart, Database, Internet of Things, Network Layer.

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1. INTRODUCTION

1.1 BACKGROUND

The Internet of Things, which allows data transfer without the need for human involvement, is an example of such a phenomenon (IoT). In other words, according to the business, the Internet of Things offers users with low-cost cellular technology as well as cloud data transmission support. Because of the Internet of Things, it is now feasible to provide more user transparency (IoT). The Internet of Things originated with a mechanism for linking a varied range of devices via the identification of commodities, which became known as the Internet of Things Protocol. Providing you have a computer and internet connection; you can keep track of and operate these devices remotely. In the Internet of Things (IoT), "Internet" and "Things" are combined to form a two-word phrase that stands for "Internet of Things." The word "Internet" refers to a massive network of computers and other electronic devices that communicate with one another through the world wide web. Things are also referred to as "things," which are a collection of interconnected devices that are used in conjunction with one another. Data transmission and receiving, as well as connection with other devices, are all possible via the Internet. [1] As a result of parking concerns, air pollution and traffic congestion have worsened. Consequently, many individuals now have difficulties in finding parking on a daily basis. Accordng to a recent projection [2], more than 1.6 billion people would possess automobiles by 2035 throughout the globe.

Oil is consumed on a daily basis all around the world. [3] shot this scene using his camera. As a consequence of the widespread use of smart parking systems, it has become simpler to cut fuel use. Reduced time and gas spent looking for parking may result in significant financial savings for consumers, as well as time and gas savings for the company. [4] "has been made available for viewing. Following the collection and delivery of sensor data to the person who requested it, the data is subjected to further analysis and processing. It is necessary to provide data to the Arduino device in order for it to be able to transmit commands to all of the devices at the same time. The Arduino gadget then isolates and delivers the data to each individual device in a distinct packet of information. Communication between the Arduino and servo motor occurs via the servo motor, which in turn connects with the GSM module, which provides the user with instructions and alerts. The RFID card of the registered individual is decoded by a reader module. It is impossible to

determine the identity of the user when he or she is traveling into and out of the parking lot. Using this program, a person may get reminders on their registered mobile phone when parking spots become available in their immediate vicinity. There are three areas in all, the first of which is the parking lot, which includes Arduino devices as well as an infrared sensor (IR). This is the most important aspect of the scenario. Users will have a new way to engage with the parking lot thanks to these gadgets. As an intermediary between the parking lot and the customer, cloud web services will be examined in depth in the second section. Parking availability information is updated on a constant basis on a cloud server.

Despite the fact that the cloud service is controlled by the administrator, the user has the opportunity to check to see whether it is accessible. Each piece of the material is broken into three parts, with the third section aimed toward the final user. As soon as the service becomes accessible, the GSM module notifies the user's mobile phone through SMS notifications. Both the parking lot and the cloud are used by the users to interact with them. Users are alerted when all available parking spaces have been used, helping them to save valuable time in the process.

The number of individuals who drive vehicles has increased significantly in recent years. As a consequence, a smart parking system was developed to deal with the problem of parking. Another important aspect to examine is the method for identifying and using on-site parking spots, which is one of the most important elements to take into consideration. By designing a well-thought-out parking plan, you can make the most of the parking places that are currently available [5]. Increasing traffic congestion and parking issues in urban areas are being exacerbated by a rise in the number of cars on the road, which is being compounded by insufficient parking slot management. It is critical to have a smart parking management system that makes use of Internet of Things sensors to assist cars in identifying parking spaces as quickly as possible. However, despite the large amount of research that has been done on the creation of intelligent parking management systems, the great majority of these studies has fallen short of solving the problems of real-time detection of incorrect parking and automated collection of parking fees " [6].

It has recently been discovered that there are applications for the Internet of Things (IoT) in the human life domain that have been investigated. Customers and terminals, according to the firm, are linked through the Internet of Things, which is made possible by novel sensors and middleware. User interaction with the program provides them with the opportunity to learn about a number of

issues that they come across on a regular basis. The intelligent parking system is one of the most significant Internet of Things initiatives now underway [7]. The steady increase in the number of private automobiles on the road is a result of the rapid globalization of the international economy, which has resulted in gains in labor productivity, income, and living standards in urban areas, as well as an increase in the total population growth, over the past several decades [8].

Automobiles are becoming more necessary as the urban population continues to rise, and the two are inextricably linked. Because of the cheap cost of small city vehicles and the availability of free or low-cost parking, many of these people choose to drive rather than use public transit to their destinations [9]. Currently, cities create more than 75% of trash, 80% of pollution, and 75% of energy in the United States, according to the Environmental Protection Agency. Automobiles and trucks account for around 20 percent of overall carbon dioxide emissions in Europe, with urban transportation accounting for 40 percent of total carbon dioxide emissions. According to estimates, vehicles looking for free parking places account for more than 30% of daily traffic congestion in a city's central business district. [10].

The number of available parking spots, how often they are utilized, how long they are parked, and other pertinent information must be known from the outset of the study in order to make the necessary modifications to enhance parking circumstances. The results of surveys, which are frequently referred to as parking characteristics or statistics, are collected on a wide range of parking characteristics or statistics [11].

a) a more in-depth grasp of the situation.

b) Observation of human behavior, second edition

c) It is standard practice to employ analytics to make decisions based on information received by sensors.

d) The capacity of the internet of things to adapt rapidly and effectively to a broad range of events is a crucial property of the technology.

It is used to detect the speed of automobiles, persons, or any other object (or anything else) in particular. It can also detect other variables such as temperature and pressure[12]. A few sectors have already adopted Internet of Things technology, including manufacturing, distribution, and

logistics, to name a few. Throughout the process, intelligent parking must be recognized as a crucial strategic problem. Smart parking systems are built on radio frequency identification (RFID) technology, which is at the core of their operation. The autos are fitted with radio frequency identification tags, which make check-in and check-out easier. Following these suggestions can aid you in avoiding traffic congestion. [13] advises that smart cities use an electronic parking system that is based on the Internet of Things. They are working on inventing a parking meter that can identify unlawful parking in real time, anticipate how long a car will be parked, and then collect parking payments automatically. By including new performance indicators to quantify user parking costs, the system assists users in selecting a free parking spot at the lowest possible cost, taking into consideration factors such as distance between parking lots and the total number of vacant spaces at each parking lot [14].

There are many different types of smart parking technologies available. Parking guidance and information systems (PGIS), transit-based information systems (TBIS), intelligent payment systems, E-parking, and automated parking are just a few examples. Each system makes use of a different kind of technology in order to detect the presence of an automobile in the vicinity. The kinds of vehicle sensors and detecting systems are divided into two categories: intrusive and non-intrusive [15].

Testing revealed that a web-based and mobile application for parking operators, users, and controllers was functionally innovative in terms of functionality. Additionally, along with the capability of utilizing virtually any kind of parking garage or lot, the proposed strategy offers several advantages, including the ability to integrate with third-party services (such as Foursquare and Google Maps), the establishment and enforcement of a limited traffic zone, and the capability of inviting users to submit suggestions for parking lot accommodations. The proposed intelligent parking system was examined, and it was discovered to save time, money, and pollution while also reducing energy consumption and consumption. Because of these factors, end users who took part in the assessment praised it, and they expressed a readiness to use it more often as a consequence of their participation [16].

At the present, the automobile sector is experiencing a significant transformation. In recent years, automakers and technology developers have been working tirelessly to create new automotive technologies such as linked autos, electric vehicles, and cleaner fuels, among other innovations.

The development of new features and advancements that will make driving safer and simpler to navigate is a collaborative effort between several automakers and technology providers. This category of automobiles includes electric, natural gas, and hydrogen-powered vehicles, as well as hybrid vehicles that are electric, natural gas, and hydrogen-powered [17].

1.2 THE INTERNET OF THINGS

The goal of the Internet of Things is to link all items, equipment, and devices together via the use of an Internet connection (IoT). Embedded technology, network technology, and information technology all have an influence on the modern civilization in one way or another. An extensive network of sensors and tracking devices is used in order to get the desired outcome. [18] Almost all of these Internet of Things applications are now included into autos, including safety features, intelligent parking systems, navigation systems, and fuel-saving technologies. For example, intelligent parking systems are already incorporated into vehicles.

With the Internet of Devices, it is possible to monitor and operate things that are linked to the Internet remotely (IoT). Several instances of how the Internet of Things (IoT) has gained widespread acceptance over the past few years and is currently being utilized in several applications including smart homes, telemedicine, and industrial settings are shown below [8]. Wi-Fi-enabled smart devices with greater capability may now be linked worldwide through wireless sensor networks, allowing them to exchange data. This is made possible by the Internet of Things (IoT) technology [9].

When the Internet of Things (IoT) was first proposed, it was thought to be a way of linking items with one another and with other objects. Remote computers linked to the Internet are used for tracking, controlling, and monitoring devices and their activity. There are many different viewpoints on the internet of things. This term refers to anything that has sensors or embedded systems, and which is either placed in a quantum environment or is linked to a network via an interconnected web of other networks. These networked devices are referred to as "smart gadgets" or "smart objects" depending on how they perform their functions. Intelligent machines are a component of this system that, in addition to communicating and interacting with one another and with the surrounding environment, perform a variety of other duties as well. The processing of these may be accomplished by a number of processors, including microcontroller/multiprocessor

devices and network processors. Communication between the devices is accomplished by the use of GPS, Wi-Fi, Bluetooth/BTLE, RFID, and other technologies. Kevin Ashton was the first person to take use of the internet of things, which was initially introduced in 1999 by an auto-ID firm dubbed Auto-ID, as a marketing tool. It is anticipated that this technological innovation would allow all of our linked gadgets to speak with one another without the need for human intervention. At this time, there is no standard architecture for the Internet of Things that has been created.

The search for new and inventive techniques to improve their quality of life via the usage of cutting-edge technology continues to be a continual pursuit for consumers in the present day and age. Customers are continuously on the lookout for new facilities and equipment that will enable them to live a more fulfilling lifestyle. The greater the number of facilities and appliances that are built, the more important it becomes to have simple and easy ways of controlling and administering them.

In order to construct a smart parking system for automobiles, the Internet of Things is being used. Automating parking space management using the internet of things (IoT) may be done to better meet the demands of both companies and consumers. Using the Internet of Things, you may be able to detect whether or not there are any open parking places nearby when you connect to the network. A rise in the number of cars on the road has caused cities to become more congested in recent years, resulting in increased congestion.

People from all over the globe are now able to contact with one another because to the advent of the Internet. Inevitably, advancements in Internet technology will make it simpler to link items in a manner that is both acceptable and efficient. [3], the total number of networked items on the planet topped the total number of humans for the first time in history. The Internet of Things (IoT) is shown schematically in Figure 1 of this document. Cities and their citizens will benefit from the Internet of Things, which will result in more inexpensive municipal services, a more progressive citizenry, less traffic congestion, and a safer environment for everybody. Policies (such as those aimed at decreasing pollution and saving energy) are established with its assistance, monitoring systems are put in place, and the appropriate infrastructure is put in place with its assistance. Efficiencies and cost-effectiveness in the creation of a more efficient and cost-effective system are enhanced by energy conservation regulations, economic considerations, and a high degree of dependability. Use for personal and domestic reasons has the ability to provide more than just

virtual relaxation and entertainment when it is carried out properly. Improvements in energy management may be made by the use of Internet of Things-controlled equipment, such as refrigerators and washing machines, among other things. It is possible to monitor the health of the elderly in their homes and save money on healthcare costs by establishing body area networks in their residences. Among the many communication tools available for contacting self-created groups are SMS and video calls, to mention a few examples.

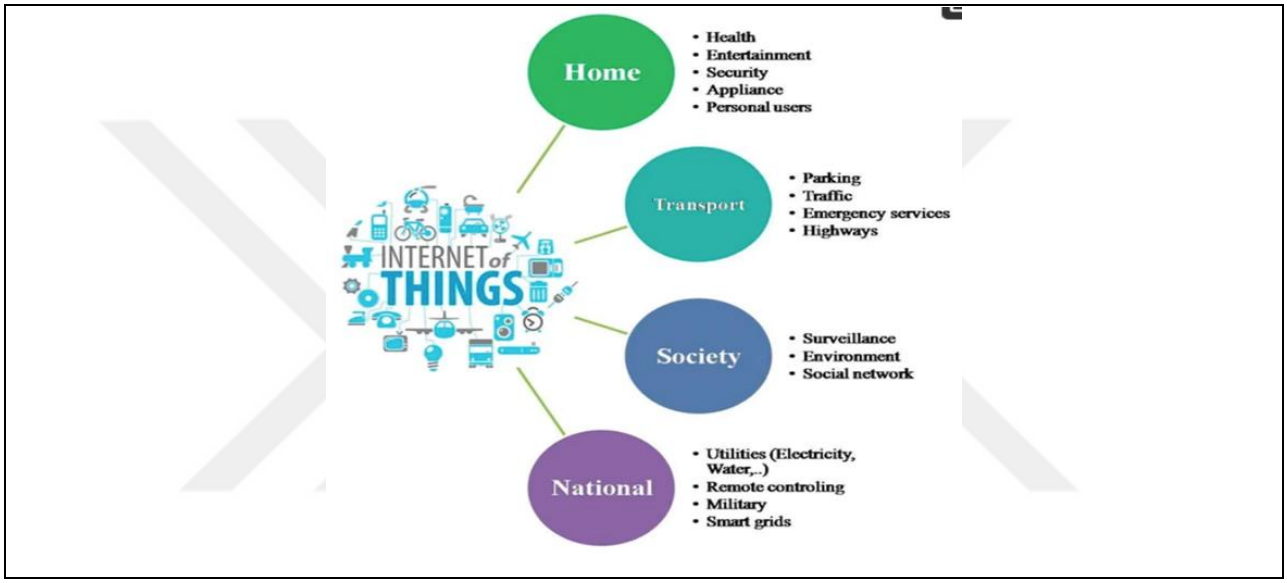

Figure 1.1: IOT Based Linkages

Congestion may have a negative impact on a city's economy, both monetarily and in terms of the amount of time it takes for residents to go from one place to another. By integrating the Internet of Things and large-scale WSNs, the transportation sector may benefit from dynamic traffic information, online monitoring of travel times, and route selection behavior, all of which are beneficial to the business. Also possible is the use of these tools in the development of stochastic models for disaster mitigation strategies and highway traffic control algorithm development. Identifying and addressing environmental dangers may be accomplished via the use of Internet of Things sensors, which can monitor air pollution and noise pollution, among other things. Enhanced water quality and waste management may be achieved via the monitoring of water sources and distribution networks, both of which are beneficial to society.

1.3 IOT BASED PARKING SYSTEM

Several examples of system and hardware architectures are presented in this section.

