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PERFORMANCE ANALYSIS FOR VIRTUAL CHECK POINTS FOR FUTURE ROAD TRANSPORT SYSTEMS

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Abstract - There are situations to extract details and auto-verifying of those from the databases indicate the functionality to be completed in seconds or minutes. One such example is transport system especially heavy load vehicles where authorization of vehicle verification, driver drowsiness verification, and vehicle load estimation and verification operations are carried out automatically during specific check points and alert the control station on the violation of policies. The issues with traditional check points are causing traffic to other vehicle drivers when manual inspecting taken up, lack of the technology, more human resources required, and time taking process. These issues are eliminated using auto-virtual checking. During this virtual checkpoints, two or more simulated checkpoints are installed for verification and validation using smart cameras, usage of internet of Things to communicate with one another, checking driver drowsiness, verifying the type of material load, and alerting to the control centre. The installation of these checkpoints are easy and customizable according to officer's choice on the roads. This objective may be the demanding and would be the future revolution in the transport system. The computing the penalty amount is based on level wise violation of the policies. The integration of all these into one would benefit the government body's in terms of generating the revenue, transparently to the public, and take actions against the many times repeated violation of policies bythe same vehicle. The proposed novel machine learning approach would be compared against few other approaches based on accuracy and performance and results are shown in graphs.

Keywords: Verification, Novel, checkpoints, alerting, policies, automation, accuracy, and performance.

1. Introduction:

In the inspection of vehicles on roads, always it is done by involving manual monitoring and checking. This checking disturbs the vehicle drivers, verifying their documents and assessing their attitude. The physical checkpoints on a road in which certain vehicles might be missed using the manual verification. To make this process effective, a specific innovative approach is needed where the vehicle documents are scanned and ensure they are valid, also the driver

attitude is judged between the given two virtual checkpoints. Here, scanning the documents instantly while the vehicle is in motion and also recording driver attitude between the given two authorized virtual checkpoints. The need for virtual checkpoints may reduce human efforts, reduce the traffic on the road, minimizes leading ways to corruption and reduce the misleading the drivers and vehicle owners.

Many studies existed on determining the driver's drowsiness or passive behavior at the time of driving. Also, how to make the driver active is challenging in such a scenario. The attitude of the driver is to be analyzed. If not, it is needed to be analyzed for making alert or make active. The parameters such as driver attitude as well as the driver's safety measures are one aspect, vehicle documents to require verification as the automatic manner is another aspect, and scanning the vehicle for the kind of load that is shipping as the last aspect. The integrated set of activities to be made automatic and are to be assessed at one place. The same characteristics are again verified are identical at the other neighboring place. If a vehicle is verified at two checkpoints, then only driver attitude is observed and status is updated. At other places, the only driver attitude is to be verified and other aspects are skipped. The objective of the intended task is to automate the process of reading the documents, scanning the vehicle load, reading the driver's drowsiness and attitude. If attitude is violating the policies framed, must be fined with a message alert. If any load type is violating the norms specified, would be fined with an alert message. If any documents are not attached at the requested places on the vehicle, or they are not related to the vehicle details, a fine is imposed with an alert message. If all these are violated, then the vehicle owner and driver are alerted to meet the head RTO office and must submit the explanation there. All activities are made automatic on the road. For an alert message, if there is no response within the deadline, severe actions are imposed. The technology is nowadays becoming more and more upgrading and is made available from the user's point of view.

The order of steps that are initiated to do the intended task:

1) Choose the locations to install the virtual checkpoints
2) Install the scanners for reading the vehicle documents for one-time scanning, and road scanners for vehicle load content.
3) Install the technology side scanners that point to the vehicle drivers' characteristics, a record that attitude from one checkpoint to another checkpoint.
4) Based on loaded policies, a message is alerted.
5) Tracking the message over the vehicle and driver, initiate the auto-call to the concerned at last warning for a response.

2. Literature Review:

Many studies are available where the way of handling is represented by different approaches. Each study has elaborated on their significance but all they are restricted and not opened for automation.

