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Automatic Social Behaviour Detection of Driver in Context Environment of Tier 2 City

Anushri Agrawal[1], Prof. Sanjay Wankhede[2]

[1]P.G. Scholar, Department of Electronics,
G. H. Raisoni College of Engineering, Nagpur, India

[2]Assistant Professor, Department of Electronics,
G. H. Raisoni College of Engineering, Nagpur, India

Abstract: ***Nowadays, Tier 2 cities in India are mostly suffering from accidents because of excess and improper utilization of space among congested roads causing some impact on social as well as physical behaviour of driver with improper traffic signal monitoring, various distractions including use of mobile phones while driving, casual or zigzag drive of the young aged peoples. These are the context aware situation combining human error causes increment in accidental situations. In such cities approximately 70% of the accidents are caused by human error, from which the major factor involved in accident is the action of driver towards social rule i.e. nothing but driver's social behaviour. So, for automatic monitoring of drivers behaviour toward social rule, preventing driver from doing secondary activity while driving, to remove the manual burden of traffic police and therefore to prevent peoples from accidents the approach is proposed in this paper on automatic detection of human error, which makes the use of powerful search technique i.e. particle swarm optimization and other image processing tools to gain the optimized solution towards traffic problems.***

Keywords: Context-awareness in Tier 2 city, Social behaviour detection using PSO, Intelligent transportation, Road safety

1. Introduction

A survey was conducted in Tier 2 City of India as a part of M.Tech thesis for main reasons causing rule violations at traffic junctions. As per survey, made in 2015, the three major causes responsible for accidents are disobeying of social rules i.e. jumping of traffic signal, doing secondary activities while driving i.e. using mobile phone while driving and the driving patterns such as zigzag or rash driving. If such activities are involved in the context aware environment like congested roads full of traffic like highly loaded trucks, two wheelers, four wheelers do not following Lane, beggars, animals. So, the graph of the accidents achieves the greater height which may kill the human lives [1]. Figure 1.1 and Figure 1.2 are showing context aware situations in Tier 2 city and social rule break leading accidents respectively. These distractions and violation involves the time factor and age factor which may leads to various causes of accidents. As per the results of "Monitoring module for analyzing social behaviour", jumping of traffic light is common violations amongst all age groups and when we consider all three violations, age up to 25 is greatly involved in such violations. And in Tier 2 city, if traffic violation and distraction is counted per hour for 50 signals the count is approximately 1700, which is very critical and alarming rate. So, the model needs to be developing for the detection and correction of social behaviour of driver.

Figure 1.1: Context Environment in Tier-2 city

Figure 1.2: Social rule break leading accidents

The proposed model is based on the real time video recording at different signals of the Tier 2 city, Nagpur. The various image processing tools are used for detecting such violations. Such as Particle swarm Optimization. This belongs to a class of swarm intelligence greatly inspired by the behavior of bird flocking. Which is proved to be one of the best algorithms to find region of interest as per two best values i.e. g-best and p-best values and for detection of object of interest during violation is of great importance in video surveillance system. So, for detection of jumping of traffic signal and for detection of mobile phone, Particle Swarm Optimization and other image processing tools are utilized in the proposed approach.

2. Related Work

Driver's behavior detection is a very significant topic for all the researchers from last decade for increasing the safety of human lives. The various researchers have done the work on observing the physical behavior of the driver such as, identifying drivers fatigue using neuro-genetic approach by observing drivers eyes and mouth status which uses the non real video frame [2], facial expression i.e. mood recognition is done using committee neural network where the recognition achieved is quite slow. Other than this, lot much work is done on drowsiness, drunken, rash drive etc. using fuzzy, neural genetics, pattern recognition, etc. [3]

The social behavior of driver is more responsible for accidents than physical behavior since human error is one of the major causes of accident. Various researchers have been working in the area of social behavior monitoring among which recently, observational study and analysis of traffic vehicles doing jumping of signal, use of mobile phone while driving, zigzag or rash drive is carried and obtained the results in the urban roads of Tier 2 city in India. After observing the analysis and percentage of accidents in Tier 2 cities because of social behavior, there seems a need to develop software identifying social behavior of driver.

Researchers are nowadays focusing on Particle swarm optimization. Since, it is one of the best searching optimization tools. Many researchers are working on the segmentation of image using PSO for achieving object of interest [5]. But very few researches were observed which is using PSO for segmentation in intelligent transportation system. So, according to above mentioned research there is a need to develop context-aware system for driver's social behavior monitoring using the recently used powerful approach of optimizing the traffic problems in Tier 2 city of India with the help of real time video.

