New Priority Paper

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Executive Summary

The recent circumstances regarding the global pandemic have drastically changed the way students take their classes and labs. Because of this, the Electronic Directory Board project is rendered essentially useless since nobody is in the building. However, an increasing number of people are learning new skills at home to become self-sufficient, such as gardening, home repairs, and more. Therefore, my new priority is developing an open source diagnostic tool for vehicles that have OBD-II ports; so those at home interested in doing their own troubleshooting and repairs can do just that, without spending hundreds of dollars on specialized tools. This tool consists of three primary modules: a Bluetooth transceiver that interfaces with the OBD-II port, and a handheld unit that includes a touchscreen, a single board computer such as a Raspberry Pi, another Bluetooth transceiver, and a rechargeable battery, and lastly the user interface. There are existing tools like this already, however the inexpensive options connect to a proprietary phone app instead of a dedicated handheld unit, and the options that do have their own handheld device and a similar set of features can easily cost over $500. My solution will be accessible to as many people as possible because all code and documentation will be open source, and the hardware used will be inexpensive.

New Priority Paper

The global pandemic involving COVID-19 has changed the lives of many people. Students are learning from home, offices are working from home, and people are becoming more reliant on themselves and learning new skills. My new priority is to develop an open source diagnostic tool for vehicles with OBD-II ports. This tool will allow tinkerers stuck at home or even full-time mechanics to troubleshoot and repair their own vehicles without spending their savings on an expensive highly specialized tool. The system will consist of three primary components: the Bluetooth transceiver that interfaces with the OBD-II port, the handheld unit that houses its own computer, Bluetooth transceiver, and other components, and lastly the user interface.

OBD-II Port Bluetooth Module

Vehicles sold in the United States are equipped with a diagnostic port, called OBD-II; this began in 1996. The port is used to read engine trouble (diagnostic) codes and sensor information. The Bluetooth module in the system must interface with the OBD-II port in two ways: it must be able to read trouble codes and sensor information, and it must be able write a command to the port to clear the trouble codes. The Bluetooth module will relay information back and forth between the OBD-II port and the primary handheld unit. This OBD-II port module will be powered by the port itself, as the port has a direct 12V+ pin and ground pins. One issue with this is that the power runs directly from the battery, no fuses or other circuitry between. This means I must design some filtering and protecting circuitry to ensure the power source is stable and safe. An example of what this module may look like can be seen below in Figure 1.

Figure 1. An OBD-II scanner product from Newegg.com.

Handheld Module

The primary module in the system is the handheld module. This device will contain several components including: a single board computer which should also include a Bluetooth transceiver, a resistive touchscreen, a Micro USB port, a rechargeable battery, a power button, and a magnet embedded in the back of the housing. The single board computer will do all the processing of the inputs and outputs, and a good example of one I could use is a Raspberry Pi. The touchscreen will be resistive for two main reasons: the cost is lower compared to capacitive, and resistive screens can be used with gloves. A model of what this unit may look like (created with SketchUp) can be seen below in Figure 2.

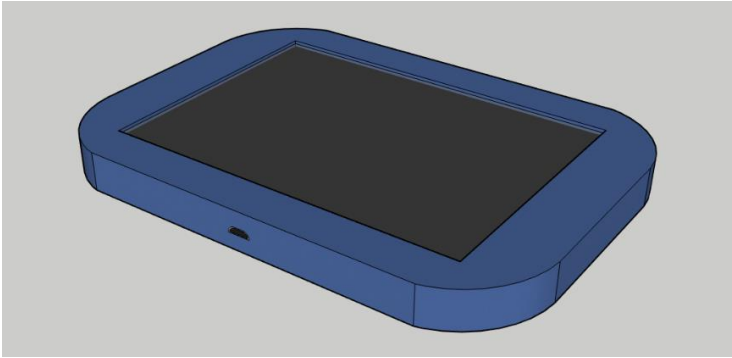

Figure 2. A 3D model of the proposed handheld device.

Ideally, the Micro USB port would be attached to the single board computer and include protection and charging circuitry for the rechargeable battery. However, if this circuitry is not included with the single board computer, I will design a Micro USB charging circuit myself. A simple power button will be included in the side of the housing, and a magnet will be embedded in the back of the housing so it can be used with dash mounts or other magnetic surfaces. A different view of the 3D model can be seen below in Figure 3, which shows the potential power button and magnet placement.

