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BREAK THE TRAFFIC: TRAFFIC CONDITION PREDICTION TO FIND BEST SUITABLE PATH USING REAL TIME VEHICLE INFORMATION FOR MOBILE PHONE APPLICATION

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Abstract

Since traffic jam is a big problematic issue in today's world, it is needed to reduce this problem. The main reason behind the traffic jam is lack of actual information about the traffic. To protect the citizens from the traffic jam monster, here we propose 'Break the Traffic' which provides the traffic information to the user. The users can get the information in two ways, one is SMS-based and another is Internet-based application. Both of the systems make traffic forecast through vehicle detection in the routes and store in a traffic forecasting server. In SMS-based system, traffic information is sent to the users who subscribe the SMS-based solution. In Internet-based application, a traffic map has been developed by which pedestrians select a desired path. If the selected path addresses any change, the user is notified with that information. Based on this, users can change his/her travel routes.

Keywords: Traffic jam, Vehicle detection, SMS-based application, Intenet-based application, Traffic map.

Introduction

Traveling more than 300 miles in an hour is not a dream. However, in most of the working days reaching destination right on time becomes a dream for the citizens of some

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cities like Dhaka. 15 years back, it was not as horrible as it is now and also it is true, 15 years from now on, only God knows how the roads and streets of the city will look like. Traffic Jam is that monster (Aridor and Hannan, 2000). Unfortunately, for a largely populated city, it is impossible to remove in an overnight. But it may be possible to avoid traffic jam. When people move one place to another in a jammed city, there exists more than one route between the source and destination and people chooses anyone of these. Unfortunately, it is really important to choose the right path on right time, because it may help you to avoid the traffic jam. However, most of the cases people cannot get proper information about the condition of the routes. So, a system is needed by which the proper information about the traffic can be found within a few seconds in a minimum cost.

Survey says that the mostly populated cities contain large volume of traffic. For example, in 2012 Dhaka city contained 708 thousands vehicles whereas 1,752 thousands vehicles are in the entire country (CASE project, 4581-BD, 2012). Among those, 54% are Motor cycles, 14% cars/ taxi, 12% rickshaws, others are 16% (CASE project, 4581-BD, 2012). It is also found that the number of cars/taxies are increasing day by day at a large rate. As the number of vehicles are increasing, traffic jam is increased. So, these large number of vehicles should be maintained. Hence, a mobile application is needed which can mitigate the sufferings of the people by saving his/her time.

Although there is hardly any effective system to get rid of the traffic jam. However, some techniques have already been established (Myr, 2002; T¨or¨ok and Kertesz´, 1996). It has turned daily trips into nightmares. Endarnoto et al. propose a technique which focuses on the people of Indonesia. They extract the traffic information continuously from the Twitter and process natural language. Based on that natural languages, authors predict how much traffic exists into a single road (Endarnoto et al., 2011). However, the technique is rule based which uses the predefined model to define the condition of traffic. Sugiyama et al. provides experimental evidence that the emergence of a traffic jam is a collective phenomenon like dynamical phase transitions and pattern formation (Sugiyama et al., 2008). Horvitz et al. propose Jam Bayes where Prediction, Expectation, and Surprise traffic is measured (Horvitz et al., 2012). However, none of these techniques collects traffic information in an effective way rather uses information from different sources.

In this paper, we propose ‘Break the Traffic’ where the main goal is to develop a mobile phone application which can give a relief to the people from the traffic jam nightmares. This application can help a person when he/she feels helpless in the traffic jam. In ‘Break the Traffic’, at first the condition of the traffic has been extracted using Global Positioning System (GPS), CC camera and vehicle detection. For finding a condition

image processing vehicle detection technique has been implemented. Based on the identified vehicles number, the traffic jam severity has been measured. If the conditions of users chosen path has been changed, an alert is sent to the user by providing the current status of that road. To provide the alert, traffic status are also taken from previous history.

Materials and Methods

In this paper, a novel traffic jam avoidance technique named as 'Brake the Traffic' has been proposed. The proposed solution collects traffic information by detecting vehicles in a route and stores this information in a server. Afterwards, two types of service has been performed and those are SMS-based and Internet-based systems.

Fig. 1. Help line.

