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IOT Based Smart Parking System

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Abstract: ***In This project we are designing an IoT based Smart parking system that integrates with mobile Application. It provides a comprehensive parking solution both for the user and owner of the parking space. Features are provided for reserving a parking space, authenticating a reserved user, identifying nearest free space depending on the size of the vehicle, navigating to the parking slot and computes accounts information on daily, weekly and monthly basis. IR sensors are used to identify if a parking spot is free. Availability of a free slot with its location information is transmitted using WIFI module technology, microcontroller and wireless communication technology to the server and is retrieved though a mobile application. RFID tag attached to a vehicle is used to authenticate a user who reserves the parking slot on an hourly, daily, weekly or monthly basis. A scheduling algorithm is used to identify the nearest free slot based on the size of a vehicle. The owner of the parking space can get the analytics of the number of free and available slots for a given period, the occupancy rate on week days and weekend and the amount collected for a given period and can use it for fixing variable parking fees. The mobile application is designed to provide rich customer experience.***

Keywords- esp32 wifi, Defined cloud platform; computing, storage ; web, mobile.

I. INTRODUCTION

The world population is frequently migrating from rural to urban areas, increasing the population density of large cities than ever before. On a practical level, the global urban infrastructure required to advance technology to meet the smart city's demands. In this regard, the advancement in sensors technology and sensors networks technology presents anew governance model to build, deploy, and promote sustainable development systems to address escalating urbanization challenges. Sustainable Urban Mobility and reducing traffic congestion are some of the most critical challenges of urban development especially in case of limited availability of parking space. With the growth of technology, the concept of the Internet of Things (IoT) and deep learning can be used in the planning of Smart cities which can gradually tackle urban mobility problems and can also help to provide a sustainable infrastructure economically, ecologically, and socially to the citizens. At present, many intelligent systems mostly in the form of mobile applications help drivers by reporting traffic jams, road conditions, accidents, and alternative routes. However, due to a large number of vehicles active on roads, parking is still a tedious task. As indicated by, drivers waste liters of gas simply trying to find parking. Normally, 30% of traffic congestion is caused while searching for an available parking space. As conferred in, on average drivers waste 3.5 to 14 min to find a free parking spot. Besides, it also causes driver frustration, traffic congestion, fuel consumption, and air pollution, and all these factors act as challenges for sustainable development. In this specific circumstance, knowing ahead of time about the available parking spots can mitigate this issue. The use of deep learning techniques with the integration of IoT can ameliorate this problem by predicting the parking occupancy and availability with great precision.

II. COMPONENTS REQUIRED

A. Esp32

Fig 1: ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.



Fig: 1: Esp32

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B. IR Sensors



Fig 2: IR SENSOR

Fig 2: To detect vehicle slot occupancy the system uses IR sensors. Also system uses IR sensors to detect vehicles arriving at parking gates, to open the gates automatically on vehicle arrival. The microcontroller is used to facilitate the working of the entire system.

C. DC Motor



Fig 3: DC MOTOR

Fig 3: A *DC* motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy.

III. BLOCK DIAGRAM

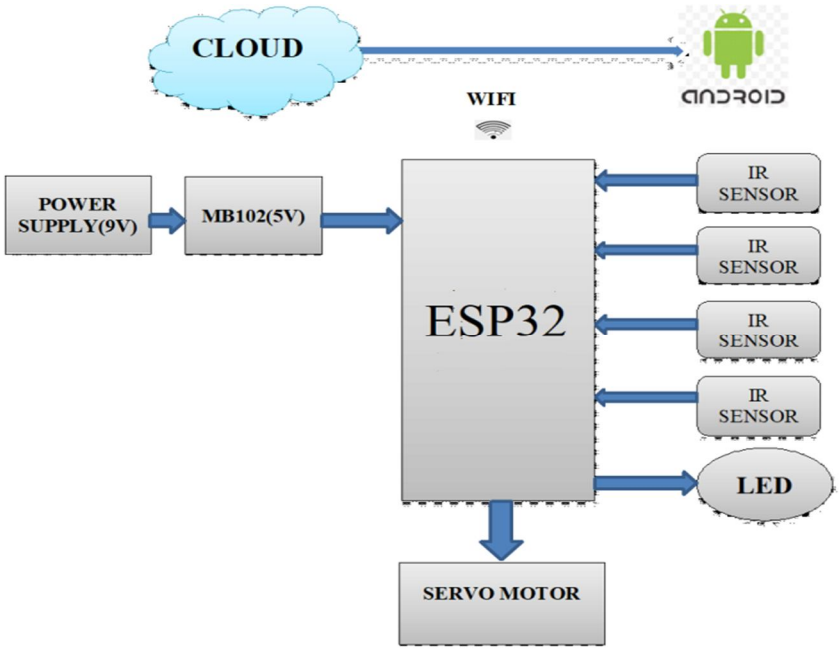


Fig 4: Block diagram of smart parking system.

