The goal of this project is to implement a heads-up display (HUD) into a helmet. This helmet will include multiple features to increase the safety and convenience of the user. These features include a heads-up display that primarily shows blind-spot detection, time, and location, as well as other important features. It will also include a very small OLED display that can show information while not being obstructive to the driver. A GPS module is used to track the position of the wearer and display relevant information onto the HUD. This display will also provide a visual cue if an object is approaching the blind spot as measured by the Ultrasonic Distance Sensor.

Motorcycles and bicycles lack many conveniences as well as safety features that cars have today. One major concern for cyclists of all kinds is their blind spot as they do not have a rearview mirror and are more vulnerable. A way to fix these issues is by implementing heads-up display technology inside of a helmet. This will allow people to see important information at a glance which in turn increases awareness as well as safety.

The HUD Helmet uses 3 sensors and a GPS module with an antenna in order to track speed, location, and objects in the wearer’s blindspot. This information is then processed and given to the wearer through a visual display as well as an audio cue. A mockup of the system can be seen in figure 1.

The final build of the HUD Helmet can be seen in figure 2 where all of the components were combined to create the HUD Helmet system.

- The blindspot monitor works using 3 ultrasonic distance sensors, placed 15 degrees away from each other on the back of the helmet to create an array that allows the sensors to detect if a vehicle is in any of the 3 blindspots of the wearer as seen in the demo system in figure 3.
- The Ultrasonic distance sensor sends out a sound wave that then bounces back toward the sensor. The Raspberry Pi then uses the amount of time it takes for the wave to bounce back and the speed of sound to calculate the distance.
- The Blindspot alert is only triggered within a distance threshold and when the vehicle in the blindspot is moving at a high speed in that threshold.
- The GPS Module is wired to an external antenna that is placed at the top of the helmet in order to allow the satellite network to easily triangulate the position of the wearer. The module itself translates that data into longitude and latitude that is then used to calculate the speed of the wearer.
- The OLED screen displays Time, Date, and Speed when the ultrasonic distance sensors do not get triggered as seen in figure 4A. When the Ultrasonic Distance sensors trigger the blindspot monitor the OLED screen displays a warning symbol as seen in figure 4B and a sound buzzer is triggered to notify the user.

Figure 5 shows how the system operates through a block diagram. The NEO-6M (GPS Module with antenna) that is used for the speedometer and the HC-SR04 (Ultrasonic Distance Sensor) which is going to be used for bling spot monitoring are the sensors that are connected to the Raspberry Pi. The Raspberry Pi processes this information and pushes it out into the helmet through the 128x64 OLED Display and Adafruit 1536 (Buzzer/ Audio Indicator).

In order to keep the integrity and safety capabilities required of a helmet, many safety measures were followed.
- A helmet shall not have any rigid projections inside its shell.
- Rigid projections outside any helmet's shell shall not protrude more than 0.20 inches (5 mm)* [1].

An industry standard to applying attachments to a helmet is to mount using an adhesive that way in an event of an accident the protrusions would snap off and are not considered rigid.

- According to major helmet and helmet accessory manufacturers Giro, Specialized, and GoPro, using adhesive mounts in this manner should not adversely affect the performance and safety integrity of the helmet as was proven in their own tests [2].

Taking these safety measures into account all components are attached to the helmet using similar adhesive. This includes the arm holding the display, all sensors, and the Raspberry Pi.

*According to Cornell Law School Section 571.218. Standard No. 218; Motorcycle helmets.SS.5 Projections.

In summary, a non-obstructive and safe method to effectively alert the wearer of important information was successfully designed and assembled. The prototype successfully tracks the users’ speed and location while enabling them to be alerted of objects in the wearer’s blindspot. The wearer is alerted in an organized manner using both audio and visual cues.

References

Figure 1: Mock up of the HUD Helmet System Left (A) is the back view. Middle (B) is the point of view of what the user could see. Right (C) is the right side view.

Figure 2: Final build with all components. Left (A) is top view. Right (B) is back view.

Figure 3: Demo system showing the range of the ultrasonic sensors for the blindspot monitor. Left (A) are the typical blind spots of a cyclist. Right (B) is how the HUD Helmet would cover the blindspots.

Figure 4: Sample of what would be shown on the heads-up display. Left (A) is in normal mode that shows date, time, and speed. Right (B) is in blind spot alert mode that shows a warning sign.

Figure 5: Block Diagram