In SMS-based system, all types of people specially the people who uses basic phone to get the opportunity. Using Internet-based application, only smart phone users get facilities from 'Brake the Traffic'. The proposed approach basically creates a

communication between server and pedestrians so that pedestrians can easily aware of the condition of the traffic. In 'Brake the Traffic', pedestrians request the server to know the current condition of a specific traffic and based on that request, server replies to the pedestrians. The server also alerts the users when the conditions of the users considered paths have been changed. The overall materials and mechanism of 'Brake the Traffic' is illustrated in Fig. 3.

Fig. 2. Reply message.

SMS-based Mobile Application

This system can be used by anyone who has a mobile phone either basic phone or smart phone. This technique is built on the concept of message passing. Here, pedestrians only send a message to the server by containing the code numbers of current location and destination. If the code numbers are not known to the pedestrians, users can send SMS to help line just typing Help for knowing the code numbers of the routes. After sending a

SMS by writing "Help", a reply message is generated which is similar to Fig. 1. Based on that code numbers of the routes, pedestrians send message to the system by typing the code numbers of the routes.

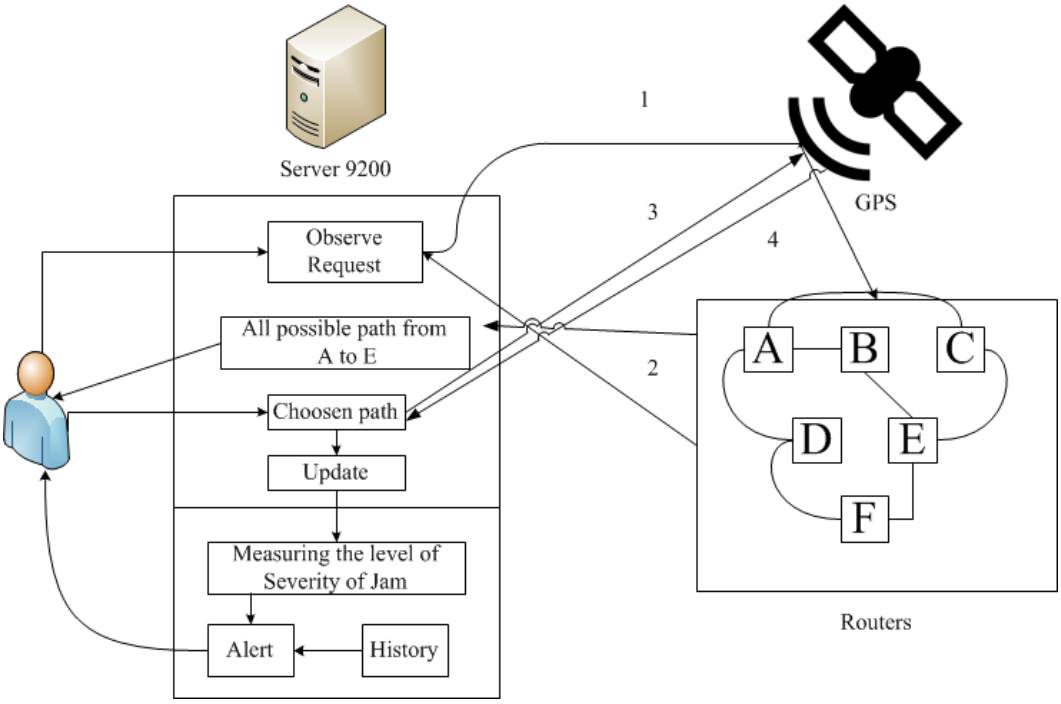

Fig. 3. Overall procedure of 'Break the Traffic'.

For example, a customer wants to go from Nilkhate to Farmgate, she or he will send a message to a number like 9200. Provided that the message format will be *<code number of Source Location><Space><code number of the Destination>*.

When a message is sent to the server, the system sends a reply message with all possible paths from the source to destination. Provided that all possible paths will be chosen based on the shortest path containing less traffic jam. The suggestion is provided based on the Algorithm 1. The path will appear sequentially on the basis of priority as shown in Fig. 2. The first one has the highest priority and so on. After getting the list of condition of multiple traffic on the road, the users choose a best suited path and sends that path number to the system if the users want to know the update in all the time about the considered road. If any changes occur, the system notifies to the users. If one customer wants to get the update message via audio, she or he just selects the audio option otherwise text is selected by default.