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Fig 4: In the block diagram, at the entry we have Boom barrier (a pole which restricts vehicles and allows vehicles) .The Boom barrier opens only when the slot is available, if there is no slot available at parking slot the Boom barrier will not open and it is displayed in the IoT Application. When Car Enters the Parking area IR Sensor that is present before Gate will detect the passing vehicle and the gate will be opened automatically. The Car will enter into the parking Slot which is empty and the own can park the car at the reserved place and the data will we updated on web and it shows the Parking Slot is filled, by this the Person will easily know which slot is Empty. There will be an indication of LED's. When the Car is leaving the parking area, the IR sensor that is present before the gate will detect the passing vehicle and the gate will open automatically and the data is updated on web, so that the next person can book the available parking slot. The user can register in IOT MIT App Inventor app built by us. From this application also the user can see the status of parking area. In this application it will show the information of parking slots individually.

IV. FLOW CHART

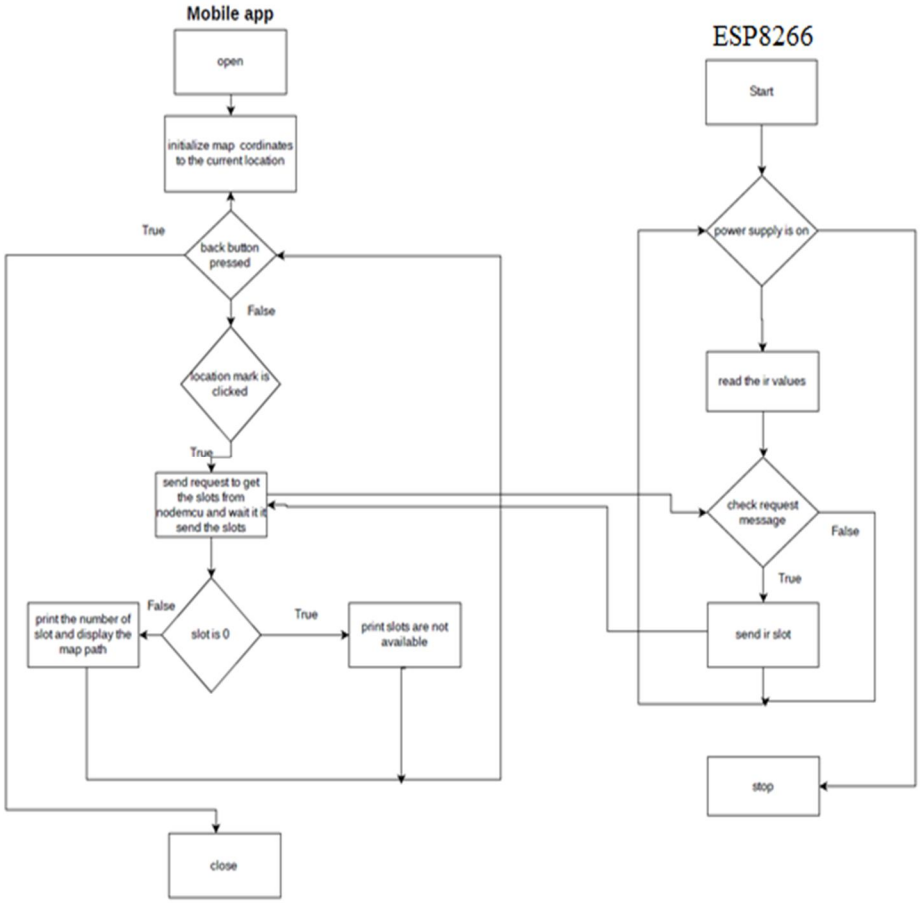


Fig 4: Flowchart

The network we are using is MQTT protocol. As we can see MQTT consists of two things, i.e. MQTT component and MQTT library. Both consists of two things "Publish topic" and "Subscribe topic". As we have used MIT App Inventor to build the app so the Publish Topic is given "mit_publish" and Subscribe Topic is given as "mit_subscribe". These things are same for Mqtt Component and Mqtt Library. The MQTT component sends the network to the Android app. Now when the user asks for parking through the android app, the app sends the requested data to the MQTT server "broker.hivemq.com" and through the server it asks to NodeMCU. It then takes information from the IR sensors and sends back to the Android app through the MQTT network. If there is availability of space then it shows a map to guide the user from the source location to destination location. When there is no slots available it shows "No slots available" and the user has to find another parking slot in the map. The map used is an "Open Route Map" system which is free to use.

