Ultrasonic Diagnostic Tool for Construction Vehicle Driver

ABSTRACT

This paper presents how the research done on the 'Swecon' vehicle repair centre, the vehicle repair centre manager, drivers, technician and stock manager had been used to inform the design of a novel diagnostic system for the drivers. The concept device was designed to improve the productivity of the 'Swecon' vehicle repair centre. To conclude the paper I will comment on the lessons I have learnt in using scenario role play and interview transcript.

Keywords

Diagnostic, 3D airborne ultrasound, faults, images, database, scan, drivers, technician, repair centre manager.

Low Ko Wee
Umeå Institute of Design
Umeå University
SE-901 87 Umeå
Sweden
lowkowee@gmail.com
http://geocities.com/lowkowee
+46 73 692 4384

INTRODUCTION

In the past, construction vehicle seldom breaks down and it is very simple in terms of mechanical and electrical construction. As the years goes by, technology is implemented into the design of the vehicles and making it complex and thus more problems are created. This project addresses the issues posed by the current construction vehicles and how it can be solved.

RESEARCH

The research done in this paper aimed to accomplish two objectives. The first objective was to research on the situation in 'Swecon' vehicle repair centre and how does it affect the people. The second objective was to gain a better understanding of the driver by using questionnaires, interviews with the user and user observation when using the diagnostic tool.

Situation Analysis

Current Volvo Construction Vehicles relied heavily on the sensors attached to the vehicles. The sensors detected the vehicles problems and then showed it to the drivers via sound and text on the information display unit inside the vehicle.

Problem Identification

Often when a vehicle breaks down the driver was trying very hard to explain to the vehicle repair centre manager the problems by using a mobile phone. Sometimes misunderstanding occurs during the communication. The vehicle repair centre manager was spending most of his time on the telephone. Even though the vehicle was sent in for repaired, it always takes a long time for the technician to find out the faults.

Findings and Analysis

Three site visits were conducted at 'Swecon' vehicle repair centre and one interview was done with the repair centre manager lasting about 1.5 hours. Three interviews were later done with a driver lasting about 1.5 hours per session. The interview conducted with the vehicle repair centre manager mapped out his problem areas. To understand his problems, scenario role play was done in his office to mimic the real situation. Through the interview with the driver, problems was identified, design concept, scenario role play, foam mock-ups and user interface design were also performed. Through the interview with the drivers, I discover from the driver that the warning system inside the vehicle was not very useful for him. When you put a computer inside the vehicle it was sensitive to shock every moment. It was not very reliable. It told you some vehicle parts were wrong but it was not wrong at all. The information display system told you the wheel pressure if it was not right but it did not told you if the hydraulic parts were broken. When the driver was driving the vehicle he knew the problems beforehand than the computer because he loses some functions and he can felt it. He did not require a computer and it was very expensive to fix the computer. The computer tells you there is a problem but in reality there was no problem.

80% of the time the drivers knows what was the problem and 90% of the case he knows where was the problem areas. It was up to the vehicle repair centre manager to figure it out the problems. The driver was keen to know the exact problem by either using a handheld scanner or a 'plug-in' product for the vehicle. A vehicle have a lot of faults but some drivers just wants to repair the most critical ones because he did not had much time. When he had more time he would repaired the minor problems.

Target Market

This product was targeted at the Y-generation drivers between the aged of 18 to 35 years old where they were techno savvy inclined.

The Product System

The diagnostic system consists of two parts:

• Ultrasonic diagnostic tool for drivers to diagnose vehicle problem areas.

• Computer software was installed in a computer at the repair centre to show technical parts information and images send by the portable ultrasonic diagnostic tool.

THE CONCEPT

• A new and innovative way to diagnose vehicle faults using high-frequency sonic waves. [1][2]

THE PRODUCT SYSTEM COMMUNICATION FLOW CHART

The diagnostic system consists of two (Fig. 1) parts:

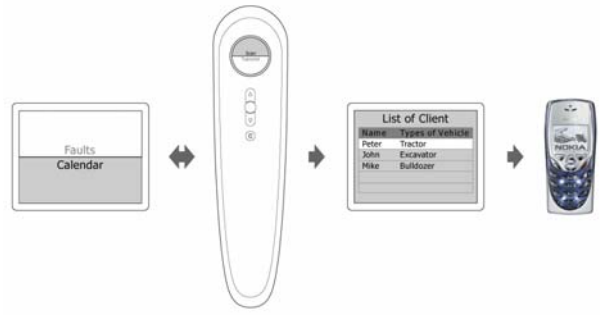

Figure 1: Product System

• A) Display Unit inside the Vehicle – To display detailed information about the faulty vehicle parts

• B) Ultrasonic Diagnostic Tool for Drivers – To collect information from the vehicle parts and transmitted it to the display unit inside the vehicle and repair centre.