Regarding the study mentioned in [1], the number plate of the vehicle is detected using image processing technique where image segmentation for decomposing into sub-images and OCR is applied to determine the valid with respect to the owner and address available in the database. With regard to the mentioned information of [2], the simulation is done in MATLAB where scanned vehicle plate image is decomposed using image segmentation, OCR is applied to

determine the characters and checks this against the data in the dataset. In the view of the study mentioned in [3], specific methods such as a Sobel edge and bounding box are useful in detecting the vehicle number and determine the region of that vehicle. As per the demonstration of [4], the method defined is template matching and later segmentation, character recognition are applied in order to determine the number on the plate. As per the study conducted in [5], all types of driver drowsiness are analyzed but the checking is done based on eye and mouth landmarks. If these are found abnormal or peculiar than normal, then alert the driver. In this, ESR, and MAR are computed using the simulated formula, and result values violate the threshold values, and then drowsiness is computed. Regarding the work stimulated in [6], the variant against convolution neural network(CNN) is EM-CNN which is a proposed technique that is based on PERVLOS and POM parameters, and detection is carried w.r.to the eyes and mouth. A lot of analysis over many driver images is done and extracts the required ROI of those images. Regarding the demonstration of [7], the machine learning techniques used such as SVM, CNN, and Hidden Markov were used for drowsiness detection. Among these, CNN is a better to approach and SVM is a commonly used technique for the detection of driver fatigue. As per the description made in [8], there were steps to be followed using python in determining the face drowsiness. Not python, there are other environments such as OpenCV, and Keras. In the view of the article drafted in [9], the accuracy of the proposed approach called binary SVM is used to detect drowsiness in the face is increased to a good level compared to the traditional approach. As per the description of the study in [10], the drowsiness is detected using the CNN over a smartphone is done with help of embedded system ARM-NEON and MALI GPU in case of heterogeneous design of the devices. With respect to the organization of study in [11], few approaches based on psychology, physical and behavioral levels are defined in which random forest for certain accuracy by excluding the physiological indicators, and ensemble approach is applied to increase the accuracy of the machine learning method. Regarding the source of [12], the specific libraries are applied from the python environment in order to capture the different vehicles and their count based on type. Among libraries, ArcGIS played a vital role. With respect to the demonstration of [13], the YOLO3 is used to detect the variety of vehicles and count the vehicles on highway road scenes. It is applied by taking each frame from the video recorded on a road. In the view of [14], the appropriate sensors were glued inside the tires in order to detect the vehicle load. The technology incorporated is the continentals ContiPressureCheck system. Regarding the description of [15], the shadow of the vehicle is removed using a shadow detection algorithm and the methods like optical flow method and immune particle filter for detecting moving vehicles. In the description provided in [16], the vehicle load is detected using the acceleration of the vehicle and acceleration resistance, the whole vehicle load mass is computed based on this approach. As per the information given in [17], the FAW truck is considered for analysis of vehicle load, and error is observed 5%. The appropriate technology is applied for monitoring vehicle load. Regarding the description given in [18], the appropriate sensors are fixed in order to make the driver alert and make the driver active in case of sleeping, and in case of drunk. In this way, the vehicle also gets alert when the obstacle is near to it. With respect to the demonstration of [19], the vehicle pollution is monitored using Sensors of IoT using a specific Arduino designed system. In this, if the observed pollution level is high, that information is alerted as SMS. In the view of the study mentioned in [20], the appropriate techniques that fall in covering the energy

