GENERATING TRAFFIC INFORMATION THROUGH MOBILE MESSAGING

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Abstract: The paper proposes a new means of generating traffic information within a traffic information system by having mobile users message the traffic data to the system. This paper is a part of a work in progress to propose and implement an Open Traffic Information System (OTIS). All existing TISs either require significant investments in new infrastructure or depend on third party sources to generate traffic information whereas the proposed system could be instantaneously deployed over the existing cellular network.

1 INTRODUCTION

With traffic congestions on the roads now becoming routine phenomena there is an urgent need to have a system in place that makes a user more informative regarding the traffic conditions on the route that he may be visiting thereby giving him more control over his time. This paper is a part of a work in progress to propose and implement an Open Traffic Information System (OTIS) where the users moving on the roads or at the traffic sites are able to update the system regarding the traffic conditions using the Short Message Service (SMS) and in the process help other users in getting latest traffic updates from the system. The system will be open in the sense that those who will be benefiting ***from the system*** will also be the ones generating the information ***for the system***. In the proposed system the gathering and dissemination of information will take place through SMS that makes this system instantaneously deployable over the existing cellular network architecture. SMS is used as means of communication between the system and the user due to its low cost and it being a set feature of the mobile telecommunication standards. For developing countries like India where traffic congestion is high in the cities, using SMSs to send and/or receive traffic updates is a viable option.

This paper is organized as follows: Section 2 discusses related work. Section 3 presents the proposed system in detail. Section 4 describes the system implementation while Section 5 performs analysis of the system. Finally, Section 6 concludes the paper along with the future work.

2 RELATED WORK

Some systems that have been suggested up to now rely on third party content providers for generating the traffic information or require installation of separate hardware to generate the traffic information. In the traffic information system suggested in (Balke et al. 2002) traffic information is generated by on-line Internet sources like local radio stations, weather reports, road works etc. which may not be able to provide real-time up-to-date.

Another system, SOTIS (Wischhof et al. 2003), makes use of ad-hoc inter vehicle communication (IVC) for generating traffic information. The SOTIS system requires fitting of GPS and other radio equipment on the registered vehicles which then start generating traffic information within a certain radius and transfer it to other registered vehicles over radio links. However, this system cannot provide information of any accidents, road works or other conditions that cannot be tracked by the vehicle's equipment.

Some systems such as Mapunity (http://www.mapunity.in) work by mapping mobile user density into the traffic conditions by assuming that the density of mobile users in a particular area is a reflection of the traffic conditions in that area. Such systems require installation of micro towers

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over particular roads and crossings, measuring the number of mobile phone users within a particular tower's range and then converting this information to the vehicular traffic conditions in that area. Such systems are not only dependent on statistical assumptions but also require large investment in new infrastructure that doesn't make them readily deployable.

3 PROPOSED TRAFFIC INFORMATION SYSTEM - OTIS

In the proposed system, a mobile phone user will be able to send and receive traffic updates using SMS (Harris 2003). Figure 1 illustrates the interaction of OTIS with the mobile station (MS). The various processes that will be involved in OTIS are discussed below.

3.1 Receiving Traffic Information from Mobile Users

The user can generate an SMS indicating the traffic conditions on the road and send it to a predefined number. Since the current technology cannot ascertain the area information of a user sending an SMS, the user will also have to message his location along with the traffic update. The receiving short message entity (SME), i.e. OTIS in this case, will continuously store and process all incoming traffic updates.

The form of the incoming traffic information SMSs will determine the complexity of the processing step in OTIS. Therefore, it is essential to strike a balance between user's convenience in generating a traffic condition message and the system's ability to correctly interpret the message in a timely manner. A plain English language message will require natural language processing, filtering, matching and estimation capabilities whereas a keyword based message would be much simpler to process. Although it seems that a natural language message will be more convenient for a user it may not always be so. For instance, if the user wishes to inform to the system that traffic in area X is heavy then a natural language form of the message would be something like 'heavy traffic in area X'. However, if a keyword based format is used where the keyword 3 indicates heavy traffic then the same message can be written in the form – '3 area X' – which is clearly much easier and faster for the user to type and at the same time makes the processing easier and unambiguous. This paper suggests a part keyword, part English format - <keyword> <location> - as illustrated in the right column of the table in figure 2.

