PERFORMANCE ANALYSIS OF SMARTPHONE BASED REAL-TIME DRIVER ASSIST SYSTEM OVER IEEE 802.11 WIRELESS NETWORKS

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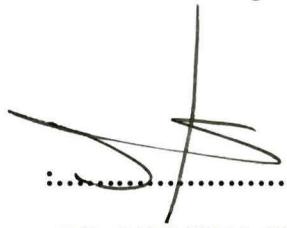

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Dedicated to my beloved family members.

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ABSTRACT

When a car is just behind the truck, car driver's view is blocked by the truck in front. Since the distance between the truck and car is about a length of a car, only the truck is viewed by car driver, but not the incoming traffic. Car driver cannot determine whether it is a suitable time for safely overtaking. A driver assisting system is proposed for this scenario.

Two smartphones are needed in the proposed driver assisting system. Smartphone A is placed in the truck while Smartphone B is placed in the car. Truck driver's view is captured using Smartphone A and sending out. Smartphone B is used by car driver to receive view shared by Smartphone A to extend the view. Therefore, car driver will know the reason causing the slow moving truck in front. Car driver can then decide and able to make safely overtaking decision. However, this video transmission must be in real-time with over the inherently non real-time wireless communication channel. This means that the Wi-Fi link performance has to be able to determine in real-time by the receiver smartphone, to make sure that data is smoothly transferred with throughput of 1Mbps. No video shall be displayed by the receiver smartphone if the link is not able to stream the video at the required data throughput.

The investigation processes involved firstly determine the expected working distance for this proposed driver assisting system. Then, the expected throughputs for both vehicles in static and moving conditions including the Doppler effect are figured determined. Throughput between smartphones and PC is measured using Iperf. Experiment is carried out to ensure it throughput around 1Mbps can be obtained in real scenario. The obtained measurement result using the developed application shows the similar measurement as obtained with the Iperf. The actual performance of the Wi-Fi link in real-time, which is a good indication to alert user with the stability of the inherently non real-time characteristics of Wi-Fi channel, can then be determined through the develop application with the calculation on packets received and packet lost at the receiver. The result obtained from the designed and constructed application not only can give measurement as Iperf, but also allow custom data (for instance, messages in this case or video image for further development of deiver assisting system) to be transmitted.

ABSTRAK

Apabila sebuah kereta berada tepat pada belakang trak, pandangan pamandu kereta dihalang oleh trak depan. Jarak antara kereta dan trak kira-kira panjang sebuah kereta, oleh itu, hanya trak dilihat oleh pemandu kereta, bukan trafik yang dating. Pemandu kereta tidak dapat mengambil keputusan memotong trak depan dengan selamat. Satu system memandu pemandu dicadangkan.

Dua telefon pintar diperlukan dalam cadangan projeck ini. Telefon pintar A diletakkan dalam trak, Samrtphone B diletakkan dalam kereta. Pandangan pemandu trak ditangkap menggunakan Samrtphone A dan dihantarkan. Samrtphone B digunakan oleh pemandu kereta untuk menerima pandangan yang dikongsi oleh Smartphone A untuk meluaskan pandangan. Dengan itu, pemandu kereta akan tahu sebab trak yang lambat bergerak. Pemandu kereta boleh mengambil keputusan memotong trak depan dengan selamat. Akan tetapi, video yang dikongsi mesti diterima pada masa yang sama dengan masa menghantar. Dengan itu, pemandu boleh mengharapkan system ini dalam mengambil keputusan memotong jalan. Ini bermaksud analisis pautan prestasi Wi-Fi diperlukan untuk memastikan pemprosesan penghantaran data kira-kira 1Mbps. Tiada video dikongsi apabila pemprosesan penghantaran data tidak memadai.

Proses penyiasatan yang terlibat kan megesan jangkaan pemprosesan jarak berkesan untuk system ini. Selepas itu, jangkaan pemprosesan untuk kedua-dua kenderaan dalam keadaan static dan bergerak yang melibatkan Doppler effect dikesan. Pemprosesan antara telefon pintar and PC diukur menggunakan Iperf. Eksperimen dijalankan untuk memastikan pemprosesan lebih kurang 1Mbps berkesan dalam keadaaan sebenar. Keputusan yang dapat adalah lebi kurang sama dengan keputusan yang dapat melalui Iperf. Prestasi sebenar Wi-Fi dalam keadaan sebenar, adalah satu petunjuk kepada pemandu mengenai kestabilan cirri-ciri masa sebenar Wi-Fi saluran, dapat dikesan melalui pembangunan apikasi kiraan paket diterima dan kehilangan paket pada penerima. Keputusan yang dapat daripada rekaan aplikasi bukan sahaja memberi ukuran seperti Iperf, tetapi juga membenarkan penghantaran data (contohnya, mesej dalam kes ini atau video penggambaran untuk pembangunan system membantu pemandu).

