TWO-AXIS LASER JOYSTICK

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Project Goals

1. Design and implement a distributed real-time control system using a microcontroller and an FPGA to convert inertial sensor measurements into deterministic servo actuation.

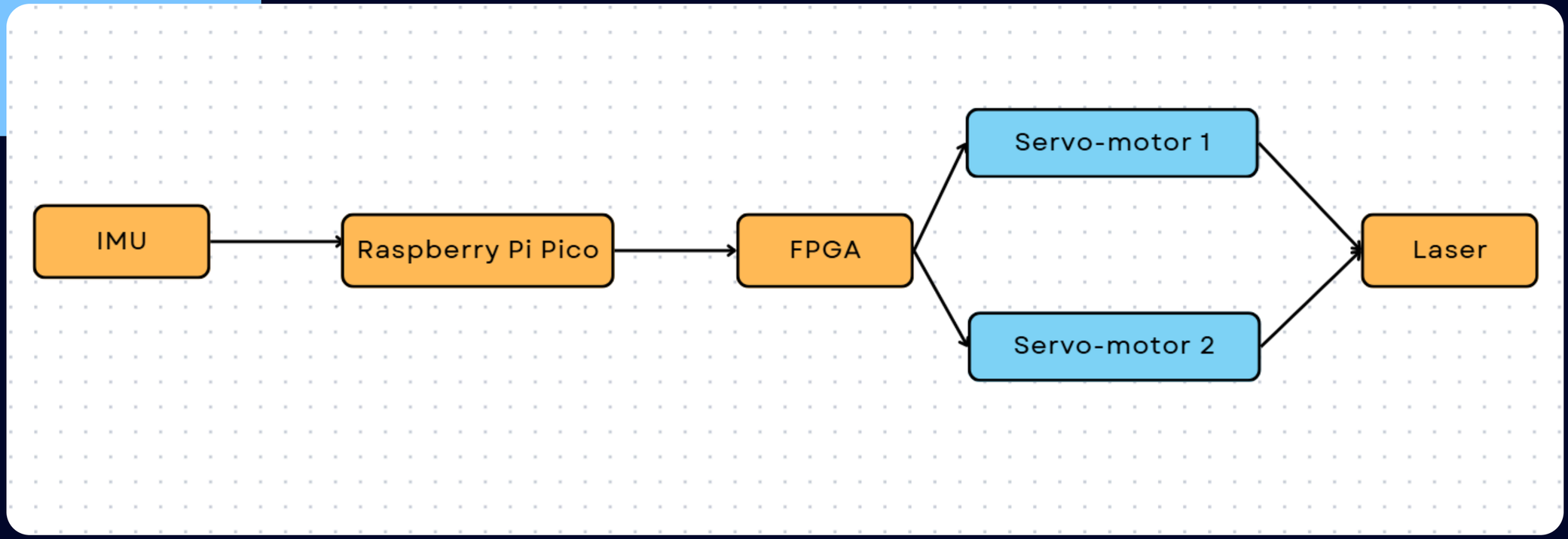
2. Demonstrate practical MCU–FPGA co-design

