International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 5 ǁ 2021 ǁ PP. 44-48

Participatory Scrutinized Monitoring System Using Raspberry Pi

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ABSTRACT
Automatic detection of the license plate and reading of license plate electronically becomes essential for providing security and other regulatory purposes. The detection of number plate is of two steps namely, (I) License plate edge detection and (ii) Character recognition. Detection using Haar cascade classifiers is considered as an effective method for object detection. A lot of positive and negative images are trained to make the cascade file. It is used to detect the license plates by getting the edge points location. It provides high accuracy with a wide variation in imaging condition. It is based on image segmentation using OpenCV. The system is designed to deal with variations in weather and lighting conditions. The system is independent to any number of plates in captured images. The image is fed to pytesseract which returns the text in the number-plate. Object detection system is mainly based on the YOLO networks. The image is fed to the object detection (YOLOv3) which returns the bounding boxes of the predicted objects. There are many techniques to transfer data but are costly, making them impractical for real-life applications. LoRa transmission shows good performance for long-range transmission at lower cost which is used for sending and receiving, the results of the above detection algorithms.

KEYWORDS: *License plate detection, Weapon detection, LoRa Transceiver.*

Date of Submission: 27-04-2021 Date of acceptance: 11-05-2021

I. INTRODUCTION

The existing work on number plate recognition and object detection used MATLAB with optical character recognition (OCR) technique, random sampling consensus and automatic number plate recognition (ANPR) are used respectively. Although there are some remarkable progresses in OCR and CNN for number plate detection and object detection there is still a demand for clear training of characters in OCR and optimization of mAP in CNN and to increase LoRa transmission security and transmission rate. Our machine learning and OpenCV are used for number plate detection with yolov3 in convolution neural network (CNN) for object detection then LoRa transmission with high security.

II. RELATED WORK

Ref. [1] Uses Lora with an embedded device that is connected to IoT cloud using home internet and data can be transmitted over 1.6km and have a loss of 3% in the data, and stored in a database for further use. Ref. [2] The author uses a normal good pixel camera with MATLAB software with OCR which recognizes the number plate along with some text that is written on it. This has not been trained for larger data sets. The images have to be still so that the accuracy will be 75%. Ref. [3] using ANPR with deep learning and Yolo for number plate detection. 6500 real-world images are trained, 90% for training and 10% for testing. Using 37 class CNN for character recognition for training A-Z, a-z, except (0, o). (o, 0) are eliminated Because this character is difficult to recognize. NVIDIA GeForce GTX 1080 with 2560 CUDA core 8 GB RAM is used for training and testing. Ref. [4] In this, the author uses Open CV for image detection using raspberry pi, with static images from proper angles and positions it can detect persons with an accuracy of 85% but not for all directions and angles. Ref. [5] In this LoRa WAN is used through which the author transmits data at 31bits/sec that is too low for live streaming and image transmission and uses RF. It is easy to get control of Wan nowadays. If jamming has happened, the data is collapsed fully so that the receiver cannot receive the encrypted message properly. The data are also stored in a cloud using Wan. The storage is limited to 100Mb/month Ref. [6] This author has used a monochromatic camera for image detection and processed with number plate detection using vertical detection and RANSAC algorithm so which the accuracy for medium data sets lies at 25%. Uses

random sampling algorithmRef. [7] Here the data sets of 1172 images were trained with R-CNN, focal loss and DCL, in which 58% for training, 17% for validating and 25% for testing method propose. Which is 2.79 times more than faster – RCNN, 2.00 times more than PCL, and 1.53 times faster than MELM. Its mAP is 0.5211 for the components that are trained. Ref. [8] In this BFAN (blur aid feature aggregation) method is used so that for detection of blur and fast-moving objects but it requires a more featured device, author has used an intel i5 – 9600 processor with 4 NVIDIA 2080Ti GPU for training this dataset so it becomes costlier and the accuracy of blur mapping is increased up to 2.9% only when compared with another machine learning algorithm such as FGFA, D&T, MANet, SCNet, etc.

