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Smart Parking Application Using Deep Learning Framework

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Abstract— Smart parking application is comprised by using Python and Deep Learning Frameworks (DLF). It provides an efficient way of improving the monitoring systems and make use of the data provided by them. By using this system, it is possible to reduce the vital information loss by the operator handling and thus reduce the human processed systems. Images are monitor through the monitoring systems and image processing technique, the data is handled by the Artificial Intelligence (AI) system and then a deciding is generated. This generated Deciding is passed with an image and vehicle information to proper personnel.

Now a days, Deep Learning (DL) and AI systems are deployed for automating human handled process using AI and Hardware Integration. The Systems are able to make decisions in various environments and conditions above all affecting factors similar to intelligence expressed by human beings. The decisions made by the systems using deep learning and artificial intelligence methods can even make decisions superior to human intelligence. Integrating the methods of image processing and AI to automate the manned systems in the manner of scaling for any automated systems helps in removing the third-party operators from the control of informant and action. Our proposed idea was reduces the duration of information gathering and deciding of the operator to the information provided and increases the chance of positive results in terms of machine automated results**.**

Keywords— Deep Learning (DL), Artificial Intelligence (AI), TensorFlow, Performance

I. INTRODUCTION

The smart parking is automated to have an efficient method of communication for deciding personnel to act in terms of human processed condition. The AI system is to ensure that the information on any vehicle is utilized efficiently and to act on that information. Also, to improve the use cases of public are monitoring system and monitoring personnel with many other applications working on human operated systems. Until recently this was managed through a manual system where this had its limitations with regard to communication process and deciding action of the personnel was in the approval of human operator.

The automated deciding system using artificial intelligence is introduced to overcome the limitations of the manual system. The system also generates information base that is used by various other fields in the governing personnel for optimum data utilization. Nowadays, for getting a deciding from medical or any other personnel needs a manual action by the agent on the environment. For getting approval from the necessary personnel the human operator is required.

The AI system can retain the vehicle real-time data works are done automatically by the computer. By using this system all the manual operator is removed by the automated system. The basic idea behind this system is to computerize the communication between the personnel and environment agent for getting an immediate deciding. It provides an efficient way of improving the monitoring and security system for many other applications. The log generated by the automated system contains the vehicle information, which is the necessary information for the deciding personnel. The rest of the paper is planned as follows: Section II explains about the Methods and Materials. Section III gives the proposed idea. Detailed description of Modules and working procedure in section IV. Section V Presents the implementation .Discussion and result are given in section VI, Conclusion in section VII.

II. METHODS AND METRIALS

Jonathan Barker and Sabih Rehman use a smart parking application that utilizes machine learning algorithms to help predict future car parking occupancy rates at port used to identify high-performing algorithms for predicting future parking occupancy rates [1]. Jaspreet Kaur [et.al], manual vehicle parking system and waste of time and fuel problem, we need to park our car, which requires a good amount of lighting. Another issue is the chaos that occurs when parking because there is no special system [2] [3]. ShahanYamin Siddiquiab et.al Predicting the location of parking is a long-lasting problem that has ultimate importance in our daily life.artificial neural networks are used to predict the parking location that will be helpful for drivers to settle on a reasonable area for stopping. By using the approach of Deep Extreme Learning Machine (DELM),

reliability can be achieved with a marginal error rate thus reducing the skeptical inclination. Khaoula Hassoune and Wafaa Dachry et.al the concept of smart parking system, their categories and different functionalities and technologies around parking availability monitoring, parking reservation and dynamic pricing and see how they are utilized in different settings[3][4][5]. Faheem1 and S.A. Mahmud1et.al systems will be able to reduce the problems which are arising due to unavailability of a reliable, efficient and modern parking system, while the economic analysis technique will help in analyzing the projects' feasibility. Faiz Shaikh and Nikhilkumar B. focuses on different smart parking techniques developed to overcome said problem using various wireless sensor network and providing real-time data analysis from the sensors. Resource allocation and reservation of parking lot which have various problems in efficiently achieving the goals [4][5]. Noor Hazrin Hany Mohamad Hanif and Mohd Hafiz Badiozaman et.al, a smart parking system to solve the problem of unnecessary time consumption in finding parking spot in commercial car park areas. A parking reservation system is developed in such a way that users book their parking spots through short message services (SMS). The SMS sent will be processed by a wireless communication instrumentation device called micro-RTU (Remote Terminal Unit). The system is fully automated with the use of the Peripheral Interface Controller (PIC)[6][7][8].

The main idea beyond this proposed method is to change the way of searching the parking places so that the user can easily find out the available places for parking and access all the parking related information at one point. The user can get the information related to the parking and able to select the parking slots. This is the easy and fastest way for parking the vehicles without wasting the time.