3. Implement inertial sensing and orientation estimation

Hardware components

1. LSM6DSOX + LIS3MDL IMU
2. RP2350
3. ice40
4. Servo motors

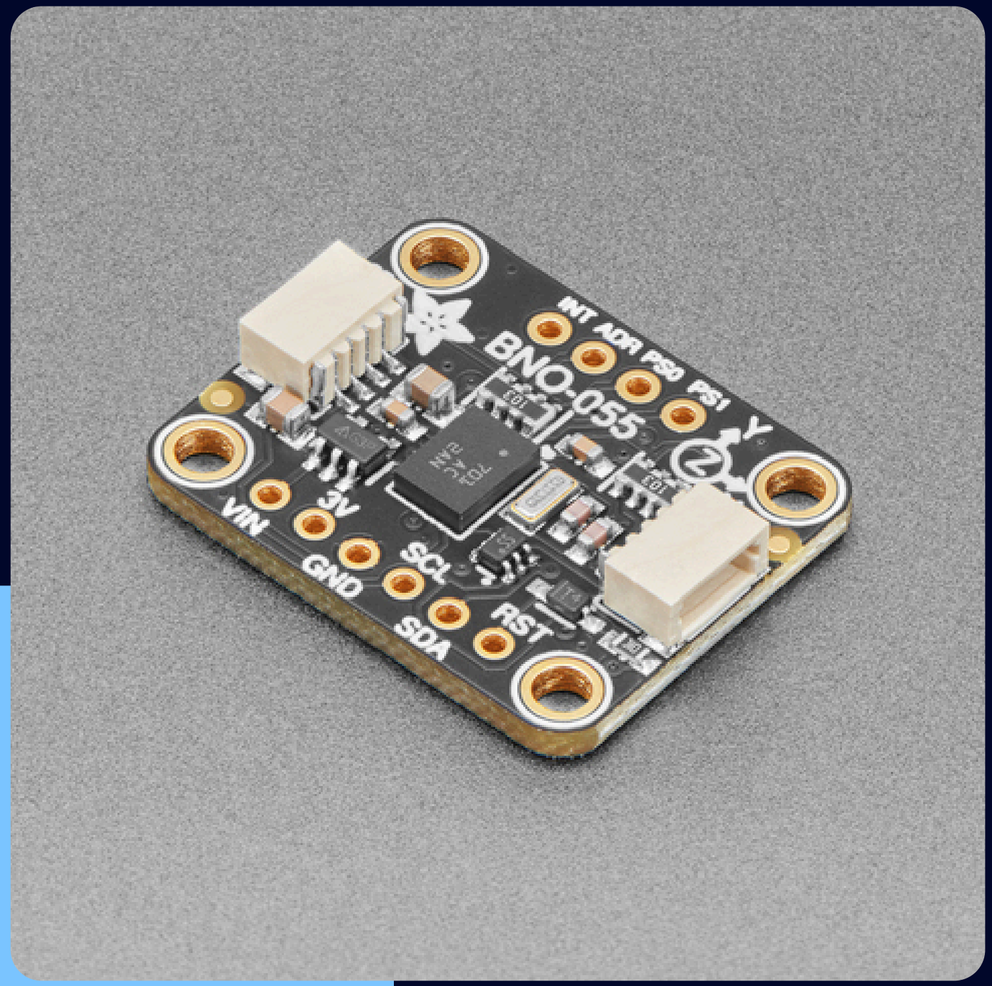
System Overview

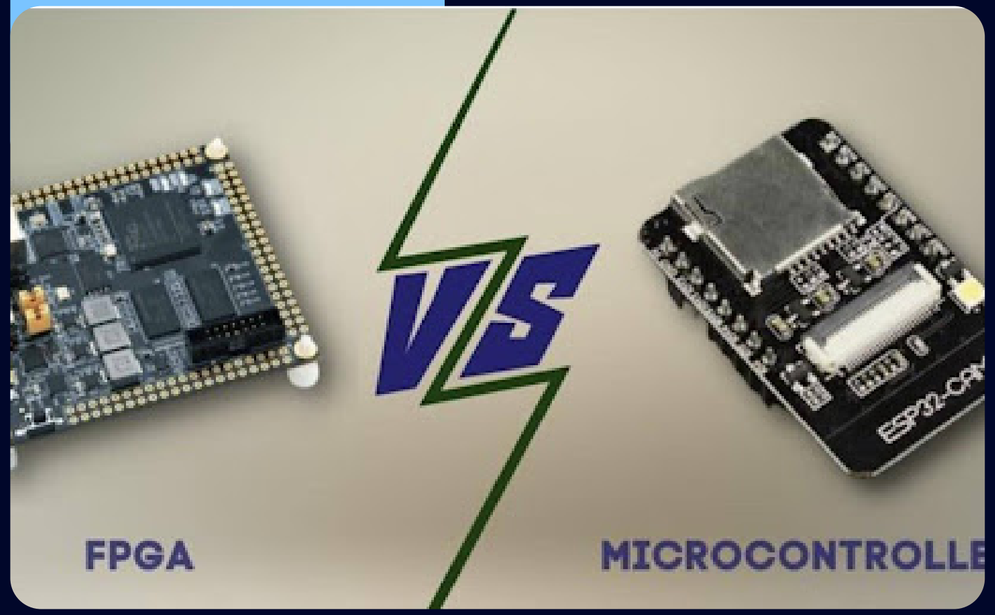


IMU

IMU includes 9-DOF:

- Accelerometer
- Gyroscope
- Magnetometer





Why FPGA?