efficiency in determining the vehicle location as well as tracking the vehicle using EECLA. Regarding the study in [21], the vehicles are connected using Li-Fi which is 10 times faster than Wi-Fi and allows front and behind vehicles to be automatically connected using advanced LEDs and photodiodes in order to avoid accidents and control the traffic. As per the data provided in [22], the traffic is to be analyzed in urban areas from one area to the next area using the ML method called reinforcement learning. With the demonstration of data given in [23], the accidents are reduced by adapting specific policies like the intimation of the location of the vehicle when the accident had occurred, also sensors are incorporated in order to alert the driver and monitor the driver drowsiness. As per the demonstration of data given in [24], the accidents against the heavy vehicles are avoided by making internal design used for braking as both motor and generator. If the vehicle is at slant places on a road or going at high speed, would reduce speed automatically in controlling it. Regarding the study demonstrated in [25], the neural network method is applied to detect the registration number on a plate while the vehicle is moving on but earlier few studies were on if it is still staged. The OCR is applied for capturing the printed characters. With respect to the source given in [26], the location of the vehicle is obtained by GPS in terms of longitude and latitude and is controlled using ARM Controller. The switch is used to set on initially and is made off for controlling and information is sent to the nearest controlling unit. In the view of the demonstration of [27], the characteristics of the proposed fractural structure of the antenna over the vehicle are analyzed and are demonstrated in the virtual environment for the vehicle body. As per the demonstration of [28], the proposed method called ANN-OGSA is designed in order to detect background scenes and vehicle moving scenes. The efficiency of this is achieved using ANN chosen classifier and results are compared against other methods in that domain. With regard to the demonstration of info in [29], the human effort is maximum minimized and increases automation through the app based on IoT devices and checks the eyesight remotely. The significance of IoT is clearly depicted and would be useful in making the proposed system. With respect to the source specified in [30], the IoT is useful to the users in such a way that users' health bulletin to be monitored and provides a guide to maintaining fitness based on a food diet. With the view of the source mentioned in [31]-[33], the IoT and GSM are used in determining the popular places when a user wants to make a trip in the world. The guidance is to be provided about the top places and ranked places in those cities along with a route map.

All the studies mentioned above are for vehicle monitoring and management of it through the virtual environment but they are not automated in full mode for detecting the vehicle number for verifying the owner details and vehicle is valid or not, vehicle load determination, and driver drowsiness detection.

3. Proposed Work:

The activities to be monitored are reading the moving vehicle registration number, reading specific fields in the documents attached at specific places where the installed embedded device could work, verifying the details between the two virtual checkpoints in the road, any violation during verification would alert the owner through a message, and also vehicle load type, its weight is noted, verifying through the government policy. If any violation in the measured objects is found, the appropriate actions are initiated and this whole process is automated. The post-checking is also to be done at the end time of the complaint raised.

There are 4 modules identified in this ideology. They are

1) Scanning the vehicle number and documents:
2) Verifying the details and Approve the authentication
3) Scanning the vehicle Load and authentication
4) Driver Drowsiness and alerting to the nearest control station

These four modules are represented in both ER diagrams as well as in terms of pseudo procedures.

Pseudo_Procedure Virtual_CheckPoints(Weighing_Machine,Scanner_Load, Scanner_F, Scanner_B, Two_Scanners_Eye_duration):

Parameters:

Weighing_Machine – Installed in the road for observing the load of moving vehicle

Scanner_Load – Another scanner fixed in the road which already trained, new loads if any captures and added to its list

Scanner_F: Front scanner for observing the various docs pasted on left window of the vehicle and also Vehicle Number

Scanner_B: Back Scanner for observing the vehicle number

Two_Scanners_Eye_duration: Special scanners for determining the eye fatigue and eye clicks at first Virtual Point, and also compare at second Virtual Point

Step1: Extract the weight of the vehicle at first Virtual Point and also at second Virtual Point, if both observed values are close, and then check against the cutoff_Weight fixed by the government policy w.r.to vehicle type. It uses Weighing_Machine.

Step2: Extract the kind of load in the vehicle. If it is in the list of trained type, displays it. If it is not in the list, Update list with new one as confirmed by the station observer. It uses the Scanner_Load.

Step3: It is decomposed into two scanners. Top one focusing on the left glass Window according to instructions would consist of license, vehicle RC, Pollution certificate, these are scanned by Scanner_F. Below scanner scans the vehicle number.

Step4: It reads the vehicle number using Scanner_B.