Internet-based Mobile Application

In this phase, the users are informed through an internet-based mobile application. Here, at first a traffic map has been developed. Afterwards, among two traffic points (nodes) of a traffic map is selected by clicking over those points. After selecting source and destination, users can see the entire possible shortest path between source and destination. For example, if one customer wants to see the current traffic condition between Nilkhet and Farmgate, after selecting those nodes the users can see all possible paths. If the number of possible paths is more than 7, the system will only show the first 7 possible shortest paths. The whole process is depicted in Fig. 5.

Algorithm 1. Selection of Effective Routes

Data: Number of vehicles, $n_{vehicles}$,
Distance of Route to Route, D_r
Result: List of Routes, L_{routes}
$Calculate_{jam} = (1\text{-}\gamma) \times n_{vehicles} + \gamma \times D_r$
while $Calculate_{jam} \leq \tau$ **do**
  $L_{routes} \leftarrow route$
end
Sort L_{routes}
if $L_{routes} \geq 7$ **then**
  Show the first 7 best routes
else
  Show all the routes
end

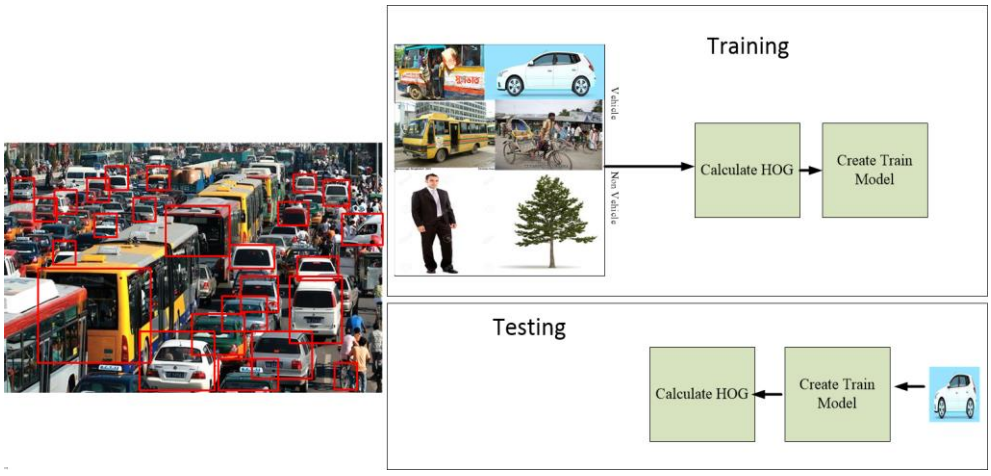

Fig. 4. Procedure of object tracking system.

Fig. 3 shows the overall procedure of Internet-based Mobile application to know the conditions of the traffic. In Fig. 3, at first user selects routes where the users want to go. Server gathers this information and sends the requested routes information to the GPS or object tracking system. The object tracking system collects the information from the traffic and based on that traffic density has been measured. The proposed object tracking acts like Fig. 4. For tracking the vehicles, a machine learning based algorithm has been developed. Here, at first the system has been trained using multiple types of vehicles such as Bus, Cars, Trucks, Motorcycles, Rickshaws, etc. For the purpose of training, HOG descriptor is used (Dalal and Triggs, 2005; Watanabe et al., 2009) which is described in the next subsection. From this, a training model is developed. During the phase of testing, when a vehicle is come, HOG has been calculated for that image. For the detection of vehicles, Support Vector Machine (SVM) is used (Suykens and Vandewalle, 1999). SVM classifies the images as vehicle or non-vehicle. By following this procedure, vehicles are detected and this information is used for providing the priority of the routes. The large number of vehicles represents that the route is densely populated.

These calculated information is also sent to the server. Later server colors the path of the road based on the traffic density and displays this to the users. This process is described in Fig. 5. Provided that all possible paths are chosen on the basis of shortest path containing less traffic jam. Here, four colors have been used. Each path is colored differently for different traffic conditions. Here, the red color means that route is highly jammed. After finding the roads conditions, user selects one of the paths and informs to the server. After getting the chosen path, server finds continuous information of the selected routes until the user reaches his or her destination. The server alerts if any change has been occurred in the chosen routes. This is measured by using both the current information of a traffic as well as the previous history of that routes. Previous information has been considered because it may happen that a route which does not contain jam with a long period of time.

