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# Internet-Of-Things For Automated Parking Space Booking System

**Devesh Pratap Singh** Department of Computer Science & Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India, 248002 devesh.geu@gmail.com

**Prabhdeep Singh** Department of Computer Science & Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India, 248002 psingh.geu@gmail.com

**Vrince Vimal** Department of Computer Science & Engineering, Graphic Era Hill University, Dehradun, Uttarakhand India, 248002 vvimal@gehu.ac.in

**Vikas Tripathi** Department of Computer Science & Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India, 248002 vikashtripathi@geu.ac.in

**ABSTRACT**

Nowadays, automobile usage is increasing, and there is a high need for parking management systems in places such as offices, universities, malls, tourist attractions, and many more. The automatic parking guide system is much needed in recent days to avoid traffic and confusion. Research is being conducted in software technologies to develop a programme or website that would lead the car user to the proper parking place. However, they frequently fail due to a lack of understanding among the general public. The Internet of Things is a developing field that can read the physical environment, interpret input, and provide an output based on the circumstances. This research develops a web programme to automatically assist parking based on the available space using image processing technology. The system is built with a high-resolution camera and a Raspberry Pi 4. The proposed system can identify the presence and absence of a car and direct it to the most efficient parking spot in a busy region.

**Keywords:** Internet of things, Image processing, Raspberry pi, Parking management.

## 1. Introduction

Nowadays, human resources are much saved, and excellent output is achieved in all industries with the help of the Internet of Things (IoT) [1]. Some of the IoT's outputs are automated machinery operation, temperature detection and operation of the cooling system, home security, vehicle operation, powerplant monitoring and maintenance [2]. A recent issue in transport management is the allocation of parking for cars [3]. Especially in hospitals, malls, cinema theatres, schools, and colleges, parking and taking a vehicle at a particular time is an issue now-a-day. Manual assistance in guiding the vehicle is hectic

and leads to confusion in the busy environment [4]. Hence considering these challenging automated vehicle parking without human intervention is much required in recent days.

Especially in a congested environment, the complete utilisation of parking space is much required for the easy movement of the vehicle. Improper parking can cause much traffic on the road during peak hours [5]. Resolving this issue has recently been much needed due to heavy vehicle usage [6]. Also, the development of software technologies can help address the issue much more easily. The major objective of the research is to provide a solution for parking efficiently to avoid traffic and confusion without human involvement [7].

The proposed research can also resolve the problem of parking the vehicle in the desired location.

- Designing a robotic structure for parking the vehicle and efficient usage of parking space to avoid traffic
- Offering secure parking based on the free space available in real-time

Automated parking management was first introduced in France in the year 1905. The system is mainly developed for guiding the industrial vehicle. In the year 1920, they build a multilevel lift kind of structure to lift the vehicles on a certain floor from the ground to provide parking efficiently [8]. The developed system can operate eight vehicles simultaneously and is run by pigeon software with complex architecture. Later this system completely vanished in 1990 due to mechanical failure and demand for breakdown maintenance. Later in 2012, the various sensor and feedback monitored the 6000 cars with software technologies. And present, with the advancement in image processing technologies, the system can assist 1.6 million cars at a time [9].

In one research, Arduino UNO-based parking management was used. The ultrasonic sensor is placed in the parking area. The sensor produces ultrasonic waves [10]. These waves move to the free space and will return only when there is any obstacle. This way, the free space available in the environment can be detected [11]. But the problem with the system is that if there is a man's presence or some other obstacle like a dustbin, the system may not work efficiently. In another research, a bench value for the reflected wave is fixed to overcome the problem. If the reflected wave has a higher frequency, it will sense the vehicle is present and there is no empty space and vice versa. But also, the accuracy of the reflected waves gives the efficiency of the system [12].

The alternative solution is to avoid this problem and provide efficient parking image recognition and processing [13]. The high-speed cameras capture the image of the environment. The recorded image is analysed to detect the free space, and the data is used to guide the vehicle to the free space.