3. Proposed Work

The context aware situations are referred as practical situations or problems faced in real time. In Tier-2 city the context situations are faced due to driver's performance, poor road maintenance, traffic congestion, etc. So, in the context-environment of Tier2 city, detection and tracking of driver's social behavior is of primary importance. Therefore, context aware system for drivers behavior monitoring is proposed and discussed here. Since, PSO is used for preprocessing so it must be studied first.

3.1 Particle Swarm Optimization and its Algorithm:

The swarm based intelligent technique PSO is developed by the great scientists Kennedy and Eberhart in 1995 .This technique is greatly inspired by the class of swarm i.e. bird flocking where the birds are searching for the food and following the path of bird which is nearest to the food by updating two values i.e. pbest and gbest value.

The algorithm steps which they follow are given as:

1. Initialization of particle with random position and random velocities.
2. Each particle fitness value must be calculated with the personal best (pbest) value which is best value obtained in each iteration.
3. Calculate the best value among all pbest values which is nothing but the global best value obtained among all iterations.
4. In such a way go on updating particles velocity and also its position. Repeat the above steps until the best value or the object of interest is reach.

3.2 Context Aware Intelligent System

Figure 3.1 shows the block diagram for context aware intelligent system for detection of jumping of signal and detection of mobile phone while driving which involves the steps real time video collection, segmentation, feature extraction and tracking of feature. For detection of mobile, template matching plays the major role with segmentation. Data base of different person jumping the signal and talking on phone while driving can be collected and then the template matching can be performed using this database combining feature extraction of green signal, to detect the mobile phone during green signals whereas for jumping traffic signal detection segmentation is directly performed without template matching with red light detection.

Block Diagram:

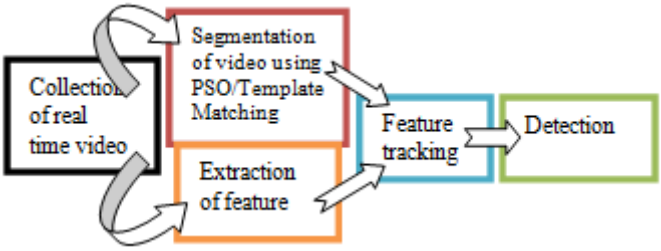

Figure 3.1: Context aware intelligent system

3.2.1 Collection of real time video in tier 2 city

The various signals in Tier 2 city were observed and collected the real time video of several squares with signals where more traffic is observed regularly. The cameras are located on Diksha Bhumee square, Bajaj Nagar square, Mangal-Murti square and near law college square in Tier 2 city Nagpur. Collection of video consists of 20 small video clips of around 20 or 30 seconds each, with many vehicles jumping the signal and some persons are talking on phone. This video is broken into various small videos observing the condition of persons, using video cutter or other image processing tools.

Table 1: Video Description

Video description	
camera resolution	640 X 420
Distance of camera from location	8-9 meters
Direction of video from camera	LHS (top view)
Format of video supported	Video clip(.avi)
Frame rate	29 frames/sec
Total bit rate	3164kbps

3.2.2 Segmentation of video

Segmentation is a significant step to achieve object of interest because it segments the video into homogeneous regions containing regions of same characteristics. The segmented result is more meaningful as well as it is simple to analyze. The partitioned image or video consist of same color according to characteristics like intensity, texture, color. There are various methods of segmentation like edge based, region based, pixel based segmentation etc, but having some

limitation like noise insertion. Therefore use of PSO based segmentation found to be more prominent to solve traffic optimization problem since, region of separation is sharp and clear in case of PSO. Perfect threshold value is achieved within short duration of time with minimization of cross entropy with the help of PSO.

Application of PSO algorithm for segmentation

Nowadays scientists are greatly involved in the area of segmentation using PSO to obtain better result. The application of PSO algorithm for segmentation of video requires the following steps:

1. Read the image or the video which is to be segmented.
2. Apply the particle swarm optimization method to video at certain threshold level.
3. Go on updating the particles fitness value and best value by comparing it with threshold.
4. If the better value as compared to threshold is obtained then extend the life of swarm and move it in search space
5. If the better value of swarm is not obtained then delete that swarm from the population and check for another.
6. Repeat the above steps and go on resetting the counter threshold value.

