Social Road Maintenance Application for Estonian Road Administration

AYOBAMI EPHRAIM ADEWALE*

University of Tartu
adewale@ut.ee

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Abstract

Intelligent Transportation System combines information technology services such as computing networking, and communication with transportation in other to improve mobility on the road. The current trend in ITS is the use of mobile technology to deliver real-time road information to road users and commuters. In this paper, the author discusses how mobile technology can be incorporated to the existing infrastructure used in the maintenance of road by the Estonian Road Administration and how it is a smart and cost effective solution to the lingering problem of maintenance that currently exist in the country.

I. Introduction

Roads, and means of transport, make a crucial direct or indirect contribution to economic development and growth and they bring with them important social benefits [1]. They are part of the most important public assets of a country and its maintenance should not be ignored. Poor maintenance of the infrastructure often leads to direct or indirect cost for a country and also reduction in the level of security of her citizens while effective and quick maintenance amounts to low maintenance cost, improved access to schools, hospitals and markets.

Knowing the importance of road maintenance, the Estonian Ministry of Economic Affairs added National Transport Development to its 2020 vision of developmental plans. This transport plan includes maintaining the condition of main roads, improving the condition of basic and secondary roads and the development of smart solutions for improving and maintaining road conditions. This paper proposes a smart and cost effective solution that will augment the existing road maintenance infrastructure by increasing the interaction between road users and road masters (road engineers, snow removal personnel e.t.c) thereby increasing the efficiency of road maintenance, increasing the response time and finally, increasing road users satisfaction.

The remainder of this paper is organized as follows, section 2 talks about the architecture of existing infrastructure, the architecture of the proposed system is presented in section 3, section 4 discusses the implementation and the last section covers the conclusion.

II. Existing Infrastructure

The Estonian Road Administration(ERA) is a government agency within the administrative area of the Ministry of Economic Affairs and Communication. The sole responsibility of the ERA is to handle road related issues ranging from road management, traffic safety, public transport and the environmental safety of vehi-

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cles. Within the ERA is the Road Information Center(RIC), whose main function is informing the public users and institutions involved in the management of accidents and emergencies about the state of roads in the country and changes in traffic which might be caused by bad weather or traffic accidents.

The RIC was created in 2011 for the purpose of increasing quality of service of the ERA and to improve communication between road users and other state agencies [3]. Figure 1 below shows the existing infrastructure of the RIC. As seen below, the Road Information System

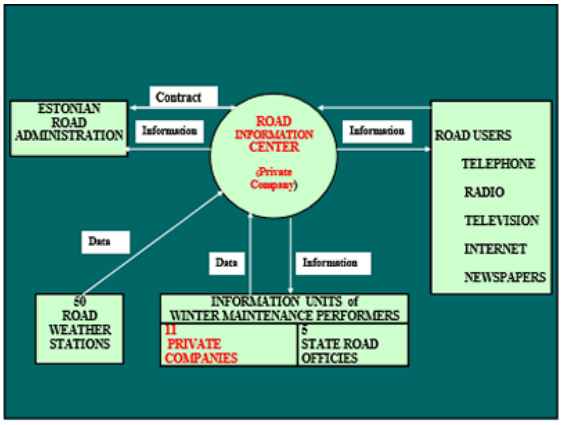

Figure 1: *Road Information System [4]*

can be divided into two subsystems, one handles the dissemination of road information to interested parties and the other receives road information. Road information System receives road information from:

- 50 Weather Stations
- Road users through telephone calls
- Road Masters
- State Road Offices
- During Road Supervision runs

The road information centre processes this information and forwards it to the appropriate road masters for effective handling of the report. Road information meant for road users is sent through :

- Radio and television broadcast
- Newpaper
- Road Administration Web Page

Road information shared through the above mentioned means are restricted to information relation to major road constructions or major road crashes and this means that they cover very little of actual information. With this form of road information dissemination and retrieval, it is evident that 60% of road users will not be able to receive real time information about road conditions or traffic situations. It is also evident that the Road Information System will not be able to receive real-time information where there are no cameras installed thereby leading to low response time from Road Masters and also low quality of service.

To increase the quality of service and response time of road masters to road incidents or maintenance we propose a social maintenance application.

III. Proposed System

The use of mobile technology for road information dissemination have been adopted in Countries like Singapore, United State of America, United Kingdom and some IT developed countries. For example, the Singapore Land Transport use mobile technology to deliver real-time traffic information to car drivers. Research has shown that people may learn about a road traffic or incident through mobile technology before they hear about it from traffic information service [2].

