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Revolutionizing Smart-City Parking: An IoT Model using Convolution Neural Network for Intelligent Parking Management

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Abstract

In this paper we are trying to proposed a model of smart-parking for smart-city. Parking in a city is one of the biggest problems. Many times, it was observed that Instead of finding a parking zone or parking space nearby people park their vehicles on road which in traffic and because of this ambulance stuck in traffic jam which results in death of many patients because they are unable to get medical facilities on time. The objective of this paper is to propose a relevant system that will provide a more accurate location system thus helping in deciding the positioning of the parking system by detecting the free spaces in a parking lot and letting the driver know about the location that can be allocated to him. The system also deals with proving the accuracy that cannot be achieved by global positioning system as this system works on the neural network algorithms that break the information down to a matrix and analyze the data to deduce conclusions that would help find an appropriate parking space for the person on the real time basis. The objective of this paper is to reverse the adverse effect of the wrongly parked vehicles.

Keywords: Smart-City, IoT Model, Convolution Neural Network, Intelligent Parking Management

Introduction

Human basic need starts with food, clothes and shelter but with sustainable increase in development and technology human run behind the comfort. In this tumultuous 21st century human develops many things which reduce human efforts and make survival much easier with development of technology and transport is one of the developments which help a man to go from one place to another with approx. no efforts. Now people have their own vehicle which help them to go from one place to another but as it was said that excessive use of anything result in problems. The problem arise using a personal vehicle to go places is that they require their own parking space which is sacred in the area given that the place is extra crowded or the parking space do not take the large population into consideration. Whatever the reason maybe for this blunder it always results with people parking on the sidewalks, thus leaving no place for the shops and people to persist or walk. The system that we propose is a solution to parking solution in its innovative sense as it allows people to make an aware decision about whether to use personal vehicle or go for public transport. The system that we put forward collects data from the parking lot on real time basis and gives the status of whether the parking is available or not. This allows the people to opt for public transport and at the same time avoid chaos that comes as a result of unawareness about the traffic of the parking lot. The system makes use of IOT (Internet of things) to sense the number of vehicles that are parked in the parking lot and generate this data further for analysis using Convolution Neural Network that can provide a ground for decision making about the use of the personal vehicles.

Urbanization and the growing number of vehicles on the road have presented significant challenges for parking management in cities. As urban areas become more congested, finding an available parking space has become a time-consuming and frustrating task for both drivers and city administrators. To tackle this issue, smart cities have emerged, utilizing cutting-edge technologies to optimize urban systems and enhance quality of life.

This research paper introduces an innovative approach to revolutionize smart-city parking by employing an Internet of Things (IoT) model powered by a Convolution Neural Network (CNN). The objective is to develop an intelligent parking management system that improves the efficiency, accessibility, and convenience of parking in urban environments.

By integrating IoT devices with parking spaces and deploying a CNN-based model, traditional parking systems can be transformed. Our proposed system utilizes realtime data from sensors embedded in parking spots to accurately detect and relay the availability of parking spaces to drivers in a timely manner. This empowers drivers to make informed decisions regarding parking availability, thereby reducing traffic congestion and minimizing unnecessary fuel consumption.

The primary contribution of this research lies in the design and implementation of a robust CNN model capable of effectively analyzing and interpreting data collected from IoT devices. Leveraging deep learning algorithms, the CNN model accurately predicts parking space occupancy, classifies parking spot types, and generates intelligent recommendations for drivers searching for parking in real-time.

Furthermore, our intelligent parking management system incorporates advanced features such as mobile applications and web interfaces, enabling seamless access to parking information for drivers. Through these interfaces, drivers can reserve parking spaces in advance, efficiently navigate to available spots, and even make cashless payments, streamlining the entire parking process.

The outcomes of this research have the potential to significantly alleviate parking challenges faced by urban residents while fostering sustainable urban development. By reducing the time spent searching for parking and optimizing parking space utilization, our IoT-based model has the capacity to enhance overall traffic flow, minimize carbon emissions, and improve the quality of urban life.

In the subsequent sections of this paper, we delve into the specifics of our proposed IoT model, the architecture of the CNN-based system, the implementation methodology, and the evaluation of its performance. Through this research, we aim to establish a foundation for the deployment of intelligent parking management systems in smart cities, paving the way for more efficient and sustainable urban environments.

Related Work

Time and again many people propose their different model for solving this problem but every model has some limitation. In this existing project total no of Parking Space is stored in a variable and when a car enter in a parking area using Arduino it can be sensed that a car is enter in a parking area and it decrement the no parking space when a car enter in the parking area and increment the parking space when a car leave the parking space.

Figure 1: Existing System.

This project is implemented on a closed parking area if there is an open parking area this project is of no use because count strategy can be followed on only closed parking area, it is utmost impossible to implement this strategy on open parking area. In other existing system the system consists of Arduino Uno, Ethernet Shield, Blink App, and IR sensors. Sensors are used to detect the presence of a Vehicle. As soon as a vehicle is detected in a particular slot and the corresponding led on the App goes high. This project also has limitation and those limitation are as: This project is useful in the case of small parking system. It will become very tedious and complicated if we have to implement the same for a large parking system.

Methodology

Data flow diagram (DFD) is the graphical representation used to show flow of data in deep learning model. Graphical representation shown in Fig 2 shows the implementation of our work. For this work first of all we identify all the external sources of information from where we collect all the data related to melanoma and normal mole. Afterward we preprocess the data and discard all the unrelated data from the dataset and curate a clean dataset. We divide the data into 3:1 ratio where 75% of total no images are stored in training image dataset and 25% of total no of image are stored in test image dataset. Using the training image we extract the features using the Convolution Neural Network and trained a model on the basis of these features and using test image dataset we find the accuracy of the model to know how accurate model is trained on the training image and after this we use validation dataset to know about the performance of the model.

