Multimedia System for Taxi Services with Awareness of Malicious Behavior as a Part of Smart Transportation

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Abstract. This paper is part of a wide work developed in the context of Smart Cities. Main objective is focused on taxi services for longer distances and mostly dedicated for business clientele which has specific needs. This paper presents a new comprehensive multimedia information system for taxi vehicles. Competition points out a potential in this area – however, they primarily focus on advertising which discourages users rather than attracts them. Presented system is also focused on protecting customers from being betrayed by the taxi service, providing them the possibility of continually monitoring the recommended route and also the real, traversed route on the map along with the number of actual kilometers traversed.

Keywords: taxi service, multimedia, trusted planning, smart city

1 Introduction

Public transportation is indivisible part of every city. As mobility of citizens rise the congestions and traffic collapses appear more often. As initiative of Smart cities starts, the public transportation became one of the most important part of it [1], [2].

Taxi services, as part of a public transportation, have not changed a lot in last years. In nowadays, there is big competition among taxi companies, so they have to add new services for increase overall passenger satisfaction (i.e. in London 70 % [8]). Because of permanent presence of taxi services many cities include them as important stakeholder in public transportation in their process of conversion to Smart cities [10]. For better imagination, in New York the popular yellow taxis make more than 2 million kilometers each day [12].

In many countries there are problems with overpriced taxi drives just because driver used longer road or because he used device which will measure longer distance travelled than the distance really was [9].

Related systems are usually just for playing commercials or just for watching TV, for example in New York there is system called Verifone [3] inside cabs and it can only be used for watching television and for paying of bill (This solution has built-in feature for contactless payments). Other system called Cabadvertising [4] is just used for playing commercials. One of the best systems is sold in India and it is called Tabbie [5]. There is possible to play music, watch movies and also watch map where the taxi is currently located. But there is no possibility to see whole route so customer does not know if the driver is driving by optimal route or if the distance for which customer is paying is no longer than the actual travelled distance.

Other types of systems for taxi services such as Hopin [6] and Uber [7], which are focusing on user when passenger is searching for cab. This area is wildly researched also for effective usage of cabs or evaluation of drivers [10], [11] when customer is not inside vehicle (i.e. process of booking of a cab). From our point of view, they all have one common disadvantage, they "do not care" about passenger when she/he is already in the cab. Usually, the only available additional service is free Wi-Fi.

Our system described in this paper is here to solve problems when user is inside a vehicle with the use of GPS inside tablet just for customer. As an additional features system will be able to provide Internet access for passengers, play multimedia files – movies, television, music and headlines news which are possible to play directly into built-in car audio system.

2 Solution

The system consists of two types of tablets (customer's and driver's) and they communicate to each other (see Figure 1). For this communication is used wireless network with direct connection to the Internet by a mobile network. TCP protocol is used for sending commands for activation, deactivation and sending ID of the commercial. It has to be done by TCP because of the packet lost rate of UDP protocol. During system testing, we tried to use UDP protocol but some commands were lost, because these messages are usually sent in city areas with a lot of wireless networks and the interference was high. The only use of UDP protocol is in position sending, because if sometimes packets get lost it is not a problem – the route is just not as accurate as it could be.

All features described later are implemented inside tablet mounted on front seat so customer in back seat can control it. Tablet has the possibility to receive video from DVB-T server inside vehicle.

Every driver has its own "control" tablet, which can send commands to "customer's" tablet and activate it, deactivate it, send which commercial should be played and send location data periodically. When driver activates "customer" tablet,

the data packet is send from “controlling” tablet. Data packet contains driver’s name, locations of starting and end position and also ID of first commercial, which will be played right after activation of tablet. When the “customer’s” tablet is deactivated, customer cannot do anything with it – the application is disabled.

