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Anfis based road accident prediction and detection by analyzing and tracking vehicular movement

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ABSTRACT

As technology emerges, the road traffic also increases with the increase in road accident. Solving this major issue is profound and important. Though hardware and software developments increased the influence of surveillance, road accidents can only be detected and not predicted. In current scenario the road images (videos with the help of cameras on road) are been collected in the control room and monitored by human resources which are prone to error. Hence Automatic incident detection can be used to overcome the limitations in surveillance.

One such method is this paper which involves both prediction and detection of accidents. The cameras on road collect the videos which are being processed, analyzed and the output denotes the occurrence of accidents. The project can be classified into two modules: Module1-Video processing module and Module 2- the decision making ANFIS module.

KEY WORDS: Automatic Incident Detection (AID), ANFIS Software Tool, 2D Matrix, Detection Rate (DR).

1. INTRODUCTION

Transport is of great importance in a day to days society. The effective management of traffic, especially of road vehicles, is an important issue to be solved. Though Surveillances is at our doorstep, it is not effectively processed. Traffic surveillance using monitoring cameras has already been widely applied in current traffic management. Current methods depend on human observation (analyst) of captured video sequences of images. Up growing town requires a large area to be covered, this increase the amount processing data

Each analyst is assigned a portion of the video and is given a list of events (behaviors) and objects for which to look. The analyst issues an alert to the proper authorities if any of the given events or objects are spotted. Manual analysis of video is labor intensive, fatiguing, psychological limitations in the ability of humans to monitor simultaneous signals leads to errors.

The idea of creating a virtual analyst or software tools - Automatic Incident Detection (AID) for video analytics has become of great importance to the research community. With computer vision and image-processing methods, intelligent traffic surveillance systems can detect, localize, track, and recognize vehicles in video sequences captured by road cameras with little or no human intervention.

Traffic congestion has become a part of daily routine in lots of large cities around the world. There are two kinds of traffic congestion. One is the recurrent congestion appearing in peak hours, the other is the non-recurrent congestion caused by traffic incidents (such as accident, disabled vehicle and construction and maintenance activities etc.).

For the past many years, one of the most important objectives on researches has been the development of systems that reduces accidents and congestions in urban traffic. It is said that half of the accidents can be avoided if drivers can aware of dangerous situation in 0.5 seconds before the moments of incidents, and if drivers can aware of the occurred accidents.

In this paper, we focus on vehicle's behaviour in order to control and maintain the road traffic accident free. A camera is placed above the road at an angle to view and capture the current situation of the road. The captured video is converted into continuous sequence of frames. From these sequences of frames the features or objects of interest are detected and segmented; hear the feature is a moving vehicle.

Then masking is done to track only the moving vehicle. After masking the sequence of frames are converted into 2D matrix. This matrix is given to the ANFIS block. The main goal of ANFIS block is to detect whether a road accident has occurred and to take corresponding control action such as informing the security cob, calling the ambulance, etc.

The whole virtual monitoring or software analysis is carried out using the Matlab simulink. The software analysis consists of two parts. The first part is the image processing part which includes image processing and enhancement, objection extraction and converting the image into matrix is done using Matlab's Video Processing Toolbox and Image Processing Toolbox. The second part is intelligent control part which is used to detect whether there is an accident in the road and to take corresponding control action. The control action is based on the ANFIS‟s knowledge base. The ANFIS is also modeled in Matlab code. The whole procedure is done with no or one human analyst.

Existing Methods and Its Limitations: Though there are many techniques in behavior and interaction recognition which have software tools instead of human analyst. techniques such as "A real time surveillance system for metropolitan railways," by J. Black, S. A. Velastin, and B. Boghossian, "Target segmentation and event detection at videorate: The EAGLE project," by K. Schwerdt, D. Maman, P. Bernas, and E. Paul, "Metro railway security

algorithms with real world experience adapted to the RATP dataset," by C. Seyve, "Tracking-based event detection for CCTV systems," by L. M. Fuentes and S. A. Velastin, and "Homography-based analysis of people and vehicle activities in crowded scenes," by S. Park and M. M. Trivedi. Some of these papers do not have real time simulation. And some papers have real time simulation but it deals with railways rather than roadways. Issues of Traffic policy have recently changed from traffic Management to offer information services to users. Users want to receive correct information about status of road traffic until their Destinations. For the reasons mentioned above, many Investigations are going into research on travel time estimation, Incident detection and data fusion. In the cases where the measured data from traffic observations is applied directly for incident detection, the incident detection contains many false alarms. This is because there are possibilities that the data has a noise in itself, due sometimes to traffic detector breakdowns. Furthermore another issue is that the detector itself is measuring different types of data and there can be data from many sources. Therefore, measured data must go through a data fusion process which aims to merge information from different sources and reduces false alarms. This research uses data of spot speed where outliers of measurement are removed by data fusion. This research is develops a model for incident detection using Artificial control algorithm. Using increase and decreases in rate of Speed that are calculated through a comparison of current and old data and spot speed. Detection rate (DR) and False alarm rate (FAR) of incident of the model is 83.3333% and 23.0769%. There are few other roadways techniques which are used to detect accidents on road. These techniques use GPS sensors to detect the presence of vehicle instead of camera. This covers only a small area. Existing techniques uses the speed of vehicle in upstream and downstream. The detection of accidents is only 80% to 85%.