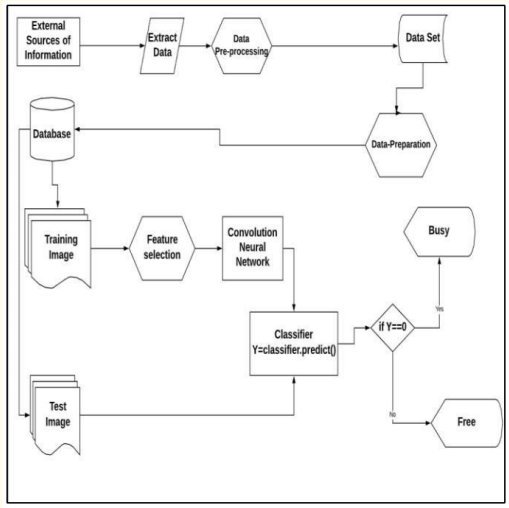

Figure 2: Data Flow Diagram.

After Training our model we have to check whether our model work fine for a new image of Parking space to detect whether the parking space is free or busy because this will help people to find nearby parking space using cloud based application. Overview of the implementation of our work is shown in fig 3.

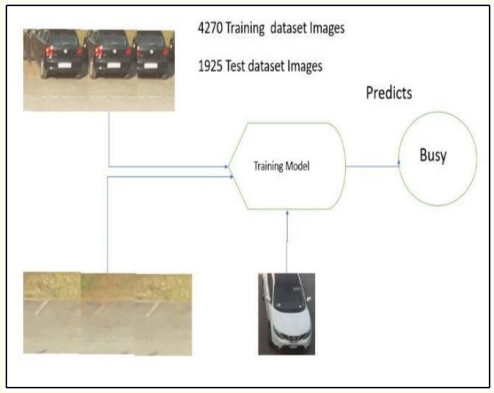

Figure 3: Overview of Implementation.

Results and Discussions

Convolution Neural Network algorithm has different layers like convolution layer, max pooling layer and dropout layer where each and every layer has specific function and these layers help in extracting features from training image dataset and train model on extracted features. In our work total no parameters are 167,105 and our model is trained on all of these parameters therefore trainable parameters are 167,105 and role of each layer is shown in fig 4.

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 62, 62, 32)	896
max_pooling2d_1 (MaxPooling2	(None, 31, 31, 32)	0
dropout_1 (Dropout)	(None, 31, 31, 32)	0
conv2d_2 (Conv2D)	(None, 29, 29, 32)	9248
max_pooling2d_2 (MaxPooling2	(None, 14, 14, 32)	0
dropout_2 (Dropout)	(None, 14, 14, 32)	0
conv2d_3 (Conv2D)	(None, 12, 12, 32)	9248
max_pooling2d_3 (MaxPooling2	(None, 6, 6, 32)	0
dropout_3 (Dropout)	(None, 6, 6, 32)	0
flatten_1 (Flatten)	(None, 1152)	0
dense_1 (Dense)	(None, 128)	147584
dense_2 (Dense)	(None, 1)	129

Total params: 167,105
Trainable params: 167,105
Non-trainable params: 0

Figure 4: Convolution Layers.

Training dataset is used to train the model and validation dataset is used to measure the performance of the model and the graph between training and validation accuracy is shown in fig 5.

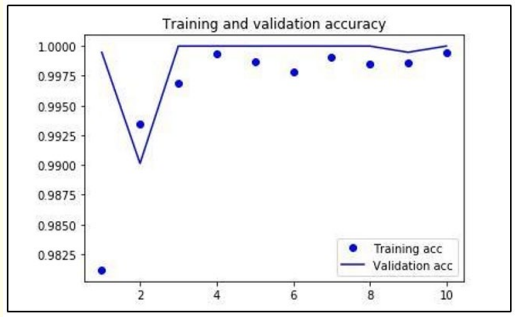

Figure 5: Training and validation accuracy.

Training loss is the error occur at the time of running the network and validation loss is the error obtained after running the validation dataset through the trained network and this graph is shown in fig 6.

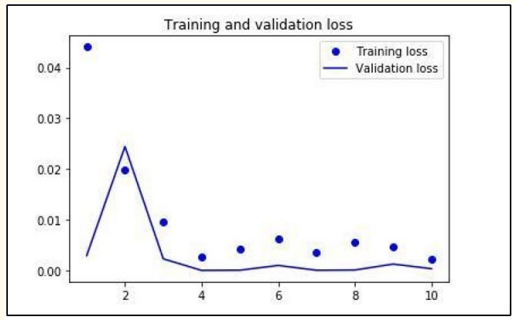

Figure 6: Training and Validation loss.

In this paper we show the importance of technology in healthcare where with the help of CNN algorithm we are able to find the parking space and we are able to get more than 98% of accuracy in our work. It means out of 100 times ,98 times our model able to find free parking space nearby a person correctly and as there is increase in different type of dataset its accuracy increase automatically because deep learning algorithm has the ability to learn from experience

This system holds a lot of future scope as this is what will solve the problem of the parking and unwanted traffic on the road and will ultimately leads to pollution control in the environment. This is environment friendly and this allows the user to make a wise decision about the use of personal vehicles. Moreover, this also helps in reducing the road traffic from unwanted side parking that can cost a lot to the user as well if their vehicles are towed. This project is the game changer that will lead to safer and less busy roads along with the solution to environmental degradation.

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