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Design and Management of an Intelligent Parking Slot System using Computer Vision

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Abstract – Our nation has been rapidly developing for decades, with many business buildings, well-maintained highways, and an increasing number of vehicles. Due to the transportation sector's extensive use in trade and commerce, it has also turned into the foundation of the economy. Parking the automobiles has therefore become an issue. Parking availability is a major problem in some areas, particularly in retail centres, hospitals, and other structures that need a lot of room to park cars. The established methods of placing sensors for parking cars grow expensive. As a result, an effective strategy that lasts a long period is needed to handle the congestion problem. The goal of this project is to provide an IoT framework for smart vehicle parking. The method that has been created yields consistent results when the parameters of parking effectiveness and search time are used.

Keywords: Intelligent Parking, Raspberry Pi, Yolo.

1. INTRODUCTION

Industrial boom across the globe is exhibited by means of growth in the wide variety of cars on roads around the arena, creating number of issues associated with parking. The problem of slow-paced urban making plans has even increased. Searching for parking places does not only affect the effectiveness of economic activity but is a time-taking method that affects social interaction and costs. When parking facilities do not cooperate with the companies, network companies additionally cannot offer updated data about parking websites on the internet. Some big cars do not fit into the normal parking spaces. Therefore, taking into account all the important factors, there is a need to find a place to park. Human trafficking is a major source of traffic accidents, so parking is an integral part of the road to investigate

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park, eliminate accidents and set up car technology to drive parking. The purpose of such technologies is to reduce the burden on driver, improve the transportability and ensure reliable and secure car functions. It requires maneuvering for cash management and requires a precise change in payment of parking fees so that parking meters referring to money or token are an inefficient system.

A parking place, which is very distinct from the park information system, is the ultimate adventure in the smart parking service. Parking in the parking area uses parking facilities coordination and integration, resulting in negotiation and coordination between car information systems and parking facilities. This system launches a way to negotiate the cost of parking, parking area and negotiates the best way to reach destination. Coordination for the bargaining business is a crucial job. The parking information system has created a smart foundation with the parking arrangement system. It can react to problems related to parking and traffic handling issues. This research work focuses on an intelligent car park mechanism design and development.

1.1 Background of the Study

Parking control and protection methods ensure that meter monitoring and parking space management is effective and reliable. This will make the parking space as good as possible to increase revenue. However, this requires human power that needs several capitals. The presently used parking systems are allowing drivers to park their vehicles without any regulations because of which these systems are not always efficient and also the parking facility cannot be utilized fully. Intelligent transportation, a part of Intelligent Transportation System (ITS), establishes special parking centres based on the idea of latest features. This service is designed no longer best to manage the internal function of parking object, but additionally to work with distinctive features of the parking object. The facilities to be given in the future by Intelligent Parking method are as follows:

- Advanced information and navigation services should be provided about the availability of parking lot and parking systems.
- It is important to electrically mount the mobile electricity trading system and the continuously working door system.
- The in-facility navigational method should manage the traffic in best possible way.
- Ensuring effective security for car safety.
- Providing powerful functionality to facilitate directors and supervisors in the parking object control.

Information on the accessibility of free parking spaces; before access, the parking information system provides the driver with navigation to the parking lot. An empty car park is protected by a car park system. The continuous access-exit system helps the driver to get rid of retrieval processes such as buying a ticket, collecting tokens but it provides freedom to choose any payment method. The company navigation method is used to find an empty space and then guides the driver to the parking lot. Additional changes will result in even better structures including maintenance of parking spaces on-line and support to locate the destination quickly, thoroughly and easily with the usage of smart card. It will be aware of the entry and exit of these vehicles as well as the occupancy price, despite a

system that does not require any human power. These systems can even lessen the traffic jams because of decrement in number of vehicles parked on-road. These new structures increase parking jobs with the aid of growing wide variety of customers. Also, modern technology has led to advanced automotive information systems, standard equipment for luxurious and expensive cars including mobiles, digital maps and satellites to look real-time traffic using wi-fi technology.

