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# Smart Parking System using Python and OpenCV

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***Abstract:*** ***An image-processing-based smart parking system created for multistory parking garages, open parking lots, and more is presented in this study. The proposed system architecture determines if a parking spot in the received video is occupied or not by combining edge detection and coordinate bound pixel sections. Using the OpenCV library, it is implemented in Python. It also demonstrates how picture-to-text conversion was put into practice. Tesseract is used to extract text from the image after processing. In order to get the best results for the text, different photographs are processed to different degrees using a variable level of image processing.***

***The suggested system is built on the Prewitt Edge Detection method, which can recognise parking spaces with filled and unfilled spaces, potentially eliminating human labor requirements. The freshly established approach requires exact results to be obtained in real-time to recognise an intelligent parking spot or slot. The tool may also determine whether the car was completely, partially, or inappropriately parked.***

***Keywords: Python, Wamp server, Parking, Datasets.***

## I. INTRODUCTION

To locate a specific location for occupation detection, which confirms whether it has been detected, use the automatic parking slot. Either routine management occurs, or manual management occurs. Finding available parking spots is never easy. This problem typically occurs in urban areas where parking spaces are in greater demand than automobiles. Several IoT and machine learning systems have been developed to provide information on available parking spaces [3], but they all rely on hardware sensors or nearby views and monitoring. Thanks to recent economic progress and the availability of affordable vehicles on the market, any average middle-class person can now buy a car, which is a good thing.

It would be extremely beneficial for both the environment and the drivers if we could figure out a way to have parking itself offer the precise vacant position of a parking place. Finding a parking spot might be challenging when you live in a big city, which is a major problem. The primary cause of this is a scarcity of parking spaces.

Finding alternatives to standard parking methods is essential because they waste space and aren't practical for parking situations nowadays. The early systems were expensive because each parking space requires numerous cameras, and a fish camera is used to identify certain free spaces. The parking lot has several issues that cannot be fixed with the best practices. There is no automated system in use today that can accurately and automatically manage parking. There are times when delays occur because drivers must physically search the spaces and park.

Smart city ecosystems enable smart mobility [8], and cutting-edge smart parking technologies are essential for creating cities that are more sustainable. Finding parking places gets more challenging as cities' populations grow. The once-useful solutions are no longer adequate. The time spent in traffic trying to find a parking spot causes issues with energy use, pollution, and stress.

Nowadays, parking is much more expensive [12] and time-consuming in almost all major cities across the world. The issue is that the user couldn't park now, and it was found that cars may look for very little parking space, which badly clogs traffic. Therefore, it is necessary to use smart parking systems to find nearby parking when it is needed.

This study proposes to provide free parking spots to those who need parking lots by employing a smart parking system [2]. To provide the user with a list of all accessible parking spaces, this system will be able to immediately process images of the parking lot and open spots. The user can select the ideal parking space based on their need.

Due to the increasing number of cars on the road and the exponential increase in traffic worldwide, traffic management has become vital in most industrialised countries. One of the primary tasks carried out by the intelligent traffic management system to address this issue, particularly in parking lots, will be automatic automobile counting [3].

The main benefit of automatic vehicle counting is that it makes it possible to track and examine traffic patterns in the transportation networks of urban areas. As computer vision becomes more commonplace, traffic counts using inexpensive control cameras might be a workable method for automated traffic flow control.

 

Automatic vehicle counting has the main advantage of allowing for the regulation and evaluation of traffic patterns within the transport system in urban regions. using the increasing use of computer vision, automating traffic flow control through traffic counts using low-cost control cameras may become a possibility.

An innovative strategy and a mobile application based on image processing are provided to handle the problem of finding parking spaces in urban areas. The mobile application's user can dynamically access the model that was built using various methods. As cities continue to develop in population, it becomes more difficult to find parking spaces. The formerly effective solutions are insufficient today.

There are problems with energy use, pollution, and stress associated with the time spent looking for a parking spot in traffic. The proposed technology can fix issues with the parking management system and is sophisticated enough to tell whether a car is partially parked or not. The proposed system may also monitor speed in real time, alerting the controller to approaching or departing cars.

## II. LITERATURE REVIEW

Park Hop is a sensorless mobile crowd-sensing device that collects and makes information about on-street, retail centers, parking spaces, and roadside parking spaces available to urban cars in a reliable manner [10].