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V. RESULT DISCUSSION

1) As always, we first set up the network connection as NodeMCU.
2) Next, we will have to create an account on Mit App Inventor. Go to this website and create your own account https://.appinventor.mit.edu.com/

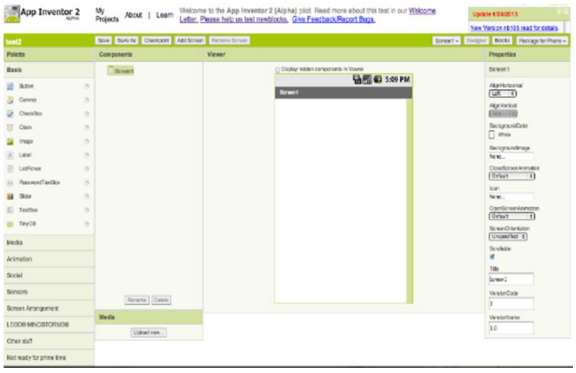


Fig 5.1

3) Click the orange "Create" button from the App Inventor website
4) Use an existing Gmail account or school-based google account to log in to ai2.appinventor.mit.edu.
5) Start new project

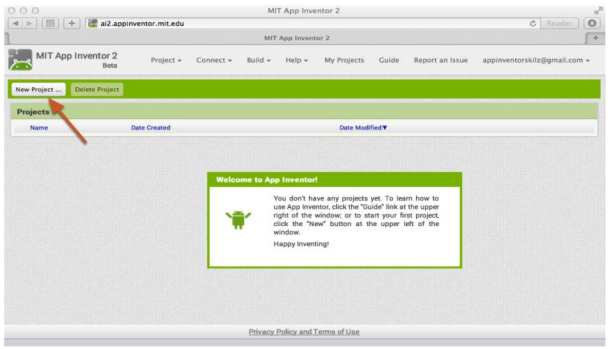


Fig 5.2

6) Type in the project name (underscores are allowed, spaces are not) and click OK.
7) The Design Window, or simply "Designer" is where you lay out the look and feel of your app, and specify what functionalities it should have. You choose things for the user interface things like Buttons, Images, and Text boxes, and functionalities like Text-to-Speech, Sensors, and GPS

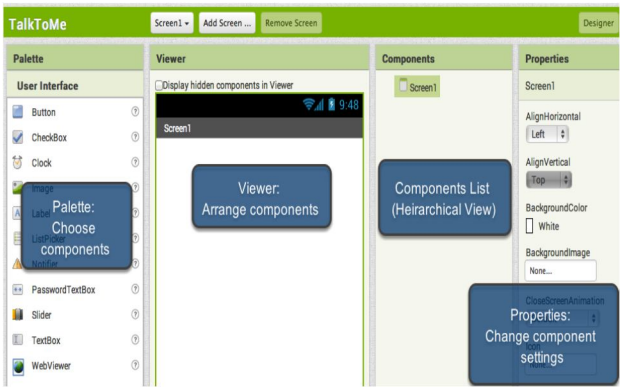


Fig 5.4

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8) Our project needs a Buttons, text boxes, GPS. Click and hold on the word "Button" in the palette. Drag your mouse over to the Viewer. Drop the button and a new button will appear on the Viewer. Do as same for rest things

9) One of the neatest things about App Inventor is that we can see and test your app while we're building it, on a connected device.

10) Download the app from the Play Store by searching for "MIT AI2 Companion".

11) You can connect by either scanning the QR code by clicking "Scan QR code" or typing the code into the text window and click "Connect with code".