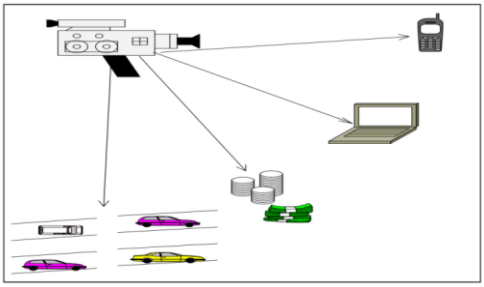

Figure 1 Smart Parking

1.2 Challenges

- More than half of mankind about 4,000 million individuals, now lives in town. This number will rise to 60% by 2030. Cities have a major issue of movement, energy and emissions that reduces the value of life.
- A 35 percent rush hour trip in search of free parking places that is difficult to locate. That is why parking is very essential to control the stream of cars and for decreasing air pollution.
- New independent, linked and electronic vehicles will appear as garage intruders that will have to adjust to this fresh fact.
- Cities must become soft, clever and effective locations and develop to become intelligent cities. With regard to mobility, it should mean.
- Improve infrastructure and the supply of government travel.
- Availability of vibrant schemes to direct vehicles to its ultimate location, parking.
- Promote the use of independent, linked, electrical, intelligent and non-polluting cars to decrease congestion, vibration and emissions.
- Get a more efficient and environmentally friendly charging room that enables the customer to locate open parking room rapidly, securely and with minimal energy usage.

2. LITERATURE REVIEW

An automatic parking system [Massobrio et al. (2017)] has been proposed primarily on the basis of parking scene recognition for solving parking related issues which includes such as parking scene popular techniques are much less intelligent, vehicle control has a low degree of automation and the related studies scope is constrained to conservative fuel vehicles. Computer vision and pattern popularity techniques were used to increase the use of parking spaces and parking convenience as well as to intelligently define a vertical parking situation, plan an accessible parking path,

extend a monitoring system to enhance automation of vehicle control and explore a roadmap for intelligent automated parking technology. A management scheme that utilizes vision-based parking to handle outdoor parking by putting cameras inside and around the parking area has been defined [Lin et al. (2006)]. These cameras collect the parking space information and display the free spaces available on the screen. By using wireless communication devices, the collected information has been transferred to the driver and thus increases the accuracy of the system.

A smart phone based sensing scheme is proposed that identifies the unoccupied space [Nawaz et al. (2013)]. This scheme uses wi-fi network to sense the free parking space. As the user starts their vehicle, wi-fi beacon sense the vehicle on the basis of speed. It has been concluded that the proposed system performs well than GPS.

3. SYSTEM ARCHITECTURE

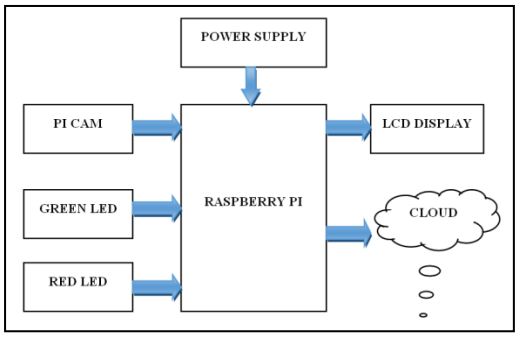

Figure 2 Block Diagram

Raspberry Pi

A GPU, Ethernet port, multicore processor, I/O peripherals, USB host, ROM, DDR RAM, and micro HDMI are all included in the Raspberry Pi. We will use the Raspberry Pi board in our waste separation system because it can help with many forms of process automation and smart agriculture. A Raspberry Pi 4 board will supply power to the smart trash can.

Raspberry Pi V2 Camera

The ideal camera module for trash separation is this Raspberry Pi camera module V2. It has a fixed focus lens and an 8-megapixel sensor with native resolution, allowing it to take still images with a 3280 x 2464 pixel resolution. These images will serve as input for the machine learning model that will identify the type of waste.