Edge computing has been suggested as a means of enabling a smart parking system that is both secure and energy efficient. Using deep extreme machine learning [2], it says that locating a parking place may be challenging because of the increase in the number of vehicles on the road, especially during the busiest times of the year.

In order to find a parking place, the driver must complete several laps under the present system. Smart Parking can lessen or perhaps eliminate the issues with the current system by directing the driver directly to the parking place. Technology has advanced significantly in recent years, which has led to improvements in parking systems and, ultimately, the payment system.

Smart parking is being suggested, with a quick, secure, and automatic charging system. Here, the consumers can apply a billing system that would reduce time wastage. A system is proposed to develop a parking lot billing system that is efficient with the least amount of human intervention. By maintaining an efficient and automated billing system, each user's waiting time is reduced, giving them a seamless and trouble-free experience. A deep learning-based reinforcement technique has been used to suggest an architecture for a smart parking system. This is accomplished by selecting an appropriate course of action that will maximise the benefit in the given circumstance. It implies that looking for a parking spot in a congested area consumes a lot of time, fuel, and carbon dioxide emissions.

Recent developments in the Industrial Internet of Things have shown that this concept of smart cities with smart parking has enormous potential [2]. A deep reinforcement learning-based framework for a smart parking system supported by the Industrial Internet of Things is used to handle parking difficulties.

## III. OBJECTIVES

The primary objective of the smart parking system is:

*1)* Smart parking uses inexpensive sensors, real-time data, and apps to keep track of the available and unavailable parking spaces.
*2)* The Prewitt edge detection technique is used to gauge the occupancy of parking spaces in real-time.
*3)* The proposed system can identify walkers among vehicles and detect motion for transition alerts in real-time.

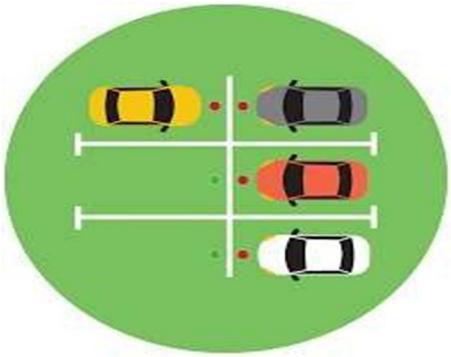

Fig.1. Smart Parking System

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## IV. MACHINE LEARNING ALGORITHMS

A component of artificial intelligence (AI), machine learning (ML), enables software systems to increase their propensity to generate predictions even when they are not expressly trained to do so. Machine learning approaches use previous data as input to anticipate new values.

Although machine learning methods [6] are evolving quickly and have made significant strides in autonomous vehicles and cyber security, there is still much to be done in this field of artificial intelligence. This is because several problems that machine learning has attempted to solve have proven to be intractable. Computer vision is essential because it helps companies spot trends in customer and operational behavior. In supervised learning, the relationship between the measured properties of the data and a label associated with the data is in some way modeled; once the relationship is established, it may be used to apply labels to newly labeled data.

Tasks for classification and tasks for regression are further divided into these; labels for classification are discrete categories, whereas labels for regression are continuous values. Following that, we'll look at examples of both types of supervised learning. Algorithms used in machine learning are constantly improving in terms of accuracy and efficiency. As a result, they can choose more carefully. Consider developing a model to predict the weather. As your data collection grows, your algorithms become more efficient at creating predictions that are more accurate.

### *A. Convolution Neural Network*

Convolutional neural networks have a few layers. Layer one is the convolutional layer, which is on top. The core of the system handles the bulk of the computation, Utilising filters, the data is convolved. The component product of the image's filters is first multiplied by the values for each sliding operation. A neuron or kernel employing machine vision is another name for this filter. [1]

The following layer is the activation layer. In this layer, the rectified unit is employed to reduce the linearity of the ConvNET. The feature-down sampling is then the focus of the pooling layer. Hyperparameters are frequently seen in the pooling layer. It minimises the dimension of the feature of the representations by replacing the CNN output at specific locations with an aggregate statistic of the neighboring outputs, which reduces the amount of processing and weights required.

Researchers have used convolutional neural networks to improve segmentation models by including rich input. They are used in both facial recognition systems and object recognition systems in self-driving cars.

### *B. Advantages*

*1)* Important component CNNs can do identifying tasks without human supervision.
*2)* They excel in categorising and identifying visual content.