12) Now after scanning the code the app will open and will show us our location and the parking slot's location

13) Now if we click on the parking slot it will show us the number of slots available and do we want to continue

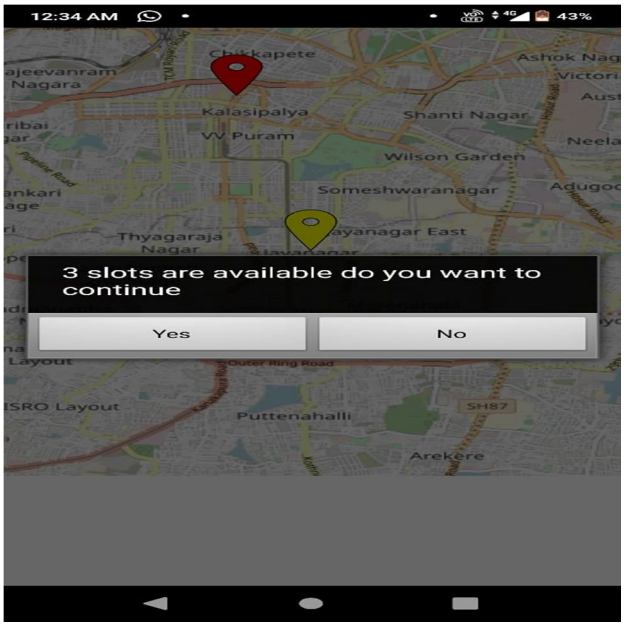


Fig 5.4

14) Now upon clicking on the "Yes" button, a map will be displayed with a message "Please follow the map" and a dialogue box "OK"

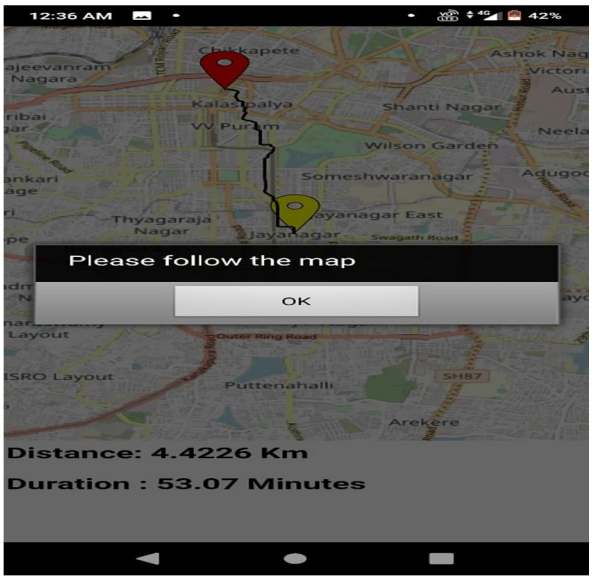


Fig 5.5

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15) On clicking the "OK" button, the distance and the duration will be shown along with the directions.

16) Now when the car will be parked, if another user tries to book a slot in the app, then again it will show the available slots and we have to do above steps.

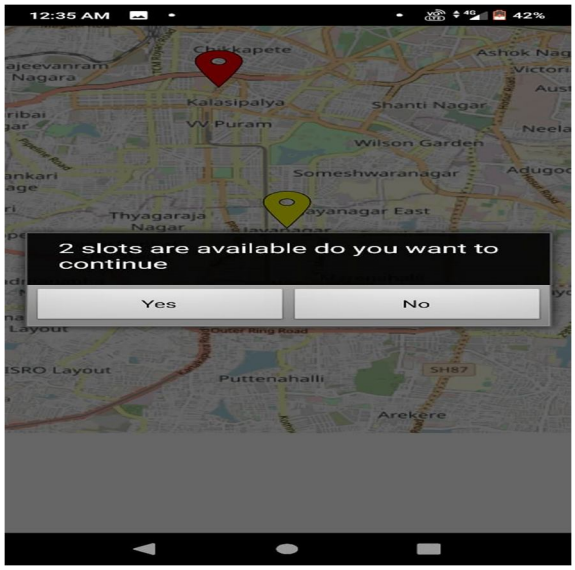


Fig 5.6

17) Now, when there are no slots available in the parking space, on trying to book, it will show a message "no slots available". Then the user has to find another parking space to park his vehicle.

VI. EXPECTED OUTCOME

In this research, we have developed an IoT based smart car parking framework. This project mainly focuses on predicting the availability of car parking spaces using the sensors data. In this regard, we have developed a simple and fast decision support system that supports the car parking information system about the availability of car parking locations on slot. In the decision support system, we employed a deep LSTM network to predict the availability of car parking space. The proposed deep LSTM network predicts both the overall availability of parking space.