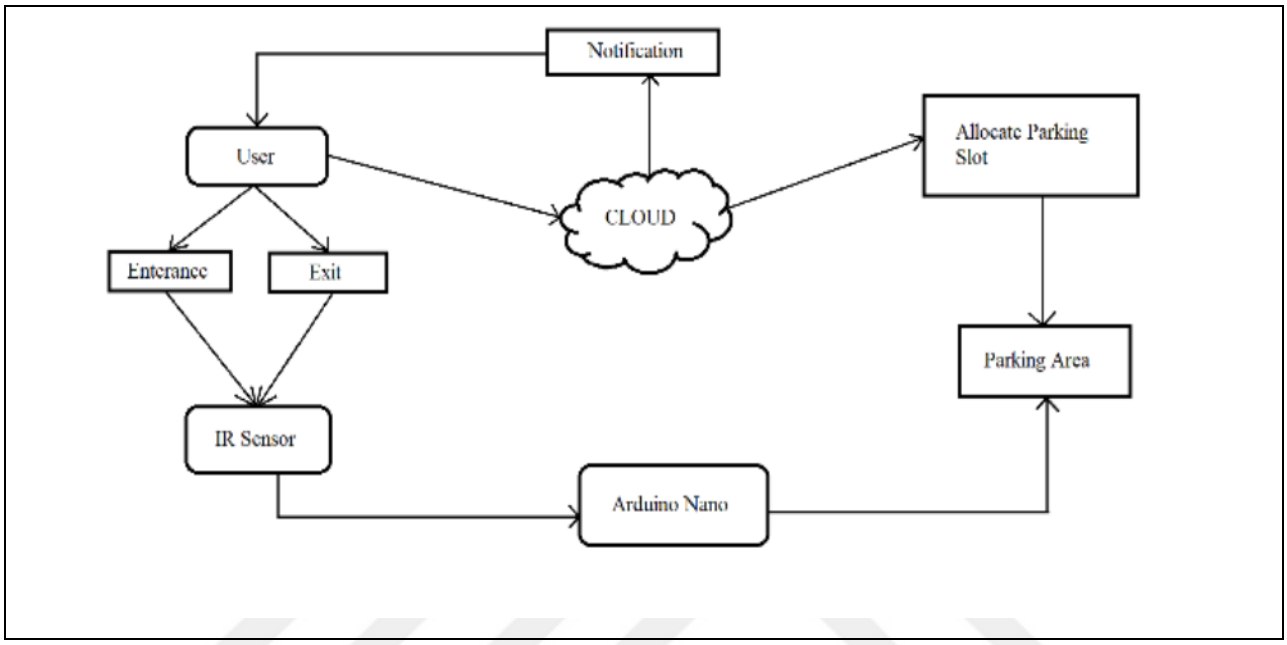

Figure 1.2: System Architecture [11]

The parking spot is divided into three sections: the first contains Arduino devices, as well as maybe an IR sensor; the second contains IR sensors; and the third contains IR sensors. These devices allow the user to engage with the parking lot in a variety of ways. The user would be unable to access the parking lot unless they were accompanied by someone who had an RFID card. In the second section, cloud-based online services such as user and parking area management are discussed. In order to establish how often the cloud is updated, the availability of parking spaces must first be determined. There is an administrator in charge of cloud computing, and users may check with him or her to verify whether everything is running well. The last section is from the user's point of view. If the GSM module determines that the user's mobile phone is not accessible, it will send an SMS notice to the individual who is unable to access the phone. As of right now, the vast majority of parking lots do not follow any kind of logical layout or design. It is inherently inefficient and time-consuming for the great majority of them by their very nature. Individuals spending an excessive amount of time hunting for a parking place is the most often seen problem in the lot. It is expected that users would continue to circle the parking lot in loops until they come upon an available parking place. Whenever the number of vehicles exceeds the number of available

parking spaces in a highly populated urban region, it is referred to as a "parking gridlock." These inefficient conditions have emerged as a consequence of the current market's incapacity to absorb technological advancements in a timely manner. Increasingly common are local parking lots located inside shopping malls and other multipurpose buildings as a means of better serving motorists. Car parks within buildings have grown more popular as a convenient choice for consumers and as a means of protecting their cars from the sun's damaging rays. This is especially true for shopping malls and other commercial companies. When it comes to guiding vehicles through this kind of parking lot, the vast majority of parking guidance systems rely largely on message signs to accomplish their goals. In some instances, sensors that count the number of cars entering and exiting the parking lot, or by comparing the tickets issued by the automated ticketing equipment in the parking lot, may be used. The presence or absence of a full or empty sign at the entrance to a parking lot is often used to indicate the availability of parking spots in the lot. Information on the number of available parking spots in a car park's parking lot is difficult to come by on a regular basis. The parking lot sees a significant number of autos each day, everyone hunting for an open spot to park their vehicle. Because of this, it is difficult to get a parking space. In the vast majority of municipal parking lots, car drivers are still responsible for finding an available parking place. Because of the restricted number of unoccupied parking spots accessible in each row of parking spaces, they will almost certainly spend a large amount of time searching for an available parking space. Having an effective system for monitoring unoccupied parking spots is crucial for ensuring that vehicles can locate a parking spot whenever they are required to do so. This prototype might be used by a parking lot driver to navigate them through the lot by guiding them in the direction of freshly available parking spots. The Arduino microcontroller is responsible for providing electricity to the gadget. Unoccupied parking spaces are identified throughout the car park by infrared sensors, which wirelessly transmit this information to a CPU, which analyzes the data and displays the total number of available parking spaces on 16x2 LCD panels. Additionally, when the app is utilized, it displays the locations of parking spaces that are available. If you reside in a developed country where practically everyone has access to a vehicle, finding a parking space may be a challenge. Every day, people in cities all around the world are forced to deal with the tedious and time-consuming task of parking, which may be a particularly unpleasant experience. Money and time are two of the most important issues we face on a daily basis, and they are intricately interwoven in our lives. This means that any business with a big or even a small

site must ensure that there is enough parking accessible for its customers. Because of the information provided by the Smart Parking System, drivers may be able to minimize the length of their travel as a consequence of utilizing it. Vehicles might save time and money by using the available information instead of searching for an empty parking place that is really full. When conducting the study, it was necessary to choose a popular parking spot, such as a retail mall or a shopping complex. In order to alleviate the problem of parking shortages in some areas, this effort was launched. The purpose of this study is to discover the most effective strategy of sending automobiles and vehicle users to a free parking lot that is conveniently located.

1.3.1 Hardware

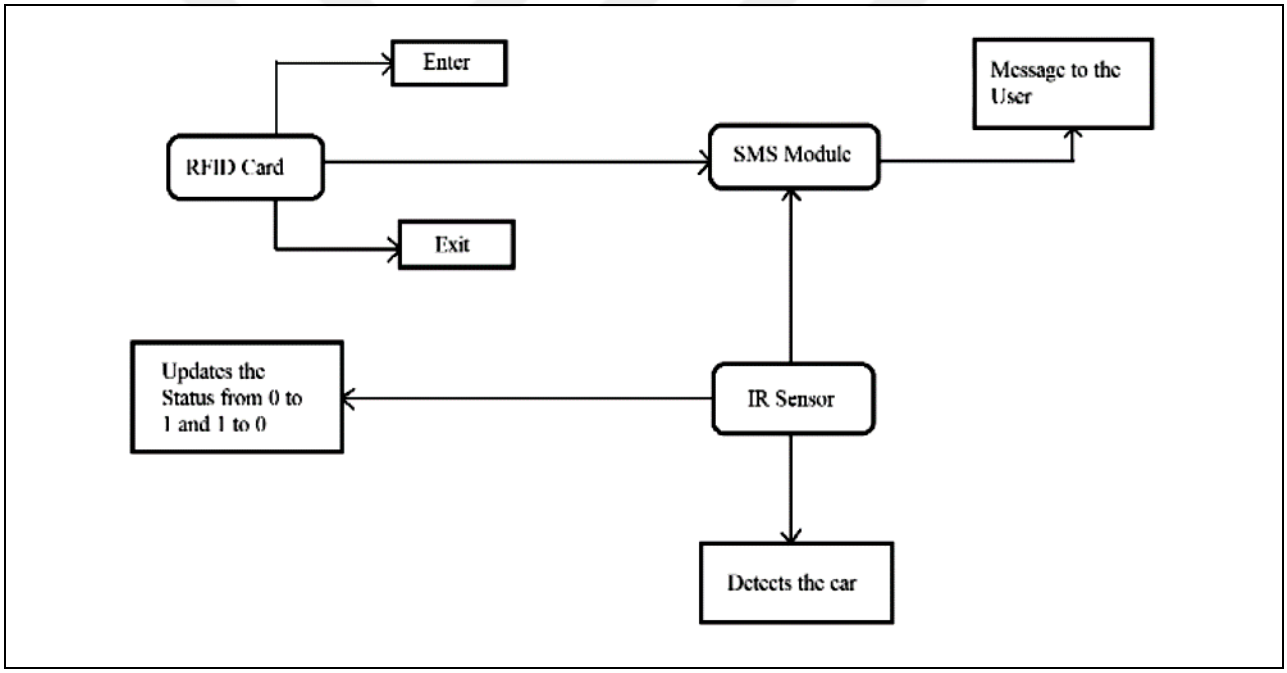

Figure 1.3: Hardware Architecture [11]

The GMS module, the RFID card, and the infrared sensors are the three most important pieces of hardware in the system. Individuals will be denied access to parking places if they do not have an RFID card, and those who do not have an RFID card will be turned away. The RFID card includes the personal information of the registered user on it. When a registered RFID badge is admitted into the parking lot, the electronic area detects the badge's existence and alerts the driver. The Arduino checks to see if there is any available parking and notifies the user if there is any open

parking. The GSM module of a device is in charge of the transmission of messages. The infrared sensor sends messages to the driver to warn him or her of an impending collision.

1.3.2 Software

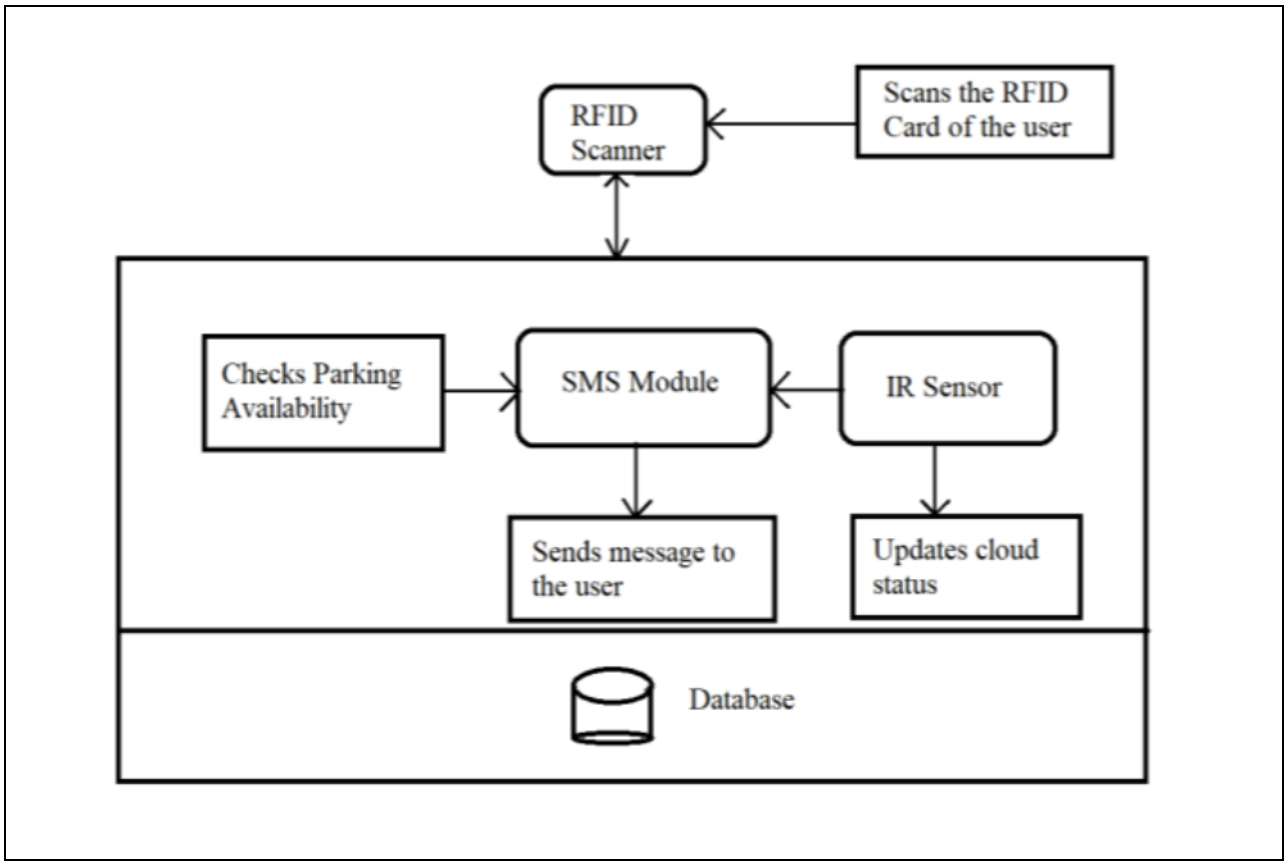

Figure 1.4: Software Architecture [11]

The cloud server serves as a point of contact for the system's many parts and components. The Wi-Fi module is in charge of establishing a connection between the device and the cloud server. Whenever a vehicle enters or quits an assigned garage or parking place, the owner of the RFID card is notified through SMS of the event. The SMS module, as well as the messages that are sent, are managed via the cloud. When the infrared sensor detects a vehicle, the cloud's state is changed from 0 to 1, and when the police officer departs the parking lot, the car's state is also changed from 0 to 1. When the infrared sensor detects an automobile, the cloud's state is changed from 0 to 1.

1.4 SMART PARKING SYSTEM (SPS)

Cloud computing, databases, and mobile devices are just a few of the technology that intelligent parking systems use to make parking easier. A "smart system" parking garage (abbreviated as SPS) is a kind of automated parking garage that is growing in popularity. A smart system parking garage is a type of automated parking garage that is becoming increasingly popular. [19] was born in the year 2015.