III. PROPOSED METHOD

The proposed system utilizes the DL and image processing concepts to deal the out passing of information process in the Deciding Systems. The system simplifies the process by transferring the information such as image data, data to the appropriate personnel. So, the people interfere in the communication process between the agent (source of image data) and decision-making system. The system also helps to store and track the vehicle data log easily. Object recognition is an emerging field of research with many challenges such as large set of images, improper illuminating conditions. Data augmentation techniques such as cropping, padding, and horizontal flipping are commonly used to train large neural networks.

IV. MODULES

The proposed system has four modules:

- **DATA PREPROCESSOR**
- **IMAGE CLASSIFIER**
- **VEHICLE DATA DECODER**

DECISION CLASSIFIER

A. ***Data Preprocessor:***

Preprocessing data is an essential step to enhance data efficiency. Data preprocessing is one of the most data mining steps which deals with data preparation and transformation of the dataset and seeks at the same time to make knowledge discovery more efficient. Preprocessing include several techniques like cleaning, integration, transformation, and reduction. This paper shows a detailed description of data preprocessing techniques which are used for data mining.

"Img = tf. keras. preprocessing.
image.ImageDataGenerator(rescale=1. /255)"

B. ***Image Classifier:***

Deep learning is able to find out complicated structures in high-dimensional data, which eventually reaps benefits in many areas of society. Image classification refers to a process in computer vision that can classify an image according to its visual content. For example, an image classification algorithm may be designed to tell if an image contains a human figure or not. While detecting an object is trivial for humans, robust image classification is still a challenge in computer vision applications.

C. ***Convolutional Neural Network(CNN):***

Convolutional Neural Networks (CNNs) are a biologically-inspired variation of the Multi Layer Perception's (MLPs). Neurons in CNNs share weights unlike in MLPs where each neuron has a separate weight vector. This sharing of weights ends up reducing the overall number of trainable weights hence introducing sparsity.

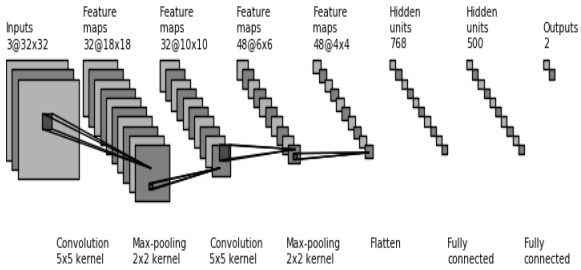


Figure1. CNN

D. ***CNN - Algorithm:***

a. Cross-correlation

Given an input Image represented as II , a filter (Kernel) represented as KK of dimensions k1×k2 k1×k2, the cross-correlation operation is given by:

$$(I \otimes K)ij = \sum_{k=0m=0}^{k1-1} \quad \sum_{k=0m=0}^{k1-1} \mathrm{I(i+m, j+n)K(m, n)} \tag{1}$$

b. Convolution:

Given an input Image II and a filter (kernel) KK of dimensions k1×k2k1×k2, the convolution operation is given by:

$$(I * K)ij = \sum_{k=0m=0}^{k1-1} \quad \sum_{k=0m=0}^{k1-1} \mathrm{I(i-m, j-n)K(m, n)} \tag{2}$$

$$= \sum_{k=0m=0}^{k1-1} \quad \sum_{k=0m=0}^{k1-1} \mathrm{I(i+m, j+n)K(-m, -n)} \tag{3}$$

c. Convolution Neural Networks – CNNs:

CNNs consists of convolutional layers which are characterized by an input map II, a bank of filters KK and biases bb.In the case of images, we could have as input an image with height HH, width WW and C=3C=3 channels (red, blue and green) such that I∈RH×W×CI∈RH×W×C. Subsequently for a bank of DD filters we have K∈Rk1×k2×C×DK∈Rk1×k2×C×D and biases b∈RDb∈RD, one for each filter.

The output from this convolution procedure is as follows:

$$(I * K)ij = \sum_{m=0}^{k1-1} \sum_{n}^{k1-1} \quad \sum_{c=1}^{c} \mathrm{Km, n, c \,.\, Ii+m, j+n, c+b} \tag{4}$$

The convolution operation carried out here is the same as cross-correlation, except that the kernel is "flipped" (horizontally and vertically).

For the purposes of simplicity, we shall use the case where the input image is grayscale i.e single channel C=1C=1. The Eq. 4 will be transformed to:

$$(I * K)ij = \sum_{m=0}^{k1-1} \quad \sum_{n=0}^{k1-1} \mathrm{Km, n \,.\, Ii+m, j+n+b} \tag{5}$$

E. ***Relu Function:***

ReLU stands for rectified linear unit, and is a type of activation function. Mathematically, it is defined as $y = max(0, x)$. ReLU is the most commonly used activation function in neural networks, especially in CNNs. ReLU is linear (identity) for all positive values, and zero for all negative values.