In this paper, I present an android based application that will complement the existing infrastructure by improving the exchange of road information between RIC,Road Users,Road Maintenance agencies and Road Masters. By doing this, the system will increase efficiency of road masters and road maintenance agencies, increase response time, provide a smart and cost effective solution. This application is based on the recent trend in the use of mobile application in Intelligent Transportation Systems.

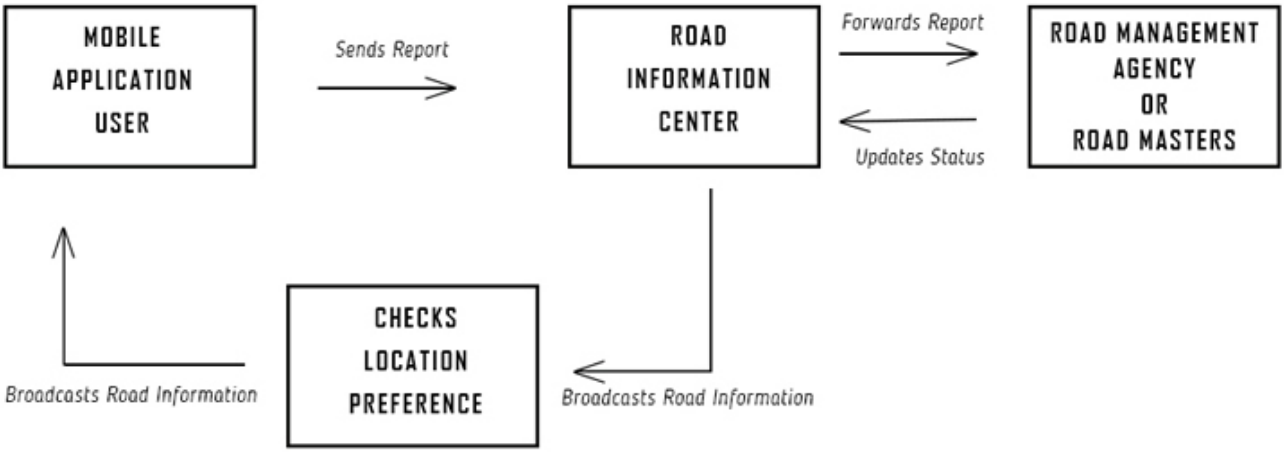

Figure 2: *Social Road Maintenance Application*

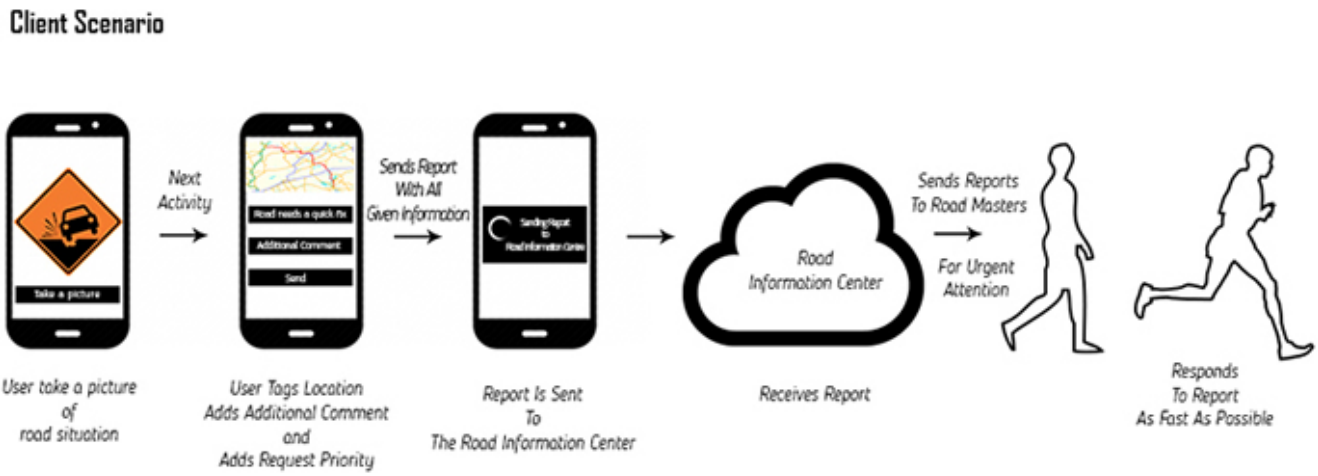

Figure 3: *Use case scenario*

Figure 2 above describes the architecture of the proposed system. The architecture is divided into two components:

- Client
  - Road Users
  - Road Masters
  - Road Maintenance Agency
- Server
  - Road Information Center

How information is been exchanged in the system is represented with arrows. The road users with the application can make road report to the information system by taking the picture of the incident or road situation, with the event location and send it to the system. On receiving this report, the system processes and alerts the appropriate road master or road agency. On receiving this information, the appropriate road agencies or road masters are able to respond to the report as fast as possible.