The system is classified as a parking lot management system since it maintains track of data and makes it easy for users to get information about the parking lots that they are currently using. The ability to operate a self-sufficient parking lot operating system is critical when it comes to offering clients with speedy, safe, and transparent parking services.[20], the system's purpose is to "simplify both the process of identifying available parking places and the process of checking the quality of those parking spots." Aside from that, the system gives information on the location and profile of parking garages, as well as the present condition of such garages." The system is now undergoing beta testing in the meanwhile. After many years of manual ticketing, it has evolved into a more complex system that is largely based on the spread of information technology and sensors in the transportation industry. [21]. If users take use of this service, they will be able to access the internet more quickly and effectively, download mobile applications, and hunt for a parking place more efficiently. [22] are still alive and well as of 2017. Parking systems have been in use for quite some time as a result of the increasing volume of traffic on the roadways. They are a relatively new invention. They, on the other hand, are completely out of touch with current events, technology breakthroughs, and the general population at large. The fact that cloud data is easily available for any purpose and at any moment encourages users to send and gather cloud data on a consistent basis. The Internet of Things is changing the way that people and goods move across the world. In general, this research's ultimate goal is to enhance traffic flow via the use of Internet of Things information and other technological innovations. The need for this is critical because people need a break from being stuck in traffic. As a consequence, issues such as traffic congestion and other factors must be addressed as well as the original complaint. Incorporating an Internet of Things-based smart traffic system into your business will help you optimize traffic flow, alleviate congestion, and cut down on your CEO expenditures. For those with modest fitness levels, this is a good exercise to try out. Traffic lights, as well as drivers, must be linked in order for the Internet

of Things to function properly. All of this will be networked together over the internet, and sensors such as RFID and infrared devices, as well as other global positioning systems and laser scanners, among other things, will be used to offer executives with instantly recognized evidence. I am thus able to provide information on customers, and dare I say, explorers, who are interested in buying on every street in the city, and I do it on a daily basis. In the absence of an official source, the quantity of material accessible is so vast that it is difficult to thoroughly investigate and examine it all. It is now possible to detect the stream and separate it into its component pieces using modern technologies by quantifying it and separating it. Everyone wants to save both time and money while also gaining new knowledge and competencies. Their ability to overcome all of their obstacles is a direct result of cutting-edge technology and creative problem-solving. Because of the fundamental foundation structure of the building, a huge volume of traffic on streets, commercial malls, and parking lots cannot be maintained by the street framework. Due to the rising use of vehicles, there have been considerable changes to the world's transportation infrastructure as a consequence. Finding a parking place has grown more difficult, particularly around rush hour. Finding an empty parking space in a busy city amid rush hour traffic is every driver's worst nightmare. The group is expected to cause traffic congestion in the area by driving around looking for parking spaces, according to speculation. Drivers get bewildered as a result of the winding road, which also increases gas consumption and air pollution. Confounded drivers who have been driving about aimlessly in search of an answer have hoped for a remedy that will quickly transport the person in question to the inconspicuous spot in which they have been searching. According to the findings of an ongoing research, a motorist would have to leave their vehicle for around eight minutes while looking for a parking place. The fact that they're seeking for a safe place to halt indicates that they're most likely running out of time. In order to estimate inheritance, municipal specialists must first be licensed and subjected to background checks before they can begin their work. To complete this project, a total of three components have been prepared. On the basis of subjective criteria, candidates for the position of project pilots were chosen in phases 1 and 2 of the project. It was the third stage of development that was responsible for the establishment, use, and planning of the frameworks in place. Second, we wanted to take a look at some of the challenges that a seasoned stop-frame could face during the course of its working life. The project's goals were met, and the participants were made aware of the challenges associated with completing a pit stop in a crowded metropolis by way of demonstration. When a cessation environment is

created, there are frames that depict intelligent stopping methods that assist in the creation and management of stopping inventories. It is necessary to deploy Internet of Things (IoT) integrated remote sensor systems to connect real parking lots to information and communication enhancements due to the unique character of these situations, as well as cloud-based board organizations, according to the unique nature of these scenarios. Undoubtedly, one of the most important Internet of Things problems is the large-scale networking of hubs via flexible system administration, as well as personalized connectivity to the real world and integration with client-created information, among other things. The mechanical and academic arrangements that existed before caused issues since they placed constraints on the ability to do certain things. According to the corporation, users now have access to a network of smart devices that go beyond traditional machine-to-machine communication to provide a more personalized experience. The Smart Parking System is a cutting-edge system that enables users to do basic tasks from any framework or portable device, such as a phone, without the need for a dedicated computer. By connecting to the Internet, it is possible to access its features from any point on the earth. Other systems are distinguished by the ability for users to administer and monitor their systems from any place with an Internet connection. With the use of large-scale controls and a wireless connection, customers can take control of many aspects of their parking experience and make adjustments as needed. At present point, the Internet of Things does not have a critical foundation in place to support it. Our study materials have been completed, and executions have commenced in all but the most improbable of the potential end-of-world scenarios. A result is that the Internet of Things has become so important that it is difficult to overestimate its significance. It follows that the Internet of Things may take on a variety of meanings or implications, depending on the application to which it is used. In this illustration, already-existing objects are shown to be linked together through wired or wireless connections to sensors, embedded structures, and the overall framework. A piece of equipment is described as "amazing gadgets" and "sharp things" at the same time by two different people. In addition, it is made up of eager robots that speak with one another and exchange information about their conditions and fears with one another. My proposal includes the construction of a parking system for retail establishments, shopping malls, and other adjacent attractions that is based on the Internet of Things.

1.5 BENEFITS OF IMPLEMENTING ONLINE PARKING SYSTEM

To take advantage of these benefits, consider investing in a smart parking system.

a) Put aside your search for a parking space.

b) By eliminating the need to travel around looking for parking, motorists can save time and money.

c) There will be less waits as a result of the new parking advice system.

d) Determine the optimal vehicle for the situation based on parking availability.

e) Parking facilities benefit from increased income and profit generated by online parking.

One of the goals of the project is to find a solution to the city's parking issues. There is a goal behind this program, which is to solve the problem of parking in developed cities. In the process of hunting for a parking place in a certain parking lot, a user typically loses time and effort. The location of the parking spot is sent to the user by e-mail. As a consequence, users' search times for parking spaces are shortened. Car theft is discouraged by the usage of RFID technology.

Today's contemporary way of life allows us to enjoy high living standards in more luxury than we ever imagined possible before. In order to maintain a good quality of life, it is necessary to have convenient and efficient transportation. Anyone who walks down the street these days is followed by at least one automobile. To be sure, automobile use is expanding at an alarming pace, creating a variety of challenges in urban areas. The availability of parking is a key issue. Because many nations have greater per capita automobile usage than the United States, metropolitan areas are especially hard hit by this problem. Numerous nations have sought to turn themselves into smart cities as a consequence of the use of advanced technology in recent years, with mixed results. When it comes to investigating intelligent car parking, researchers have a plethora of options to choose from.

It is the ongoing pursuit of creative ways to difficult issues that keeps scientists on the lookout. Due to the fact that everyone has a smart phone (Android), they are all striving to make use of this technology. To overcome this issue, the most effective option is to use a smart phone and the

Internet of Things (IoT) together. There is increasing interest in exploiting the Internet of Things (IoT) to solve challenges relating to wireless communication in order to address these issues.

Making use of the Internet of Things (IoT) across a variety of platforms Increasingly popular are Internet of Things (IoT) gadgets such as smart homes, smart mirrors, intelligent healthcare systems, intelligent security systems, and other IoT-related devices. Simply said, the Internet of Things (IoT) is a network that links all physical items, including instruments, autos and other vehicles, as well as software and electronic material, with the goal of sharing data and information. Kevin Ashton is credited with inventing the Internet of Things. It is his belief that the sensor has the ability to make connections between the actual and virtual worlds.

The capacity to monitor and manage the network's accessible infrastructure is a fundamental feature made possible by the internet of things. More than this, however, it promotes the integration of electronic technology with the rest of the physical universe. The Internet of Things (IoT) has been widely used in a variety of applications, and previous research has shown that this technology can be used to develop a system that is more efficient, dependable, and accurate. This technology is being used to develop a system that is more efficient, dependable, and accurate.

It is not required to have human engagement when it comes to the Internet of Things. The automobile sector, the transportation system, and other important Internet of Things applications have all been investigated. Interfaces, standards, protocols, and infrastructure are just a few of the considerations that must be taken into account while designing an Internet of Things-based system.

This thesis investigates the basic ideas and architecture of the Internet of Things, as well as a model for an intelligent car, and proposes a solution. A solution for alleviating the parking issue in densely populated cities was devised by combining the Internet of Things (IoT) with an Android smartphone. The fundamental notion is to arrange the weight sensors in such a manner that they detect the weight of the car and, in reaction to that weight, produce a signal that signals to the user whether or not parking is available. As part of the system's design, parking spots are shown on mobile devices to aid with navigation. While the parking zone is being watched, the data obtained is communicated to the server and subsequently to the user, who may utilize the information to find a parking place that is available.

The remaining sections of the thesis are as follows: Section II provides a synopsis of the relevant literature. On the IoT architecture and suggested system, as well as a number of significant principles, Section III goes deeper into the details. In addition to the final conclusions, Section IV highlights the limits, recommendations, and future scope of the study. In the end, Sections V and VI provide a summary of the conclusion and references, respectively.

1.6 THESIS OBJECTIVES

The goal of this research is to determine how difficult it is to get parking in downtown Los Angeles in contrast to other major metropolitan regions. This research study explores the need for smart parking solutions in the Helsinki area from the viewpoint of the motorist in order to determine whether or not they are necessary. It would be possible to detect and resolve some of the implementation issues if smart parking were conceived, developed, and deployed. Students may run into issues with design, execution, deployment, and operational barriers, among other things, as they go through the learning process. A smart parking system must meet certain architectural and hardware criteria. This section will look at the decisions taken during the design, development, and implementation process of the system. This section provides an overview of the technologies and standards that will be used throughout the project.

a) To study the need of smart vehicle parking system

b) To introduce the IoT system in the vehicle parking system

c) To study the real time application of smart vehicle parking with artificial intelligence (AI)

d) To monitor the vehicle parking as security point of view

e) Implementation of smart vehicle parking system

1.7 ORGANIZATION OF THESIS

Chapter 1: An overview of the project has been presented in the first part. All of the foundations have been provided, including major project modules such as the implemented system's goals and objectives, as well as the rationale for adopting this project title.

2nd Chapter: To provide the groundwork for the present implementation, the second part of this project report looks at the literature surveys that were undertaken. The methods and processes employed in this study are contrasted with similar and competing approaches that have been developed and evaluated. These procedures are then double-checked for any potential dichotomies in their system. In addition, strategies are combined to close the gaps.

Chapter 3 focuses on the project's technical aspects. Building smart parking security and safety systems will have a solid basis and architecture based on these principles. Images, diagrams, and text are utilized to explain this. This makes it easier to visualize and organize the project in stages.

Project implementation is the subject of Chapter 4's Section 4. All the software limits and needs that need to be addressed to meet the explicit building principles have been enrolled and fully appreciated.

Chapter 5 concludes with a section devoted to the findings and recommendations. For the project's brief and an overview of the project's work scope, the same foundation has been utilized as.

2. LITERATURE REVIEW

Das suggests a parking strategy that is facilitated by the Internet of Things, which might help drivers save both time and money. A master Raspberry-pi, an infrared sensor, 16 Raspberry-pi for each lane, one of which contains a camera, and a display board are also needed in addition to the display board. Each lane was equipped with an RPi master, which was connected to an ultrasonic sensor through an RS232 interface[10]. The detection frequency of the sensor was first set to two seconds, which proved to be a reasonable starting point for the experiment. As soon as the ultrasonic sensors on each RPi detect an approaching car, a signal is sent to the array, instructing the 16 RPis to snap photographs of objects such as a license plate in the rearview mirror. The data had been saved up to a cloud-based database for safekeeping. Using Google's cloud vision API, the license number was identified in an image captured by sixteen Raspberry Pi cameras and retrieved (Application Programming Interface). In order to accommodate the fact that the number plates on each car were not securely attached to either the front or rear, a total of sixteen Raspberry Pi devices were used in total. If you employ this combination, you should be able to capture between 97 and 100 percent of the number plate of any automobile. After obtaining the license plate number using the Google API for vision, the information was sent back to the Raspberry Pi that started the whole process. A unique identification for each of the slave Raspberry Pis may be obtained by the master Raspberry Pi as a consequence of this process on the master Raspberry Pi. Each driver was issued a little pager as soon as their car pulled into the parking area. Through use of the master RPi, previously collected information from the RPi unit, such as the license number and unique RPi index, is entered into the database and updated. Through the use of the SMTP protocol, the pager gadget notified the driver of the location of the parking space available. When a car is parked at a predetermined position, the system recognizes the slots as being occupied and marks them as such. Consequently, the master RPi updated the database while the location was indicated as vacant, and the operation was reversed as a consequence of the error.

Developed an approach for managing indoor parking that was comparable to the previous one[23].

It may be used by the user to find a nearby parking place in the chosen geographic area. For data transmission over the internet, the system is comprised of an IR sensor, a Raspberry Pi computer, and an Arduino board, as well as a gateway and a Wi-Fi module. The layout contains information

on how to get there and where to park. When an infrared transmitter and receiver are used together, they can determine whether or not a parking place is presently occupied. The transmitter was positioned on a sidewalk close to the parking lot's entrance, where it could be seen by everyone. Each parking spaces LED bulb was linked to a Wi-Fi module through twisted pair wiring. With the help of an infrared receiver, these Wi-Fi modules are able to gather data. Each parking space has been outfitted with a light bulb as well as a Wi-Fi module. In addition to collecting data from the Wi-Fi modules, the gateway also acts as a data storage device. Because it will be more accessible in the future, the data has been relocated to a cloud storage facility. First, the motorist must register an account on the parking application on his or her mobile phone in order to book a parking space. The driver's car is guided to a parking place that has been reserved particularly for him by the smartphone app, which makes use of geolocation technology. The driver's fare and payment choices, as well as any remarks made by the driver, are shown on the app after the vehicle has left the parking lot, among other features.

A system such as that shown by [24] uses infrared sensors to locate empty parking spots and then guides drivers directly to the most accessible parking space based on their location. Real-time data is gathered in the parking lot using sensors that are linked to a gateway (RPi), which subsequently transfers the information to the cloud in real time.

The following steps are carried out within the context of Internet of Things data processing: information aggregation; data filtering; data fusion; preparation; storage; and distribution. In order to reduce the quantity of data provided by the sensor, the data filtering function is used. Accurate and useful data is obtained via the process of collecting and integrating accelerometer data in order to deliver more complete information to customers, which results in more accurate and usable data. A number of concerns, including data fusion and filtering, have been brought up recently in discussions about Internet of Things technology (IoT). Data processing may take place at any point along the way: at the beginning, in the middle, or at the end of the process.

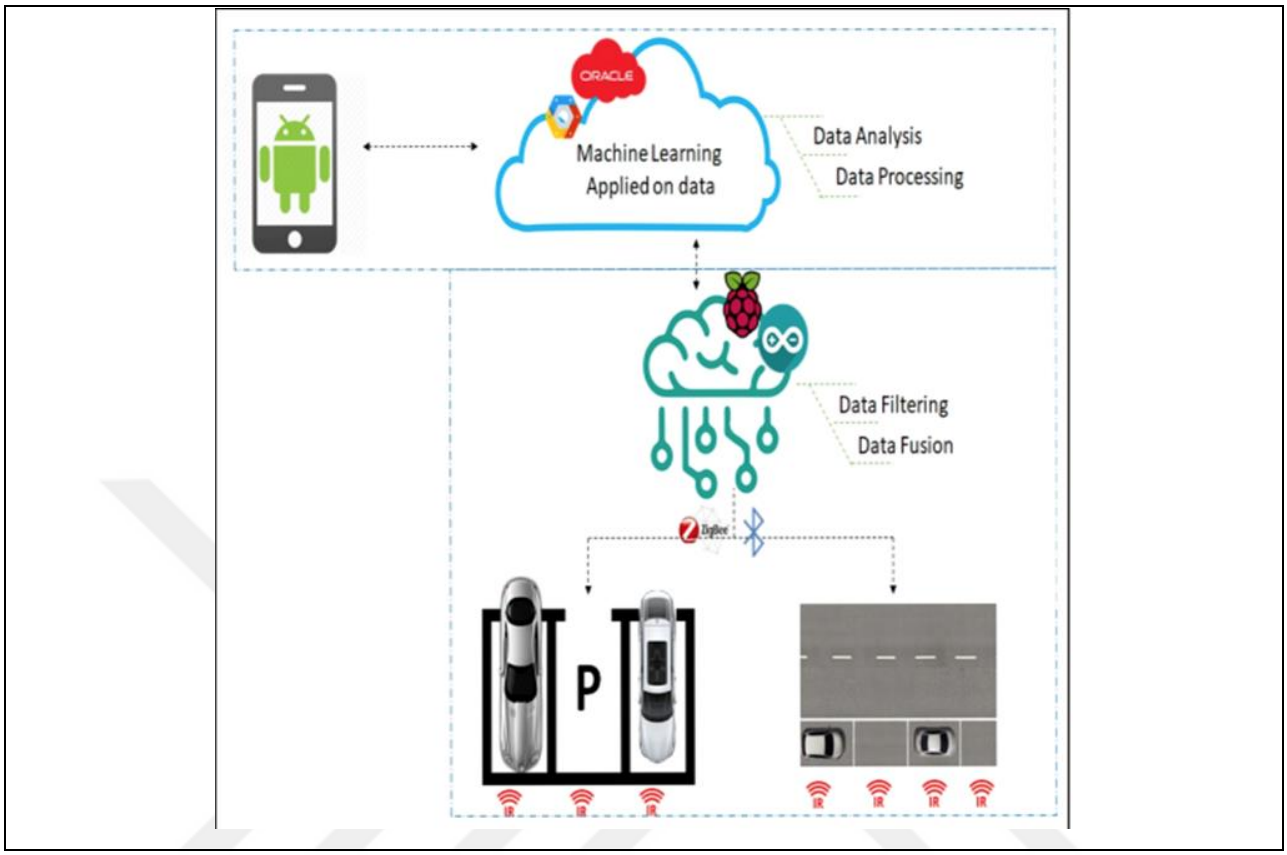

Figure 2.1: Smart Car Parking System Features and Functions

The cloud-based network operations of the Smart Car Parking System are shown in Figure 2.1. Cloud computing, rather than network-wide abstractions of computation, has been the primary focus of research for the greater part of this decade, and it is expected to continue to be so. It may be possible to resolve this issue with the help of a middleware system that allows for the administration of data, data processing, and real-time services for the Internet of Things (IoT). For a number of reasons, including data storage and processing power, cloud computing is essential for the Internet of Things (IoT). To make the best decisions possible, it is essential to understand how data is handled in the most efficient manner. A critical, but often ignored, part of the internet of things involves processing and storing sensor data locally before transmitting it to the cloud for further processing.