Step5: Driver attention is noted at the first Virtual Point, and also at second Virtual Point. If huge distraction is found, alert to the nearest control station for action. If the eye clicks count is less than the observed time by the scanner, alert the driver as well as pass the information to the nearest control station.

```
diff = (first Virtual Point_eye_clicks- second Virtual Point_eye_clicks>10)
if(5<diff<10)
        Alert through the first type
else if (10<diff<20)
        Alert through the second type
else
    High alert to the control station
```

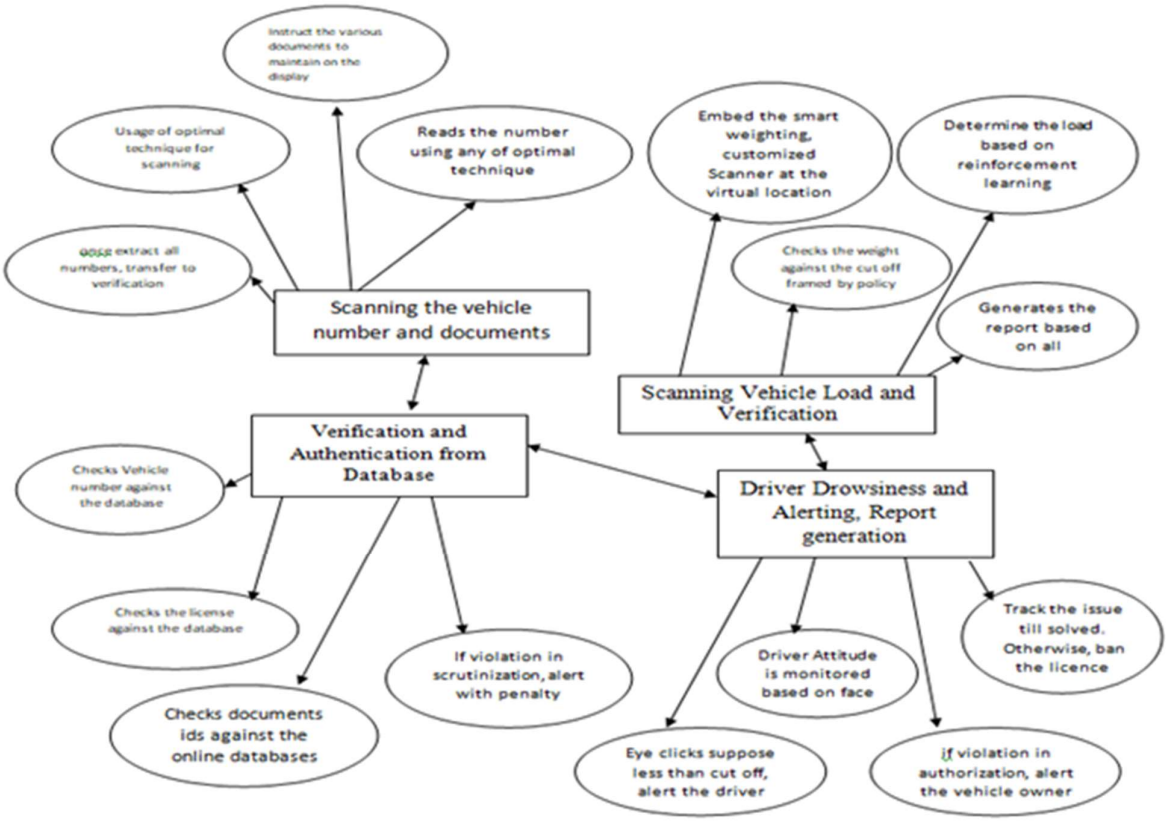

Fig.1: ER Diagram of Smart Virtual Check points

Pseudo_Procedure Scan_VehicleN_Docs(Vehice v):

Step1: Virtual check post have scanners at left side as well as right side, they are on 24/7 service to capture the vehicle number. The vehicle backside number and front side number are to be scanned. Matching is checked.

Step2: The left top of the glass Window is scanned and is customized to get required number. From the driving license scan, license number is to be extracted and validity. From pollution certificate scan, number is extracted and valid. From the RC, extract the vehicle number and Validity.