The road information is also able to send road related reports to users, this could be information about ongoing road maintenance in specific areas or detours as a result of bad weathers. This information are sent and filtered based on users location and they are guaranteed to be delivered in real time compared to the sending methods in the existing infrastructure.

The main aim of the proposed system is to improve the interaction between Road information system, road users , road maintenance agencies and road masters. The system allows road situation to be sent and received in real time.

IV. IMPLEMENTATION

As discussed above, the application is divided into client and server side. The client side was realized as an executable application in Android while the server side was developed using PHP,JAVASCRIPT and HTML. Both server and client communicate with a database where reports and road related information are being kept.

CLIENT:
The client side was developed considering user friendliness. The client side was developed using Android and communication to the server was done using PHP with data sent in JSON format. The map on the application was implemented using the MapBox Api.
On successful launch of the application, the user can either send report , view other user reports and also view road information sent in by the road information system.

Figure 4: *Home Interface*

Figure 4 gives a view of the home interface

of the application with the aforementioned options. When a user decides to make a report, the user takes a picture of the location and the location of the user is obtained using the gps of the user's mobile phone. The current location of the user is also displayed on the map. This interface is displayed in Figure 5 below.

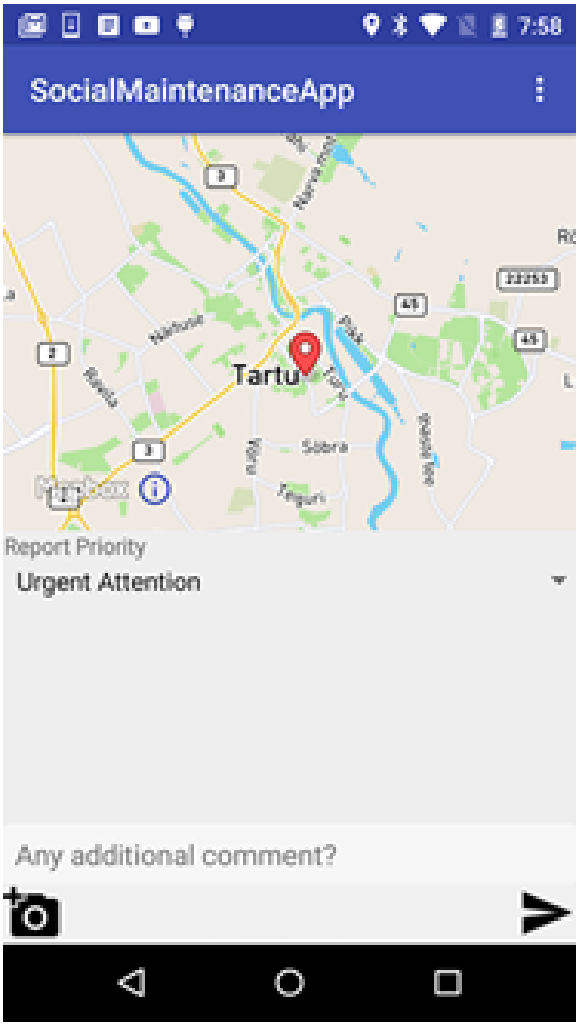

Figure 5: *Report Interface*

Report made by a user can also be viewed by fellow application users but they are not notified once the report is made. Users are only notified of information sent by the road information system. This guarantees that notified information are reliable(valid and with integrity). Figure 6, shows this interface with some user report data that is being retrieved from database.