Power Supply

The microcontroller and sensor units are powered by this power supply.

LCD Display

The I2C 1602 LCD module is a 2 line by 16 character display that is directly connected to an I2C daughter board, and the LCD display panel is an electronic display [11]. It is utilised in this proposed system to show the users the parameter value.

YOLO

YOLO technique is to identified photos' class possibilities are provided. Because of its greater effectiveness over the previous object detection methods, the YOLO algorithm has gained prominence. CNN is used in the YOLO method to recognize objects in real-time. It indicates that one algorithm run is used to forecast the entire image. The CNN is used to predict the probability of distinct classes. The YOLO technique is important for the following reasons:

Speed: This method accelerates detection speed because it can predict objects in real-time.

Capabilities for learning: Strong learning capabilities in the method enable it to learn object models and use them for object recognition. YOLO algorithm is performed based on Residual blocks, Intersection over Union (IOU) and bounding box regression.

Residual blocks

The image is initially divided into a number of grids. Each grid has the dimensions S x S.

Bounding box regression

A bounding box is an outline in a video frame that defines an object.

Intersection over union (IOU)

In object tracking, boxes overlap as shown by the idea of connection over union (IOU). The IOU is 1 if the predicted and actual bounding boxes match. This method eliminates bounding boxes that don't match the size

4. RESULTS AND DISCUSSION

The aim of this research work is to design and develop a novel enhanced vehicle parking mechanism by introducing the concept of Yolo Algorithm. Performance such as parking space finding time and parking efficiency are considered for computation.

Table 1 Parking Space Searching Time

Time (HH: MM)	Parked Vehicles	Non-Parked Vehicles (with Yolo)	Non-Parked Vehicles (without Yolo)
08:00	285	17	70
09:00	305	19	83
10:00	425	15	81
11:00	415	15	78
12:00	435	18	89
13:00	385	16	64
14:00	245	15	57
15:00	385	17	76
16:00	405	19	88

17:00	430	16	92
18:00	445	18	96
19:00	405	19	85
20:00	355	16	68

Table 1 depicts the parking space searching time of proposed method. It has been observed from the table that searching time of proposed work with the concept of AI is less because of the usage of supervised technique. The searching time is computed with respect to time because in some specific time periods, the parking congestion is more and searching for free space to park is a difficult task.

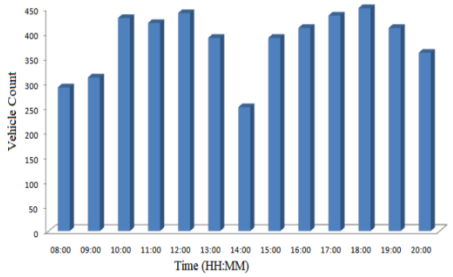

Figure 6 Amounts of Parked Vehicles

Figure 6 shows the amount of parked cars during the hours of 8:00 and 20:00. The chance of parked cars increases from 10:00 to 12:00 and 16:00 to 18:00, according to analysis of the graph. 500 vehicles can fit in a parking lot, which is taken into account when analyzing the proposed work.

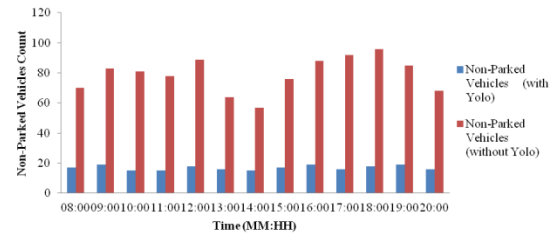

Figure 7 Parking Efficiency

The proposed increased parking mechanism's parking efficiency is shown in Figure 7. Parking efficiency is calculated with regard to time. From 8:00 am to 20:00 pm, parking effectiveness is being evaluated. The graph shows a comparison between using Yolo in the parking system and not using it. It is evident from the fact that there is a lower likelihood of incorrect parking when the Yolo idea is applied. It is due to the usage of Yolo since the proposed work makes use of a system that flashes red LED lights when a car is parked incorrectly in the lot. Without Yolo, the average number of non-parked vehicles is 79, whereas Yolo increases that number to 16.92.