Step3: The above details to be sent to Authorization_N_Docs_Weight_Load() module.

Pseudo_Procedure Scan_Vehicle_Weight_Load ():

Step1: The installed weighing machine scans the weight and extracts the in terms of tones.

Step2: Customized scanner at bottom and road sides read the load type, identifies if it is in trained list. If not, send to Authorization_N_Docs_Weight_Load(Vehice v).

Pseudo_Procedure Authorization_N_Docs_Weight_Load(output_ Scan_VehicleN_Docs(Vehice v), output_ Scan_Vehicle_Weight_Load ()):

output_ Scan_VehicleN_Docs(Vehice v): V_No, D_L_No,P_No,RC_No_validity, D_L_No_validity, P_No_validity

output_ Scan_Vehicle_Weight_Load (): W_in_tonnes, Load_Type_V_No

Step1: Search the V_no in the database, extract it and checks against RC_No_validity

if(RC_No_validity violates policy_RC_validity)
Records that as issue1
if(D_L_No_validity violates policy_DL_validity)
Records that as issue2
if(P_No_validity violates policy_P_validity)
Records that as issue3
Step2: If(W_in_tonnes exceeds the Policy_WT_wrt_Vehicle_Type)
Records that as issue4
If(Load_Type_V_No violates the Policy_trained_type_entities)
Records that as issue5 and asks for control station to respond immediately before next virtual point
Step3: If Issue1:
Alert with penalty1
else if Issue2:
Alert with penalty2
else if Issue3:
Alert with penalty3
else if Issue4:
Alert with penalty4
else if Issue5:
Alert with penalty5
Step4: If 2 issues are there:
Apply penalty w.r.to policy framed
else if 3 issues are there:
Apply penalty w.r.to policy framed
else if 3 issues are there:
Apply penalty w.r.to policy framed
else if 4 issues are there:
Apply penalty w.r.to policy framed
else:
Vehicle ban for whole life ie ceased
Pseudo_Procedure Driver_drowsiness_detection_generating_action():
Step1: Specific duration at virtual Checkpoint1 is observed and extracted.
if(driver_eye_clicks violates the policy_count)
Perform action and is mentioned in the module Virtual_CheckPoints(Weighing_Machine,Scanner_Load, Scanner_F, Scanner_B, Two_Scanners_Eye_duration)
Step2: Driver face expression is determined based on eye focus mainly, and second is fatigue which describes attitude.
if(driver_face_fatigue violates the policy_fatigue at Virtual Checkpoint1 as well as Virtual Checkpoint2):
Alert the nearest control station
Step3: Report of the observed drowsiness and observed load, type, observed Vehicle Number, observed documents are stored in a report if any violation w.r.to policy norms and threshold

values. That report would be sent as alert to the vehicle owner as well as control station automatically.

Step4: Track the issues till they are resolved. If not solved, The week-wise report to be consolidated and sent to higher control station for further action.

Step5: Likewise, every vehicle is considered as an entity. Many entities are passing on a road. If the verification of an entity is satisfied, the no action to be taken. If the violation in any of the mentioned, alert the control station as well as vehicle owner.

The optimal techniques for extracting the objects information is done using few approaches such as optical character reading in case of vehicle number, CNNs in case of extracting specific ids from docs over the left glass window, advanced scanners in extracting the vehicle weight, as well as vehicle load type.

The 4 modules are on activation on a road and each vehicle is processed as a thread. Road will process many vehicles and all are as threads.