III. DATA SET OUTERVIEW

We have trained YOLOv3 with nearly 6000 images and are trained with a single convolution neural network (CNN) that is of class 53. The above algorithm is used for gun detection Ref. [10]. For number plate detection we have used a cascade classifier that is trained with 1000 images and is built using a number a weak classifier to make it a strong classifier. The given image is edge detected to get the number plate Ref. [9] and save it as img1 Pytesseract is used to detect the characters from the saved image img1. This method gives an overview of the methods and algorithms used.

IV. WORKING

The raspberry pi will continuously take images using the camera module. The captured image will be processed by using a trained dataset stored in xml format to detect the number plate. The detected plate will be processed using pytesseract orc for recognizing the text in the image. The detected vehicle registered number will be stored for transmission. Similarly, the image used for number plate detection will be feed to object detection part. Where the yolov3 and darknet are used for detecting the gun using trained dataset stored in cfg format. The detected gun information is stored for a time in order to ensure that all the data are transmitted. The information is encrypted and then the encrypted information is transmitted and received successfully through LoRa transmission. Receiver will decrypt the information received and separates the information received whether it is number plate or gun. Based on that the information will be stored in the appropriate database. If it is a number plate it checks in a database with registered vehicle information. The number plate is entered with time in the database. It checks with the registered list in database, if not a registered vehicle, it pops up an alert and inserts into the database. If gun is received, the receiver prompts an alert. It also enters the details in the database. All the alerts will be displayed in LCD Display.

The data in the database can be updated, added or removed only by person whohas these three details so it cannot be edited by other than the person with authority.The database access will be permitted only by entering all three authentication values [user id, user name and password] correctly.There is an option in which if we enter the vehicle number it will display the details of the vehicle like the owner's name, car manufacturer, model, color, address in which the vehicle is registered if found, otherwise it will display "Vehicle number not found in registered list!!!". If the vehicle has been detected it will show the time of crossing of the vehicle, otherwise it will display that "Vehicle is not detected till now".

A. Number plate Detection

The camera will capture an image, and store it as image1, now this image1 is fed into OpenCV for converting it to a grayscale image, then OpenCV calls cascade classifier for edge detection that is build using a number of weak classifiers. These cascade classifiers output will give us the edges of number plate, that is corresponding x and y coordinates of the number plate. With these x and y coordinates given as input OpenCV is used to crop the number plate from the image1 and store it as img1.The img1 is given for the next process the character recognition which is done by using pytesseract. Python Pytesseract is trained for all alphabets, numbers, and symbols. The accuracy of detecting text in gray scale image is high when compared with colored image which is the reason for converting colored image to Gray scale image in our project. So, it becomes easy for Pytesseract OCR for recognizing characters from img1.

In another part, the output from Pytesseract OCR is printed in the terminal for our verification and also saved in a database tx.sqlite. tx.sqlite database is used to store these detected number plates and objects detected. We have developed this project mainly for India, Indian number plates have the form of 2 alphabets followed by 2 numbers followed by 2 alphabets and 4 numbers e.g., TN11AQ1879. So, these conditions are checked while detecting the

