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Real-Time Local Train Tracking System through HaarCascade Classifier and OCR Model

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***Abstract*—** Indian railways are one of the most vast and complex railway networks in the world in which majority of the population is dependent. But such vast and complex system comes with a cost, the real time tracking which are implemented by railways using GPS tracking mechanism is far from accuracy. People get annoyed due to late arrival of passenger trains and wish to switch to other means of transport. There is a lot of wastage of time and money of the passengers due to this unscheduled timing of trains where passengers are unaware of time at which the train actually leaves the station. Although efforts like "Where Is My Train" by Sigmoid Labs have managed overcoming this situation to an extent but it's operating principle is not enough for keeping exact track of such a huge network and we users are quite aware about its limitation and discrepancies regarding real time train's location. In this manuscript, we are proposing a real time local train tracking using surveillance camera. OCR based Computer Vision model is developed in order to fetch status of trains from the snaps and accordingly relevant data is generated and updated in the main frame server. CCTV's installed at stations ends are utilized for this purpose the feed from these cams are passed to our OCR Model & the data collected or analysed from those feed is further uploaded & updated in the database. Data refers to train name, number & time stamp. Users are provided with an app through which they can keep an exact track of passenger train's arrival & departure on a real time basis.

***Keywords*—** Local Train tracking, Computer Vision, Haar-Cascade, Optical Character Recognition (OCR), Tesseract v4

I. INTRODUCTION

India is a country of estimated 133 crore population and on an average 1.9% of this population used to travel by trains. Railways are the backbone of Indian transportation services and are one of the basic reasons behind the progress of country. Holding such a responsibility is never easy, railways face several challenges time to time but with the joint efforts of Indian govt. and citizens it managed maintaining a descent reputation. But still there exists some unfaced hurdles, and most commonly is its punctuality. Keeping a track of such a huge network and maintaining a descent punctual approach was never an easy task but with technical advancements like GPS tracking [1][10] and corporate efforts of 'Where is My train' have managed to reduce these difficulties to some extent. But we travelers are quite aware of the reality, that maintaining a perfect error free tracking system is still a dream. Our approach to this problem is to use computer vision for labelling passenger trains and keeping tracks of train entering & leaving a particular station with exact time stamps, so that passengers can get much accurate data regarding their trains.

Computer vision, a technique derived from ML & AI enables computer & electronic systems to "see" and analyze contents of digital image or video. The feed of the cam's was vigorously monitored and using object detection algorithm snap triggering program were initiated which further take snap of the locomotive. In simpler terms, object detection technique will let us know about the presence of a train in a particular station and will accordingly trigger further processing tasks. Then comes the OCR [4][5][8][2] based model which primarily focusses on analyzing snaps from preinstalled surveillance cams & conclude train's arrival & departure at particular station. Thus, keeping a track of a particular train. Optical Character Recognition, OCR refers to extraction of text from image containing valuable data. Tesseract v4 includes a highly accurate deep learning model for text recognition. Snaps of trains were processed using OpenCV [6] & Tesseract v4 and data regarding it's tracking such as train name, number and it's time-stamp were recorded & accordingly updated in mainframe database. OpenCV's EAST TEXT DETECTOR detects the presence of texts in the image & returns bounding box (x, y) co-ordinates. These ROIs are fetched to Tesseract v4's LSTM deep learning text recognition algorithm. And the output of the LSTM fetches us OCR results.

An app is interfaced with the system so that users residing within the range of internet can access data regarding train's

location. IRCTC in collaboration with Google is carrying out a project of providing travelers with free hi-speed data by installing WIFI's at stations. This WIFI enabled stations will establish communication with our centralized server and will lead an interconnection of CCTV's leading an efficient data flow from stations to app-users.

II. RELATED WORK

A. Conventional Tracking using Axle Counters

Axle counters [11] are installed on ends of a section and with each pass of train's axle the counter performs increment operation and if the count at section begin matches with section's end it indicates that the particular portion of the track is clear. With help of critical computer popularly known as Evaluators which are installed at the site railway staffs keep track of trains & operate signalling systems. Axle counters need proper maintenance & human attention for perfect operation which limits it usability features.

B. GPS Based Tracking System

The Centre for Railway Information System (CRIS) with collaboration with ISRO have already developed a GPS based tracking system [9]. The project was aimed installing GPS system over trains and provide users an google map enabled app-based interface for live train tracking. ISRO's INSAT-3C satellite guarantees the accuracy in the location of about 10 metres & latency of 2 minutes on real time basis. Although it's a great approach towards real time tracking & accident prevention but it failed due to poor implementation & system-management strategies. Even signalling issues of GPS [10] are there, in dense deciduous forest & tunnels communication lags are often encountered.