The Fig.2 specifies the modules of the system:

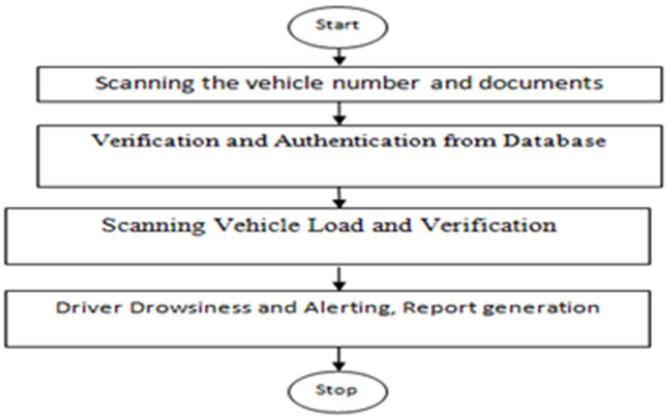

Fig.2: Flow of modules in the Smart Virtual Check points

4. Results:

The order of screen windows which are to be depicted in this section are the demonstration of output windows of the intended ideology called smart virtual checkpoints.

According to the modules defined, the output screens are simulated in that order. First, Scanning of Vehicle Numbers and vehicle documents are read by installing appropriate sensors. Second, the Scanning of the vehicle load, load types are read by installing the weighing machine, and advanced sensors are installed inside the road. Third, the verification is done against the online database connected via a cloud and verified the details available in the database with vehicle details scanned. Fourth, driver drowsiness is observed for 30 seconds at the first checkpoint and also at the second checkpoint, and also face fatigue is judged using online face apps connected by the internet.

#1: Roads with established Virtual Check Points in which scanning the vehicle number, and the documents.

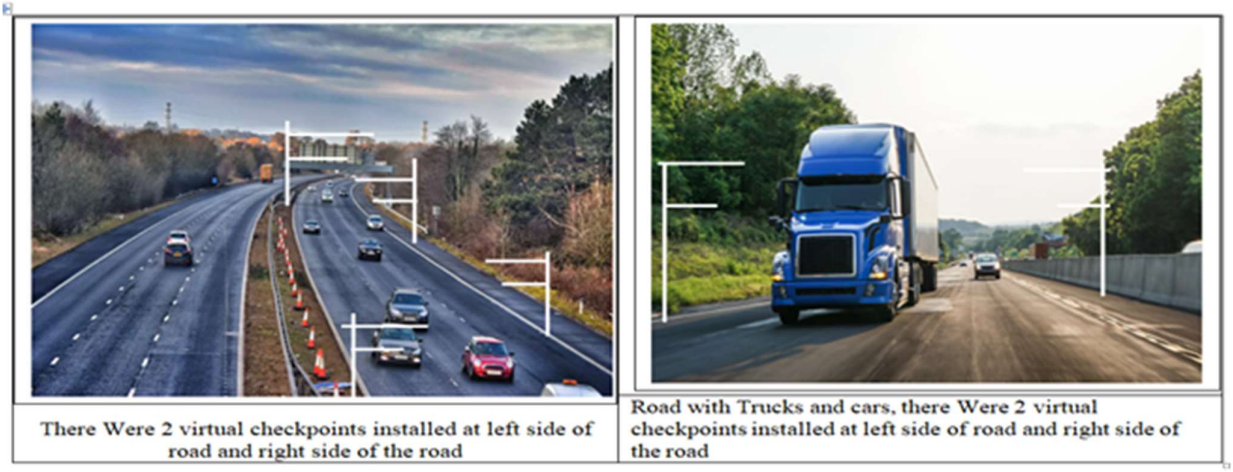

Fig.3: Two Virtual Check posts with left and right sides on a road installed with scanners to read the first module.

#2: Inside a road at virtual check points, weighing machine and advanced scanner are installed in order to determine the weight of the moving vehicle as well as load type.

Fig.4: Two Virtual Check posts with left and right sides on a road installed with scanners to read the first module.

#3: Scanned details from #1,#2 are transferred to the third module Authorization_N_Docs_Weight_Load(output_ Scan_VehicleN_Docs(Vehice v), output_ Scan_Vehicle_Weight_Load ()). Here, the details are extracted from the online database and authenticated the validness.