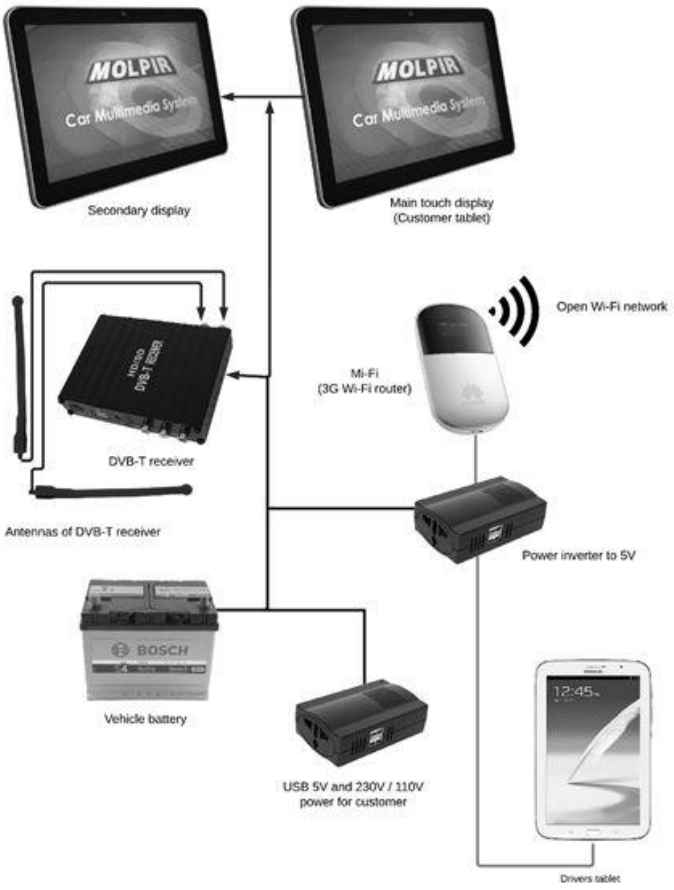

Fig. 1. System architecture

2.1 Applications

Our solution is based on the cooperation among several independent applications. This approach ensures minimal risk of compromising whole system when one of its part is compromised.

For tablet maintenance there are two applications – for synchronization and file browser. Synchronization application is used for first installation, copy of the content (movies, music, settings etc.), synchronization of data and applications update. In file browser application, operator can copy only content from USB flash disk. Unlike synchronization, not every file has to be copied, operator can select what he wants to update.

Main application (Figure 2) is first application that passenger can see – right after commercial is played (commercials are optional and it is on a company policy if driver has to play it or not). During the ride, a costumer can check travelled route and possible difference to optimal route on a map. There is also daily newsletter downloaded by RSS and list of other applications for entertainment. Also on the top there are additional information about driver's name, names of streets (start and end of the route), estimated length of route according to Google Maps API and actual travelled length of route so far.

Every multimedia and informational application has its own submenu and list of content (i.e. movies can be divided by genre, music by albums, TV channels by its name and Internet browser has quick access for most used pages defined by administrator of the system).

Fig. 2. Graphics interface of main application

2.2 Synchronization

Multimedia data inside tablet are possible to synchronize by Wi-Fi or by USB flash disk. At the beginning we were proposing distributed synchronization so every cab could be server or client during Wi-Fi synchronization and part of the synchronization would be managed at taxi positions throughout a city. Based on our observation we cancelled this idea. In praxis there is not enough time and nearby taxi vehicles to process such synchronization, hence it is possible to update multimedia content only in a taxi company (i.e. during other type of service).

Wireless synchronization is used for easier update of data (commercials, movies, music, settings etc.) stored in a tablet. Wireless connection makes possible to synchronize more vehicles at once by connecting to one access point. USB flash disc synchronization has to be done manually inside vehicles.

Synchronization starts by a special control packet. Due to necessity to connect to different Wi-Fi network it is not allowed to implement synchronization as some kind of daemon service which would automatically performs an update. After receiving of the control packet application searches for defined Wi-Fi network. If successful, it performs an update and reconnect to original Wi-Fi network.

3 Testing

System described in this paper is deployed on approximately 150 vehicles of taxi service in Prague. Every one of these vehicles is equipped with the same set of applications and the same configuration. If any crash happens, it appears on Crashlytics[1] site. This testing is made by passengers hundreds of times a day.

System is now fully functional. Comparison of related work is displayed in Table 1.

Table 1. Comparison of related work and TickTack solution

Features	Verifone	Cabadvertising	Tabbie	Hopin	Uber	Our solution
Commercials	✓	✓	✓	×	×	✓
Advertisement	✓	✓	✓	×	×	×
Television	✓	×	✓	×	×	✓
Map: current position	×	×	✓	✓	✓	✓
Map: travelled route	×	×	×	✓	✓	✓
Internet browser	×	×	×	×	×	✓

[1] https://crashlytics.com/

Difference between Commercials and Advertisement is understood as follows:

- Commercials – video clips with paid content. Can be played when customer will get inside cab or anytime during travelling.
- Advertisement – paid content visible at any time or when video or TV is played. Usually small banners with dynamic content.

From Table 1 can be seen that none of these solutions do not have so many features as our purpose. Only described feature which is missing is advertisement. Reason behind this is that advertisements were marked as annoying and are visible at any time. Paying customer usually do not want to be distracted by this kind of services or products promoting.

4 Conclusion

Our work present unique solution in way that it contains combination of competitors' features with addition of tracking travelled route with comparison of optimal route according to Google Maps API. This way customers will not be lied to and can be sure that price is right and they are paying just for route they actually travelled.

Our solution is after testing phase and now is already deployed in a taxi company in Prague (Czech Republic) inside approximately 150 cabs thanks to our commercial partner. Based on every day usage, passengers like proposed features because they can trust this system and can be sure that taxi driver would not take more money than he should. Also the great advantage of system is offer of many types of multimedia (such as music video, television, headline news and internet) – the most popular seems to be playing of music of own choice inside a cab.

Nowadays there are plans to extend use of our system on other taxi company. Future work can be focused on better integration with existing reservation systems for taxi companies.

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