### *C. Disadvantages*

*1)* It works well; however, a lot of trained data is needed.
*2)* No information about an object's position or orientation is encoded. They struggle to distinguish between images taken in diverse positions.

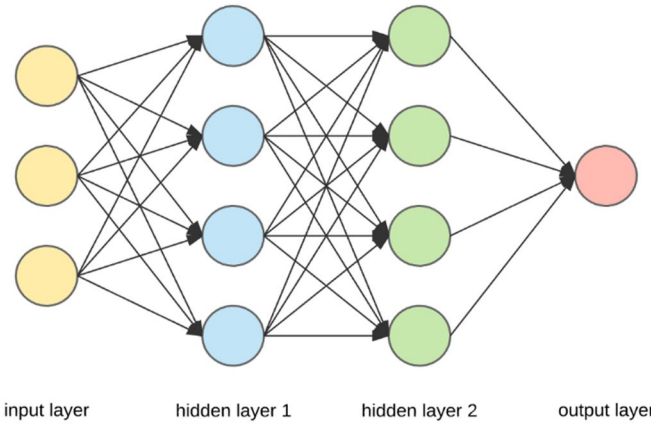


Fig. 2. CNN Algorithm

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## V. LIBRARIES USED

### *A. Numpy*

They include broadcasting procedures, powerful N-dimensional array objects, and code integration tools. practical experience with linear algebra, random numbers, and the Fourier transform. In addition to its apparent applications in research, Numpy is a strong multi-dimensional data container. Due to its ability to establish any datatype, it can quickly and easily connect with a range of databases.

### *B. CVZone (Computer Vision Zone)*

The image is taken with the use of computer vision. The slot numbering is tested using CVzone, and the edges are then highlighted. Red and green are the two colors used to denote these edges. The free software library for computer vision and machine learning is called OpenCV.

The integration of intelligent machines into products has significantly advanced thanks to the usage of OpenCV to create a standardised infrastructure for computer vision applications.

### *C. Pickle*

Pickle is used to load the location and size of the parking space as well as to find any open spaces within a parking slot. Pickle, a Python library, is used to serialise Python objects into byte forms, which are subsequently decoded and returned as Python objects.

The pickle module implements a straightforward yet efficient method for serialising and deserializing a Python object structure. Dumping is frequently used to serialise and dump an item structure. Pickle.load() is used to load the vehicle's position and height. Recursive objects and object sharing with user-defined classes for their instances are features of it.

## VI. IMPLEMENTATION

### *A. Data Collection*

The algorithms for the smart parking system are run on a video, which is considered. Occupied spots are signaled using red slots, and open slots are indicated using green slots. We can consider a variety of sources while evaluating the information.

### *B. Algorithm*

An algorithm is a set of guidelines and instructions that must be followed sequentially to carry out a specific task. It represents a strategy for quickly solving the issue.

The steps in the algorithm below are intended to help drivers locate both occupied and open spaces where their cars can be parked securely.

1) *Step-1:* Start the procedure.
2) *Step-2:* Image acquisition means capturing the data. This can be done manually or by taking data sets from various sources. This is done using the CV library.
3) *Step-3:* Finding the x, y coordinates using various factors.
4) *Step-4:* Initialize the space counter to zero value.
5) *Step-5:* Consider the obtained value and compare it withthe assumed value.
6) *Step-6:* If the assumed value is equal to the obtained value, then end the procedure. Else do frame selection.
7) *Step-7:* The frame selection is done using the pickle library by selecting the coordinates as width and height.
8) *Step-8:* If the frame selection is true then the next step isPrewitt edge detection.
9) *Step-9:* In Prewitt edge detection, the first edges are calculated using the Prewitt operator. If that matches, theparking slot's width and height are detected.
10) *Step-10:* If the edge detection is not equal to the assumed value, then go to the comparison of the obtained value and the compared value. Then find out occupied slots using a threshold value.
11) *Step-11:* If the occupied slots are not greater than the threshold value mark them as a free slot.
12) *Step-12:* After marking it as the free slot, then the procedure goes to the comparing value and the obtained value and compares both the obtained value and thecompared values.
13) *Step-13:* If the occupied space is greater than the threshold value, then mark that slot as the occupied slot. Else, markthe place as a free slot.

### *C. Flowchart*

Using different shapes and lines, a flowchart separates the steps in a specific order. Image acquisition technology is used to capture images. The coordinates are then computed. if the calculated value differs from the assumed value. The choice of frames is then made. However, if the values match, the spot is taken.