3.2.3 Subdivision and Extraction of features from video

When the input image or video consist of many parts in the image, in such a case the video should be transformed into reduced set such that only part which will be needed is obtained first. Then after combining it with segmentation of image the detection of required objective is achieved. For jumping of signal and mobile detection while driving, the following feature is to be extracted:

(a) Traffic light detection

The main objective of various automated system is the localization of vehicles violating the red light signal and capturing the image of such vehicles. Running red light signal is a very serious and common issue which will not only affecting our physical safety but also brings us with a big problem of daily regularity control .Traffic light detection involves red light and green light detection. It plays the major role while identifying the jumping of signal as well as during detection of mobile phone. The traffic light detection can be achieved by color intensity thresholding method used in image processing which is shown in the Figure 5.3.

(b) Vehicle detection

Vehicle detection is very important stage since the entire three concept i.e. signal break, mobile use, zigzag drive are must be identified with the vehicle. The vehicle detection can be done by using background subtraction or binarization method.

Steps for binarization:

1. In binarization method, height and the width of image or the video is calculated first.
2. Find the index of pixel, since we are using three depth bits to present color of one pixel.
3. Get the pixel depth of red, blue and green colors' using image processing.
4. Set color threshold among, to decide which pixel becomes white otherwise those pixels become black.
5. The vehicle detection using binarization is shown in the Figure 5.4

(c) Mobile detection

As using mobile phone while driving adversely affecting the driver's performance in maintaining the lane position, in maintaining appropriate and predictable speed, reaction times, judgment and acceptance of safe gaps in traffic. So, mobile detection is also one of the major factor responsible for accident needs to be detected in green light i.e. while driving this can be achieved by collecting different database of hand movement and object detection in hand using the template matching technique is as follows:

Figure 3.10: Database for template matching

1. Let the co-ordinates of template of mobile be $\mathbf{M(x_t, y_t)}$, where $\mathbf{(x_t, y_t)}$ are the co-ordinates of pixels of template and its intensity is given as $\mathbf{Im\ (x_t, y_t)}$.
2. Similarly, co-ordinate for search space are **S(x, y)** and its intensity is **Is(x, y)**
3. For template matching absolute difference of intensities of search space and template of mobile must be calculated using the formulae.
   $\mathbf{Diff(x, y, x_t, y_t) = | I_s(x, y) - I_m(x_t, y_t) |}$
4. By using above steps mobile is getting detected and results using template matching is shown in Figure 5.8

3.2.4 Feature tracking and detection

The last stage involves tracking of feature where the detection of social behavior in the context aware environment gets achieved. As per the block diagram is concerned after segmentation of video ,when the extracted features are combined and simultaneous result generation condition is achieved which is nothing but the tracking and detection of social behavior i.e. automatically the image is captured by the software as soon as social rule broken is detected.

4. Advantages of Context Aware System

As per the problem statement is concerned there should be reduction of accidents in the context aware environment. So by using the automatic monitoring of social behavior the chances of reducing the accidents may get achieved. Other than this the following advantages can also be achieved:

1. The burden of traffic police for traffic monitoring gets reduced by using automatic monitoring. As people will know that cameras are fixed here and due to fear of getting detected they will not break the rule.

2. As PSO is used for segmentation more clear and sharp image segmentation is achieved such that the object of interest is reached.
3. Perfect threshold value is obtained with reducing cross entropy and less time consumption.
4. As Particle swarm optimization is used for detection more accuracy is gained.
5. As no work is done for traffic monitoring using PSO segmentation is also gets succeeded with better results which help in reducing no. of accidents.

5. Results

When the real time video is gone under segmentation using PSO, the zebra crossing i.e. the white line where the crossing in red light denotes the jumping of signal is getting highlighted which is nothing but our object of interest in case of jumping of signal and the other objects in the image containing the same characteristics are also highlighted and if any movable objects coming in contact with this white line during red light gets detected and counted, provided that the camera should be located at perfect angle i.e. at the top-view on the traffic signal. This is one of the best methods used for tracking and detection of moving object and here it is showing perfect results reaching object of interest. Figure 5.1 and 5.2 shows original image and segmented image with white line detection as object of interest.