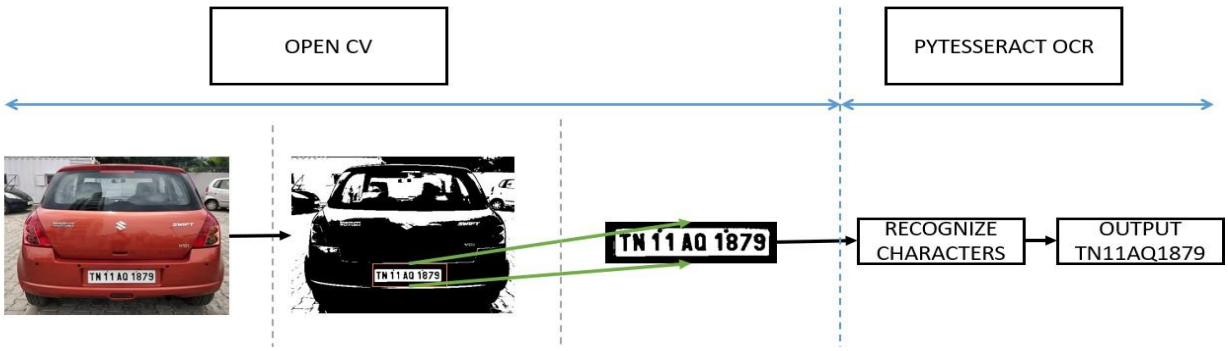

Figure1: Number plate detection process

number plate. These conditions can be changed to adapt to the rules and regulations followed by other countries.Ref. Fig 1 explains the detailed block diagram of this number plate detection, not only we have numberplate detection we also have gun detection using a convolution neural network. In this transmission process we have another process called the gun detection from the same image1 saved in the

B. Gun Detection.

Yolov3 object detection is trained with single convolution neural network algorithm, which is faster when compared with other algorithms like SSD, DSSD, R-FCN, FPN FRCN, Retina Net. With mAP 50 among all the algorithm yolov3 is the fastest.Yolov3 have 3 files mainly that are yolov3.weights, yolov3.cfg, coco.names. The above saved image1 is taken and processed by using yolov3 algorithm. let's consider the image1 has a gun. Yolov3 will put number of boxes covering the image1 through various positions. These boxes are called boundary boxes. In the center box of each boundary box, the probability will be entered and is called as probability box, each boundary box will compare with all the objects in name that are listed in coco file. Consider that we have trained the yolov3 for only one object that is gun, so our coco.names will only have gun as a tag.

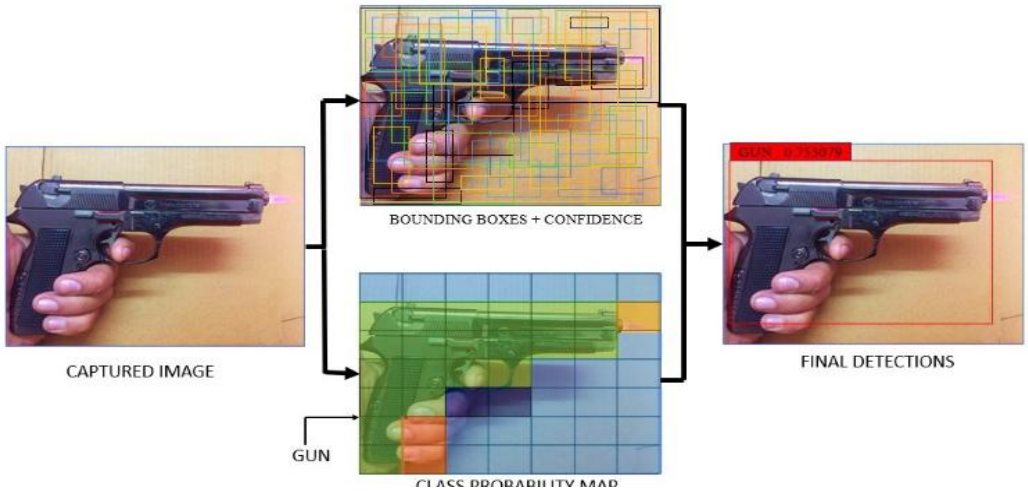

Figure2: Gun detection process

All the boundary box will be compared with the weight files and its accuracy(probability) of the maximum matching object will be saved at the center of each boundary box. So, the center box will be responsible for the detection of the object. If the image has more guns in the same frame then, that number of bounding boxes and confidences are generated and the name with confidence is printed in terminal and entered in tx.sqlite database. This results in gun detection with yolov3 is so fast that it can detect 4-5 guns in the same frame and can detect within 4-5 sec which is faster than other algorithms. We have trained only for gun so that the detection would be faster, simpler and accurate.

