

# V2X Motorcycle HUD

Ryan Hiser  
Jorge Pacheco  
Jacob Nguyen

## HUD DISPLAY

Directions  
Fuel Warning Indicator  
Speed  
Range/Speed of Rider 1

## HUD DISPLAY

Directions  
Fuel Warning Indicator  
Speed  
Speed of Rider 2

Communications with Range Estimation

Data: Name, Lat/Long, Speed, Nav, Fuel



Rider 2



Rider 1



# Motivation

- Motorcyclists often ride in groups. To effectively and safely ride it is often necessary to communicate. This takes many forms:
  - Hand gestures (hands off of handlebars)
  - High speed maneuvers
  - Intercoms (difficult with multiple riders)
  - Refuel periods (gas tanks size/consumption speed vary)
  - Modern cruise control is handled as a throttle lock
    - Riders at rear cannot easily keep consistent following distance
- A HUD system would allow for fewer distractions from the driving experience by displaying this information in a digestible format:
  - Driving Directions
  - Speed
  - Simple Messages
    - Others need to refuel
    - Following distance



# Abstract

- V2X (vehicle-to-everything) system using two motorcycles
- Share driving information using wireless communication.
  - Make navigation easier to digest
  - Make following others easier
  - Make road trips more enjoyable
- Shared vehicle data is displayed on HUD
  - Name
  - Navigation
  - Speed
  - Geographical location (longitude/latitude)



# Apparatus / System Diagram (For Demonstration)

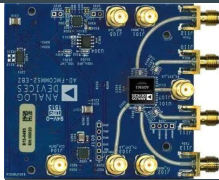




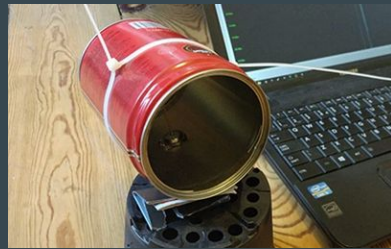
# Apparatus / System Diagram (2)



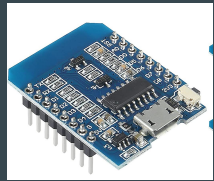
ZCU104



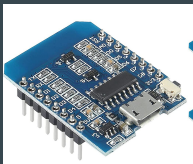
FMComms



Antenna  
(Cantenna)



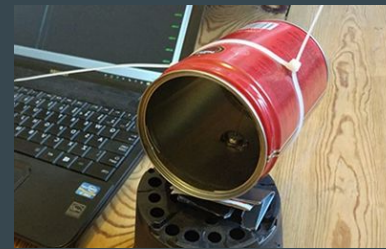
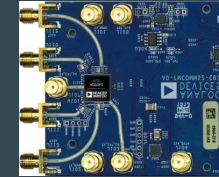
Wifi adapter



DIY HUD for motorcycle 1



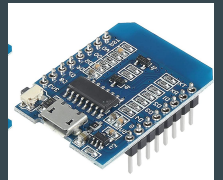
FMComms



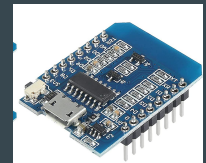
Antenna  
(Cantenna)



ZCU104



Wifi adapter



DIY HUD for motorcycle 2



# Bill of Materials (BOM)

## Hardware:

Item	Qty	Price	Notes
ZCU104/ZedBoard	2	\$0	Borrow
FMComms Board	2	\$0	Borrow
PlutoSDR	2	\$0	Borrow
HUD	2	\$0	DIY: <a href="https://www.instructables.com/DIY-Smart-Glasses-ArduinoESP/">https://www.instructables.com/DIY-Smart-Glasses-ArduinoESP/</a>
OLED	1	\$0	Already Have (x3)
Battery (LIPO)	1	\$0	Already Have (x3)
Batter Charger	1	\$20-30	Need to identify (based on battery)
Google Cardboard	1	\$0	Already Have (x3)
Wifi/Microprocessor	1	\$0	Already Have (x5)
2GHz Antenna	1	\$0-100	Find/build: <a href="https://www.askaprepper.com/make-tin-can-wifi-antenna-extend-communication-emp/">https://www.askaprepper.com/make-tin-can-wifi-antenna-extend-communication-emp/</a>
GPS Unit	2	\$?	Need to Identify (or will use a preloaded LUT to simulate)

