Joshua Paul

Embedded Software Portfolio

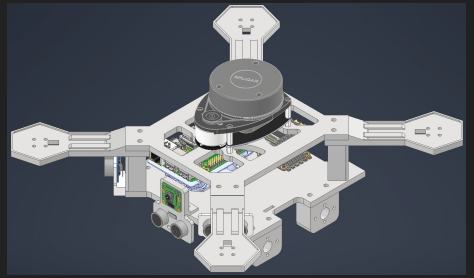
Github: https://github.com/Jcpaul1226
Website: https://jcpaul1226.github.io/

Nasa Minds 2023 Flying UGV Senior Project

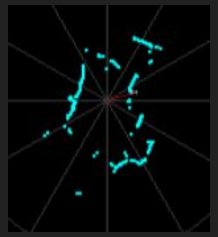
Creating a custom drone capable of both flight and ground navigation

Methodology

- Design a flying UGV with the function of traversing both ground and air
- Alternates between two modes for desired travel method
- Autonomously navigate its surroundings with the use of sensors
- Main goal is for space exploration, for the use in to the NASA Artemis missions



Physical Hardware Design



Radar Detection with Lidar

Ground

Ability to roam terrain on the ground using motors and wheels

Flight

Ability to lift above the ground and maneuver in the air via propellers

Both

Navigation via LIDAR, ultrasonic, and camera

Hardware

- Raspberry PI 3B
- Navio2
- RPLIDAR A1
- Ultrasonic Module HC-SR04
- Raspberry PI Camera Module 3

Interfaces

- Ardupilot
- Mission Planner
- OpenCV

Personal Contributions:

- Leader of the sensors subsystem.
- Established Connection between Lidar sensor and Navigation System
- Utilization of Mission planner for easier software implementations and collaboration

Digital Clock

Objective:

Create a Digital clock with adjustable time

Functions:

- Accurate display of time in Hours:Minutes:Seconds
- Individually adjust the hours, minutes, and seconds.

Hardware

- Xilinx Nexys A7-100t
- 7 segment display
- Switches
- Buttons

Interfaces

- Vivado
- Verilog

Skills Acquired/Enhanced:

- Syncing strategies to avoid metastability
- Debouncing to eliminate jumping signals
- Proper Flip Flop usage

VGA Game of Tag

Objective:

Create a game of tag using a VGA display

Description:

- Player's (red) goal is to catch the bot (blue)
- Bot moves pseudo-randomly whenever the player moves

Hardware

- Xilinx Nexys A7-100t
- VGA displayport
- Push Buttons

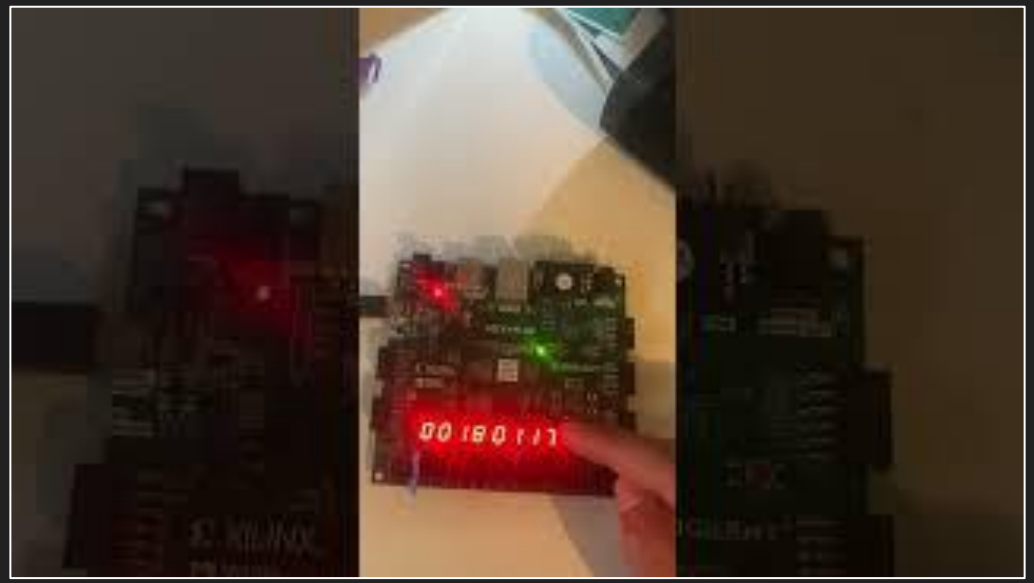
Interfaces

- Vivado
- Verilog

Skills Acquired/Enhanced:

- VGA utilization
- Pseudo-random data generation using a Linear Feedback Shift Register

Multi-bit BCD Calculator



Objective:

Create a 2-bit input calculator that can show results up to 9999

Functions

- Addition & Subtraction
- Multiplication & Division
- Inputs up to 99

Hardware
- Xilinx Nexys A7-100t
- 7 segment display
- Switches

Interfaces
- Vivado
- Verilog

Skills Acquired/Enhanced:

- Proper Case statement usage
- Array manipulation