C. Where is My Train –

Sigmoid labs came up with an app 'Where Is my train' which aims providing users with train schedules & live tracking. The app uses standard schedule prepared by Indian Railways & provides & approx. data regarding train's status & being more precise it uses user's cellular network [1] who is on a particular train to provide its location to all other app users. 'Where is my train' is a big hit and got a huge user response and over 1 million downloads in Google's play store. But hopefully, we all are quite familiar with the reality 70% data provided by this app was inappropriate raising the concern for the need of a much accurate real time monitoring system.

III. METHODOLOGY

Keeping track of such a huge network is never easy. Although after continuous efforts of Indian govt & technical firms, results were un-satisfactory. Our work focuses on providing a simple software-based approach for keeping tracks of local trains using installed surveillance systems in platforms.

Keep Using the live feed from installed CCTV's the tracking model is carried out. Object detection by Haar-Cascade [7] classifier & Optical Character Recognition (OCR) are building blocks of our location tracking model. A haar-cascade classifier basically detects the presence of a particular object in a input image for which it is trained by superimposing positive image set over negative one. Live feed from cams were fetched to object detection model & the presence of a train was confirmed. On this confirmation further triggering of snap capturing program was initiated and the snap was forwarded to OCR model for character recognition. Optical Character Recognition was carried out by OpenCV & Tesseract [2][5][8] v4 framework and data from the snap was obtained. Here data refers to train name, train ID with engine number & the timestamp. Based on the obtained data conclusion is drawn regarding arrival & departure of a train at a particular station on a fixed time interval. This data was sequentially arranged & using internet & computing facilities at railway station this data was made online to the app users. Thus, keeping exact tracks of trains on a real time approach.

A. Schematic Representation

Following figure is a basic illustration of the proposed work. As per the figure we are fetching local train snap from CCTV's and processing it for concluding its arrival & departure from station 1 and station 2.