Vehicle Number: X Driving License Number: APXXX1 RC Number: APYYY1 Pollution Certificate ID: Y1 Insurance Number: X1	CTR_District_DB V_No. | V_Owner | Owner_Address | DL_No. | RC_No. | I_No | P_ID X | HKR | KT Road, TPT | APXXX1 | APYYY1 | X1 | Y1
Scanned entities	The attributes such as Vehicle Number (V_No),Owner(V_Owner), Address(Owner_Address), Driving License Number(DL_No), registration copy(RC_No.), Insurance Number(I_No.) and Pollution Certificate Number(P_ID)

Fig.5: Scanned details are authenticated against the database

#4: The driver drowsiness is observed by scanning the driver's eye clicks as well as face fatigue at the two virtual check points. The 30s timer for each vehicle is observed in that suppose the count of eye clicks are severe, that information is alerted to both that vehicle through the audio, and SMS, also alert the nearest control station.

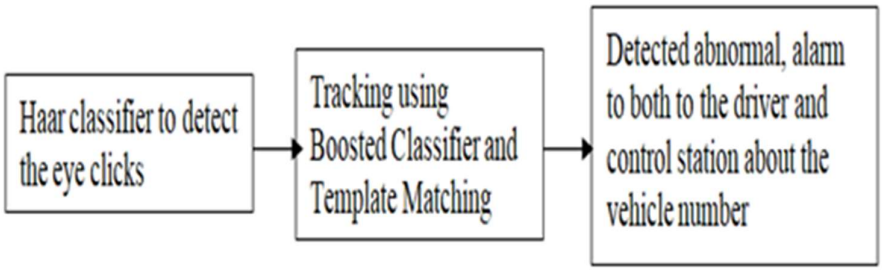

Fig.6: Eye blinks detection and tracking

Fig.7: Eye clicks detection and face fatigue detection

#5: The extracted details at the first virtual check point are observed as below:

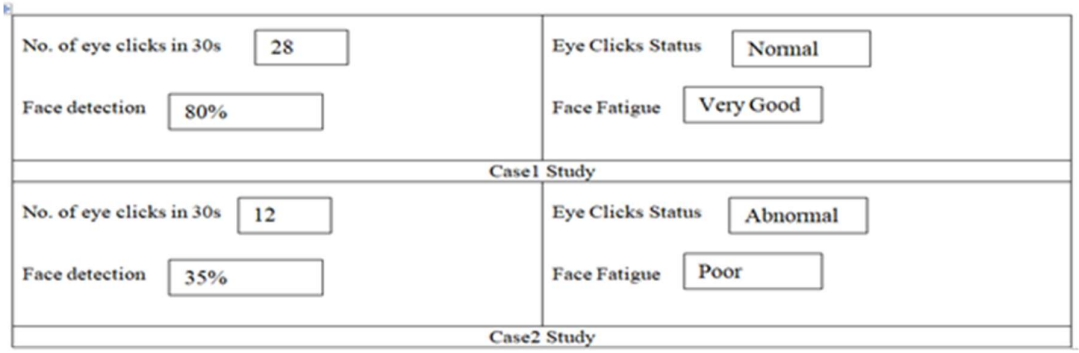

Fig.8: The normal, abnormal detection of eye clicks and face fatigue.

#6: The extracted details at the second virtual check point are observed as below:

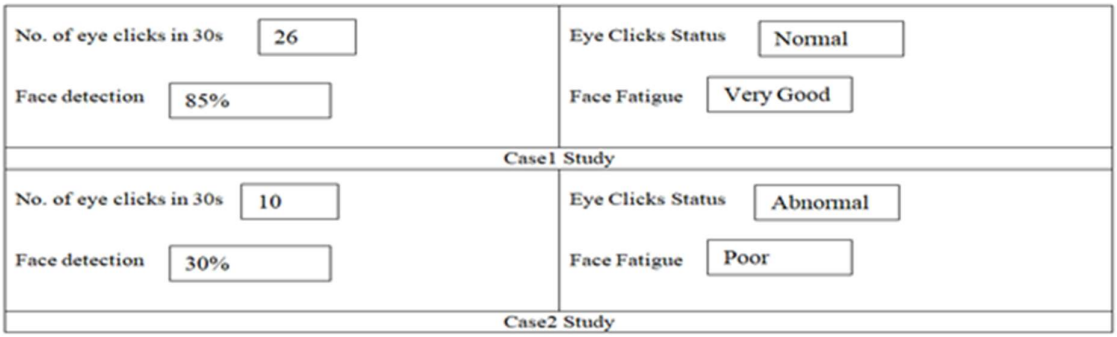

Fig.9: Normal and abnormal detection of eye clicks and face fatigue.