## 2. **Methodology**

The proposed system is equipped with a high-speed camera and the Raspberry pi 4 operating system. The working of the proposed method is illustrated in figure 1. The high-

speed camera captures the image from the environment. The image contains the detail of the free space and the parked vehicles. These images are processed using the Python program. The program can detect the edges of the object present in the image and process it. It detects the object based on the change in the light intensity values present in the images. If any vehicles are present in the image, the program detects the intensity of the light captured in the image and this process is called frame grabbing. For the free space, the intensity of the light is minimum, and for the higher intensity of the light, it represents the presence of vehicles. Based on the image processing data, the free space is identified and sent as feedback to the LabVIEW custom-made software, which is interfaced with the web program. Finally, the free space after the analysis is displayed on the website. The webpage information allows the user to identify the real parking slot.

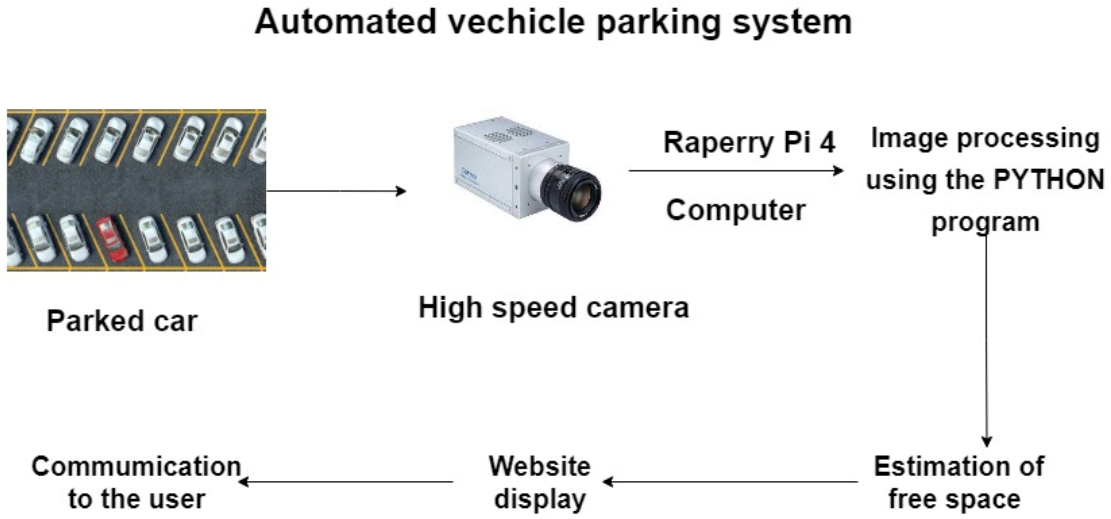


**Figure 1. Block diagram of the working of the system**

## 3. Working and analysis

The camera captures the images at an interval rate of the 20s. For every 20 seconds, the image is captured and sent to the Raspberry pi 4. The signal from the Raspberry pi 4 operating system is communicated to the computer, and a special program is running in the custom-made LabView software to detect the object in the image. The sample python program used for detecting the image is shown as image 2. The presence of the image is identified, and the free space is calculated. The estimated free space is then communicated to the website display. The people coming for parking uses the website tool to identify the free slots. As the system operates by taking an image at a rate of 20 seconds, the user can identify the accurate free space and uses the parking slot effectively without any confusion, which is the major advantage of this proposed method.

```
# Opening image
img = cv2.imread("image.jpg")

# OpenCV opens images as BRG
# but we want it as RGB and
# we also need a grayscale
# version
img_gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
img_rgb = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

# Creates the environment
# of the picture and shows it
plt.subplot(1, 1, 1)
plt.imshow(img_rgb)
plt.show()

import cv2
from matplotlib import pyplot as plt

# Opening image
img = cv2.imread("image.jpg")

# OpenCV opens images as BRG
# but we want it as RGB We'll
# also need a grayscale version
img_gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
img_rgb = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)


# Use minSize because for not
# bothering with extra-small
# dots that would look like STOP signs
stop_data = cv2.CascadeClassifier('stop_data.xml')

found = stop_data.detectMultiScale(img_gray,
                                   minSize =(20, 20))

# Don't do anything if there's
# no sign
amount_found = len(found)

if amount_found != 0:

    # There may be more than one
    # sign in the image
    for (x, y, width, height) in found:

        # We draw a green rectangle around
        # every recognized sign
        cv2.rectangle(img_rgb, (x, y),
                      (x + height, y + width),
                      (0, 255, 0), 5)

# Creates the environment of
# the picture and shows it
plt.subplot(1, 1, 1)
plt.imshow(img_rgb)
plt.show()
```

