The Lack of Understanding and Confusion Surrounding Car Fundamentals

Industrial Design for Game Hardware Assignment 1

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***Abstract*—In this paper, we discuss the lack of understanding that most people have regarding the fundamentals of their vehicle. Car owners lose hundreds to thousands of dollars annually on easily avoidable expenses. The reasoning behind this as well as the far reaching consequences of this stems from a lack of understanding. Structured interviews were conducted with 12 participants in which a desire to perform self-maintenance, over paying for a mechanic was expressed with the limiting factor preventing them from pursuing this option being a lack of time to properly educate themselves. Additionally, many entry level mechanics will lack the proper experience and training upon initially starting their jobs. This causes them to face the increased mental demand and need for precise skills to be confident in their craft, thus correlating to an increased risk factor of an accident occurring. To combat these problems we have identified, we have found a solution that we believe could help. With our solution, we aim to help people understand the fundamentals of a car through a more immersive, and hands-on experience.**

I. Problem Definition

Cars are the cornerstone of modern transportation for humanity. It is an essential part of daily life and is used by billions worldwide. However, when it comes to performing maintenance/repairing one's car, many people fail to fully grasp the fundamentals of their own car. Not only that but, new mechanics entering the field are feeling pressured when dealing directly with customers' cars. Without the proper training to help them understand, both mechanics and car owners are now faced with a lot of stress. If people were to learn more about their cars they would have to spend lots of free time researching and may have to practice on their own cars, which may be uncomfortable for many people.

A. When are people affected by this problem and how?

People will be affected on a daily basis as this may escalate into a much larger problem for both car owners and mechanics. Car owners are now left with an additional expense that they will have to deal with on top of other expenses they may have. With people being unable to perform these tasks themselves, and without taking the proper research to learn, they have no choice but to rely on mechanics. For example, if a car owner was in need of an immediate tire change before the winter, rather than performing this simple task themselves, they would have to resort to paying a mechanic. Additionally, this problem affects mechanics as well as those who lack hands-on experience, may feel overwhelmed and stressed when faced with repairing a customer's car. For a job that requires constant demand and precision at a very fast rate, the physical and mental workload can be exhausting. In a very high-stress environment, these factors can significantly reduce productivity.

B. What solutions or attempts have been made to solve the problem?

In order to solve this problem, solutions have been established. One such is a Virtual Reality Car Mechanic Simulator in which players can perform maintenance on a car at a very detailed level (Fig. 1). The player is able to perform necessary maintenance tasks on a car such as, changing tires, oil changes, cleaning rust, dismantling components, etc. After performing maintenance on a car, the game will allow you to test drive the car while performing mandatory checks like brake testing, suspension testing, acceleration testing, etc. This simulation has been very well received by the public and very informative for those who wish to learn more about cars. Similarly, another solution that was implemented was an Augmented Reality device used for simulation training (Fig. 2). This device would be worn around the user's eyes and would simulate a training environment for the user to partake in. One of those training environments was used for car maintenance. The user would be able to enter the environment where physical objects located somewhere else, could be projected into the space the user was located in [1]. This was used for performing maintenance on a car engine where the user could disassemble, repair and reassemble parts onto this simulated engine. This solution definitely helped many professionals like mechanics who needed some better experience before working on an actual customer's car.

II. Justification

A. Who will feel the consequences if the problem is not solved?

1) Car Owners: We feel that this is an important problem to address as it affects various people, yet it can be avoided in certain ways. However, if the problem is not solved it will continue to affect car owners and mechanics who lack sufficient training/experience. Right now, car owners are losing hundreds of dollars annually on expenses that they could very easily avoid if they knew how to perform the maintenance themselves. In a study done by 2 Degrees institute [2], the average annual vehicle maintenance costs per household for gas cars averaged $931 per year in Ontario alone (Fig. 3). This expense can become even heftier incorporating other potential maintenance, thus leading to the expense becoming even greater. Depending on the type of car, some car owners may spend up to ridiculous amounts of money with BMW owners spending approximately $17,800 on repairs over the course of 10 years [3]. Regardless of the car, the costs still remain at very high values for everyone involved. Not only that but, many car owners have simply put off the maintenance on their cars. A study by Utires in 2021 showed that roughly 92 percent of car owners admitted to neglecting car maintenance for longer than they should have [4].

The main factor for the delay was an insufficient amount of time. More than 50 per cent of car owners said they did not have time to take their car in, and paired with that, were unable to accomplish the task themselves [4]. In addition, another factor happened to be the cost where around 50 per cent of people were unable to afford the repairs, so they let their cars be [4]. If car owners are unable to perform maintenance on their car due to a lack of education surrounding the topic and are unable to pay for repairs from a mechanic, this poses a massive problem potentially leaving car owners with a car they cannot use or fix. Alternatively, if the owner takes matters into their own hands, the lack of clarity poses a great risk of a very costly accident.

