Intelligent Parking System

Integrating Artificial intelligence into parking systems

Vishal Anand
Computer Science and Engineering
Panimalar Engineering College
Chennai, India

Mughil Vannan
Computer Science and Engineering
Panimalar Engineering College
Chennai, India

***Abstract*— The idea makes use of machine learning and artificial intelligence to solve this problem. At the entry the number plate of the car is scanned by a cctv cameras by deploying computer vision using neural networks. This will be used for vehicle identification and billing. This will eliminate the time taken for ticket collection during entry. Similar technique will be used at the exit for identifying the vehicle and generating the bill.**

Another feature which will be supported by the same system is "empty parking bay locator". Under this feature, the vacant parking bays will be identified by the cameras, and notified to the users thus helping them to navigate through the parking area efficiently.

By scanning the register plates, we not only reduce the verification and billing time but also will be able to maintain a live database of the vehicles within the premises which will add to the security. The stolen vehicles database and this information can be used to check for stolen vehicles entering the premises and if entered, the system will notify the concerned authorities.

***Keywords*— Computer vision, Neural networks, Security**

I. Introduction

The number of malls and parking spaces are increasing day by day. But so is the number of commuters and their vehicles. The rate of increase of the latter exceeds that of the former by a noticeable margin. The existing parking systems cause congestion and inconvenience to the commuters. This idea aims at reducing the waiting time by a great margin and thus serving greater convenience to the users.

The existing security systems at public and private parking lots have been proven to be a sham. This modified system can provide real time security and accountability to the administrators

The system is also capable of finding vacant parking spaces so that the users can efficiently navigate through the parking lot.

II. Problems Addressed

A. Identification and Billing

Most of the time taken to park is consumer by this process. The users are expected to wait until a token is generated, collect the token and then move. This consumes a fair amount of time for every vehicle and also causes inconvenience to users waiting for their turn.

B. Finding vacant parking bays

After spending a fair amount of time in checking in, another problem arises – finding a spot to park the vehicle. As we know, most of the buildings and malls these days have a multi-floor parking system spread across thousands of square meters. Navigating through the parking spaces takes another considerable amount of time.

C. Security

The existing parking system has little to no control over the vehicles and users entering the premises. Stolen cars or blacklisted cars can enter the malls with ease. This may lead to unpredictable or uncalled-for events. Such events may lead to the loss of public trust.

III. Proposed System

The proposed system makes use of open-sourced computer vision libraries such as OpenCV, and artificial neural networks to solve the stated problems.

A. Identification and verification

The CCTV cameras are set up at the check-in points in positions which have a good line of sight with register plates of the entering vehicles. The CCTV systems are trained to read number plates of vehicles by integrating it with OpenCV[2] and artificial neural networks. This helps the system to read and store the register plate's number. This serves as the unique ID for each user and is further used for the billing process.

A similar procedure is followed at the time of check-out. The vehicle proceeding towards the check-out is identified by its number plate and its bill is generated.

This reduces a multi-step manual process into a single-step automated process.

B. *Detecting vacant parking slots*

The empty parking slots can be effectively detected by the proposed system. This is done by making use of the already existing CCTV systems at the parking lots. The CCTV system is trained to detect empty parking slots by using object recognition through the libraries such as OpenCV and neural networks.

Another model which can be implemented in parallel is, You Only Look Once (YOLO)[3] which will recognize objects such as vehicles and other obstacles in the parking bays efficiently within a fraction of a second, to notify the system that the parking bay is occupied.

This information is then used to notify the users for efficient navigation through the parking lot.

C. *Security*

Just by collecting the register number of the vehicles entering the premises, the security of the building or complex is stepped-up by a considerable measure. The parking system can be synced with the government database of stolen/blacklisted vehicles such as zipnet.in. The database of the parking system and the database of the blacklisted vehicles can be cross checked for any matches in real-time. If a match is found, the concerned department can be notified.

IV. ALGORITHMS

A. *OpenCV*

The OpenCV library will be used to read the number plate in the entry vehicle. The matchTemplate() function from imgproc module will be used to match the entry vehicle number plate to a default number plate. This ensures that the vehicle number is of legal format then using the OpenCV built in "scene text" object detection module to read the vehicle number plate.

B. *DarkNet*

DarkNet[3] is a open source neural network framework written in C and CUDA. The Darknet provides a Real Time Object Detection system called You Only Look Once (YOLO) it is a start-of-the-art, real time object detection system. Unlike other real time object detection this does not demands powerful hardware system to run it. This system will be used to detect car in real time cctv feed. The YOLO works by single frame in video is divided into a 13X13 cell. Each of these cells is responsible for predicting 5 bounding boxes. A bounding box describes the rectangle that encloses an object. YOLO also outputs a *confidence score* that tells us how certain it is that the predicted bounding box actually encloses some object. This score doesn't say anything about what kind of object is in the box, just if the shape of the box is any good. For each bounding box, the cell also predicts a *class*. This works just like a classifier: it gives a probability distribution over all the possible classes. The confidence score for the bounding box and the class prediction are combined into one final score that tells us the probability that this bounding box contains a specific type of object. For example, a big fat yellow box around a car would mean that the model is about 85% sure it contains the object "car". Since there are 13×13 = 169 grid cells and each cell predicts 5 bounding boxes, we end up with 845 bounding boxes in total. It turns out that most of these boxes will have very low confidence scores, so we only keep the boxes whose final score is 30% or more (you can change this threshold depending on how accurate you want the detector to be).

V. SCOPE OF THE SYSTEM

The proposed system reduces the time and inconvenience caused to the users and increases the efficiency of the parking system by a significant amount.

The system is capable of being deployed in multiples sectors of the society. Also it is to be noted that the system is simple to setup and install. Thus it has a high feasibility factor in many areas.

The areas of implementation are and are not restricted to

- Commercial complexes
- Malls and multiplexes
- Public parking lots
- Institutions

VI. ADVANTAGES

The proposed system will bring forward a lot of positive changes to the existing models.

- The time taken for identification and allotment of tokens is eliminated.
- Users are now capable of smartly navigating through the parking lot since the new system notifies the users of the vacant parking slots.
- The human errors previously made by the existing systems can now be eliminated.
- A high level of security is provided to the users and the management of the parking lot.

VII. CONCLUSION

Thus it can be concluded that the proposed intelligent parking system brings about a variety of improvements to the exiting parking model and truly adds the "intelligence" factor to the existing models.

VIII. Areas for Further research

- Recognition of multiple fancy fonts in number plates.
- Integration of smart billing system to further increase the efficiency.
- Integration of low-light visioning to further avoid errors.

References

[1] V.Koval, V.Turchenko, V.Kochan, A.Sachenko, G.Markowsky, "Image processing using neural networks", 2003, INSPEC-8301871.

[2] Qingcang Yu, Harry H. Cheng, Wayne W. Cheng, Xiaodong Zhou, "OpenCV for computer vision", 2004

[3] https://pjreddie.com/darknet/

[4] https://docs.opencv.org/master/d7/da8/tutorial_table_of_content_imgproc.html

[5] https://stackoverflow.com/questions/4706118/read-numbers-and-letters-from-an-image-using-opencv