The year 2018 is the year of Qadir and associates. Additionally, the subject of smart parking enabled by the Internet of Things was addressed. An Arduino-based ZigBee-enabled microcontroller and a parking space occupancy sensor are among the system's components, which combined give real-time notification of available parking spot occupancy or non-occupancy. To get to their location, the driver may use an Android-based navigation application to guide them. The ZigBee protocol [25] is an example of a protocol developed on top of IEEE 802.15.4 that specifies both the network and application layers and is an example of a protocol built on top of IEEE 802.15.4. While the application layer is responsible for laying the framework for building and transmitting distributed applications, the network layer is in charge of providing networking capabilities in a distributed network. Those who wrote the books (2014) [26] It is conceivable to provide wireless communication over short distances and at low data rates with battery-powered wireless devices by combining the two protocol stacks [27] by merging the two protocol stacks. When compared to Bluetooth and Wi-Fi modules, the Zigbee module transmits data over a shorter distance than other technologies. It was given 16-bit addresses and was able to link to many devices. In addition, it communicates via the use of a unique ID number. Because of its capacity to self-route, ZigBee distinguishes itself from other wireless communication networks on the market. This gadget is made up of two important components: the Zigbee and the Arduino, both of which are listed below. In addition to an infrared sensor, a servo motor, LEDs, and an LCD, Arduino is capable of interfacing with a broad range of other electrical components. Meanwhile, another Arduino serves as a gateway, connecting to the worldwide mobile phone network with the use of a GSM module operating in GPRS mode, which is controlled by the host computer. When a driver loses sight of their car, the base station's gateway (Arduino) can send updated fares and position information to the driver's mobile device over Bluetooth. The presence of a car in a parking place is detected by the Arduino microcontroller, which uses an infrared sensor to do so. When the LED is switched off, the color of the light changes from green to yellow. There was also an LCD monitor at the parking lot's entrance that showed the current availability of parking spots. A parking place was left open if one was available; if one was already occupied, the barrier was closed to signify that the space had been taken before. While Wi-Fi and Bluetooth are both quicker than the Zigbee module, the Zigbee module outperforms both of them. It used half the amount of energy as the other two. There has recently been a publication of peer-reviewed study on the

management of parking lots and slot allocations. In addition, there is information about reserved parking spaces available.

With the use of driver's license identification, [28] developed parking lot management monitoring systems that reduce the need for human resources in parking lots. These systems are intended to lessen the dependency on human capital in the workplace. Using the recognition approach to compare results requires an unreasonable amount of time, which makes this study difficult to complete.

A wireless sensor-based parking guidance and information system, [29], is one in which data is exchanged between nodes and evaluated before being presented to display drivers. This restriction has the effect that if one of the sensor nodes fails, the whole sensor system block is rendered useless as a consequence. A approach proposed by [30] involves reversed automobiles searching for intelligent terminals that analyze the locations of parked automobiles and give a navigation route to assist users in finding a parking place as soon and efficiently as they can.

According to Bhosale and Kaystha[4], it is feasible to create a large number of images from a single camera snap while shooting in a range of lighting circumstances. This discovery was made in 2014. With regard to video data analysis and sophisticated safety systems, detection and recognition are critical components of the process of evaluating unique pictures.

Using wireless sensor networks (WSNs), [5]Tang and Zheng developed an intelligent automobile parking system in 2009. Sensors are deployed around a parking field, with one sensor node per parking lot, and the system is controlled remotely. Furthermore, since the project only installs one sensor node at a time, if anything goes wrong, all of the data from the system would be destroyed.

Customers who park in some locations may already use their mobile phones as an electronic ticket or electronic wallet,[6]. Academics and researchers have provided a plethora of information concerning intelligent transportation systems.[30,31,32].

2.1 SMART CITY IOT APPLICATIONS IN ACTION

The Internet of Things (IoT) is a network of devices that are all linked to one another. Therefore, in order to ease access, all presently available goods must be accessible over the Internet in order to be considered accessible. When operating intelligent instruments in a smart city setting, it is

essential that sensors be linked to the internet so that they may be remotely managed and maintained. When it comes to previously 'dead' physical items, we can only imagine the possibilities that the Internet of Things (IoT) will open up as a consequence of its deployment. As a result, I've come to the conclusion that the number of feasible possibilities in nature is almost endless. The Internet of Things allows devices to communicate with one another through the internet, which is made possible because to the internet's availability. Metropolitan areas now account for more than half of the world's population, and it is projected that this trend will continue in the foreseeable future. It is expected that by 2055, this ratio would have climbed to 66 percent. Population expansion causes a rise in people's expectations of what the city can and cannot provide. As a result, the city's ability to meet those expectations increases. When it comes to today's cities, environmental sustainability and cultural vitality are intertwined and reliant on one another. Following today's racial and religious conflicts, cities must create a way for people of all colors and religions to live peacefully alongside one another in their communities. By using technology such as the Internet of Things, a city may be transformed into a "smart" community (IoT). Instead of being a one-time event, they are a part of a larger digital economic revolution that is going place throughout the globe. Modern culture does not perceive cities to be self-sufficient in the sense that they formerly were. A result of the global economy, all services and living conditions are now on an equal basis with one another throughout the world. A "smart city" is defined as a "city in which investments in human and social capital, conventional infrastructure, and disruptive technology promote sustainable economic growth and a high quality of living, while simultaneously assuring intelligent resource management via participatory governance[33]." This version of the three objectives for the Internet of Things is consistent with the goals from the previous edition of the Internet of Things goals. Because of its broad acceptance, the Internet of Things (IoT) has had the greatest influence on Smart Cities. Due to the fact that it would optimize the usage of the city's resources as a whole, the plan's adoption will be beneficial to all parties involved. This may be the most advantageous of all the networks that are now accessible. Real-time updates to system settings may be made in response to real-time data gathered on anything that can be collected anywhere at any time. This can result in improved system performance as a result. Because interoperability allows decision-makers to make well-informed decisions based on correct and up-to-date information, interoperability is beneficial to all stakeholders[34]. As a consequence, it is anticipated that new business models will arise as a result of this. It's impossible for me to imagine

the Internet of Things without the presence of artificial intelligence in some capacity. Numerous experiments have shown that IBM's supercomputer, Watson, is on par with human problem solvers when it comes to issue solving[35]. Watson has previously benefited cancer patients in gaining a correct diagnosis in the past. In certain circumstances, reliable diagnoses may be made even in the absence of any other evidence, such as a medical history. Grasping massive amounts crucial data has become more viable as a result of the proliferation of the Internet of Things. This would help to increase the accuracy of the diagnostic procedure even more. As more and more items are linked to the Internet of Things, the possibility of creating a virtual world in which everything is a smart object becomes more and more realistic. It is necessary for devices to be able to interact with one another in order for the Internet of Things to reach its potential to its greatest extent. The potential to make money off of a well-known one-liner has offered itself to you. In response to the Internet of Things, our physical world has been transformed into a global network of connected devices (IoT). The whole world will be accessible at any time, and everyone will have access to everything. The Internet of Things, in my opinion, is a simple idea to understand. In the Internet of Things, there are physical items that are capable of creating, sharing, and altering data, which are referred to as "things" (IoT). When inanimate objects come to life and become cognizant of their own existence, this is the process through which they come to be considered alive. The procedure is sometimes referred to as the awakening process[36]. It is possible to do this using a variety of approaches, including energy consumption monitoring, lighting control, and air conditioner management. Sensors strategically placed across a building may be used to collect and analyze important information about the facility. A smart city is shown in Figure 2.2, which shows the most critical Internet of Things applications for a smart city. Detailed descriptions of the primary aims in this field of study are provided in the following subsections[37].

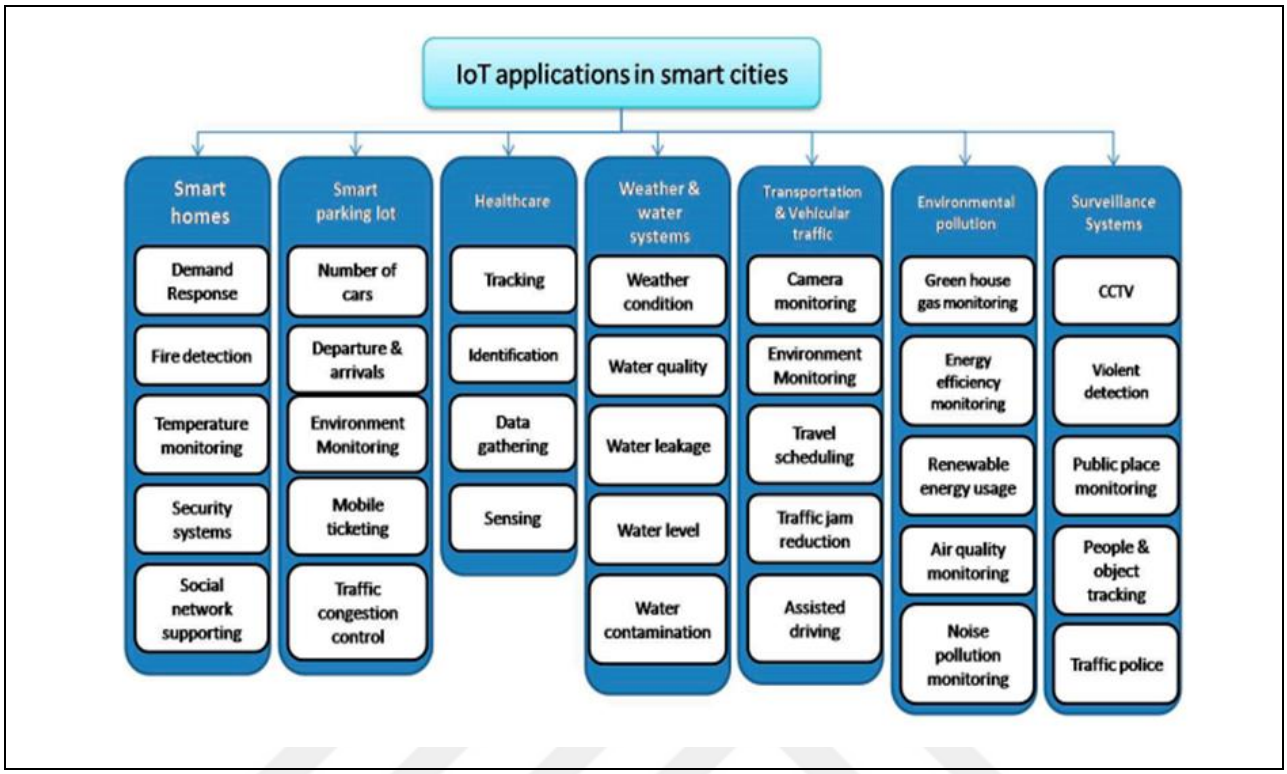

Figure 2.2 : The Main Applications of the IoT.

2.2 SMART HOMES

[19] Data acquired by smart home sensors may be reviewed if the user wishes to do so. [20]. Customer alerts can be sent out when pollution levels exceed legal or permissible limits, thanks to pollution monitoring and other novel demand response (DR) technologies. For example, pollution monitoring technologies can send out customer alerts when pollution levels exceed legal or permissible limits. In addition to smart TVs and home security systems, the Internet of Things allows for the development of remote lighting control systems, fire detection, and temperature monitoring (IoT). As previously said, the sensor nodes on an appliance communicate with a central controller, which can then be used to remotely monitor and manage the house, as well as make the best choice feasible in any given circumstance. These monitoring data may be used to predict future occurrences, take particular steps to minimize pain, provide security and comfort, and provide an overall high quality of life, to name a few of the many advantages. As well as this, several more options are available. Neighbor Area Networks, which link smart homes in a neighborhood, have the ability to convert a typical neighborhood into a smart community when implemented properly (NAN). Upon the occurrence of an accident or incident, families may share

surveillance data with the appropriate authorities, such as exterior camera video, to aid them in identifying and reporting the event or accident. Smart communities may also be utilized to offer healthcare and manage shared resources, among other applications. Thus, the development of a smart city capable of monitoring and managing all of its operations is included in this vision of smart cities, as is the creation of a smart city that can monitor and manage all of its activities. Having the option of living in a smart home appeals to some individuals, while others may already be doing so in their current situation. According to the findings of the study, a gap seems to be growing between differing perspectives on smart homes. Smart homes have been depicted in the media and popular culture as either utopian utopias or terrifying dystopias, depending on who is talking about them and from what perspective. It is possible to make home life more convenient for everyone while simultaneously increasing the efficiency of home life by taking use of technological advancements that give new methods of controlling, regulating, and monitoring the home and the people who live in it. There are concerns that such technology will be used to seize power or to perform a large-scale demographic census, as has happened in the past. All of these various smart home ideas are linked by a common thread: a desire for more control over one's environment. While this description of smart home systems may seem to be out of date, it highlights how they have historically been seen as control systems, among other things. A great deal has been done to examine control in smart homes, both technologically and from the perspective of the end user, and the results have been quite favorable overall. It took me by surprise that they placed such a high value on design, acceptability, and usefulness above the utility and change of daily living or residential environments. It is also uncommon to hear discussions on how individuals might regain control of their lives and surroundings at home, a concept that is crucial to many people's perception of their homes as a safe haven for their families. Except for those mentioned above, very few studies have been conducted with real occupants of smart homes, as opposed to trial participants or people who have seen or participated in testbeds. Based on interviews with smart home inhabitants, my research seeks to fill in the gaps in the existing body of knowledge on this group by examining how people perceive and use technological advancements. Researchers will be able to get a better grasp of how people of smart homes perceive and interact with technology as a result of this. In scientific circles, the concept of a "smart home" is a source of contention[39]. A smart house is still changing more than 30 years after the American Association of Home Builders coined the phrase "smart home," according to the

association, which claims that the idea hasn't stopped growing. In the minds of many, a "smart" house is one that incorporates a range of interconnected information technologies, as well as varying degrees of automation and computer intelligence throughout. A number of potential applications for smart houses have been proposed, including increasing the quality of life and security of tenants, as well as allowing users to conserve energy. As a consequence, numerous approaches for visualizing and comprehending smart homes have been developed. I first became interested in smart home technology after having a talk with my software engineer partner about his ideas for a home learning and speaking system[40]. This curiosity has remained with me to the current day. When I went home from work, the notion of my house welcoming me as I walked through the door or telling me that the laundry was done and needed to be put up made me feel anxious. When I look back, I can see that I've been asking myself questions about data security concerns that would arise in a future sci-fi horror picture. Anyone who is not a member of the household is able to access the account information. There does not seem to be a strategy in place to deal with the vast quantity of data that this new system will create. Despite the fact that I was completely unfamiliar with this new technology, I was fascinated by it. I began by doing research on the products presently available on the market, as well as into the difficulties that they claimed to be able to fix in the marketplace[41]. The social sciences have produced a plethora of study on people's perceptions of smart homes, the potential influence of such technology on their activities, and the societal repercussions of people who live in smart houses. Although this is the case, researchers, especially those who have spent time in such a setting, are lacking in this area. Researchers from across the globe have approached the issue of smart homes from a variety of angles and with a variety of motivations, drawing on a variety of disciplines. In the early stages of developing smart home technology, the primary emphasis was on showing that the idea could be implemented in a practical manner using already available technology. Later on in its growth, socio-technical research started to include human-centered, or maybe a more correct phrase would be user-centered, views into its findings and conclusions, and this practice continues today (although mostly based on research in laboratory settings or with prototypes). In the last three decades, there has been an explosion in the quantity of publications on the subject of smart homes. [42] of the Department of Environmental Social Sciences conducted a review of the literature on smart home user experience research and discovered that more than 60 percent of studies were

conducted in the fields of computer science, engineering, and mathematics, according to their findings.