Prewitt edge detection comes after frame selection. The first edges are computed in this manner using the Prewitt operator. If so, the width and height of the parking space are identified. There is a fantastic or innovative architecture for a smart parking system [9].

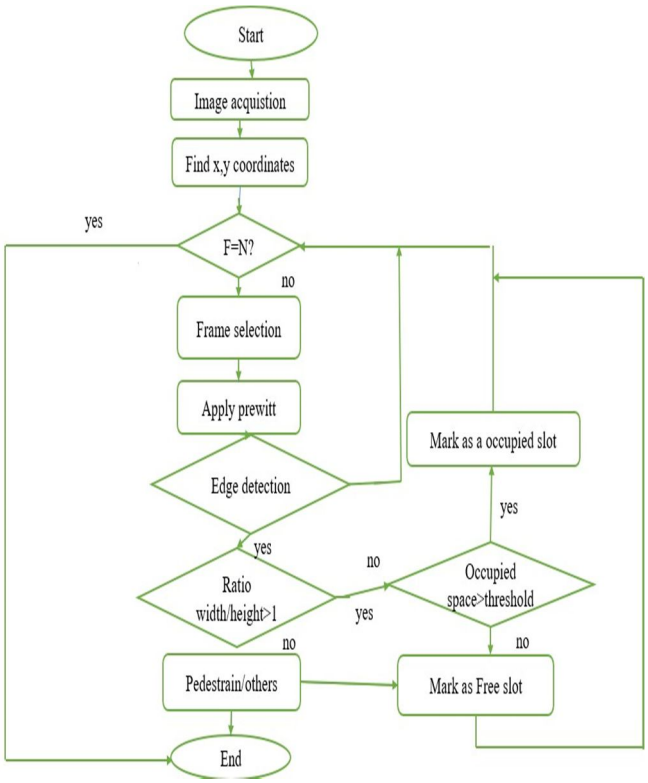


Fig. 3. Flowchart of detection of free slot

### *D. Inputs*

The original input was a video showing the cars being parked. The driver can use the vacant space for secure parking without any interruption from those two photos, where we can identify the occupied slots and vacant slots. The inputs used in the process of predicting the open slots are shown in the figures below, referred to as Fig. 4 and Fig. 5.

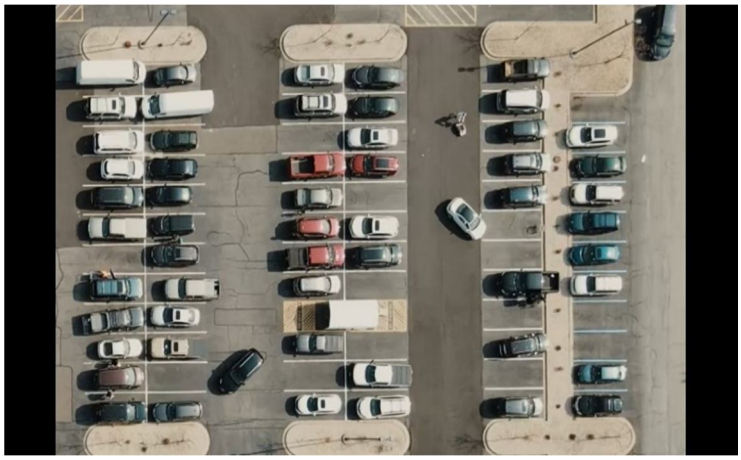

Fig. 4. Input -1

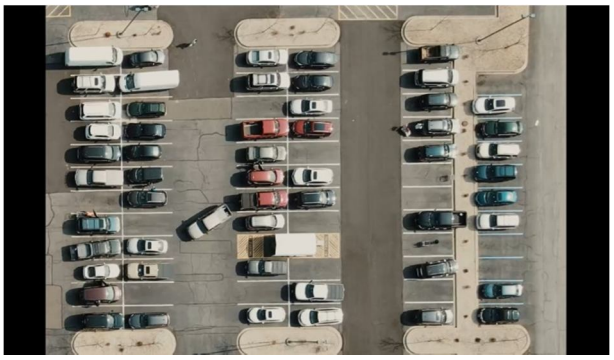

Fig. 5. Input -2

*E. Outputs*

The code runs, the inputs are provided, and the results are displayed. The two numbers below display both open slots and those that are filled. Red and green are used to achieve this. The occupied slots are indicated in red, while the open spots where the driver can park the car are indicated by the color green.