F. ***Vehicle Data Decoder:***

$$f(x) = \begin{cases} 0 \; for \; x < 0 \\ x \; for \; x \geq o \end{cases}$$

Deep learning can also be used for action and speech recognition, natural language understanding, and many other domains, such as recommendation systems, web content filtering, disease prediction, drug discovery, and genomics. With the improvement of the deep network architectures, training samples and high-performance computing, deep learning will be applied successfully in more applications in the near future. The feature generation algorithm we have applied in the BoW model is the speeded up robust features (SURF) algorithm. It is a very popular algorithm that is invariant to various image transformations.

G. ***Forward Propagation:***

To perform a convolution operation, the kernel is flipped 180∘180∘ and slid across the input feature map in equal and finite strides. At each , the product between each element of the kernel and the input feature map element it overlaps is computed and the results summed up to obtain the output at that current . This procedure is repeated using different kernels to form as many output feature maps as desired.

The concept of weight sharing is used as demonstrated in the diagram below:

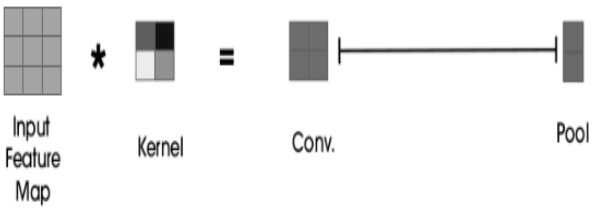


Figure 2. Weight Sharing

Units in convolutional layer illustrated above have receptive fields of size 4 in the input feature map and are thus only connected to 4 adjacent neurons in the input layer. This is the idea of **sparse connectivity** in CNNs where there exists local connectivity pattern between neurons in adjacent layers.

$$x_{i,j}^{l} = rot_{180}\{w_{m,n}^{l}\} * o_{i,j}^{l-l} + b_{i,j}^{l} \tag{6}$$

$$x_{i,j}^{l} = \sum_{m} \sum_{n} w_{m,n0_{i+m,j+n}^{i-1}}^{l} + b_{i,j}^{l} \tag{7}$$

$$O_{i,j}^{l} = f(x_{i,j}^{l}) \tag{8}$$

a. Error:

For a total of PP predictions, the predicted network outputs ypyp and their corresponding targeted values tptp the mean squared error is given by

$$E = 1/2 \sum_{k} (t_p - y_p)^2 \tag{9}$$

b. Pooling Layer

The function of the pooling layer is to progressively reduce the spatial size of the representation to reduce the number of parameters and computation in the network, and hence to also control over fitting. No learning takes place on the pooling layers. Pooling units are obtained using functions like max-pooling, average pooling and even L2-norm pooling. At the pooling layer, forward propagation results in an N×NN×N pooling block being reduced to a single value - value of the "winning unit".

- **Max-pooling** - the error is just assigned to where it comes from - the "winning unit" because other units in the previous layer's pooling blocks did not contribute to it hence all the other assigned values of zero
- **Average pooling** - the error is multiplied by 1N×N1N×N and assigned to the whole pooling block (all units get this same value).

H. ***Decision Classifier:***

For our algorithm we use a feed Forward Neural Network (FNN). The output is a decision; in our case, a next move to be made. Input Features We use a set of features describing the 3 × 3 window that includes the current state, and the 8 immediate successors. Features are concatenated in a single vector and go through a fully connected ReLU layer whose output size is αA, where α is a real constant and A the size of the input vector. Finally, the output layer has a softmax activation with output size 8, which is a one-hot codification of the movement that the agent should make given the input.

I. ***Softmax Activation:***

The Softmax regression is a form of logistic regression that normalizes an input value into a vector of values that follows a probability distribution whose total sums up to 1.

$$P_t(\alpha)=\frac{\exp(\frac{qt(\alpha)}{\mathrm{T}})}{\sum_{i=0}^{n}\exp(\mathrm{q_t(i)/T}} \quad (10)$$

The output values are between the range [0,1] which is nice because we are able to avoid binary classification and accommodate as many classes or dimensions in our neural network model.

V. IMPLEMENTATION

Implementation is the process of converting a new or revised system design into an operational one. Thus, it can be considered to be the stage in achieving a successful new system and it's vital to assure the user confidence that the proposed new system will never cause impairs and it will be effective.

A software application in general is implemented after navigating the complete life cycle method of a project. Various life cycle processes such as requirement analysis, design phase, verification, testing and finally followed by the implementation phase results in a successful project management.