2.3 SMART PARKING LOTS

Smart parking, which is becoming more common, allows for the tracking of individual automobiles' arrival and departure timings around the city. Therefore, parking spaces must be built to accommodate the number of vehicles that will be present in each region of the nation.... Additionally, extra parking lots where there are more automobiles must be constructed in order to meet the increasing traffic flow. It is possible that, as a result of technological advancements, information acquired from smart parking lots will be utilized to generate money for customers and companies in smart cities. This service, which makes use of cutting-edge road sensors and clever displays, leads cars to the most convenient parking places in and around the downtown area. The ability to find a parking spot more quickly is a significant benefit of using the service. Therefore, CO2 emissions from autos are decreased, traffic congestion is lessened, and the general public is happier as a result of this[43]. Incorporating it into Internet of Things systems in cities has the potential to be very advantageous. It is also possible to conduct electronic parking ticket verification and provide customers with enhanced services through the use of short-range communication technologies such as RFID and NFC. On a national and international scale, in recent years, transportation has emerged as a critical economic, environmental, and political concern, with implications for all three. Increased density of urban population is accompanied by increased urban mobility, which in turn brings with it a slew of transportation challenges. Traffic congestion relief is becoming increasingly important to people from all walks of life, including those in government and the general public[44]. This awareness is spreading across the country. Finding a parking spot can be difficult for a variety of legitimate reasons, which contributes significantly to traffic congestion in the surrounding area. It has been claimed that parking-related traffic accounts for up to 30 percent of all automobile traffic in big metropolitan centers, according to some estimates. On average, every vehicle on the road spends between 8 and 20 minutes per day hunting for a parking place, according to estimates. Other cars suffer increased time, money, and effort losses as a result of traffic congestion, in addition to the frustration experienced by drivers who are searching for parking places on the side of the road. According to the Texas Transportation Institute's 2015 Urban Mobility Report, traffic congestion cost urban residents

more than $160 billion in lost productivity and higher fuel prices in 2014. Since 2005, this statistic has increased by more than 105 percent, indicating a huge increase in the economy. As these data demonstrate, the subject matter discussed in this dissertation is important on a global and local scale, as well as within the academic community, as shown in this dissertation. A vast number of nations have modernized and improved the control of their existing transportation networks and road infrastructure in order to enhance traffic flow, mobility, and safety for the residents of their respective countries. Design and implementation of guidance-based parking management systems, such as Parking Guidance and Information (PGI) systems, as well as the development and implementation of other linked systems, are all part of this solution's scope. In controlled areas, the usage of parking guidance systems (PGI) provides motorists with real-time information about available parking places and the routes that lead to them. Following the collection of data by sensors on or off the highway, the information is sent to automobiles through Virtual Message Signs (VMS) on the road or over the internet, depending upon where the sensors are located. Intelligent Transit Systems (ITS) are the driving force behind public transit systems in heavily populated metropolitan areas, and they are becoming more sophisticated (PGI). They are being developed in order to minimize the amount of time that individuals spend looking for parking, hence helping to attempts to alleviate traffic congestion in urban areas. Much research has also been conducted on Parking Reservation Systems (PRS), which enable commuters to get parking information before to or during their travel, as well as to make parking reservations at the locations of their choosing[45]. When it comes to monitoring parking spots, parking management firms (PRS) often use PGI systems. If you wish to make a parking reservation for your car, you may usually do so using an online service that can be accessed through the internet, the telephone, or Short Message Service (SMS). The Parking Space Optimization Service (PSOS) may be used for the purpose of generating the reservation offers. The PSOS is often intended to maximize the usage of parking resources while at the same time reducing driving expenses, or to do both at the same time. Furthermore, PRS claims that by implementing its system, it will be able to reduce parking search time, provide real-time parking information and guarantee a specific parking space, speed parking payment, improve the driving experience, optimize parking resource utilization, and increase total revenue[45].

2.4 HEALTHCARE

It is the Internet of Things (IoT) technology that gives a slew of benefits in the healthcare business and smart cities. It is possible to monitor and identify persons and things for an indefinite period of time, such as ambulances, workers, and other vehicles, as well as to utilize automated data gathering and sensing techniques. Patients and their related objectives are monitored in a clinic or hospital setting in order to enhance and speed up the facility's workflow to the greatest extent practicable. It is essential to keep track of all blood products and transplantable organs in order to ensure that they are always available when they are most required[47]. The presence of a patient database minimizes the possibility that they will be offered incorrect medications and dosages, or that they will be given unsuitable treatment, since they have been recognized and recorded. In order to improve the conduct of employees when they come into contact with customers or patients, staff authentication must be implemented[48]. As a result, human error is eliminated, and data processing time is cut to the absolute minimum. It is feasible to improve patient care by the use of sensor devices that can identify patient problems and offer real-time data on the patient's vital signs, which can be accomplished through the use of wireless sensor technology. With the use of a variety of wireless access-based technologies to investigate the patient's state via biosignal monitoring, it is feasible to acquire information about a patient from any location at any time. It is possible to find a number of individuals who are involved in the delivery of intelligent health care services. Hospital administration, healthcare decision-making, and medical research, to mention a few of the many components that make up this organic body of knowledge, are included. The Internet of Things (IoT), mobile Internet, cloud computing, big data, 5G, microelectronics, and artificial intelligence are just a few of the technologies that are enabling smart healthcare. Other technologies that are enabling smart healthcare include: These technologies are widely used in all parts of smart healthcare, including the delivery of treatment, and are widely available. According to the National Institutes of Health, patients may monitor their health and seek medical treatment via wearable gadgets, virtual assistants, and remote residences, while doctors can employ a range of sophisticated clinical decision support systems to aid and enhance their diagnosis. With the use of an integrated information platform, which incorporates a Laboratory Information Management System (LIMS), a Picture Archiving and Communications System (PACS), an Electronic Medical Record, and other technologies, it may be able to handle medical data. Doctors may soon be able to perform surgery on patients with more precision than ever before because to the use of surgical

robots and mixed reality technologies[50]. A radio-frequency identification (RFID) system may be used to manage a hospital's supply chain, with integrated management systems collecting data and helping in decision-making. If mobile medical platforms become more extensively utilized, they may be able to make a positive difference in the overall patient experience. From the perspective of scientific research institutions, both the use of machine learning to replace manual drug screening and the use of big data to identify suitable staff are viable alternatives. Machine learning can be used to replace manual drug screening, while big data can be used to identify suitable staff. Smart healthcare benefits from a variety of technologies, including the ability to cut the cost and danger of medical operations, boost the efficiency of medical resource consumption, encourage cross-regional exchanges, and eventually make personalized medical services more broadly accessible[51].

2.5 WEATHER AND WATER SYSTEMS

In order to detect factors such as temperature, precipitation, solar irradiation, and wind speed, among other things, weather systems use a range of sensors. An increase in the efficiency of a smart city is made possible via the usage of this information. In a smart city, the reliability and efficiency of a water distribution system are equally as vital as any other piece of infrastructure in terms of efficiency and dependability[52]. The usage of traditional water distribution systems is inefficient and wasteful when it comes to moving water from a water source to a customer's location and discovering leaks or other system flaws in the process[53]. The growth of the distribution system results in it becoming intelligent and capable of identifying problems as well as conducting a wide range of new activities as a consequence of strategically placed sensors strategically dispersed throughout it[54]. Using a variety of sensors, weather forecasting systems are capable of accurately predicting temperature, precipitation, sun irradiation, and wind speed. If a well-developed water distribution system is not in place in a smart city, the infrastructure of that city will be incomplete. Conventional water distribution systems are inefficient and costly to run over time due to the challenges connected with diagnosing leaks and other system faults. Given that sensors have been strategically positioned throughout the distribution system, it has gained the ability to recognize problems and perform a wide range of functions[55,56]. It is possible to estimate the amount of water in a storage tank by using two pressure transducers that are situated at or near the tank's bottom, as well as an ultrasonic sensor. In accordance with the left-hand side

of Figure 6, there are three fundamental kinds of pipeline leak detection sensors, each of which comprises accelerometers or piezoelectric sensors and is classified as either a vibration detection sensor, a pressure detection sensor, or an audio detection sensor (which can be detected by an ultrasonic sensor)[57,58].

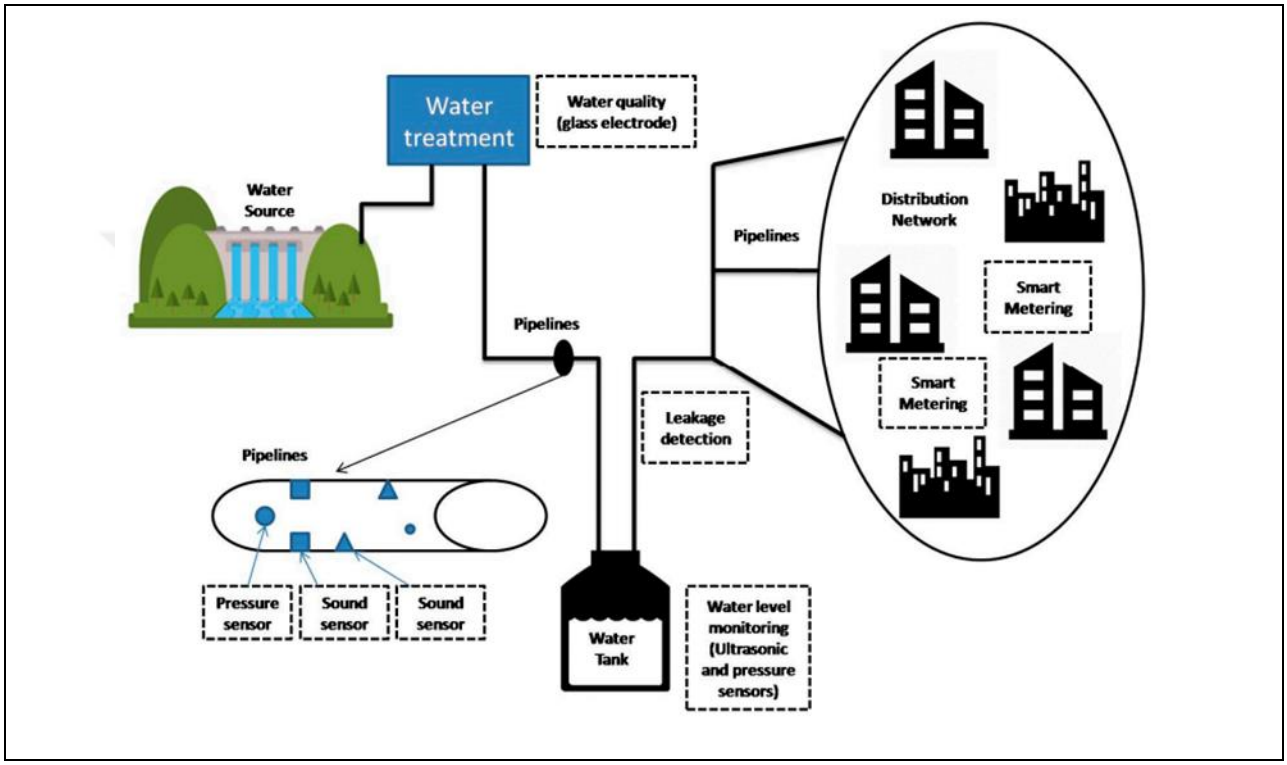

Figure 2.3: Water Systems

2.6 RELATED WORKS

A variety of parking techniques have been used in the past to accommodate customers. It is undeniable that in developed countries, automotive parking systems are deployed in parking lots employing cutting-edge technology to maximize efficiency[59]. This section looks at a variety of research that have been conducted on intelligent car parking systems. There are certain sensor-based automotive parking system studies available, and they are often used to solve the issue of locating an empty parking space[60]. On the other hand, the same characteristics were observed, which may result in greater traffic congestion while alternate parking alternatives continue to be available. Furthermore, it seems that the trouble with these systems is that they have been unable

to discover a solution for previously highlighted difficulties such as the location of the next parking space[61,62].

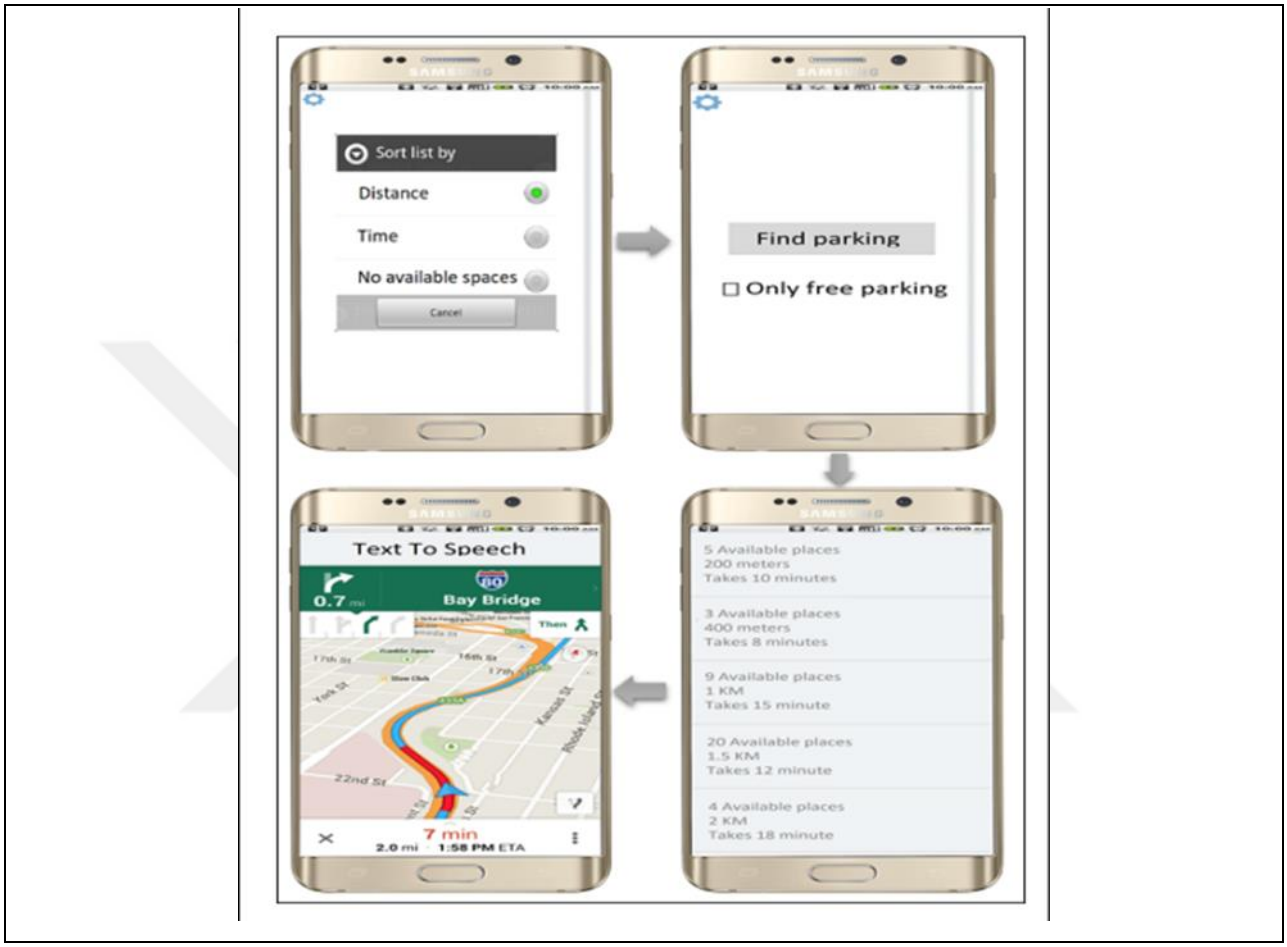

Figure 2.4: Software Design

Constant traffic congestion on highways is a daily occurrence, and avoiding it is quite tough. It was thus vital to ensure that the parking lot was in good working order[63]. For parking information systems, a considerable number of these publications presented novel research and new concepts (PIS)[64]. When a parking space becomes available, the announcement is made via digital signs that are strategically positioned around the neighborhood to alert residents. It is possible to count how many cars are parked in the parking lot at any particular moment in time since sensors have been put at the entrance and exit of the lot[65. Given the results of our research, we believe that tourists would want more dynamic and tailored] parking information both before to and during their trip, and both before and during their holiday. In addition to being energy and data efficient, the suggested system, which makes use of a microcontroller chip that transmits data