Also, in continuance with LSTM network we have introduced the "Guidance System" which helps the user to locate the parking space throughout the city. The whole concept is based on IoT technology where the user can book the slot far in advance without going to the location. We have designed an app where the user on opening will be shown the parking locations throughout the city. The user just needs to click on the parking space nearest available to him and will be shown his location along with the booking slot location. He will be guided to the destination through the city map present on the app. The distance and the estimated time will be shown to him, thus he need not open any other maps to guide him to the location. Also the directions will be provided to him. This way of parking availability prediction gives a better insight to the drivers to choose their route and destination. With the help of the proposed system, drivers will be able to locate the parking space from any location at any time. We believe that with the combination of IoT technology and sensors network the collection and analysis of sensors data will become easier as compared to using traditional techniques. IR Sensors will be attached in each slot to detect the presence of the vehicles. This sensor detects the presence of a vehicle in terms of the amount of light reflected back from the obstacle and in this case it will be the wall of the parking slot. If no obstacle is present, IR light cannot be detected by the sensor. Arduino Uno Wi-Fi board is integrated with Wi-Fi module which will be used in this project. This board is based on integrated ESP8266 Wi-Fi Module. The Wi-Fi module has TCP/IP Protocol stack which gives direct access to the Wi-Fi network [8]. This board is programmed by using Arduino IDE software. In the future, this work will be extended to implement all the services (parking location, parking information, parking supervision, vehicle tracking, vehicle registration, and identification) described in the adopted smart parking framework.

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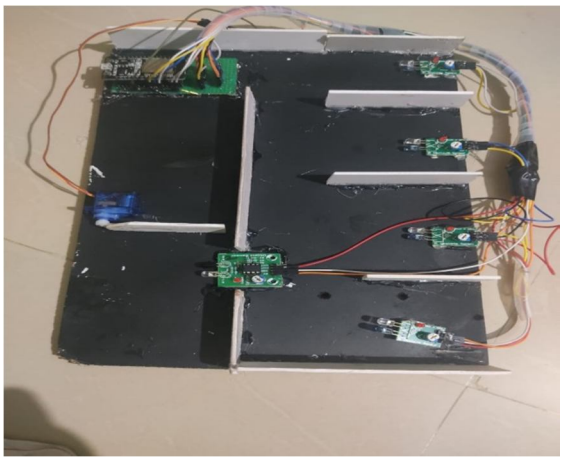


Fig 6: Parking System Model

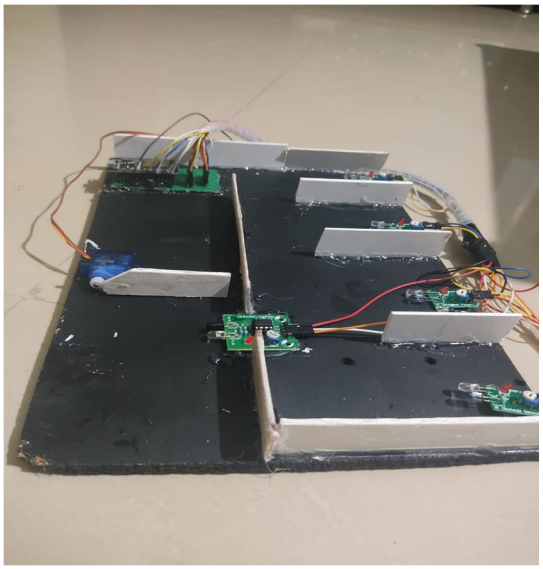


Fig 6.1: Parking System Model

VII. CONCLUSION

The development of IoT based smart parking information systems is one of the most demanded research problems for the growth of sustainable smart cities. It can help the drives to find a free car parking space near to their destination (market, office, or home). It will also save time and energy consumption by efficiently and accurately predicting the available car parking space. In this research, we have developed an IoT based smart car parking framework. This paper mainly focuses on predicting the availability of car parking spaces using the sensors data. In this regard, we have developed a simple and fast decision support system that supports the car parking information system about the availability of car parking locations on a day of week in a given time slot. In the decision support system, we employed a deep LSTM network to predict the avaSilability of car parking space.