**Figure 2. Python program for image detection and processing**

The image captured from the high-speed camera is transmitted to the Raspberry pi 4. The image is converted as a frame number with 0 and 1. The zero represents the absence of the object, and 1 represents the presence of the object. The OpenCV in the python program helps to identify the signal and process it to detect the object. The OpenCV is a real-time library used in the Python program for dynamic applications. Figure 3 shows the captured image from the high-speed camera, and the highlighted picture represents the presence of an object done using the program.

**Figure 3. The image identified and the highlighted red represents the presence of the object**

Figure 4 represents the webpage developed to guide users who will utilise the parking free space. The HTML, JS and CSS are used to create the webpage shown in figure 4. In this experimental analysis, the vehicle dimensions are analysed to give the correct free space for the vehicle inside the parking. For the initial experimentation purpose, only one high-speed camera is utilised, and the camera captures 8 vehicle images instantly. It is readily processed in the computer through the frame conversion process accomplished using the Raspberry Pi 4. The processed images are identified, and the webpage is created to instruct the parking user to share information about the available free spaces.

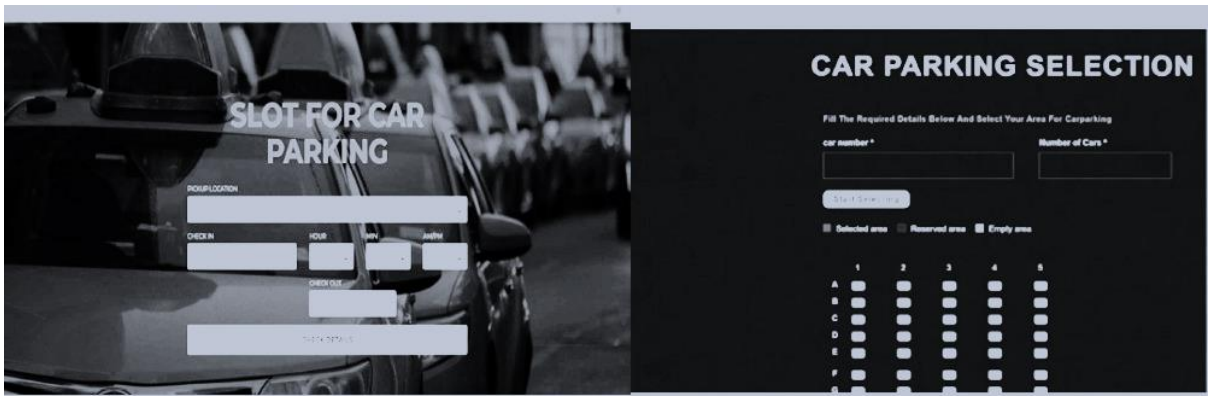


**Figure 4 User interface system for identifying free space**

When the user opens the webpage, the free space available a the time can be monitored in the particular parking location. If there is no free space at the time, the interface shows the parking slot is fully occupied. An option is given in the web interface that the user can also reserve parking at non-peak times, or the user can book the particular slot in advance. Hence from this research, the parking management with the user interface is created and verified successfully.

**CONCLUSION**

In the dynamic nature of the environment, the automatic parking and retrieval of the vehicle without the intervention of humans is much needed. Especially in malls, cinema theatres, hospitals, restaurants, and office parking, there is much demand for automated parking. Python, program-based image recognition technology, is used for autonomous vehicle parking in this research. The high-speed camera captures images of the parking area and the available free space and vehicle. The image obtained from the camera is converted into the frame using the Raspberry Pi 4 software. The frame is further processed using customised software based on the light intensity values. Finally, the free space available is calculated, and the data is transferred to the website as an interface for user access. The experiment is carried out for the 8 parking spaces, and the system detects the free space and the presence of objects with higher accuracy. Hence this kind of software management can be used in the applications mentioned above for automated parking management.

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