at a low rate and consumes little power, also delivers great performance[66]. Researchers developed a system for identifying available parking spaces for use by the general public that makes use of optical sensors[67]. It was decided to employ wireless cameras to gather photos of nearby parking lots, which were then sent to a central processing system for further analysis. Their strategy was only successful because they used a visual sensor network to get good findings and show the cost-effectiveness and success of their approach[68]. However, despite the fact that this system creates a large quantity of data, it must be sent to a central system across a network, raising the cost of data transmission while also increasing the amount of electricity used in the process. Additionally, the researcher developed a cloud-based auto parking approach that would reduce the amount of time and fuel spent seeking for parking places[69,70]. They illustrated the value of their strategy via the use of a real-world case study, which they developed themselves. Massive amounts of data were generated and uploaded to the cloud for analysis as a consequence of the sensors and RFID tags that were employed to monitor the parking lot. They did not take into consideration the expenses involved with disclosing all of that information in their study. Customers who have registered may log in and see if there are any parking spaces available at their preferred airport of departure or arrival. Customers who have not registered can check to see if there are any parking places available at their desired airport of departure or arrival[71,72].

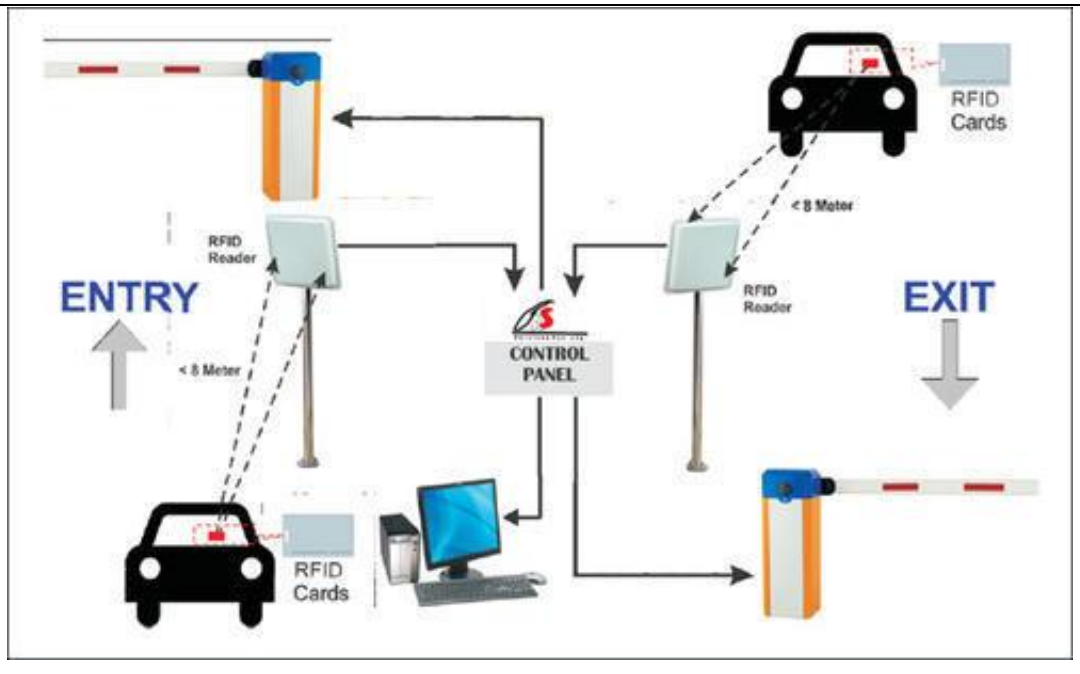

Figure 2.5: The RFID Boom Barrier For Car Access

The cloud server also employs GPS technology to provide users with the precise location of on-premises parking spots that are accessible to them. Therefore, as a result of cloud computing technology, all processed data is kept in the cloud and made accessible to consumers over the internet[73]. Because of the high cost of data transmission across the network, a significant volume of data is transmitted through the network. Because most present systems make little effort to integrate decision-making with the data that was used to design them, the vast majority of them fail to achieve their intended results[74]. The results of the research suggest an alternate data management methodology, in which sensor data is analyzed locally rather than transported over a network, as opposed to transmitting sensor data over a network as in the previous method. It was as a result of this work that the monitoring of automotive parking lots conducted by WSN was included into the system. Additionally, the WSN was on the lookout for pedestrian crossings. Through the use of data filtering, as well as current knowledge and technology, it is possible to cut energy usage and transmission costs[75]. Also included is a function that allows you to view available parking spaces in the immediate vicinity, as well as the current traffic status at the parking site you've chosen. Smart parking solutions are analyzed, classified, and further investigated in more depth than they were before in a variety of research review articles[76]. This section discusses smart parking systems, which were discovered through keyword searches in databases such as the ISI Web of Science and Scopus for the phrases "smart parking" and "Internet of Things parking," as well as other related topics. Smart parking systems were discovered through keyword searches in databases such as the ISI Web of Science and Scopus for the phrases "smart parking" and "Internet of Things parking," as well as other related topics. When these keywords were searched for in Web of Science, 127 hits were returned, and 189 hits were returned in Scopus when these keywords were searched for in Web of Science. It was discovered after duplicate items were eliminated from these two databases that there were a total of 275 articles in total after they were deleted[77]. It was taken into account the way by which the relevant articles were collected and organized. Consider that these papers address a broad variety of topics, including applicability, usability, pricing structures and contract terms and conditions, as well as availability. Please bear this in mind as you go through the documents. Additional sub-dissections of the 275 articles were conducted, with each article being broken down into three categories: scope of the problem, solution strategy, and method of evaluation. For ease of reference, the findings were provided in a tabular format[78]. Following the identification and elimination of the 14 articles that were the

most relevant to the scope and aims of the study, it was only after this research was located and withdrawn from consideration that it was discovered and removed from consideration[79]. There are a variety of elements that may be considered when classifying systems, including the parking area, the services offered, and the core sensor technology used[80]. In the broad category of parking sensors, which includes motion sensors, camera sensors, and wireless sensor-based parking systems, all parking sensors, including wireless sensor-based parking systems, motion sensor-based parking systems, and camera sensor-based parking systems are subcategories of the broader category of parking sensors, which also includes motion sensors, camera sensors, and wireless sensor-based parking systems. Parking sensors are a large category that includes motion sensors, camera sensors, and wireless sensor-based parking systems, all of which are subcategories of the broader category of parking sensors[81]. Specific smart parking solutions that make use of the LoRaWAN network architecture will be investigated in greater depth in this section because they are the ones that are the most directly related to the solution presented in this article, which is wireless sensor-based systems, and therefore will be investigated in greater depth[82]. There have been a number of articles published that demonstrate the feasibility of constructing an intelligent parking system using LoRa technology in a range of settings. A system of this kind is useful for parking monitoring and management in major cities, as shown by the implementations that have been established in terms of energy efficiency, integrity, and scalability, among other factors. An online reservation system for parking lots at Universitas Hasanuddin is also included in the system's functionality[83]. In addition to sensors, an online reservation system, and third-party payment alternatives, they developed a LoRa-based smart parking system for its customers[84]. The approach was tested in the Chinese cities of Ningbo and Zhoushan, which are both located in the Zhejiang region. The results were positive. The findings of the investigation indicated that the research would have benefitted from improved monitoring and booking capabilities. The quality, security, and reliability of LoRa technology have yet to be shown in real-world parking lots in densely populated urban regions, which will take some time[85]. The smart parking system that has been demonstrated is a combination of Libelium smart parking sensors, LoRaWAN, and a cluster of Kubernetes containers with MQTT and MongoDB running on top of them. By reducing the obstruction to information transfer, the combination increased the accessibility, scalability, and portability of the smart parking system, among other benefits[86]. The system archives all messages on the messaging server in the case of a failure of the main server responsible for

information collection[87]. Following that, the messages are dealt with by the messaging server itself. Additional parking solutions that have the potential to increase income have been offered by the city[88]. Dynamic adjustments are made to the demand and supply of parking spots to ensure that a fair price is paid for each place that becomes available[89]. A variety of sensors capable of recording contextual and environmental data may be used to identify and track automobiles[90]. Edge–cloud computing is being utilized to minimize network traffic as well as the number of network gateways on the network edge. A large number of studies have explored techniques for improving the interoperability of parking systems[91]. Using the LoRa network, an Internet of Things gateway may link all of the relevant sensor devices and/or actuators to the system in real time, allowing for real-time data exchange. It is the gateway's responsibility to transform packets from one format to another so that the server can comprehend and use the information contained inside them. Therefore, a network server is not required for the purpose of routing packets to their ultimate destinations[92]. After finishing Spring functions, users will be able to see the results of their labor as incoming packets are parsed and processed by the Spring framework. It is necessary to utilize the API payment highway to process payments for parking fees levied by the parking system[93]. As a result of the development of the Wise-IoT framework, Internet of Things apps and devices now have the capacity to achieve worldwide interoperability as well as global mobility[94]. The system was built using two separate interoperability layers and two distinct Internet of Things infrastructures, each of which was unique. The cities of Busan and Santander were the first to implement the idea. In Santander, when sensor observations were made, the data was transferred to Busan through the oneM2M and FIWARE Internet of Things platforms, with oneM2M serving as the back end. When traveling between cities, it is possible to use smart parking developed for Santander in Busan and vice versa[95].

3. METHODOLOGY

3.1 BASIC ARCHITECTURE

It is shown in Figure 3.1 how the core architecture of an it-based smart parking system should be implemented. Each Internet of Things device is identified by a unique identification. It is feasible for them to carry out duties like as monitoring, sensing, and actuating, among others.

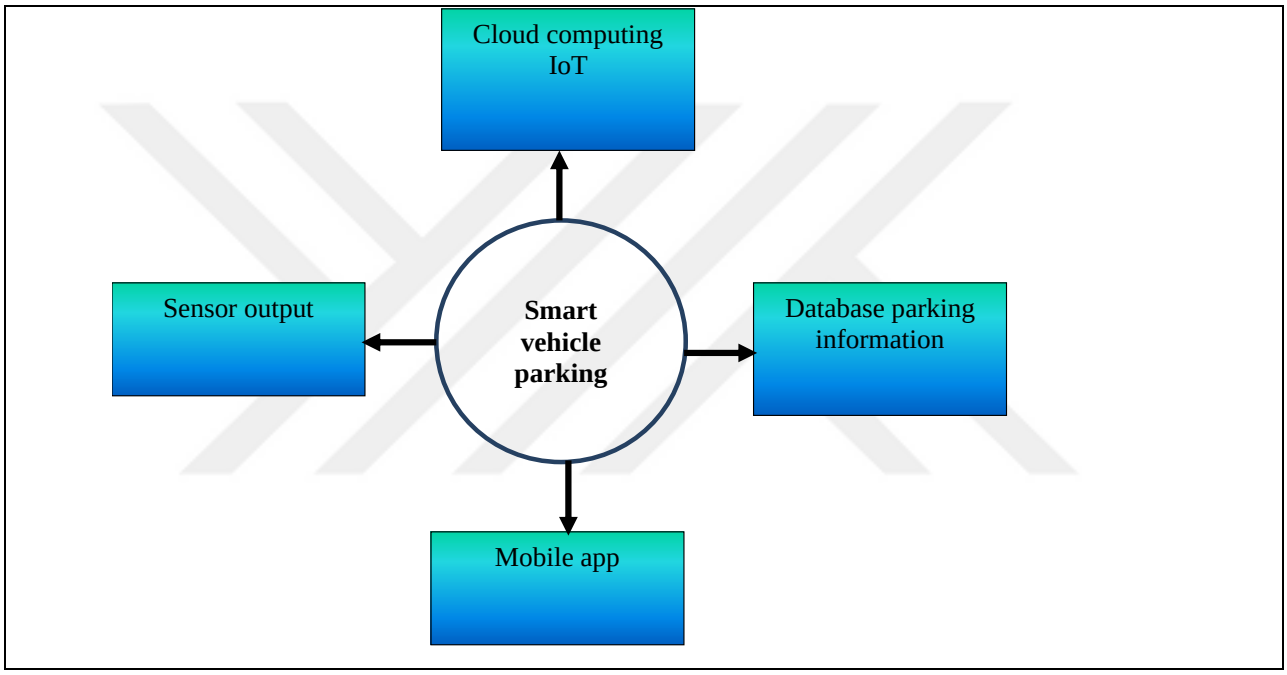

Figure 3.1: Basic Architecture of Smart Vehicle Parking System

Among the components of the smart parking system's fundamental design are a mobile application based on the Internet of Things, a sensor, a computer used for database storage, cameras, and a web browser. An example of the basic principle of the smart parking system is shown in the accompanying figure. Four unique architectural groupings have been identified, as has already been stated earlier. Sensor nodes are the first of these types of devices to be introduced.. The entire item is made up of two parts. In contrast to the intelligent parking gate system, which serves one purpose, the information display serves a completely other one. As the gateway node, it is included in the second group of nodes, which is the second set of nodes. The gateway node, which acts as a message broker, makes it possible for communication between sensor nodes and cloud-based services to take place more easily. When it comes to the last component of the system, the server