C. Lora Transmission

The transmission should be secure and faster, so we move to analogue transmission without internet. If internet is used then it can be easy to hack and easily prone to more threats. Lora is more secure as it has a FSK modulation with XOR encryption inbuild, it also has another feature called message integrity code (MIC). In transmission side lora has to send app key (APPKEY) and it's received by receiver side lora and sends a network session key (NWSKEY). So, this all feature makes lora a suitable transmission device. The transmission take place in a bit-by-bit process. To make transmission more secure we also have included a manual encryption and decryption standard in the code. The encryption technique, we have used is inserting letters for every 3 characters and adding 3 to ASCII values of every character in the message

V. RESULTS

In this we have used 3 programs for transmission that is of number plate detection, gun detection and lora transmission. The output of various terminal is shown below.

A. Number Plate execution Results

We have detected number plate (HR26DK8337). The output is printed in a terminal and in 20x4 LCD Display

Figure3 (a): transmitter, 3 (b): receiver 3 (c): output in lcd

The Fig 3 shows the transmitting, receiving process and printing the received data in an LCD. Ref. Fig 3 (a) shows the transmission of detected number plate with encryption forms a list and its transmitted and received at the receiver end. The message is now decrypted Ref. Fig 3 (b) and read's whether the number plate is registered in the data base rx.sqlite, if it is registered it will show the number plate alone. If the number plate is not registered with the data base rx.sqlite, then it shows a code red with pop up of "vehicle number not registered" as shown Ref. Fig 3 (c).

B. *Gun Detection Execution Results*

The gun detection is done and the name with its confidence is encoded and transmitted. Ref. Fig 4 shows the gun detection, encoding done Ref. Fig 4 (a) shows that, all the values are printed in transmitting terminal. The values are transmitted and received. Ref. Fig 4 (b) the values received are decrypted, if the message is a weapon then it will pop up with a code red and print the name "gun" with its confidence Ref. Fig 4 (c) shows the output printed in an LCD display

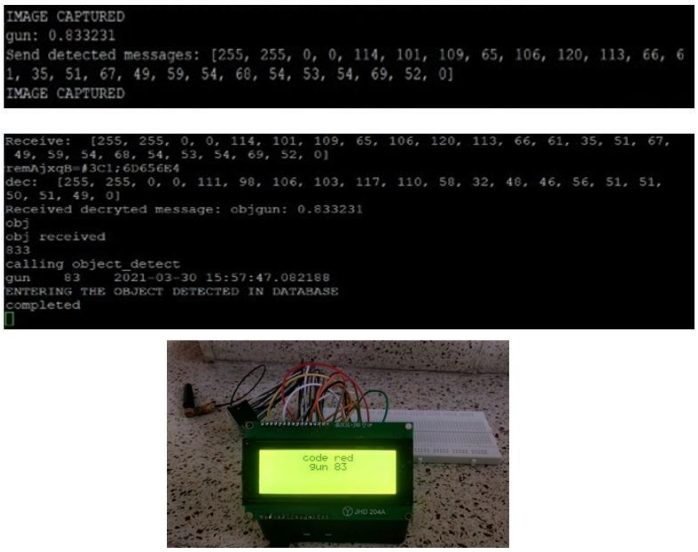

Figure4 (a): transmitter, 4 (b): receiver 4 (c): output in lcd

VI. CONCLUSION

The result is more accurate and yolov3 makes faster gun detection than other algorithms and number plate detection is made faster using open cv and pytesseract, because of the optimization standards that has been carried as explained above. The Lora transmission will be more secure by following the encryption algorithm as discussed earlier. The output is printed in a display for user.

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