CONTENT

LIST OF FIGURE

LIST OF TABLE

LIST OF ABBREVIATIONS

ISM	-	**Industrial, Scientific and Medical**
SNR	-	**Signal-to-Noise Ratio**
BER	-	**Bit Error Rate**
UDP	-	**User Datagram Protocol**
TCP	-	**Transmission Control Protocol**
IP	-	**Internet Protocol**
OSI	-	**Interconnection Model**

CHAPTER I

INTRODUCTION

Driver assist systems reveal how technology is being applied to augment drivers' skills and at the same time, improved road safety throughput. In Europe, the European Commission formed the eSafety working-group in 2002 (J.Jaaskelainen, 2002). The aim of his working-group is to encourage the development and use of intelligent and integrated safety systems in cars. According to the statistics, this eSafety web site shown that more than 1.2 million people were involved in road accidents and being injured in the EU in 2005 and, over 40,000 were killed (Christine, 2009). Analysis of accidents shows that human error is the main cause of accidents, it takes about 93 percent. Thus, a sensing system that able to assist and warn the driver could save lives. The existing technologies is on preventing rear-ending collisions, keeping the vehicle in the lane, assist vehicle in overtaking, and technologies that wakens sleepy drivers.

A driver assist system is used to provide driver additional information when driving. It can provide driver information in different ways, the path to a destination or the nearby traffic condition in the road. For instance, when driving in a two-way road, it is extremely useful in providing driver the nearby traffic condition in real time, especially when vision of driver is blocked by a vehicle with huge size. For example, when two vehicles are moving in a lane, the vision of driver may be blocked if there is a truck in front. With the use of real-time driver assist system, the driver's vision has greatly extended and allow driver to react accordingly. If there is an accident occurred or road block, the vehicles behind may choose to use an alternative lane or make a U-turn. Driver may choose to queue patiently or overtaking when the flow of vehicles in the road is slow.

With the development of advanced technologies today, mobile devices with multiple functions are available. For example, in a smartphone, the camera is able to capture a higher quality video and images, significant amount of computing power and connectivity via various wireless local area networks. The making use the inherently ISM band wireless communication connectivity is possible to send and receive the compressed video images to assist driver in making life critical decision in real time is to be examined.

1.1 Overview of project:

When driver in a car is moving behind a truck, the driver's vision is blocked by the truck. In order to extend the vision, the driver can move the car slightly to the right or left from the truck. However, this could only work if there is a far distance between the car and the truck, illustrate in Figure 1.1(a).

The problem comes when a driver in the car is just behind the truck. The driver's vision is blocked by the truck in front, as illustrate in Figure 1.1(b). Since the driver cannot determine whether there is any vehicle occupied the space in front of the truck or not, the driver cannot determine is it a suitable time to overtake the truck.

In the case where driver in the car is just behind the truck and driver's vision is blocked, the distance between both vehicles is considered short. Thus, car driver is forced to slow down the car speed until almost the same as the truck in front in order to avoid collision. The distance between both vehicles is assumed a car length according to the safe following distance by using 2-second rule. This is the scenario where the propose driver assisting system is used.

Two smartphones are needed for the usage of the proposed driver assisting system. Smartphone A is placed in the truck while Smartphone B is placed in the car. View from truck driver will be captured and sending out from Smartphone A; car driver uses Smartphone B to receive the view shared by Smartphone A. Thus, car driver's view is extended by using the proposed driver assisting system. Car driver can determine whether it is the suitable time to overtaking safely.

Figure 1.1(a) Driver's vision when moving behind the truck.

Figure 1.1(b) Driver's vision when just behind the truck.

1.2 Problem Statement:

1. Wi-Fi is inherently non real-time. Car driver required a stable wireless channel to receive view shared by truck driver to make life critical decision. (Example: Safely overtaking the slow moving truck). The data rate in PHY layer must highly enough to support 1Mbps throughput for compressed video transmission. The data rate in PHY layer must highly enough to support data transmission between two smartphones. There are parameters that affect stability of Wi-Fi channel. The effect of those parameters that will affect the usage of proposed driver assist system in the identified scenario need to be determined.
2. Besides, the parameters that will affect the usage of the proposed driver assist system in the identified scenario are unknown.
3. Designation and construction of smartphone application to capture and analyze the identified Wi-Fi channel parameter.

1.3 Objectives:

1. To critically define the scenario where the proposed driver assist system will be used.
2. To identify the parameters that will affect the usage of the proposed driver assist system in the identified scenario.
3. To construct Smartphone Application to capture and analyze the identified Wi-Fi channel parameter.

1.4 Scope of project:

1. Wireless Communication channel is used for the transmission of compressed video between transmitter and receiver.
2. Scenario where the proposed driver assists system will be used.
3. Parameters that will affect the usage of the proposed driver assist system in the identified scenario.
4. Smartphone Application to capture and analyze the identified Wi-Fi channel parameter.