node assumes control. Essentially, it is in responsible of acquiring and interpreting the information gathered by the sensor node. When administering a smart parking system, the administrator may opt to employ a client-group application in order to maximize efficiency to the greatest extent feasible. Throughout the duration of our project, the NodeMCU serves as a sensor node controller, which we will describe in more detail below. The smart parking gate system includes a card reader that is incorporated into the system. As a matter of fact, depending on the time of year, it may be found both inside and outside the home. It is the responsibility of this device to collect information about users' smart cards before allowing them to park in the parking lot. This particular module, the PN532, is equipped with a smart card reader, which will be used in our application. The PN532 module, which has 40 kilobytes of read-only memory (ROM) and one kilobyte of write-back memory (RAM), may be used for contactless communication at a frequency of 13.56 megahertz thanks to its 40 kilobytes of ROM and one kilobyte of RAM. It is necessary for the information display node to first gather and show data from the server in order to be able to display information from it. Due to the usage of the MQTT protocol suite provided by the broker, it is feasible for the broker to handle data given or received by the sensor node. Communication and data sharing between machines (M2M) are made possible via the use of Message Queuing and Transport Layer Security (MQTT), a publish/subscribe messaging system. Messages are sent from clients to the MQTT broker, which then distributes them to other clients who are also utilizing the MQTT protocol, thereby closing the communication loop. In order to send a message, it is necessary to employ a subject, which is an address that includes the message itself. In order to get all of the broker's messages at the same time, MQTT clients might subscribe to a large number of topics at the same time. So MQTT is an ideal option for sensor nodes and brokers since it needs the least amount of preamble for data transmission. As a mediator between a variety of various applications, Mosquitto is used in this design. We found Mosquitto to be the best fit for our criteria since it is a free and open-source project, which made it the most attractive of the available options. From single-board computers to large-scale servers and everything in between, it is an excellent choice for a wide range of applications. Although both TCP and TLS/SSL are transport protocols, TLS/SSL encrypts and secures communication between two computers or networks, whereas TCP just does the opposite. TCP is an abbreviation for Transport Control Protocol. a network node located near the network's entry After considerable consideration, it was decided that the Raspberry Pi would be used as the gateway's node in this particular instance, which was

implemented. The gateway node in our system, to be specific, is responsible for both the MQTT broker and the AMQP client, which is a dual responsibility. According to the perspective of the sensor node, when it comes to MQTT messages sent across the network, the gateway may act as both a publisher and a subscriber. After receiving a message from a smart parking gate system, a MQTT broker functions as its subscriber, enabling the message to be sent to a different party. In the context of an intelligent parking system, an information display node receives a message from a cloud service. When the message is received by the node, it may also function as a publisher, which means that the node may also operate as a publisher of the message. Additional responsibilities include transmitting and receiving data from the cloud service, which is accomplished using the AMQP protocol, which is used by the service. With respect to utilizing the Raspberry Pi as a gateway node in comparison to using a microcontroller such as the nodeMCU, there are some benefits to using the Raspberry Pi instead. When it comes to single-board computers, the Raspberry Pi is a popular choice because of its large amount of RAM, which enables it to do a broad variety of activities. We communicate with one another using the MQTT and AMQP protocols, which are supported by a Raspberry Pi with 4GB of RAM. It was chosen to use the AMQP protocol for this project since it is capable of supporting both request/response and publish/subscribe architectures, and it is simple to implement. In comparison to other communication protocols such as MQTT, HTTP, or CoAP, the security of AMQP is noticeably higher than that of the other protocols listed above. A variety of TLS negotiation mechanisms are used by AMQP to safeguard its communication channels, including Pure TLS, WebSocket tunnel TLS, and a single port TLS architecture. Pure TLS is the most often used strategy. Pure TLS is the TLS negotiation technique that is most often utilized. Due to the fact that AMQP provides a broad variety of message services, it has become a business standard as a result of its widespread use in the industry. Due to the ease with which this architecture connects an Internet of Things node to a web client/server, it is especially well suited for small and lightweight Internet of Things devices. During this investigation, RabbitMQ was used as an AMQP protocol broker, and we discovered that it was rather productive in terms of overall productivity. Provisioning of the cloud server was accomplished via the usage of the RabbitMQ messaging protocol. Docker is used in this example, and it is installed on the server node to act as the container management system. The intelligent parking system is able to virtualize all of its servers thanks to the use of Docker container technology, which provides more flexibility while also lowering expenses. When you use

containers, you may boost the efficiency of a single server instance by mixing many instances of the same server. The ability to conduct operations and communication across virtualized servers may be made feasible as a result of these developments. Our intelligent parking system makes use of a number of different servers, including an AMQP broker, a database server, a main server, and a recapitulation server. The primary server is responsible for the configuration and monitoring of the smart parking system, as well as for the overall maintenance of the system. Furthermore, it is in control of all data flows and is ultimately accountable for the whole system. This server is in charge of all communication between the AMQP broker and the gateway node, as well as communication between the broker and the gateway node, among other things. It serves as both a publisher and a subscriber at the same time, which is a unique characteristic. The gateway assumes the role of a publisher in order to establish a connection with the host computer. It may also act as a subscriber when it gets a message from the gateway and recapitulation server, although this is not the default behavior. As a result of this interaction, data is sent from the gateway to a main server through the AMQP broker server, which connects with it using the AMQP protocol. Communication with the server is accomplished via the usage of the REST protocol, which is discussed in further detail below. All transactions that occur inside the smart parking system are processed by the recapitulation server, which is located on the smart parking system's network.

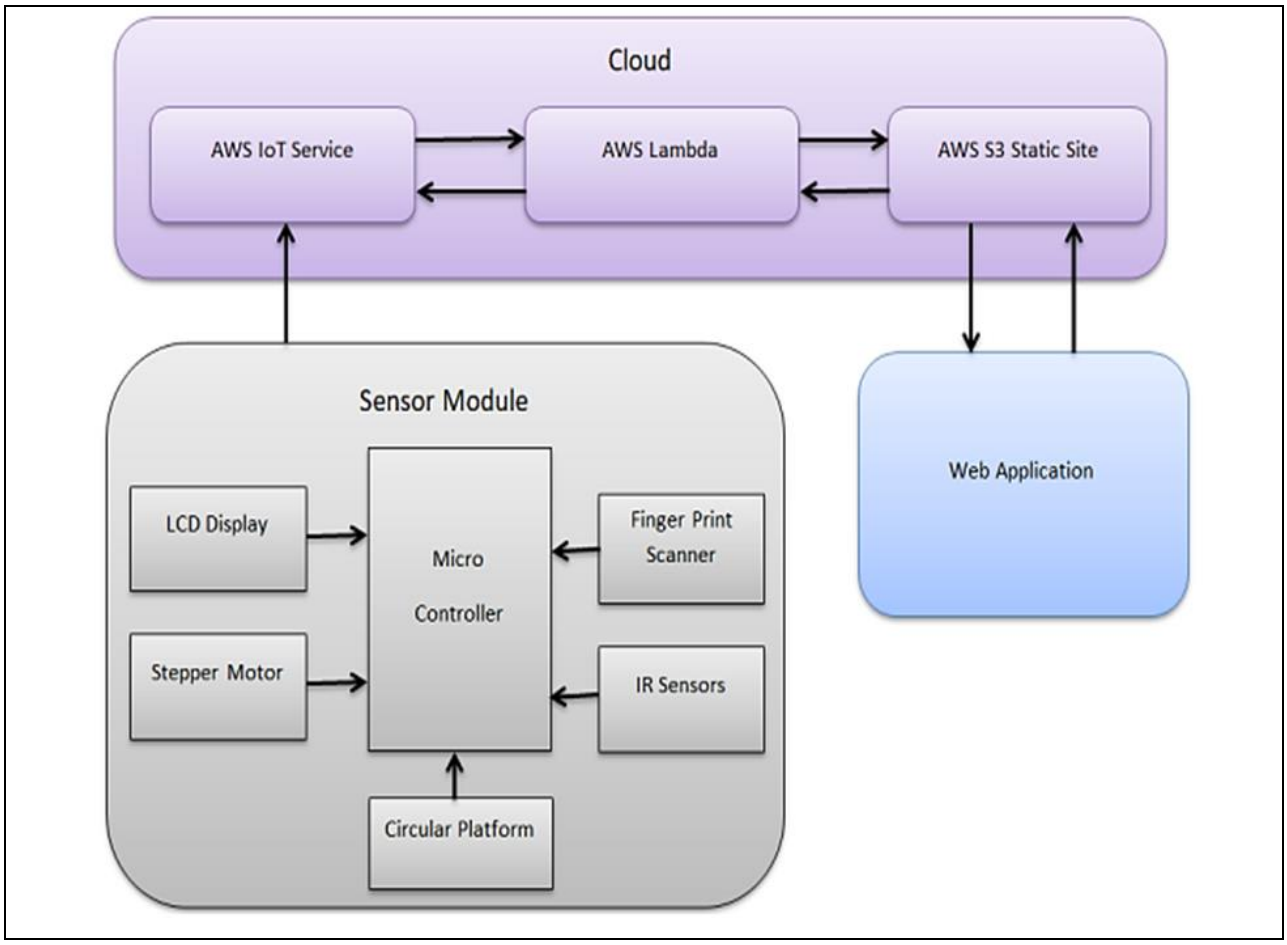

Figure 3.2: Block Diagram of the Smart Vehicle System with IoT

3.2 PROPOSED SYSTEM

In essence, the system is implemented via the Internet of Things. Using cutting-edge technology, the smart car system aims to find a vacant parking space. Computer vision algorithms have been employed in the construction of a number of smart parking systems, including automatic parking systems, among other applications. Intelligent parking systems depend largely on computer vision, which is a technology that is commonly used. Having received and analyzed all of the images and videos, the algorithm then reveals the results of its investigation. Parking at Air University has been simpler and more efficient as a consequence of SPARKAU (Air University's Smart Parking System), which was implemented in 2015. There will be no one else utilizing this lot, so obtaining a parking place should not be an issue. SPARKAU will conduct an evaluation of the films in order to determine how many remaining places are still available. Following that, customers will be able to search for available parking spots using an online interface that will be made accessible to them. SPARKAU, a new system, will address all of the issues that plagued the old system. This system's advantages include being simple to use, being economical, and being quick to set up, to name a few. Because the whole process will be software-based, there will be no need for any hardware or sensors to be used. The university's closed-circuit television cameras are critical to the functioning of this system. Using these cameras, it will analyze and make available to the user the video data that was acquired by them. All that is required is a simple computer system that is capable of running the program.

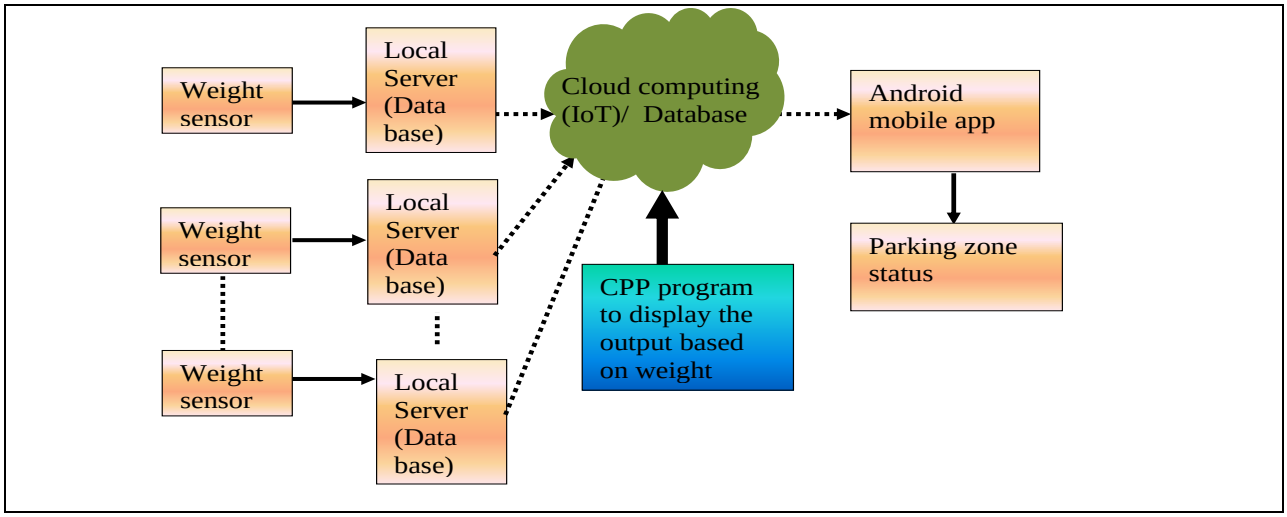

Figure 3.3: Architecture of a Smart Vehicle Parking System

The data is delivered via the network and may be readily accessible by the user based on the information gathered by the sensor. Installing the app was required to have access to the data. Figure 3.3 shows the proposed system's block diagram.

3.3 WORKING OF BLOCK DIAGRAM

It is possible to implement this system via the use of sensors and computerized systems, as well as the Internet of Things. Almost every clever or well-developed city has a parking zone dedicated to automobiles of all sizes, including two-wheelers and four-wheelers, and also a parking zone dedicated to bicycles. Use of available parking spots is the most effective strategy to reduce the number of parking-related difficulties in a given area. Because of the enormous number of automobiles on the road, traffic congestion would be a problem if this were not done.

Furthermore, all of today's commodities have some kind of embedded technology, and the significance of these systems is increasing all the time. [a page is required] The problem of producing high-quality embedded systems in less time has been taken up by a growing number of engineers during the last several years. The surge in popularity of model-based development (MBD) in recent years has been attributed to a variety of industrial goals, including the desire to design systems with more complexity in less time (and hence decrease costs) (MBD). MBD is built on the modification and control of accurate software models throughout the whole process, from the beginning to the conclusion. Software control may be made more flexible by minimizing the expenses associated with its usage, which in turn lowers the overall costs of the system. Because of this, model-based development (MBD) has become the main software development paradigm in the industry, replacing procedural development. MBD is generally regarded as one of the most effective approaches available for the development of complicated embedded systems, and it has completely transformed the way in which engineers approach the development of sophisticated embedded systems. Because embedded systems are so important in the automobile industry, there is a significant lot of interest in creating robust model-based design (MBD) tools that may be used to design automotive embedded systems that are more safe while simultaneously lowering development time. Several elements must be taken into consideration while modeling complicated embedded systems, among them the system requirements, functionality, and system design, among others. It is necessary to do this as a consequence of the large number of modeling

tools and modeling languages available. The Systems Modelling Language (SML), as opposed to typical programming languages, provides a higher degree of abstraction for describing the design and operation of systems than these languages provide (SysML). It is called ADL (Embedded Car Device Language) and it is a SysML extension that is mainly intended for usage in embedded vehicle systems, as its name indicates. The Simulink modeling language, on the other hand, is used to represent the more precise features of program behavior on the other side of the equation, while the C programming language is used to describe the general aspects of program behavior. The major emphasis of this dissertation is on the connections that may be made between various structural and behavioral system theories and models, as well as between these theories and models. This project will compare models of actual functions built in SysML and Simulink with the objective of determining which is superior. It will be covered in this course how to utilize Simulink and SysML, two programming languages that are completely separate from one another. Simulink is a widely used and well-regarded design tool for dynamic systems, but SysML is as commonly used and well-regarded as a foundation for the design of embedded system architecture and functionality, which is the primary purpose for this investigation. Simulink and SysML work very well together and give significant advantages in a wide range of areas, including specification and analysis, as well as design, verification, and validation, and are available free of charge. In the proposed idea, parking is detected by the use of a weight sensor, which detects the presence of an object.

When a vehicle is pushed against a weight sensor, the weight sensors are fitted or completed on the layout track in a way that the tires of the vehicle come into contact with the weight sensors. The layout track is designed to accommodate the weight sensors. In the event that an automobile is present on the parking track, the weight sensors in the parking track are put under additional pressure by the car. Consequently, the weight sensor is working in the active mode at this time. It transmits the signal to either an active or a de-active local server, which in turn relays it to the city's main server, which is equipped with Internet of Things (IoT) technology (wireless communication). The main server maintains a database that has been constructed from all of the signals received from the local servers. With the newest information from the main servers' database, the Android mobile application is continually being updated with the most recent information. Users who have downloaded the app will be able to access the data from their mobile

devices, and they will be able to rapidly acquire information on parking zones and other important information.