Alert will be automatically stopped when a customer reaches his or her destination. Provided that automatically knowing a person's location is possible through GPS system.

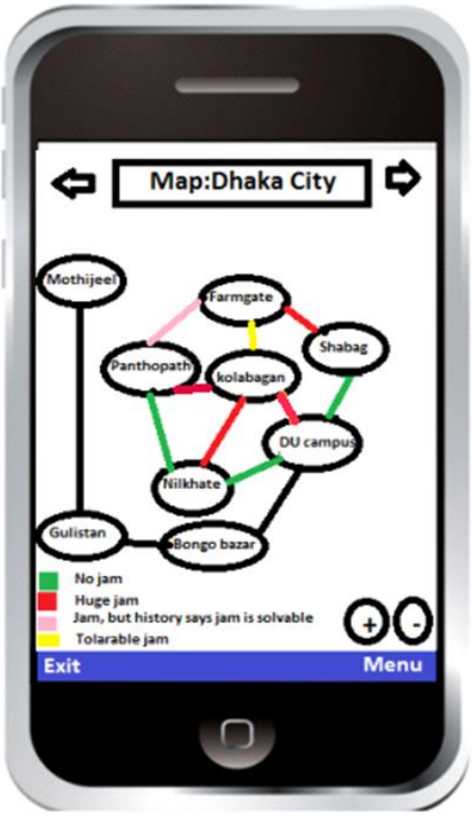

Fig. 5. Use of "Break the traffic" to show traffic map in smart phone.

Histogram of Oriented Gradient (HOG)

The proposed solution collect information using vehicles information in a route. For vehicle detection, Histogram of Oriented Gradient (HOG) (Dalal and Triggs, 2005; Watanabe et al., 2009) can be used which takes weighted votes depending on the gradient L2-norm for an orientated histogram channel (Dalal and Triggs, 2005) of the vehicle image. HOG consists of several steps. The image is divided into small connected regions (e.g., 8 × 8 pixels) named as cells, and a histogram of gradient orientations is computed (e.g., using 1D centered derivative mask [-1; 0; +1]) for the pixels within each cell. Each cell is quantized into angular bins based on the gradient orientation. Pixels in each cell are used as a weighted gradient to the corresponding angular bin. The histogram frequencies are also normalized using L2-normto adapt with the variation of illumination. The final HOG descriptor is represented by combining these histograms.

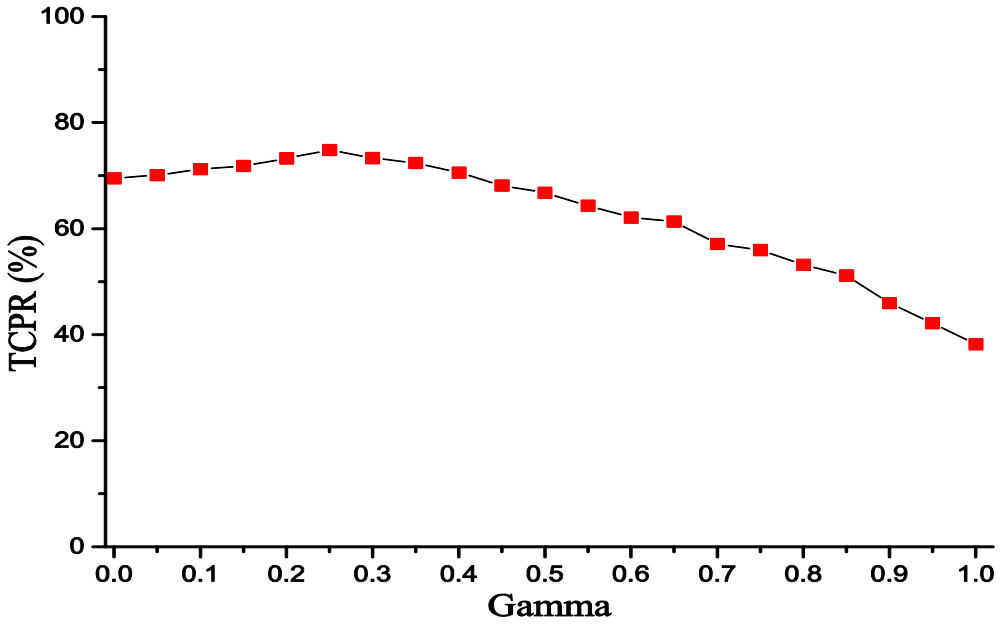

Fig. 6. TCPR for different values of γ.