3.2 Processing Traffic Information

This is the most crucial step of the system where all the updates will come together and be consolidated to generate meaningful and correct information. Assuming the format of the incoming SMS as proposed in this paper, the first keyword of the incoming message could indicate the level of congestion, while the following text could refer to the location. A database of known locations and roads could be created and the incoming messages could be processed to ascertain which locations are being referred to. A way to measure traffic condition of a location could be to take sum of all the traffic status keywords belonging to the same location. Then, a higher sum would indicate more traffic congestion and an appropriate update could be generated and dispatched to the users. However, it is important that only messages within a predefined timeframe are considered for generating information. For instance, if a 10 minute time window is chosen then all updates received within this time slot will affect the traffic status for that period after which they will become void. This means that although the traffic status of a location would be continuously updated, only those SMSs received within a particular time slot will be used for the calculation. This would prevent old information from affecting the current traffic status.

3.3 Propagating Updates to Mobile Users

Many schemes may be employed to send traffic updates to the mobile users. The users may choose to receive updates at regular intervals or send explicit requests to receive traffic updates. In the latter case a user may send an SMS to the system requesting a traffic update using the <keyword> <location> format. Here the location is the place for which the user seeks traffic information and the keyword could be a predefined number, such as '0', to indicate to the system that the incoming message requests a traffic update. Figure 3 summarizes the processes of receiving, processing and propagating information in the data flow diagram of the system.

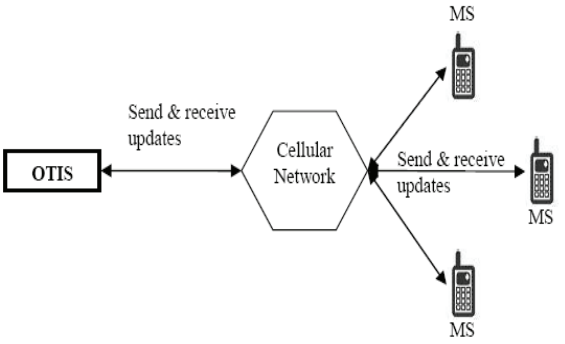

Figure 1: Interaction of OTIS, the network and the mobile stations.

Plain English Examples –	Keyword examples –
Press enclave has smooth traffic	1 Press enclave
Heavy traffic at MG road	3 MG road
Friends colony has slow moving traffic	2 Friends colony
What is traffic status of MG road?	0 MG road

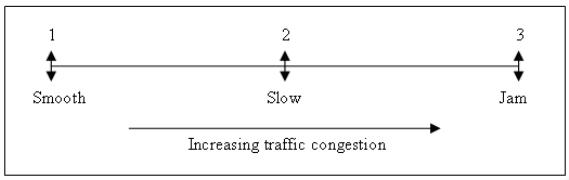

Figure 2: Traffic Status Keyword Scale.

4 IMPLEMENTATION

A working model of the proposed system was implemented that demonstrates the feasibility of the proposed traffic information system OTIS. A Java language based SMS application was built that interacted with an SMS gateway for sending and receiving SMSs over an inbuilt GSM (Global Systems for Mobile Communications) modem of a mobile phone. A database of about thousand locations in the city of Delhi, India was used for matching the location of the incoming messages. The processing logic used in the implementation was based on the discussions made in section 3. Keyword '0' indicated that the incoming message was a request-message and required a traffic update from the system while a message with its keyword lying in the set {1, 2, 3} indicated that it was attempting to provide a traffic information to the system.

The entire period of receiving user message and sending back reply using SMS took about 10 seconds while the processing time alone took about 0.14 seconds. The implementation analysis showed that majority of time taken during exchange of information with the users was due to network communication delays and for real world application purposes faster means of exchanging SMSs need to be used like directly connecting to the wireless operator's Short Message Service Center (SMSC).