Table 3.1: Data Indicates the Mode of Operations of the Proposed Model with two mode: active and de-active mode.

Weight sensor status/mode	Signal generated at local server	Signal generated at main server	Mobile light indication	Mobile app indications (Displayed message)
De-active	Logic 0	Logic 0	Green	Parking is available
Active	Logic 1	Logic 1	Red	Parking is not available

3.3.1 De-Active Mode of Weight Sensor

The logic 0 means the weight sensor is not pressurized or not activated. Hence it creates the output 0. based on that output, the main server updates the mobile app as there is parking .It can be observed with status of the light. In de-active mode, system is flashes with green light.

3.3.2 In Active Mode

The weight sensor is pressurized with weight of vehicle, so it creates the signal logic 1. this is transmitted towards the main server. Based on the data at main server the mobile app is update. It flashes the red-light showing display parking is not available.

4. RESULT

It was detailed in detail in this part how the findings of the suggested model of smart parking system code were obtained. The C++ programming language was utilized for system implementation since it is more compatible with Android applications, such as RAS berry pi. A small piece of code was created in C++ that displayed the result in either logic 1 or logic 0 format.

4.1 INPUT COMMAND

Figure 4.1 shows the command window for smart parking system code using C++. Code has considered the output generated by the weight sensor and based on weight sensor the switch in active or de-active mode.

```
*****************************************************************************/

#include <iostream>

using namespace std;

int main()
{
    int WSO;
    cout<<"Enter weight sensor output";

cin >> WSO;

    if(WSO==0)
    {
        cout<<"Switch to green light";
    } else if(WSO==1)
    {
            cout<<"Switch to red light";
    }
    else
    {
        cout<<"No light";
    }

    return 0;
}
```

Figure 4.1: Command Window

4.2 OUTPUT WINDOW

If the weight sensor output is zero, it indicates that the weight sensor is not experiencing any pressure. As a result, it was in the inactive state. This is accomplished by the main server sending signal logic 0 to the mobile app or by displaying a green light indicator. The system will indicate whether or not parking is available.

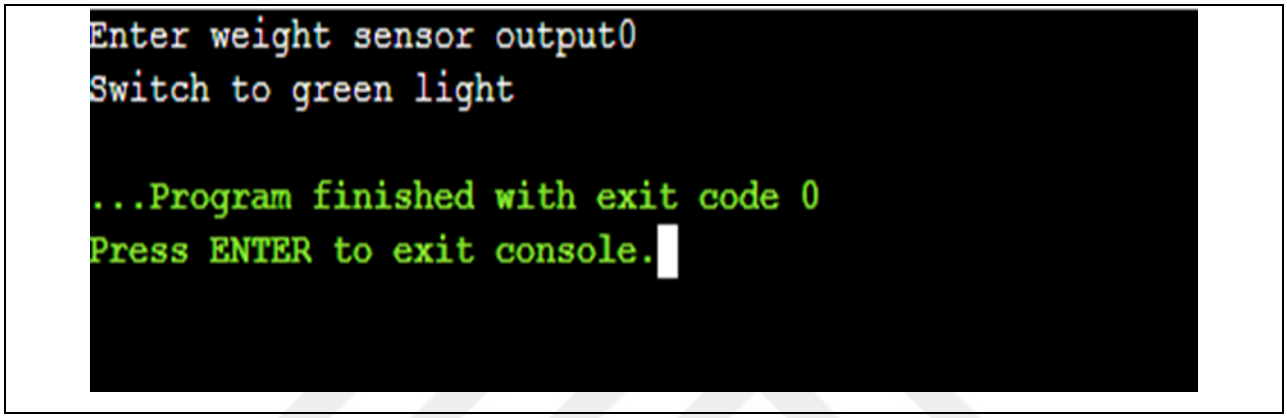

Figure 4.2: Output Window Showing Logic 0

If the weight sensor output is 1, it indicates that the weight sensor is experiencing pressure and is thus in active mode. In this case, the main server transmits the signal logic 1 to the mobile app or displays the red-light indicator, which indicates that there is no parking space to be found.

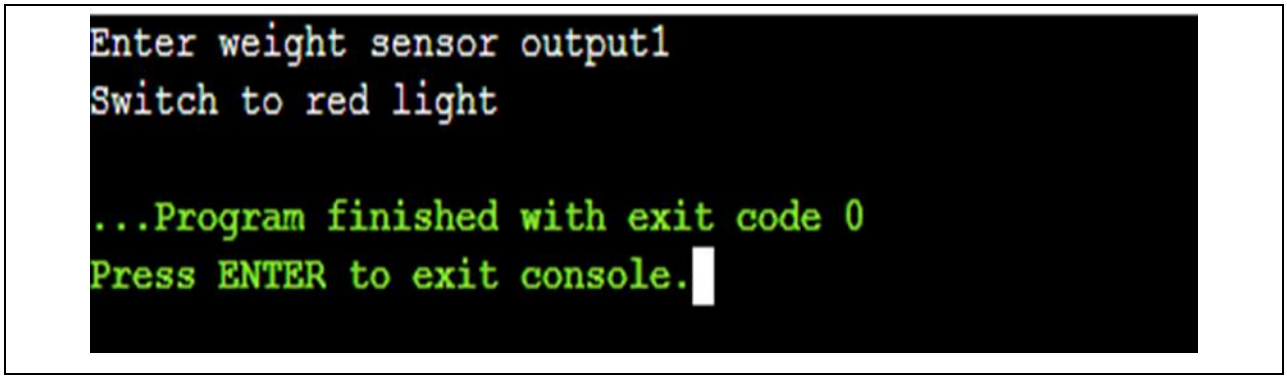

Figure 4.3: Output Window Showing Logic 1

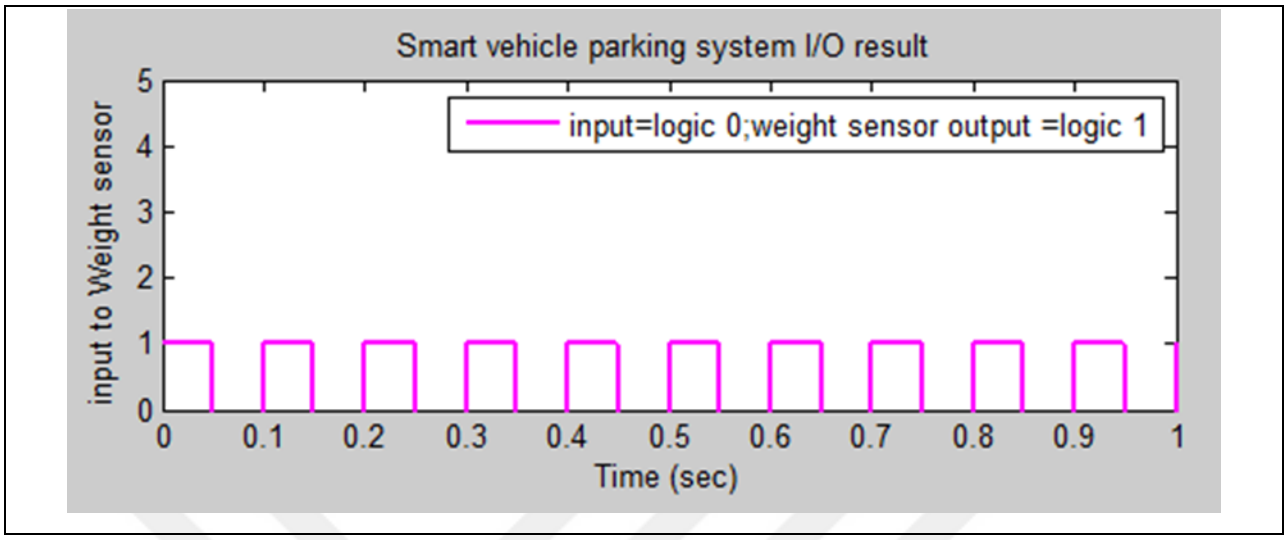

Figure 4.4: Input to Server Generated by Weight Sensor

Figure 4.4 and Figure 4.5 shows the result in logic 0 and logic 1 form. Graphically it indicates the appropriate (required result) as per the Table 1. Figure 4.3 show the input to weight sensor while the Figure 4.5 shows the server output used to display the result on mobile app.

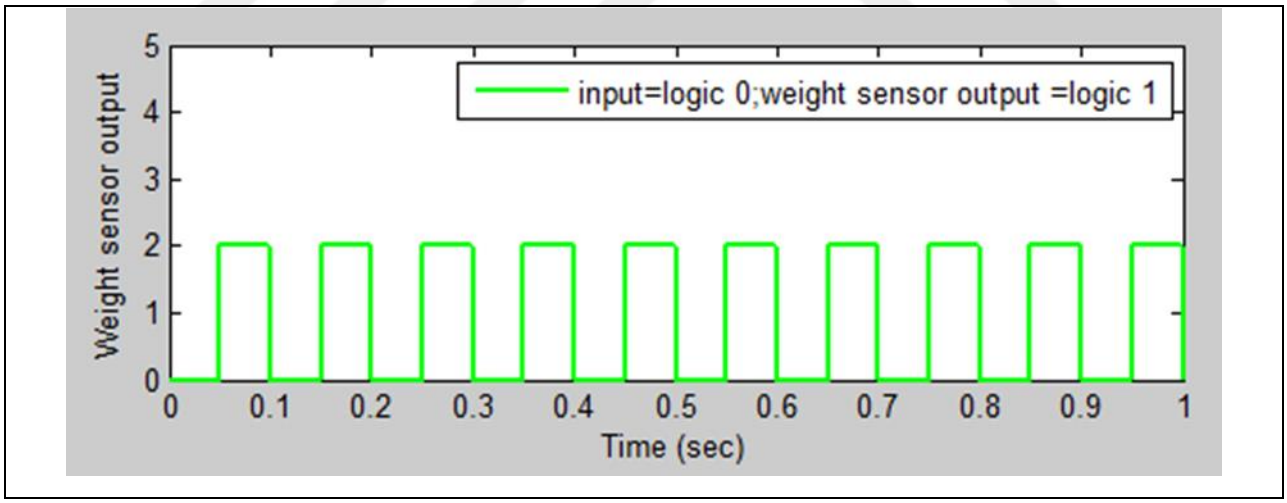

Figure 4.5: Output of Server to Check Parking is Available or not

5. COCNLUSION AND DISCUSSION AND FUTURE WORK

5.1 COCNLUSION

In response to the multiple benefits provided by the Internet of Things, a plethora of application-based solutions are already being created. Specifically, the smart parking system will be the subject of this in-depth investigation. High-density urban areas with high rates of automobile use are better suited to the proposed strategy in this circumstance. Given the fact that this technology is intended for usage in a restricted number of locations, it is more efficient and precise than other options. In addition, the price has been reduced by a percentage. This article goes into great detail on the design of a parking guidance system. The parking system directs the car to a parking space that is currently available for use. The appropriateness of an ultrasonic sensor for usage in an urban environment is taken into consideration while selecting one. In addition to providing basic information regarding parking space availability, this system also gives other information. Whenever the nearest parking lot is completely filled, the Haversine algorithm notifies the automobile of the next closest parking lot that has a spot available. No amount of emphasis can be placed on the need of investigating how new concepts and technology (particularly the Internet of Things) may contribute in the building of intelligent cities. We investigated the requirements and features of Internet of Things systems, as well as the most effective incentives for their deployment, in our review investigation. In order to maximize the potential for a varied range of smart city possibilities, it was necessary to first outline the most basic research reasons, followed by a discussion of major and helpful applications in the field of smart cities. Expandability and augmentation were shown by showing how they may be used in everyday operations. As a result of the widespread use of the Internet of Things, a number of concerns have been highlighted. A third study purpose is to provide a strategy for addressing certain key concerns, such as the privacy rights of users and inhabitants, as part of the project's overall scope. Plentiful examples of smart city implementations from across the world were given at the conference as models or pilot projects for future completely smart cities, with the hope that they would serve as inspiration for other towns to follow in their footsteps. Individuals' rights should be protected via the use of the Internet of Things (IoT), and intelligent systems and sensors should be created to accomplish this. Due to a lack of alternatives or procedures, customers are unable to park in other co-located garages or via any other centralized system within the constraints of the confined facilities.

Because of the strategy's simplicity, there are few alternatives for customers who want to have a pleasant parking experience. Parking firms may now increase their revenue streams by taking advantage of the simplified services provided by intelligent parking systems. Because it is connected to technologies such as the Internet of Things (IoT), artificial intelligence and machine learning, and augmented reality, the smart parking system has a promising future. As we reach the Fourth Industrial Revolution era, these very same technologies are driving the digital transformation of businesses all over the world. In response to urbanization, the efficiency of the parking system will improve, owing to future improvements in parking technology and the development of intelligent parking systems. For example, parking elevators have piqued the curiosity of a small number of people who are considering using them to manage parking operations. Using this mechanical approach, automobiles may be stacked in two, three, or more layers, ensuring that more than one car can be accommodated in the same parking space. This may result in a diverse range of players from many industries participating in the future parking system, which may provide a variety of services. The use of more modern, intelligent parking technologies may be used even if present parking practices are supported by the public.

5.2 DISCUSSION

Loop detectors, which are located at the points of entry and exit, have traditionally been used to monitor parking availability in parking lots. It is necessary to install wireless sensors in each parking place along the route in order for the new smart parking system to work effectively. The Internet of Things (IoT) is evolving rapidly, and there is currently no organized coordination structure in place to keep track of the various solutions and standards that are being created and proposed as the IoT evolves. There are certain gaps that are likely to occur in the next years, and even in the most extreme periods of heterogeneity, it has been seen in previous years. Because of the vast number of seminorms, it may accommodate a broad range of viewpoints and, as a result, address sectorial ideologies that state all of the universes are in accord with one another. The usage of several communication channels by device models helps to prevent the problems that might arise when there is a single point of failure. In the event of a distributed denial of service (DDoS) attack or an incidence of remote hijacking, parking may be inaccessible or unavailable. One of these concerns is the possibility of a data breach or the loss of crucial information stored in the driver and parking information databases, among other things. As a result of the huge number of

connected devices, the infrastructure's capacity to scale and adapt is critical in order to properly resolve the security challenge. When there are no application layers available, the smart parking system can only perform the most fundamental of actions when it is absolutely required to do so. In order to assist drivers in making educated decisions, real-time data sources must be linked into the application layer of the vehicle. It is necessary to keep the design as simple as possible due to the large number of data points and broad variety of consumers. The development of cloud infrastructures, whether in the public or private sectors, is required in order to accomplish this. Consumption consumers who live in close proximity to places that need the greatest amount of attention may be able to reap the benefits of the information gathered. Even in areas where sensors are not present, or where the communication link is poor, the data collected may be used to produce parking predictions and provide real-time information on available parking spaces in areas where sensors are not present or where the communication connection is weak. It may be possible to utilize this information in the business sector to detect regions of heavy traffic congestion. It is possible that the information obtained from parking data analysis will be valuable to construction businesses, who may use it to locate new parking lots, so increasing the number of available parking spaces in the region.

5.3 FUTURE WORK

The use of neural networks may be used to enhance the performance of this application in the future. Deep learning, on the other hand, has the ability to provide results that are more efficient in their execution. Since deep learning methodologies have advanced, neural network training algorithms may be more accurate than ever before during the time of parking system modernization, which is expected to take place in the near future.

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