In addition to these factors, Utires claims that another reason why car owners delay their own service was because of distrust toward mechanics. This notion of distrust and anxiety stems from ignorance of their vehicle's problems and a fear of being scammed by mechanics. Utires shop manager Matt Wojsaik notes how educating customers helps build trust and reduces the risk of more expensive complications in the vehicle due to lack of maintenance which in turn benefits the car owner [4]. However, despite this, not every customer is so willing to confront their car's problems

2) Entry-level Mechanics: This aforementioned problem also extends to car mechanics who are just entering the field as well. Many of which will lack the proper experience and training upon initially starting their jobs. They may still be at a phase that requires them to get more experience before heading onto the garage floor and begin work on a customer's car. However, the problem of increased mental demand and working hours for new mechanics to gain hands-on experience to be confident in their craft will correlate to a higher risk factor of an accident occurring. Since a mechanics' job requires an essential understanding of cars, the ability to identify problems and come up with solutions, it is a job that takes a toll mentally on people. In an analysis done examining the mental load of car repair mechanics in Yogyakarta [5], they used a scale system known as the NASA-TLX (Task Load Index) to identify certain things with these mechanics. This scale measured persons, mental demand, physical demand, temporal demand, performance and effort towards a certain task. When using this scale of questions, they found that new and young mechanics in the field from the age of 17 - 20 had scores from 270 - 500 on their mental demand [MD] [5]. With mechanics feeling such an overwhelming amount of pressure, this can reduce productivity in the work that they are doing. Not only that but, the mechanic may lose their job due to a lack of sufficient work and the particular business may lose face as well, thus causing customers to not return due to the errors caused by the mechanic.

III. Our Solution

To combat these problems we have identified, we have found a solution that we believe could help. With our solution, we aim to help people understand the fundamentals of a car through a more immersive, and hands-on experience. That way, people can train themselves before dealing with a vehicle of their own, or for a customer. The experience will solely focus on properly changing your car's tires. A standard operation performed annually on a car that many people lack the proper education on. The piece of hardware we wish to create to accompany this will be a 3D printed "baton" that acts as the base for different wrenches needed to remove bolts of a tire (Fig. 4). The baton will have interchangeable parts that will represent different wrench heads needed to remove and re-attach lug nuts to a car. We believe this added baton will make the experience feel less clunky and awkward compared to those of virtual and augmented reality as users will now have a physical component to use as a point of reference. Paired with the baton will be a 3D-printed tire rim housing 5 individual lug nuts. To use the baton and wrench, the user will have to physically loosen the lug nuts to a certain point which will simulate the action of removing a tire. We believe that these physical components can help simulate the real experience without the need for the user to handle a real car until they feel comfortable. In the end, we want to provide clarity and shine light on these components so that they will be easier to understand. Nullifying this lack of understanding will significantly reduce car owners expenses and help new mechanics refine their skills before entering into the field.

IV. Appendix

References

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Figures

Fig. 1. Image showcasing the car simulator game as a player is using a multi-meter to check the voltage in a car battery.

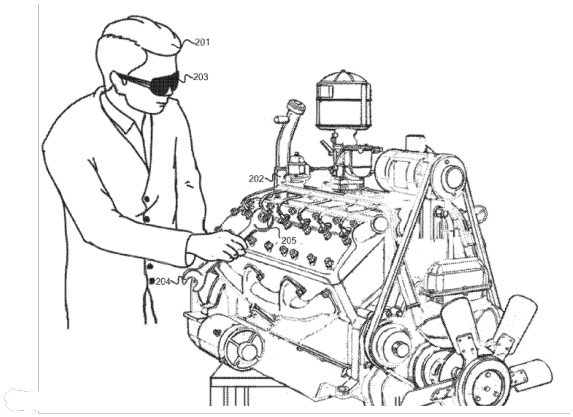

Fig. 2. Diagram showcasing the use of the AR glasses for car repairs.

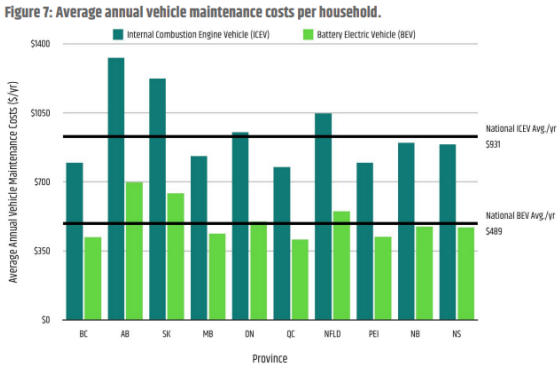

Fig. 3. Graph from 2018 highlighting annual cost for maintenance on gas and electric cars per province

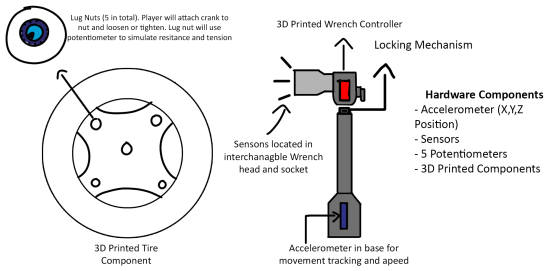

Fig. 4. Sketch showing our main concept for our solution.