• C) Computer Software at Repair Centre – To receive detailed information from the driver vehicle faulty parts.

• D) Mobile Hand Phone for Drivers – To receive the information from the repair centre on when can the vehicle be sent for repair or whether there is any spare parts available for the vehicle.

HOW IT WORKS

The driver uses the portable ultrasonic diagnostic tool (Fig. 2) to detect problem areas of his vehicles. He did that by scanning the engine parts. When faults are found, the driver transmits the information from the diagnostic tool to a display unit inside the vehicle. [3][4][5][6] Using the ultrasonic diagnostic tool allows him to do graphical menu selection on the display unit. On the display unit he can find out the details of each individual parts e.g. cost, part number. If he decided to repair the parts he could booked the dynamic online schedule with the repair centre. Once the repair schedule was approved by the repair centre it would send a short message to the driver mobile hand phone. At the repair centre, the repair manager was able to see the technical information of the vehicle parts send by the driver.

TECHNOLOGY USED

The following are some of the technology used for the development of the electrical iron.

• Airborne Ultrasound – Any mechanical, electrical part had a good and bad working condition and these produces a certain type of sound. Imagine a good bearing. If it is properly lubricated aligned and there were no faults? What type of sound would you expect to hear? Most often it would be a smooth rushing sound similar to an air leak. Now imagine a fault. Let's say pitting. What could this sound like? It would be a crackling sound. [7]

• 3D Airborne ultrasound – 3D airborne ultrasound detects the form of an object and was able to generate a digital version of it. [6]

• Bluetooth – Short range radio frequency 5 meters to 20 meters allows electronic devices to exchange data.

HOW THE TECHNOLOGY IS APPLY

Using the combination of airborne ultrasound and 3D airborne ultrasound, faults in engine parts can be detected. The algorithm of the digital form of the vehicle part was extracted and was compared with a database of good working condition of parts and bad working condition of parts. When there was a similarity in form it was then link to a database of photographs of the parts of the vehicles. The image was then extracted out and transmitted to the driver. Bluetooth was used to link the ultrasonic diagnostic tool with the display unit inside the vehicle and mobile hand phone.

TYPES OF FAULTS IT CAN DETECT IN A VEHICLE

• Mechanical Fault – Gears/gear boxes, motors, lack of lubrication, hydraulic cylinder. [7]

• Leak Fault – Valves, steam trap, radiator, hydraulic leakage, seals & gaskets. [7]

• Electrical Fault – Transformer, arcing, corona, switch gear.[7]

THE BENEFITS

• It solves the communication issue between the driver and technician / repaired centre manager in identifying the vehicles faults when it breaks down.

• The repaired centre will receive the first hand technical information and parts images produce by the ultrasonic diagnostic tool. This allows the technician / repair centre manager to check out whether there was any spare part and also to understand the faults. This crucial information was required for repairing the faults. This avoids wasting a lot of time trying to find out the faults when the vehicle was sent in for repaired.

• The driver thus did not need to wait for a long time for the repair since the repair site already had the first hand information of the parts and knows how to repair it.

• It reduces the chance of bringing the wrong spare parts to the repair site for vehicle repair due to the communication misunderstanding between the driver and repair centre manager.

• The driver and technician / repair centre manager thus saves time and money.

Figure 2: Final Design

CONCLUSION

Through the use of interview transcript one could discovered the hidden thoughts of the user which was beneficial to the project. Scenario role play engages the user and thus making the setting more realistic. The concept device thus replaces the information system in the vehicle and helps provide better communication through the transferring of technical information of the parts to the repair centre. It also allows the driver to use the tool to do maintenance on his vehicles.

ACKNOWLEDGMENTS

The author would like to thank those people who participated in this study for their time, enthusiasm and invaluable insight. Especially to Professor Mike Stott and Niklas Andersson from Umeå Institute of Design, Umeå University who is tutoring the author during this project.

REFERENCES

1. How Ultrasound Works. http://electronics.howstuffworks.com/ultrasound.htm
2. Insight with Ultrasound. http://www.research.philips.com/InformationCenter/Global
3. Measurement Science and Technology. http://www.iop.org/EJ/abstract/0957-0233/9/6/014
4. Pacific Northwest National Laboratory. http://www.pnl.gov/news/2001/01-34.htm
5. The Sonic Flashlight. http://www.stetten.com/george/rttr
6. UAV Rolling News. http://www.uavworld.com/_disc1/00000037.htm
7. UE Systems. http://www.uesystems.com.