The outputs (output-1 and output-2) of the inputs (input-1 and input-2) of figs. 4 and 5, respectively, are shown below.

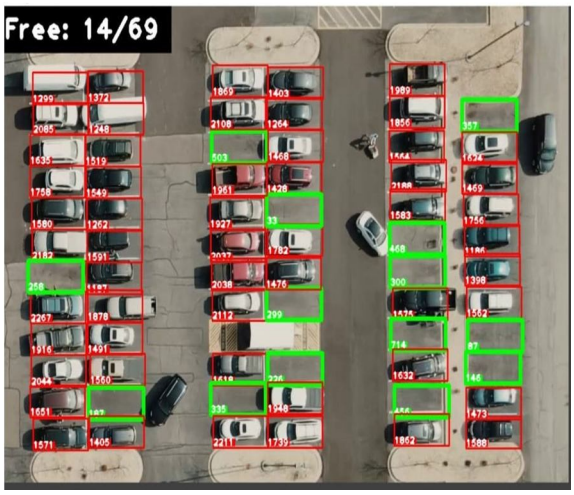


Fig. 6. Output-1


Fig. 7. Output -2

*F. Block Diagram*

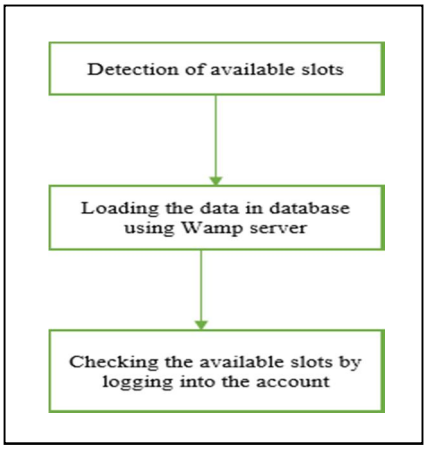


Fig. 8. Block diagram of smart parking system

*G. Loading the Data*

The process of loading data into a database involves loading the data from the code. This is accomplished by adding a few columns to a local host where we may manually create the database.

*1)* Download Wamp Server 2.4
*2)* Click on the hidden icon. There we can see the Wampserver icon, by double-clicking it we can seephpMyAdmin.
*3)* Click on phpMyAdmin.
*4)* Then it will be directed to a page where we can create the database
*5)* In that page, create a database by selecting the required number of rows and columns.
*6)* The column names are indicated as id, full name, address, city, gender, email, password, and registered date.

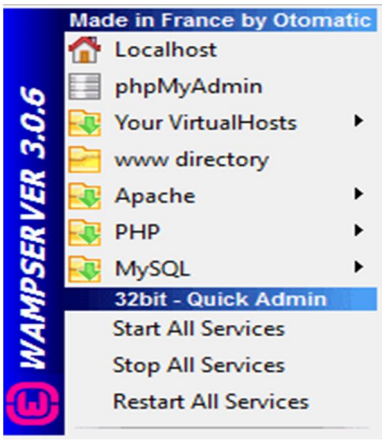


Fig. 9. Wamp server

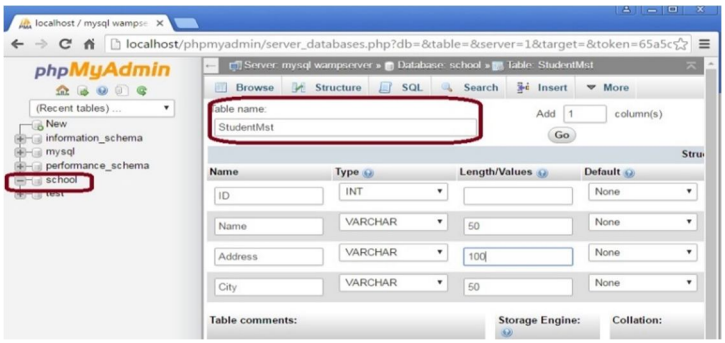


Fig. 10. Creating a database using the Wamp server

*H. Availability of Slots*

The driver should log in to the website to see if the parking spaces are open or not. The following are the steps to check the available slots:

*1)* Enter http://localhost/carparking/user-login.phpto check the available slots.
*2)* To know the slot's availability, the user needs tolog in to that account.
*3)* To verify the slot's availability if you're a new user, registration or account setup is required.
*4)* By entering the user details such as name, address, city, email address, and password.
*5)* After popping up as registered successfully. You can log in now, user can log in.
*6)* By entering the login credentials named username and password that are already given bythe user at the time of registration.
*7)* The entire number of slots that are available can be shown on the user's screen after logging in.