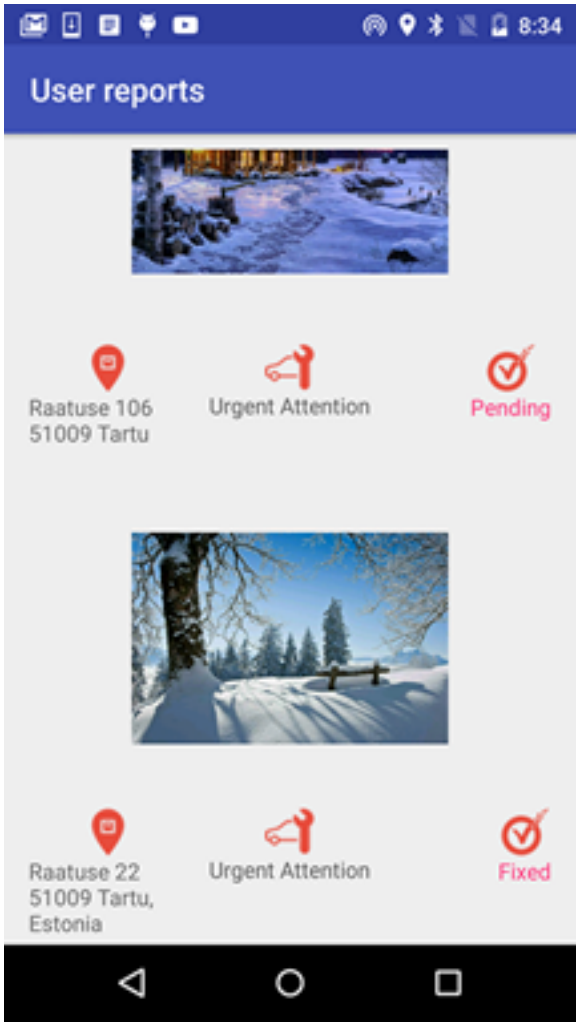

Figure 6: *View Report Interface*

SERVER:
The server side was designed putting into consideration the security of the system and user friendliness. It was designed using:

- Code Igniter MVC Framework
- PHP
- HTML
- JAVA SCRIPT
- Firebase(for Push Notification)
- MYSQL(Where reports and other data are kept)

Each administrator will have a password and a unique username which will be used to login into the system.

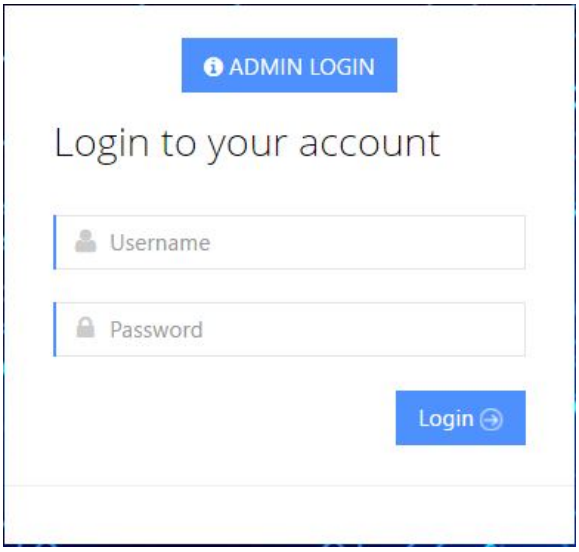

Figure 7: *Login Interface*

Once the administrator is authenticated, the administrator is able to see the statistics of reports and in this case, reports have been divided into three:

- New Reports
- Pending Tasks
- Fixed Tasks

This will allow easy tracking of reports by the administrator and will also increase efficiency. Figure 8 shows the dashboard of the server side with example of statistics displayed. The administrator can select any of this to view more.

The report view is shown in Figure 9 with test values from report sent in Raatuse 22. The administrator can view the location on the map, allocate task to appropriate road masters or maintenance agency or delete the report. Report task allocated by the administrator can be monitored by using the Task Allocation History menu on the website. Report tasks are divided into Pending and Fixed to make monitoring easy for the administrator.

As a final part of the server side, the administrator can send road related information using