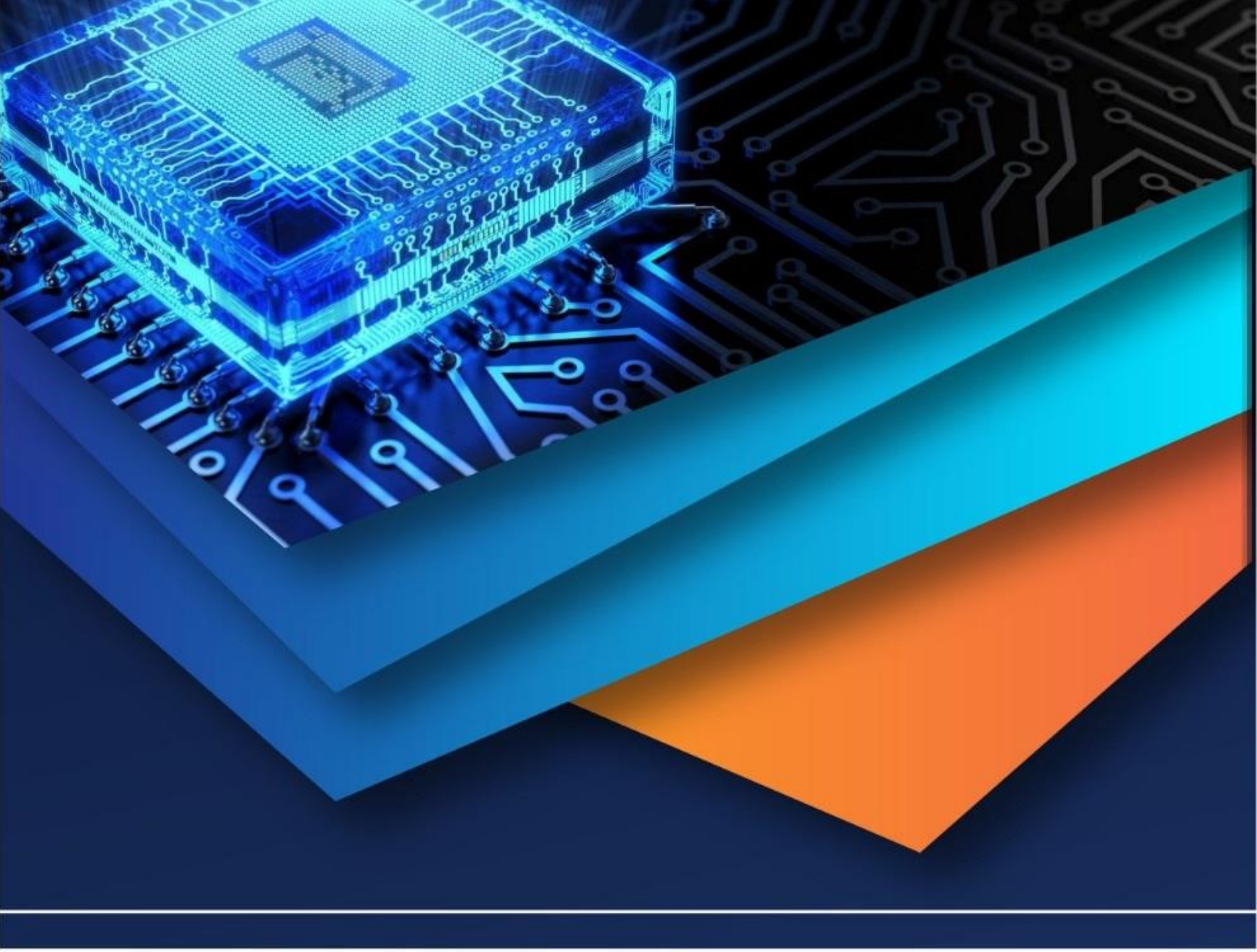
The concepts of smart cities have always been a dream. There have been advancements made from the past couple of years to make smart city dream to reality. The advancement of internet of things and cloud technologies has given rise to the new possibilities in terms of smart cities. Smart parking facilities have always been the core of constructing smart cities. The system provides a real time process and information of the parking slots. This project enhances the performance of saving users time to locate an appropriate parking space. It helps to resolve the growing problem of traffic congestion. We believe that with the combination of cloud technology and sensors network the collection and analysis of sensors data will become easier as compared to using traditional techniques. In the future, this work will be extended to implement all the services (parking location, parking information, parking supervision, vehicle tracking, vehicle registration, and identification) described in the adopted smart parking framework.

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