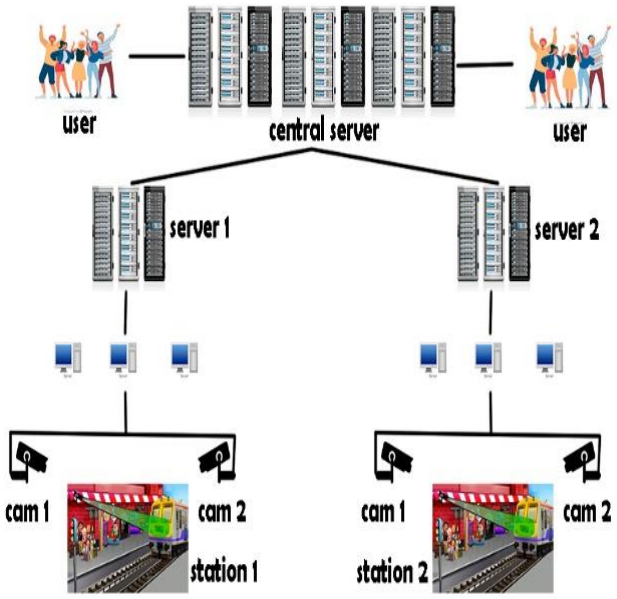

Fig 1- Schematic representation of proposed work

B. Flowchart & Algorithm

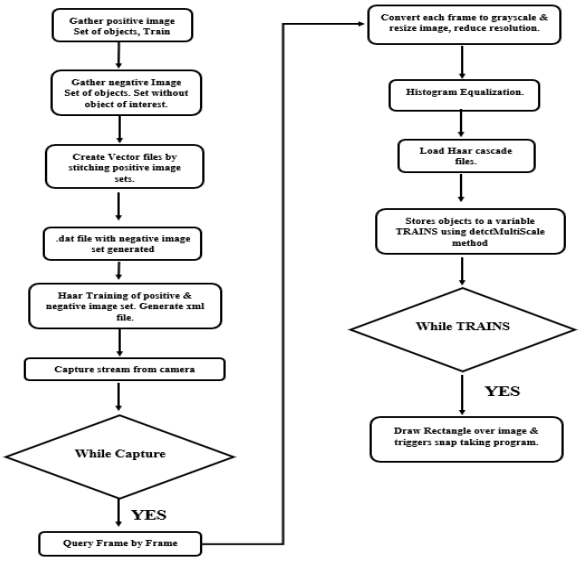

Fig 2- Flowchart for Object Detection using Haar Cascade Classifier

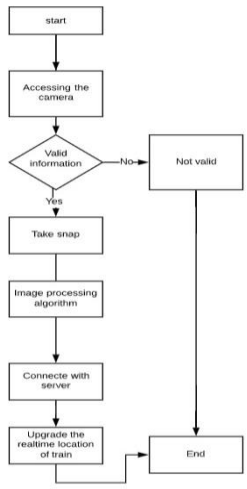

Fig 3- Flowchart of OCR Model

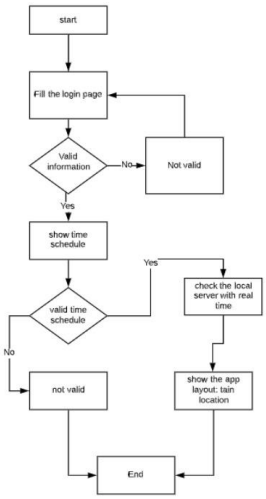

Fig 4- Flowchart representing APP backend

ALGORITHM BEHIND OBJECT DETECTION

Step 1 : Positive image set of trains were prepared.
Step 2 : Negative image set, set without object of interest were prepared.
Step 3 : Vector file images of positive image set was generated using Open CV
Step 4 : .dat file is created with negative image set
Step 5 : Haar training of both images set to generate .xml file
Step 6 : Stream was captured from camera
Step 7 : Frame by frame was queried
Step 8 : Each frame was converted to grayscale and resolution is reduced for faster processing
Step 9 : Histogram equalization was applied
Step 10 : Haar cascade files were loaded
Step 11 : Using detectMultiscaleMethod of Open CV object, train was detected.
Step 12 : If detection return TRUE, snap capturing program initiated & snap was passed to OCR model for further processing.

ALGORITHM BEHIND OCR MODEL

Step 1 : Detection of Train's presence in a particular station by OBJECT DETECTION using Haar-cascade methodology.
Step 2 : If it returns TRUE a snap is taken from live feed.
Step 3 : Snap was passed for OCR.
Step 4 : Open CV's EAST TEXT DETECTOR returns co-ordinates of bounding box, (x,y) of text ROI's
Step 5 : This ROI's are processed using Tesseract v4's LSTM Model
Step 6 : Result of OCR is obtained.

ALGORITHM BEHIND APP'S BACKEND

Step 1 : User requests login.
Step 2 : User credential validation
Step 3 : Source & Destination station is fetched from user.
Step 4 : Route validation, if routes exists proceed else returns to user input page.
Step 5 : Available trains at real time is fetched.
Step 6 : Station wise status of train was displayed at per user's train choice

IV. RESULTS AND DISCUSSION

Fig 5 - Object Detection frame 1

Fig 6- Object detection frame 2

Fig 7 – OCR of snap of locomotive

Fig 8 – ROI's extracted and processed for OCR.

For testing efficiency of our developed model, we considered video & snaps obtained from railway stations. The object detection model & snap triggering program was tested using a small recorded feed of android cam but the OCR model was tested using snaps manually clicked by smartphones in railway stations. And the results after processing both video clips & images are recorded and were presented above as fig 5,6,7,8.

Fig 5 & 6 refers to the output image obtained after feeding it into object detection algorithm. In both the frames it successfully detected the presence of train. Images of train are fed to OCR model for obtaining train number & train name fig 7 represents ROI and a rectangle is drawn over it. Fig 8 contains processed images of fig 7 ROI's used for Optical Character Recognition. Rescaling the images & making them grayscale fetch us much accurate result of OCR. OCR returns us the identified text & number from images of fig 7.

V. CONCLUSION AND FUTURE SCOPE

Railways has always been a cheaper, faster and convenient means with the vast number of last-minute connecting stations in suburbs to the remotest villages, for the lower and middle classes. An accurate tracking system will further add to the safety especially for the women who earlier were abstained from traveling alone. Access to a cheaper and subsidized means of travel for long distances in a third world country will proliferate mobility, which in turn will help in economic progress for small scale traders and the country as a whole and will also help in unifying people across caste, class and gender. One thing which is to be kept in attention, is with the improving technologies and quality the price should be as minimal as possible because railways is a governmental sector meant for the welfare of the masses, rising prices will disable a large chunk of the population. An able and cheap means of transport is an indispensable aspect and the right of the masses as the country's economy and society rests on it.

Development of efficient tracking systems have been the field of interest in recent years. Indian railways have gone through several advancement in tracking systems but still results are unsatisfactory. Computer vision have proved its efficiency in solving real world problems in several devastating situations. Implementing a low-cost software-based OCR model can benefit the existence tracking systems and can assure much higher accuracy rate. Indian railways are going through an upgradation phase. And in recent years rail services have improved to a great extent. Although throughout rail network very few stations have CCTV's installed but in coming two-three years almost all the stations will have computerised surveillance systems. Hence, leading a new path in fields of local train tracking.

Our model limits the purpose to local train tracking only but considering the purpose of express & superfast tracking slight improvements in a similar model can get us acquired result. For superfast or express train tracking we have to consider and analyse feeds of other cams installed at stations & eventually have to maintain an online database regarding addition & removal of engines from a particular train in a real time approach.

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