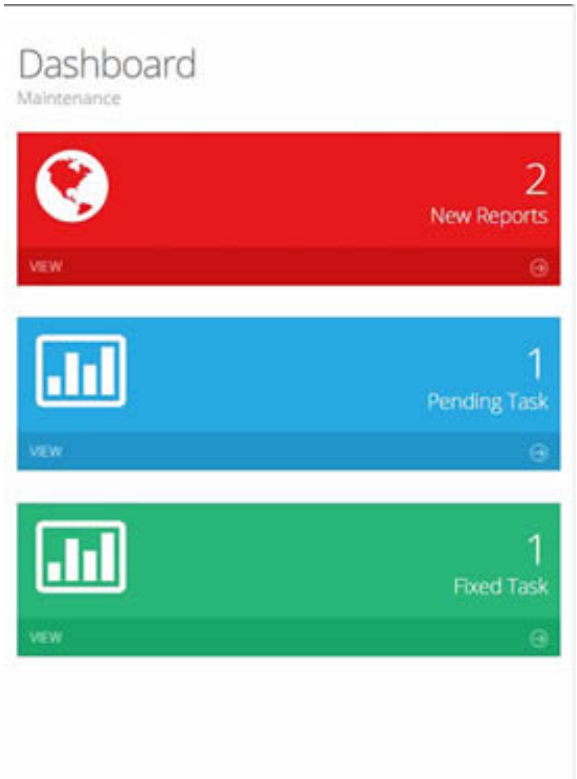

Figure 8: *Dashboard Interface*

the send report menu on the website. The information sent is delivered in real-time to users of the application who are presently in the state where the information is related to.

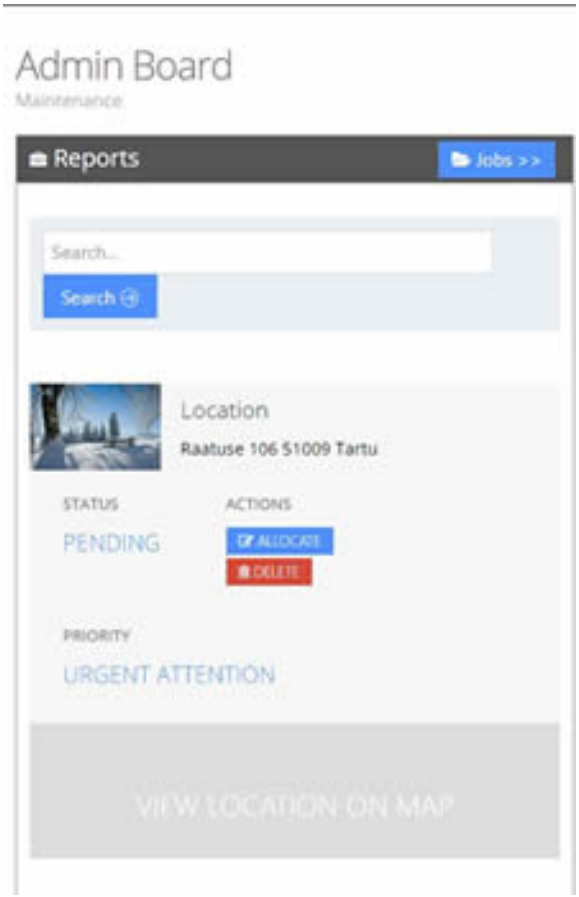

Figure 9: *Report Interface*

V. Related Works

First related application that will be discussed is WAZE. Waze is a cross platform mobile application that is owned by Google. The application is used by drivers and road users in general to share real time traffic information and other road related information between one another. The basic idea is that users create a community within the application and information such as accidents, traffic jam, speed and police traps are shared by users in the community.

The difference between the proposed application and waze is that in the proposed application, information is to be shared between road users and RIC for the purpose of improving the maintenance of road conditions. This include broadcasting road related information before the occurrence of the event which cannot be done using Waze. Though waze has a web interface that can be used by media stations to broadcast road related information, if this interface is employed by RIC, it makes RIC to function as a third party user of Waze. This means that there is a limitation to what can be done by RIC as a third party user and there is also the issue of scalability. Lastly, there is a question on how safe Waze is, that is, how does it protects it users when so much information about it users can be shared with other users of the application.

The second related application is fixmystreet which is used by UK citizens to view, report and discuss problems related to there community. It consist of a web platform, a mobile application and a back-office platform which is used by the community admin to follow up occurrences. This application is very much related to the proposed application.

VI. Future Work

As a future work, a smart solution for detecting potholes can be implemented in the application. By obtaining readings from user's mobile phone sensor, road information related to potholes can be automatically sent to the RIC without any contribution from the user.

VII. Conclusion

In this paper, the use of mobile technology was introduced to increase the interaction between Estonia road users, Estonian Road Administration, Road maintenance agencies and Road masters. The application discussed and implemented is meant to complement the existing infrastructure that is used by the Estonian Road Administration to disseminate and receive road related information. This application did not only take advantage of the current trend of using mobile technology in Intelligent Transportation System but also aligned with the 2020 vision of developing a smart solution for the maintenance and improving road conditions

which was set aside by the Estonian Ministry of Economic Affairs in 2015.

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