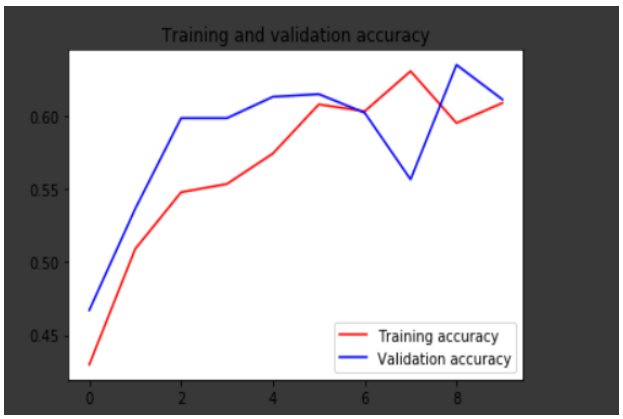
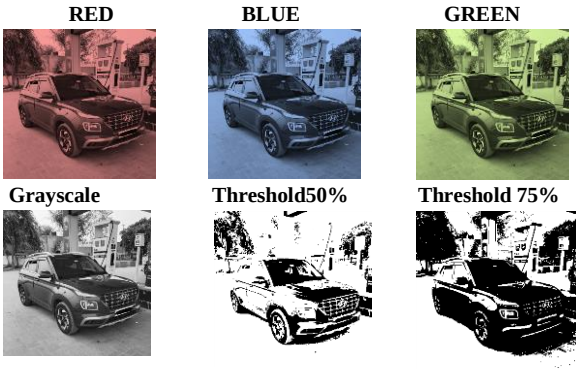


Figure .3 Performance(Proposed Method)

a. *Data Set:*

Figure 4. Source of Image

b. *Preprocessed Image Data (Color Channels) For Prediction:*



VI. RESULTS AND DISSCUSSION

The input for the neural network is undergone through various data augmentation methods using the Image and TensorFlow Library functions. Those function allows us to use an image of any size, since it automatically resizes it to the image size, we defined. The output image will not be very clear since all the image is reduced to 100*100-pixel resolution for a machine to process fast though the tradeoff between speed and information loss.

The input image will be in RGB Color channels, which is in 4-dimensional data header for a single pixel. It takes a very long time and computational power for the image classifier to identify and predict a result using the 4-dimensional arrays. So, to prevent such occasion the input image is converted to GRAYSCALE dimensions for predicting alone, the training images is used in 4-dimensional color channels.

Once the machine identifies the necessary features in the images, then it moves on to prediction phase within the image. The resultant image is visualized and the class of the input image is predicted.

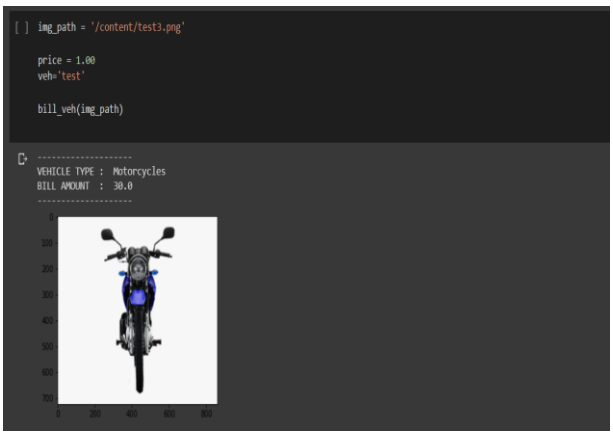


Figure 4. Visualization

VII. CONCLUSION

It is concluded that the proposed idea works well and satisfy end users. The application is tested very well and errors are properly debugged. The system is simultaneously accessed from more than one system and also simultaneous login from more than one place. The application works according to the restrictions provided in their respective systems. Further enhancements can be made to the application, so that the system functions very attractive and useful manner than the present one. The speed of the transactions become more enough now.

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Dr.R.Senthil Kumar pursed Bachelor of Computer Science from Bharathiar University, Coimbatore in 2004 and Master of Computer Applications from Periyar University, Salem in year 2007 and Ph.D. from Anna University, Chennai in year 2014 and currently working as Associate Professor in Department of Computer Application, Dr. N.G.P. Arts and Science College, Coimbatore. He is a member of Computer Society of India (CSI) since 2018, a life member of the ISTE since 2009, and IJSSH since 2020. He has published more than 26 research papers in reputed international journals including Thomson Reuters (SCI & Web of Science) and conferences including IEEE and it's also available online. His main research work focuses on Computer Networks, Network Security, Internet of Things (IoT), Big Data Analytics, WSN and Computational Intelligence. He has 13 years of teaching experience and 8 years of Research Experience.