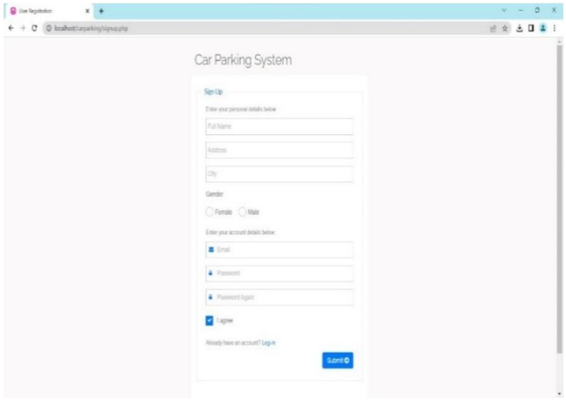


Fig. 11. Creating an account in website

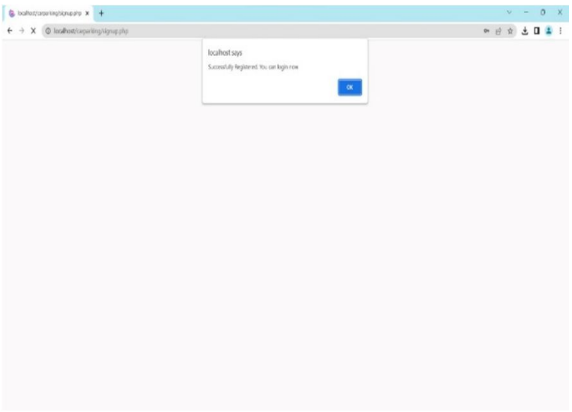

Fig. 12. Successful registration page

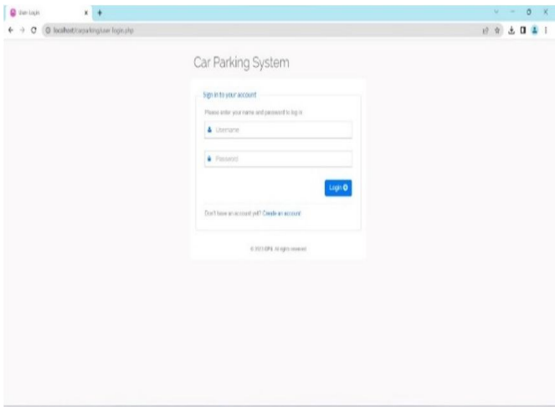


Fig. 13. Login page

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## VII. RESULTS

The number of open slots is displayed after the user logs in with their login information. This enables the user to quickly enter a slot that is open and to operate quietly and without interruption.

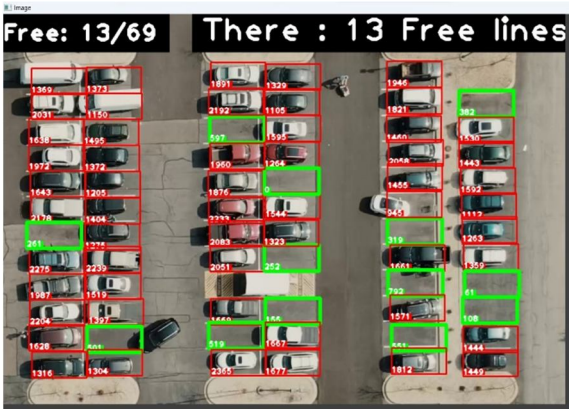


Fig. 14. Available Slots

The user can view the total number of available spaces in Fig. 14, and at the back end, we can see that the occupied and vacant slots are represented by the colors red and green, respectively.


Fig. 15. Number of available slots

## VIII. APPLICATION

*A.* Smart Parking System is used for parking lots,hospitals, hotels, offices, and shopping malls.
*B.* Drivers can find free parking space within lesstime, which reduces traffic congestion.
*C.* To reserve the availability of parking.

## IX. CONCLUSION

Ultrasonic and infrared sensors, which are required in every automobile for the system to work, are what most systems up to this point have relied on, driving up the cost of the system. The high cost of the systems is the outcome of this.