For achievement of improved vehicle parking system, Yolo technique is to maintain the parking system. The average parking efficiency computation from day 1 to day 7 results are defined below in Table 2

Table 2: Average Parking Efficiency Computation

Day (Avg.)	Parked Vehicles (Avg.)	Non-Parked Vehicles (with Yolo) (Avg.)	Non-Parked Vehicles (without Yolo) (Avg.)
1	410	19	85
2	440	15	81
3	310	19	83
4	360	16	68
5	390	16	64
6	290	17	70
7	250	15	57

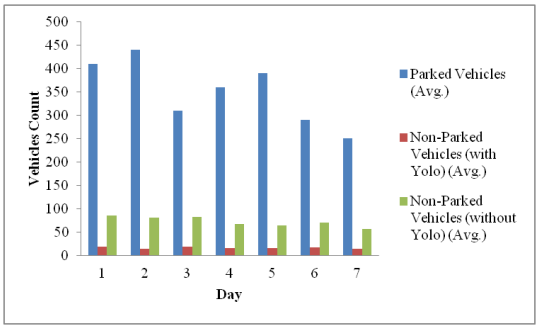

Figure 8 Average Parking Efficiency

The suggested improved parking mechanism's average parking efficiency is shown in Figure 8. From day 1 through day 7, the average parking efficiency is calculated. The graph shows an average comparison between using Yolo in the parking system and not using it. It is evident from the fact that there is a lower likelihood of incorrect parking when the Yolo idea is applied. It is due to the usage of Yolo since the proposed work makes use of a system that flashes red LED lights when a car is parked incorrectly in the lot.

Table 3 Parking Space Searching Time

Time (HH: MM)	Searching Time (seconds)(with Yolo)	Searching Time (seconds)(without Yolo)

08:00	7	18
09:00	12	21
10:00	14	22
11:00	9	20
12:00	13	27
13:00	12	22
14:00	7	16
15:00	11	22
16:00	11	24
17:00	13	26
18:00	15	31
19:00	10	22
20:00	8	17

Table 3 depicts the parking space searching time of proposed method. It has been observed from the table that searching time of proposed work with the concept of Yolo is less because of the usage of supervised technique. The searching time is computed with respect to time because in some specific time periods, the parking congestion is more and searching for free space to park is a difficult task.

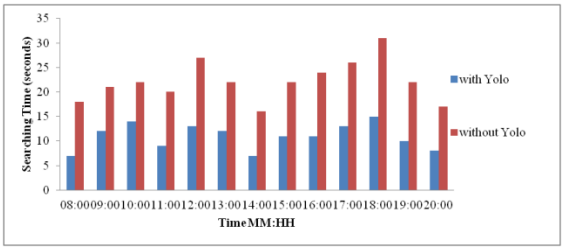

Figure 9 Parking Space Searching Time

Figure 9 demonstrates the parking space searching time of proposed method. It has been observed from the figure that searching time of proposed work with the concept of Yolo is less because of the usage of supervised technique. The searching time is computed with respect to time because in some specific time periods, the parking congestion is more and searching for free space to park is a difficult task. So, in the proposed work, concept of Yolo technique is used which helps to find parking space in much lesser time. The average searching time with Yolo is 10.92s and the average searching time without Yolo is 22.15s.

5. CONCLUSIONS

The use of cars is also enhanced by the rise in population. Thus, an enhanced parking mechanism is proposed in this study using Yolo algorithms that helps minimize the factors leading to the issues. The designed architecture has

carefully determined the need of driver's ease to park vehicle at an appropriate location. The architecture provides guidance to drivers, which reduces the need of man power at the parking sites. To estimate the effectiveness of proposed work, parameters, such as parking efficiency and parking space searching time are considered. The effectiveness of the proposed approach is evaluated using parking efficiency and parking space search time parameters.

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