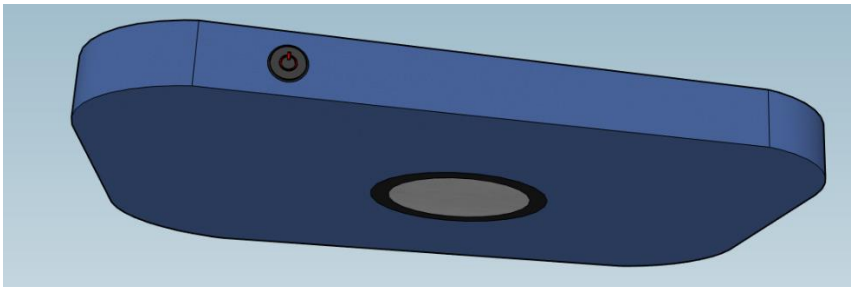

Figure 3. A view of the power button and magnet placement.

User Interface

The user interface will be kept as simple and user friendly as possible. Most of the operation will be tapping on onscreen buttons, so no swiping or gestures will be required. This is great for those with limited motor skills in their hands and is another reason to choose a resistive touchscreen over capacitive. The interface will display a list of the trouble codes on the left-hand side, and the onscreen buttons for input will be in a column on the right-hand side. The user must tap on one of the codes in the list to read a description of the cause. A mockup of this interface (created with Photoshop) can be seen in Figure 4 below.

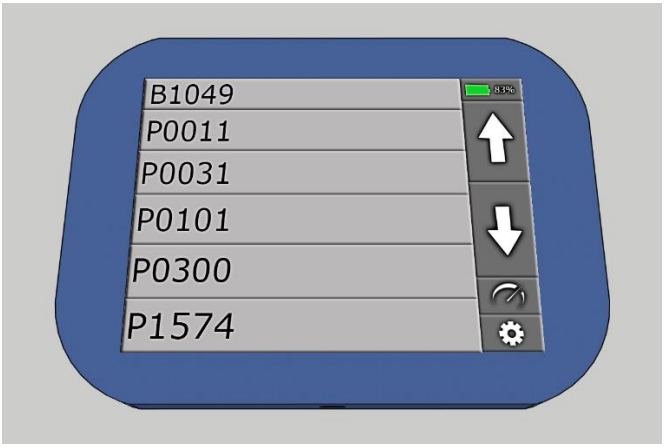

Figure 4. A mockup of a potential user interface for the handheld unit.

In the top right of the screen is the battery status, which is displayed as a color and a percentage. Then, there are two arrow buttons to scroll up and down through the code list. Below the arrows is a gauge icon. This button will bring the user to a new screen that displays live sensor information including speed, coolant temperature, and oil pressure. The last button, located in the bottom right, is for settings. In this menu, the user can pair the Bluetooth devices, adjust the screen

brightness, change units to metric, and more. All code and documentation developed for this system will also be open source. This means anyone with the same single board computer can download and customize the code as they see fit.

Existing Solutions

A tool like this is not a brand-new invention, however a system with a dedicated handheld unit and the features I described can easily cost over $500 and is not open source. An example of one of these devices, seen in Figure 5 below, costs $560 and is bloated with features wrapped in an arguably cluttered user interface.

Figure 5. An existing product with similar design and features from Amazon.com.

There are many features included that many home users do not need, so they cannot justify spending so much on one tool. The other option is the cheap Bluetooth devices, like the one seen in Figure 1. These often come bundled with an app that you must install on your phone or tablet, and a lot of people do not like doing this, especially if it is from some obscure company. With a dedicated handheld unit and custom user interface, the user is free to use their phone for other things like looking up information or using the flashlight.

Conclusion

As society and the environment is constantly changing and evolving, it is important to be flexible and adjust to make the situation as bearable as possible. The pandemic has taught people to not rely on others so much for their needs and are learning new skills along the way. An affordable and easy to use device like the one described encourages the home mechanics and hobbyists to perform their own diagnostics and repairs. Not only that, the open source code and documentation allows the user to modify the system to their liking, allowing for new features to be added and potentially improving the programming skills of the user as a result.

References

[Figure 1] ELM327 Bluetooth OBDII Car Diagnostics Tool, Newegg, (2020). Retrieved from https://www.newegg.com/p/2A7-00J7-00005?item=9SIAEG2AW38435

[Figure 5] Autel MaxiCOM MK808BT Diagnostic Scan Tool, Amazon, (2020). Retrieved from https://www.amazon.com/dp/B07MBSZH48/