Results and Discussion

Evaluation plan is in place to test the prototype and meet the usability requirements. To evaluate the system, we will conduct an experiment with several routes in Dhaka city. At first, we will observe the condition of Dhaka city and then a mobile application will be developed. Afterwards, the feedback of the efficacy will be collected from the citizens.

We have implemented 'Brake the Traffic' in the laboratory. Here, we have used the Matlab Simulink for this purpose. The simulation is performed for different values of γ. We also use different density of traffic. The Traffic Correct Prediction Rate (TCPR) is measured for each simulation. TCPR is the average of the ratio of the predicted traffic rank by this system and the actual traffic ranking of all routes. The simulation results are presented in Fig. 6. This figure shows that, for $\gamma = 0.25$, 'Break the Traffic' performs well.

Threat to Validity

Several kinds of threats may be occurred which may degrade the accuracy of 'Brake the traffic' mobile based application. Some of the threats are given in the following.

- If the routes do not contain any camera to capture the scenario of the traffic.

- The image capturing devices may have low quality.
- If the camera fails to capture accurate image of traffic, then the object detection module will be failed though this is a common problem in most of the camera based application.

Conclusion

'Break the Traffic' is a personalized mobile application based on the traffic information system. Using mobile de-vices, users are informed about optimal routes for traveling, optimized with respect to his or her personal preferences. This notification has been performed using SMS-based and Internet-based application. If any condition occurs in any road, the users are notified through the system. By the system implementation, the people of Dhaka city will be highly benefited. In near future, all other cities can be brought under the system by doing some minimum reconfigurations. This helps to take a decision of pedestrians which path should be considered. A smart phone application development of the proposed system is ongoing.

References

Aridor, M. and L. A. Hannan. 2000. Traffic jam: a compendium of human diseases that affect intracellular transport processes. Traffic. **1**:836-851.

Clean air and sustainable environment (CASE) project, IDA CREDIT No. 4581-BD. 2012. Revisions of vehicular emission standards for Bangladesh. Government of the People's Republic of Bangladesh, Department of Environment.

Clean air and sustainable environment (CASE) project, IDA CREDIT No. 4581-BD. 2012. Emission-inspection-of-in-use-vehicle-in-Bangladesh. Government of the People's Republic of Bangladesh, Department of Environment.

Myr, D. 2002. Real time vehicle guidance and forecasting system under traffic jam conditions. US Patent 6,480,783.

T¨or¨ok, J. and J. Kertesz´. 1996. The green wave model of two-dimensional traffic: Transitions in the flow properties and in the geometry of the traffic jam. Physica A: Statistical Mechanics and its Applications. **231**:515-533.

Endarnoto, S. K., S. Pradipta, A. S. Nugrohoand J. Purnama. 2011. Traffic condition information extraction & visualization from social media twitter for android mobile application. International Conference on Electrical Engineering and Informatics (ICEEI), IEEE, pp. 1–4.

Sugiyama, Y., M. Fukui, M. Kikuchi, K. Hasebe, A. Nakayama, K. Nishinari, S.I. Tadaki and S. Yukawa. 2008. Traffic jams without bottlenecks-experimental evidence for the physical mechanism of the formation of a jam. New Journal of Physics. **10**:033001.

Horvitz, E. J., J. Apacible, R. Sarin, and L. Liao. 2012. Prediction, expectation, and surprise: Methods, designs, and study of a deployed traffic forecasting service. arXiv preprint arXiv: 1207.1352.

Dalal, N. and B. Triggs. 2005. Histograms of oriented gradients for human detection. IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR). **1**:886-893.

Watanabe, T., S. Ito, and K. Yokoi. 2009. Co-occurrence histograms of oriented gradients for pedestrian detection. Advances in Image and Video Technology, Springer, pp. 37-47.

Suykens, J. A. and J. Vandewalle.1999. Least squares support vector machine classifiers. Neural Processing Letters. **9**:293-300