

The Instrumented Bike Project

Josh Garot, Yaqoub Abdulkarim, Ibrahim Aljarbou



Abstract

The project aims to simplify the sensor assembly process and improve the sensor logger's performance to help in the progress of the instrumented bike, and our primary purpose is to discover obstacles such as cracks, potholes, and bumps on the bike routes. The sensor logger captured the vibration data/signals while mounted to the bike and wirelessly communicated them to the smartphone, in which the data processing and computation procedures were done and will be added to the map to provide the location of each obstacle. On the other hand, the sensor logger requires an upgrade three years after its development to better support the performance of an instrumented bike. Therefore, as a team, we need to research newer sensors and implement them into a single system to make it easier for other professors and students to test our updated product.

Requirements

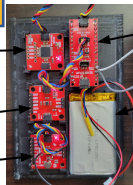
- GPS sampling frequency at least 1 Hz.
- Accelerometer sampling frequency at least 100 Hz.
- The system needs at least 3 hours battery life to collect data.
- At least 100MB of memory to store multiple trips.
- Must be able to locate other obstacles in the trail. (Figure 8)

Components

QWIIIC OpenLog (with an SD Card)

KX132 Accelerometer

Sparkfun ZOE-M8Q GPS



Arduino Nano 33 IoT
 PkCell LP503562 3.7V Rechargeable Battery

Figure 1: System Components

System Architecture

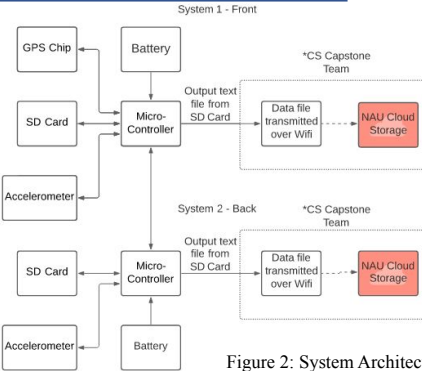


Figure 2: System Architecture

Testing & Results

Figure 3 shows some of the data collected during the testing, which are the date, time, hazard (Accelerometer), and hazard location (GPS).

```

37390, 35.18880, -111.65507, 2022-3-23-13-32-41
374171, 35.18878, -111.65507,
374192, -0.1196, -0.0605, 1.0287
374221, -0.1213, -0.0595, 0.5916
374244, -0.0914, -0.0798, 1.0046
374267, -0.0662, -0.1233, 1.0239
  
```

Figure 3: Section of output file



Figure 4: Pothole - Skyview



Figure 5: Pothole Patch - 1899 Bar

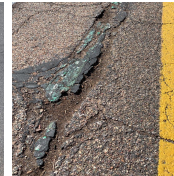


Figure 6: Large Crack - Skyview

Results



Figure 7: Final System

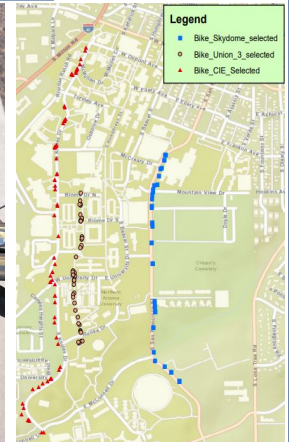


Figure 8: Obstacles location

Conclusion

Our sensor worked as expected and met all the requirements. We were able to collect the data needed and save it to the Micro SD card. We were not able to use the second system when comparing the data since we need to connect them wirelessly. Instead, a set of data from the mobile app was used to compare it with our own collected point.

Acknowledgments

Our team would like to extend a special thank you to Dr. Kyle Winfree, Dr. Chun-Hsing Ho, Dr. Robert Severinghaus, Mahsa Keshavarz, and Yifei Zhang for their support during the project time.