2. METHODS AND MATERIALS USED IN PROPOSED TRACKED VEHICLE SYSTEM

Proposed Method: In the present scenario, we face many accidents per day. There are about 50 accidents per day in a city atmosphere, whereas almost 20 people die in those accidents. The main aim of this proposed method is to have an accident free road. The sequence of operation is illustrated in figure 1 below. In order to monitor the vehicle –vehicle/location interaction/behavior, a camera with good resolution is placed on the road. The height of the camera from the ground has chosen carefully such that it is able to capture a large area with more accuracy and resolution. The camera captures the current situation in a road (with and without heavy traffic). This video is converted into sequence of frames.

The captured video is processed using Matlab's Image Processing Toolbox software and Video Processing Toolbox software. The processing involves de-noising, filtering, segmentation, morphological operations, converting the image into gray image, converting the gray image into binary image and converting the binary image into digital matrix. The object of interest is segmented from the frames received. The main purpose of image processing is to extract the required feature. Here the vehicle is tracked by an over shaded rectangular box.

In this paper the required feature may be any crowded place in a normal road, more number of vehicles than expected. The matrix is given to ANFIS block. Here ANFIS is decision taking block. The main control action to be taken is stored in the ANFIS database. Whenever there is an abnormality detected the ANFIS is programmed in such a way to estimate the problem and to take corresponding control action. The accident between two or more vehicle is detected if the tracked rectangular boxes collide with each other.

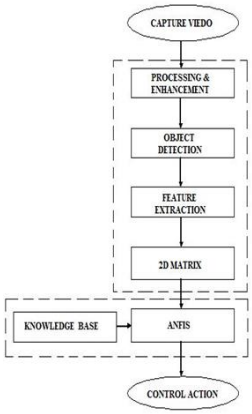

Figure.1. Overview of software analysis

3. IMPLEMENTATION AND RESULTS

The proposed methodology was implemented using Matlab simulation tool kit. The whole virtual analysis is seperated into two parts, namely the „Image Processing and Feature Extraction (Tracking) Part" and the „ANFIS control part".

Image Processing and Feature Extraction

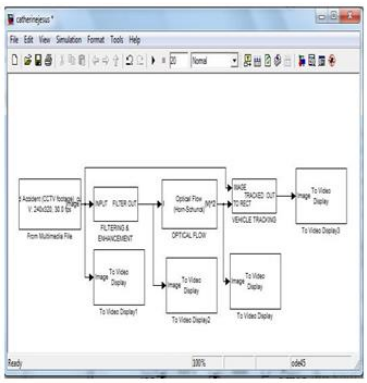

Figure.2. Overview of Image Processing Simulink

The image processing and feature extraction part is the first part which consists of three subsystems. Fig 2shows the image processing and feature extraction simulink model. The input to the image processing block is given from a file. This input is given to the Filtering and Enhancement subsystem and to the vehicle tracking subsystem. The input image frame is given to Color Space Conversion block. The various color spaces exist because they present color information in ways that make certain calculations more convenient or because they provide a way to identify colors that is more intuitive. This subsystem is used because the variation in the color map can be reduced. This intensity frame is given as input to median filter block. The filtered frame is given to Optical flow block to find the object's motion detection.

Any change from one frame to the next frame is detected. By fixing the camera at fixed location only the vehicles move. The object here is the vehicle. The output of the Optical Flow is a binary image frame. This output is given to the Tracking subsystem to track the motion of the vehicle. This binary image frame along with the original input image frame is given to the Tracking subsystem. In this subsystem with the help of functional blocks like: math functions, blob analysis, variable selector, draw shapes, assignment operator and other Matlab simulink tool, the vehicles‟ motion is tracked. With many parameters and using trial and error method the best solution for vehicle tracking is obtained. The tracked vehicle is over shaded with the rectangular shaped block.

The tracking of vehicle is done after a certain threshold in the image frame. Each tracked vehicle is assigned a value. Thus the number of vehicle in the image frame after the threshold value is indicated. The image processing and feature extraction part was trained with

Figure.3. Original image frame

Figure.4. Image after filtering and enhancement subsystem

Figure.5. Image frame after Optical flow

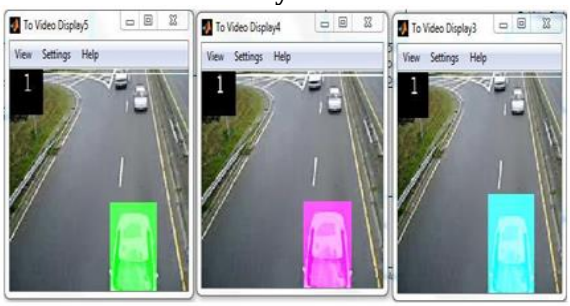

Figure.6. Tracked vehicle using different method along with assignment number

video in which accident was present and also with videos without accident. The output of all the three

subsystems was monitored and viewed using the video display. The displayed showed a clear understanding of the whole process in image processing and feature extraction part.