The proposed system effectively separates occupied and vacant parking spaces utilising Prewitt edge detection, significantly improving the system's accuracy and competence. For real-time implementation, accuracy is frequently crucial, and a solid technique can successfully test it. Traffic jams can be avoided by using this clever strategy [4].

The user can easily view the outcomes both now and in the future. Users may find the greatest parking spot nearby, saving time, energy, and resources. The parking lot fills up quickly. quickly, enabling companies to effectively utilise the space at hand. Traffic flow increases as fewer vehicles are required to search for vacant parking spaces. Every day, finding parking burns close to a million barrels of oil.

 

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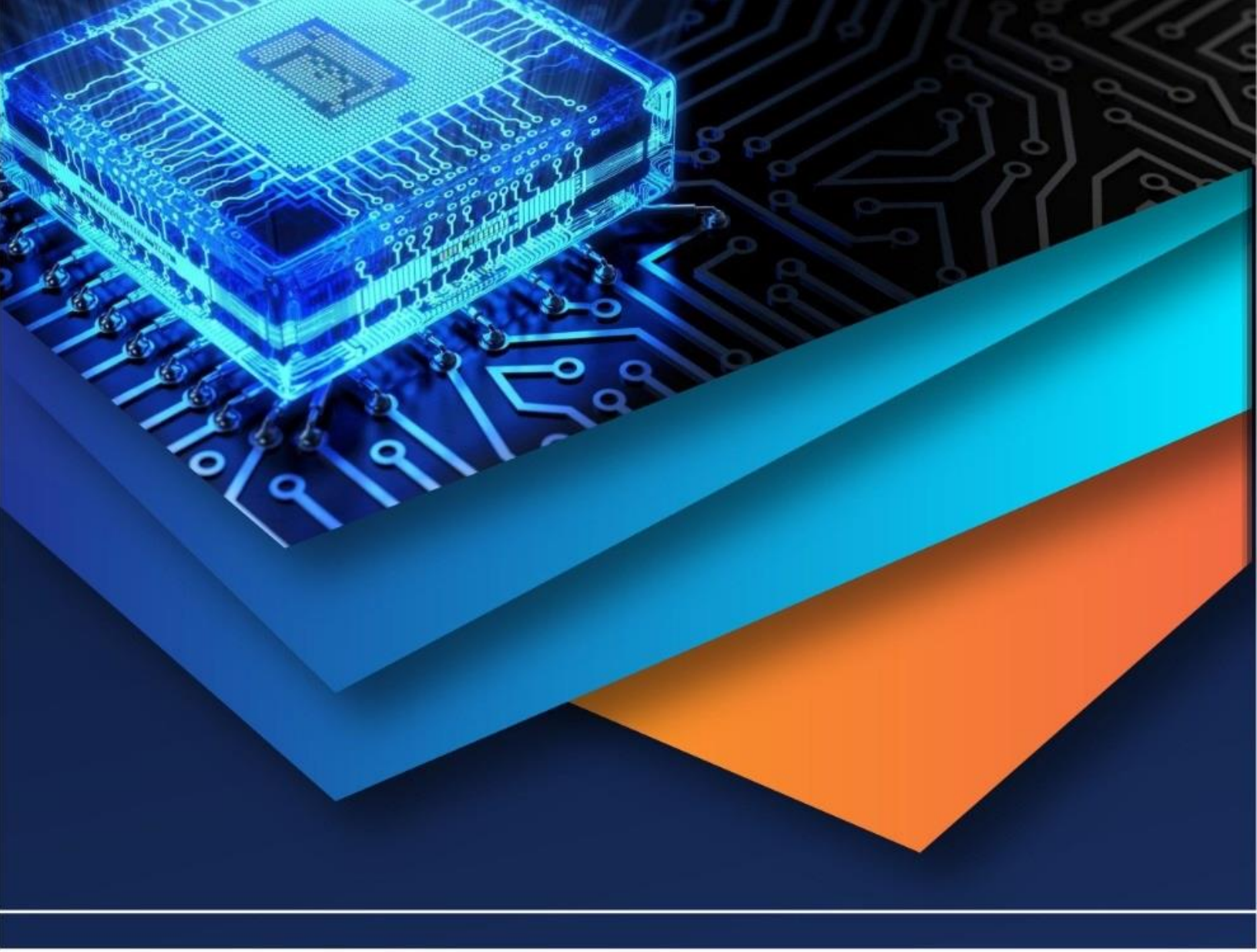

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