## Software:

- Matlab
- GNU Radio
- Xilinx Vivado and Vitis
- Python/C/C++

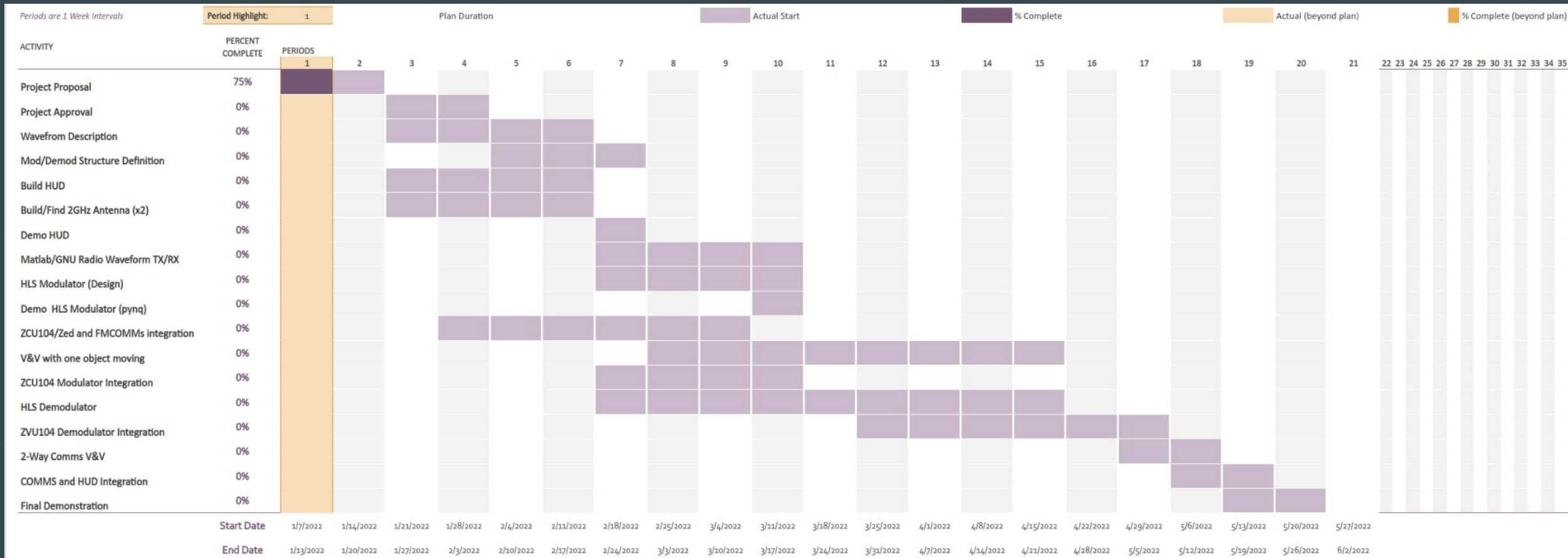


# Task List

- DIY HUD for both vehicles
- Simulation of waveform with MATLAB/Simulink
  - Note: TDMA will be used instead of our original intention of combining RADAR and a Comms.
- Data communications with GNURadio (2 Pluto SDRs)
- Embedded Hardware design utilizing our communications protocol.
- Distance estimation
- Real world system verification with desired hardware
- Real time HUD updates from system verification
- Kalman filter for improved range estimation



# Schedule







# Final Demonstration

- The final demonstration will be simplified to avoid any safety issues with using motorcycles.
- Rider 2 will remain stationary
- Rider 1 will move toward and away from Rider 2
  - Will use scooter/cart
- Rider 1 and Rider 2 will negotiate TDMA access requirements
- Both Riders will determine range of other rider.
- Rider 1 will have a Lookup Table (LUT) with data for navigation/directions
  - Directions will be relayed to Rider 2. Rider 2 will return fuel level and indicate if a stop is required.
- Received Data will be displayed on a HUD for each Rider
  - Data will also be saved to a data file for post-experiment verification

**No motorcycles were harmed in the making of this Capstone Project.**