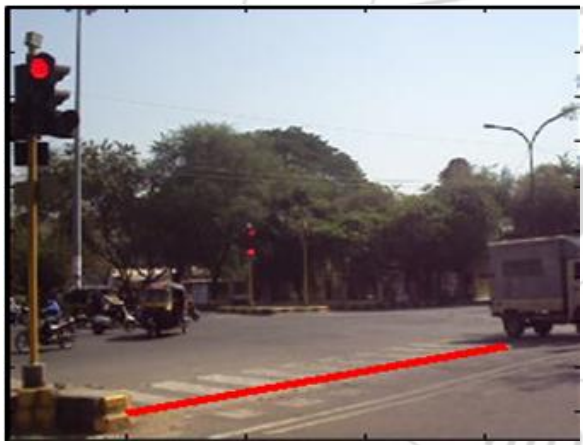

Figure 5.1: Original image

Figure 5.2: Segmented image

When results of segmentation are combined with the results of extraction of feature gives the proper results for the detection of jumping of signal. And the various results obtained by extracting the feature such as traffic light detection , vehicle detection and mobile detection in green light with template matching are as follows:

Figure 5.2: Red light detection

Figure 5.3: Vehicle detection

Figure 5.4: Signal with red light

Figure 5.6: Mobile not detected

Figure 5.7: Signal with green light

Figure 5.8: Mobile detected

The above results in Figure 5.7 and Figure 5.8 are obtained when the database collected is matched with the original video using template matching and extracted feature i.e. green light is combined with template matching results, the person talking on phone while driving in green light gets detected.

As the results for feature extraction is obtained and that result is when combined with the segmentation the jumping of signal is detected and the GUI is made for jumping of signal is as shown in Figure 5.9

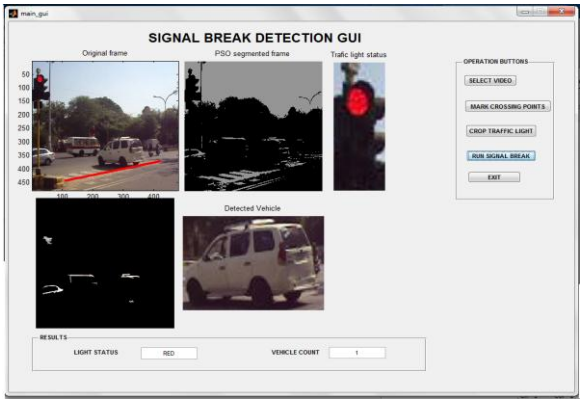

Figure 5.9: GUI for jumping of signal detection

In the above Figure we can observe the steps performed as keys are given on RHS of GUI, where the keys are select video, mark crossing points, crop red light, run signal break and exit. And the results are obtained at the bottom showing status of traffic light and count for jumping of signal in red light. After combining the segmentation results and template matching results for detection of mobile more accurate results are obtained. The Figure 5.10 shows the results for mobile detection in green light by using PSO.

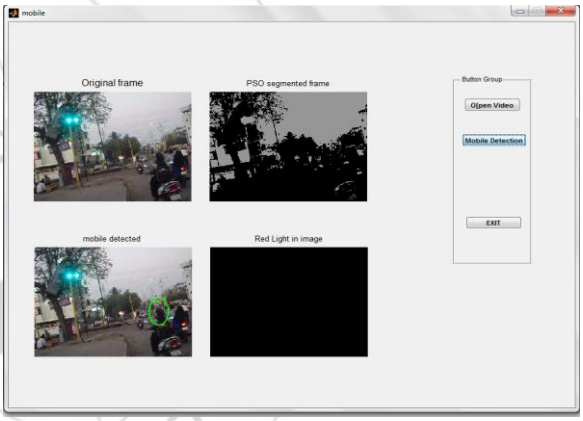

Figure 5.11: GUI for mobile phone detection

In Figure 5.11 the first image is showing the original frame, second is showing the segmented image and third is showing the mobile phone detection by combining the use of template matching and segmentation.

6. Conclusion and Future Work

Context aware system is tested on two real time videos for jumping of signal and detection of mobile each, after testing the results for small video clip of around 20-30 sec, conclusion can be drawn that from 5 persons jumping the signal 4 are detected and counted correctly. Similarly, 1 person talking on phone is detected for 2 video clips each with the help of template matching and segmentation. Testing the results proved that the developed algorithm is producing accurate result in detection of driver's social behavior. Automatic traffic monitoring by detecting jumping of signal and mobile phone use while driving is achieved with context aware intelligent system.

There are many social parameters which are affecting driver's behavior from which work is performed on mobile detection

and jumping traffic light signal. In future the work must be done on other social parameters from which zigzag drive of young aged people is a very common issue which can be also be solved and comparative analysis of all three parameters must be calculated.

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