1. Precise timing
2. No jitter
3. Parallel control of multiple servos
4. Closer to real systems

Software Components

1. C on the RP2350
2. Pico SDK and Pico ICE SDK
3. GitHub repository
    a. branching, Pull Requests
4. SystemVerilog

Protocols

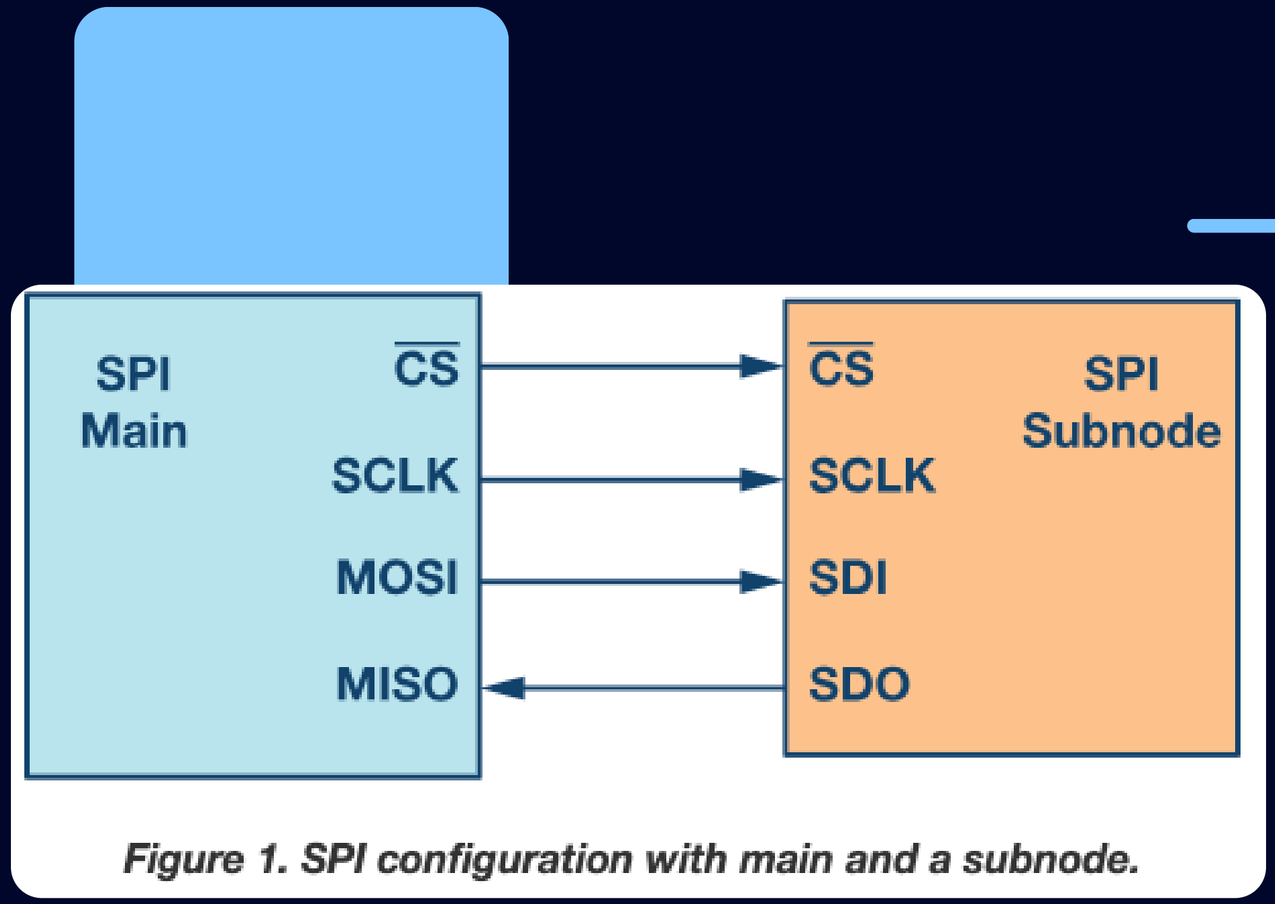


Figure 1. SPI configuration with main and a subnode.

1. I2C Communication
2. 16-bit SPI Packets
3. PWM Signal Generation

Posible Improvments

01 Test-Benches

02 More accurate sensors and servos

Challenges Faced

01 Project Pivots constrained our Timeline

02 Application did not require Digital Design