#7: From #5, and #6, the driver drowsiness in terms of eye clicks and face fatigue are identified poor in case2 study and hence alert is initiated automatically. The case1 study is normal, hence it is ignored.

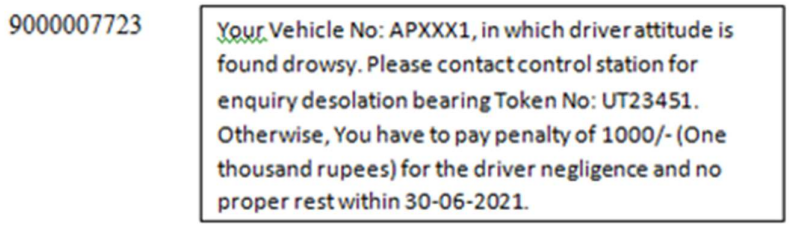

Fig.10: Alert the owner of vehicle for case2 study.

The below graph shows the automation amount in case of intended ideology against the traditional, semi-traditional approaches where smart virtual checkpoints (intended ideology) are fully automated and others in which traditional is manual, and semi-traditional is consisting of some entities are human dependent and few entities are computerized.

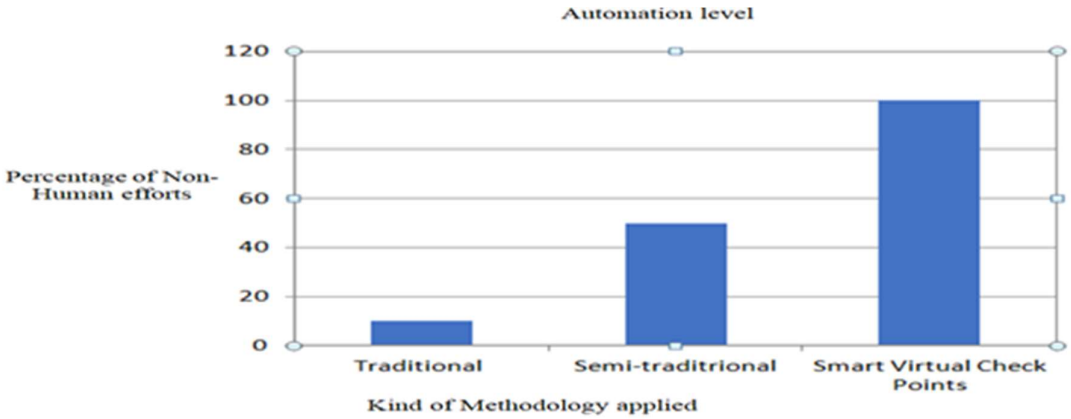

Fig.11: The automation of activities according to the methods specified.

5. Conclusion:

The recognitions of specific entities of a vehicle are extracted using specified optimal approaches mentioned from the studies in the literature review. After recognizing the entities, the verification module checks violation of policies are observed. The instant alert would be done when violation is observed. Each module observed in this ideology is decomposed into four modules where scanning in 2 ways and the other 2 in which one is verification, and the other is driver drowsiness. All these activities are integrated and work efficiently over a vehicle as an automated Task. So far, this kind of automation is not invented, and this invention may get demand in near future. The significant tasks considered in this are scanning, verification, drowsiness detections are all executed by customized virtual checkpoints. The benefits of this theme are user-friendly, making transport verification is an automatic process, minimize human efforts, and revenue generated to be transparent. In the future, this system may be made more effective and would be performed in very little time. The limitations are to make more reliable and make cloud environment automatic, work on a 24/7 basis. The challenging is night time capturing and validation is to be monitored as per expectations.

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