5 PERFORMANCE ANALYSIS

5.1 Benefits of OTIS

Following points indicate why OTIS could be a successful traffic information system:

1. The *for the system – from the system* aspect of OTIS where users both send and receive traffic updates lends credibility to it and prevents misuse of it similar on the lines of open access projects like Wikipedia (http://www.wikipedia.org) and Open Directory Project (http://www.dmoz.org).
2. Although traffic information may be communicated using Internet and/or other methods, it would have required high-end handsets with General Packet Radio Service / Wireless Access Protocol services enabled. This would have severely restricted the reach of this service. The proposed model only requires the use of SMS that is a standard part of all the current and upcoming mobile standards like Universal Mobile Telecommunications System (UMTS) and GSM etc. and doesn't require any special handsets or subscriptions bringing OTIS within the reach of all mobile users.
3. These days short message service is being used for all kinds of applications – from movie ticketing to voting. For developing countries like India, where traffic-congestion is a major problem in the cities low-cost SMS is a viable option for sending and receiving traffic updates.
4. The system would be able to generate real-time up-to-date information by allowing mobile telephone users that are 'on the scene' to generate and update traffic information.
5. With mobile telecommunication growing at fast pace and call tariffs continuously reducing, more and more people are using cellular communication and becoming more mobile.
6. OTIS is instantaneously deployable without requiring any major changes to hardware or software.

5.2 Discussion on Possible Issues in OTIS

Following points discuss solution of some problems that may arise in OTIS.

1. Since OTIS will use messaging to both propagate and receive traffic updates, the short message center may be considered to be a bottleneck. However, this can be easily averted by using distributed network architectures and appropriate SMSC hardware like CMG HP SMSC that supports 2500 messages/sec (Zanen n.d.).
2. Use of mobile phones for messaging while driving could be a distraction but most messaging is likely to be done during traffic jams where the vehicles are intermittently moving and stopping. Furthermore, in cases where other passengers may be accompanying the driver, the messages can be sent and received by them. Besides messaging may be done any time even when not driving. For instance, one could inquire the traffic status of a location before setting on the journey or make traffic updates as a by-stander.
3. Another concern is to maintain the correctness and validity of the traffic information being sent to the users. By using improved algorithms for matching locations the effectiveness of the systems can be increased. Moreover, by constantly adding and updating locations in the database the updates can be made more successful and accurate.

6 CONCLUSIONS & FUTURE SCOPE

This paper has proposed a novel means of generating traffic information using mobile phone technology. The proposed system – OTIS – allows mobile phone users to both send and receive the traffic information of a particular area in the form of short messages (SMSs). The current system suggests the use of SMS for generating traffic information as it requires no change in current network infrastructure and makes this system instantaneously deployable. Once the system is implemented other methods of data collection and dissemination may be added to further improve the system. For instance, cell broadcasting (CBS) (Harris 2003) may also be used for disseminating traffic updates to the mobile users. By allowing people who are moving through a particular road or a location to generate its traffic status rather than relying on other agencies like radio broadcasts and other vehicular probes, real time up-to-date information can be collected using this system.

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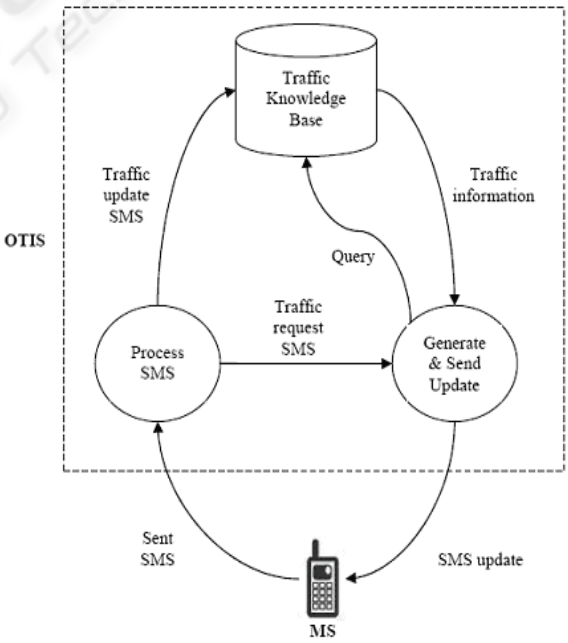

Figure 3: Data Flow Diagram of OTIS.