Figures 3 to 7 shows the different stages in the image processing and feature extraction frame. From the tracked vehicle it is seen that the method which had magnitude square as math function had best tracking system. From that tracked vehicle the over shaded rectangle‟s dimension is collected. The collected dimension shows some integer value which is greater than zero and the rest of the pixels in that image will have the value -1. This image value is reduced to 2D matrix form. The tracked image frames are in form of 4D matrix. This 4D matrix is first restricted to image frame with just five Columns. This process restricts the system to detect accident occurring within five vehicles. Then the restricted image frames are converted into a matrix with single column and five rows, which is a 2D matrix.

RESULTS AND DISCUSSION OF TRACKED VEHICLE CONTROL

Anfis Control Part: The 2D matrix is given as input to ANFIS M file and the ANFIS is trained. The figures below shows the performance of ANFIS control part. The 2D matrix given as input is trained to give the value zero for No Accident, four for Donot Overtake and eight for Accident Occurred. 1500 epouches are used to train the network.

Figure.7. Tracked vehicles in different set of frame

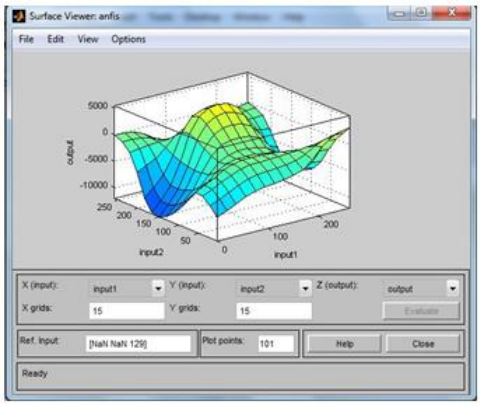

Figure.8. Surface viewer of ANFIS

Figure 8 shows the surface viewer of the trained ANFIS model. The input to the ANFIS consists of three columns of the tracked bound box of the vehicle. After the conversion of the image frames from 4D to 2D. The first column and the last column is removed for data reduction. This process is done separately to decrease the processing time. The input to ANFIS trainer consists of image frame with and without accidents.

The comparison of ANFIS output and the training data is displayed in figure 9The output from the ANFIS block is taken and rounded off and plotted as in figure 10 below. Due the errors present in the training process the output is not classified as mere numbers zero, four and eight but as the range of values. This figure shows whether the accident has occurred or not.

From the figure 10 above it is seen that at what time the accident has occurred, whether there is chance of accident and also indicate when no accident occurred. The range (0-3.5) indicates that no accident has occurred. The range (3.5-6.5) indicates that two vehicles are present and there is a chance of accident. It warns the vehicles not to overtake because there is chance of accident. The range (6.5-8) indicates that accident has occurred.

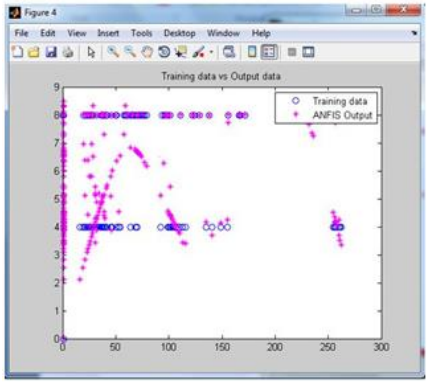

Figure.9. Comparison of Training data and ANFIS output

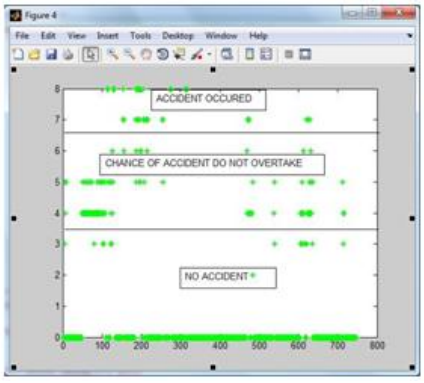

Figure.10. Indication of accident

4. CONCLUSION

Visual surveillance is an upcoming research technique. In the proposed method the captured video is processed and the feature, that is, the moving vehicle is tracked and over shaded using bound box. The dimension of each bound box is extracted and converted into a 2D matrix. This matrix is given as input to the ANFIS control part for training. The output of ANFIS indicates the occurring of accident. This thesis is to infer whether an accident is occurred or not. This also indicates the chance of accident to occur, so as to prevent the accident occurring. After an accident the security personal can also be informed. This virtual visual surveillance can also be used in industry, to detect the collusion between objects.

Future Work:

- Can be extended to other behavior/interactions.
- To reduce the error rate.
- Extended to cover a large area.
- Extended to be an automatic in-built system.
- To operate without any (even one) human analyst.

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