Bluetooth Gesture Recognizer Glove

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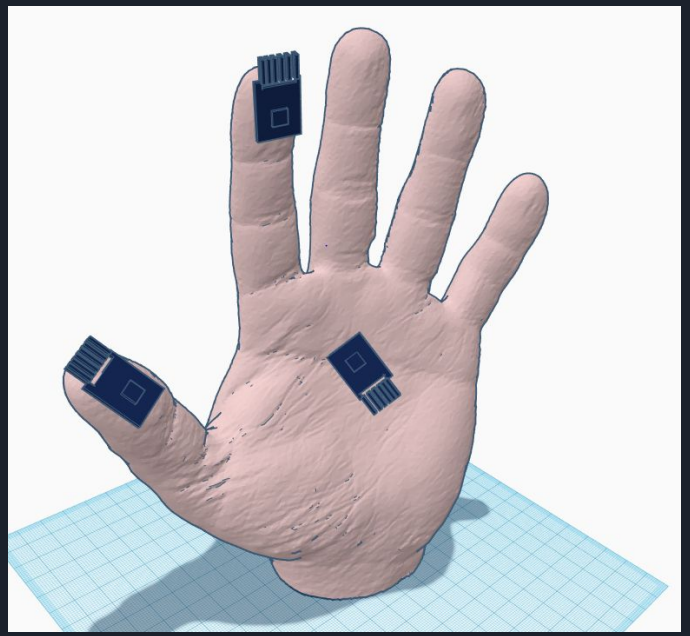
Introduction
Background and Motivation

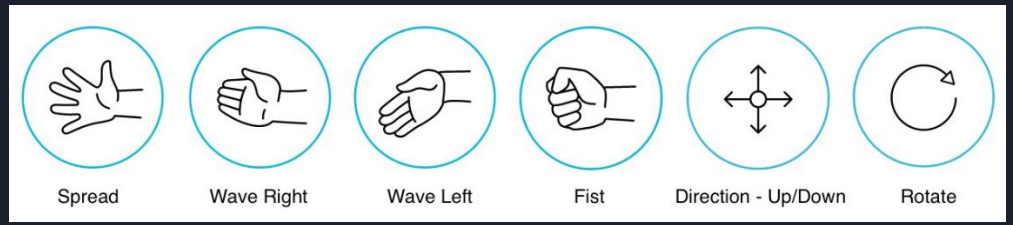
- Keyboards and mouse do not capture human behaviour effectively

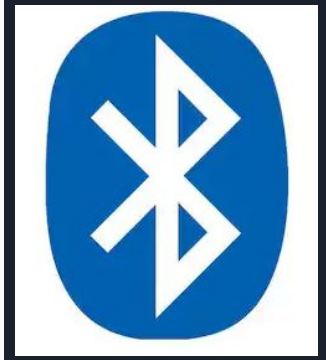
- Human hands are high bandwidth communication medium

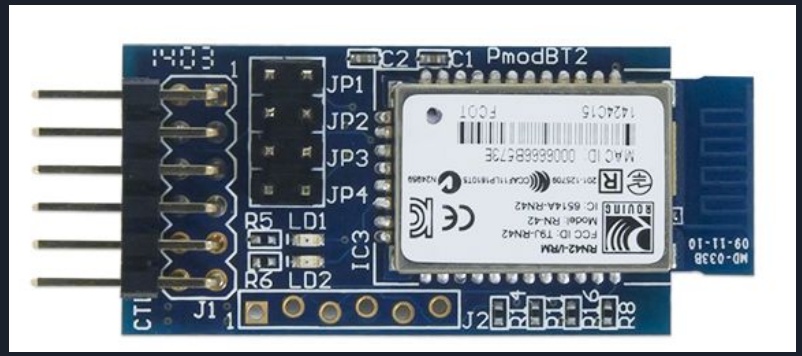
- Existing glove controllers are not very successful

Introduction
IoT Aspect

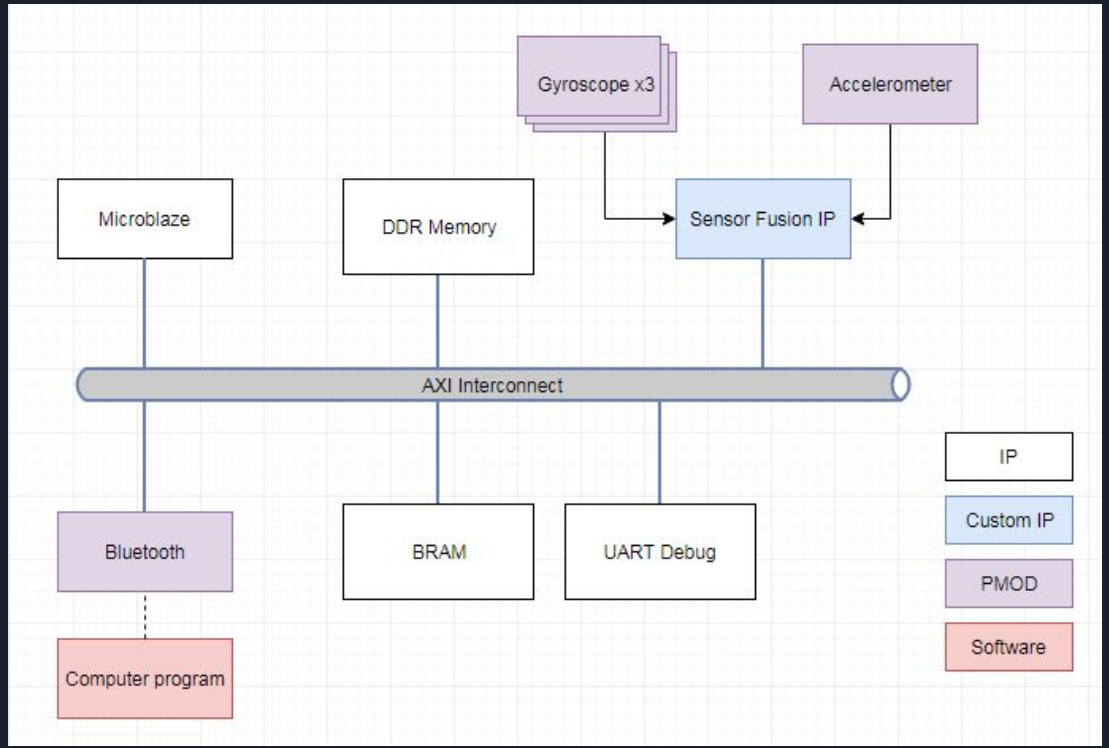






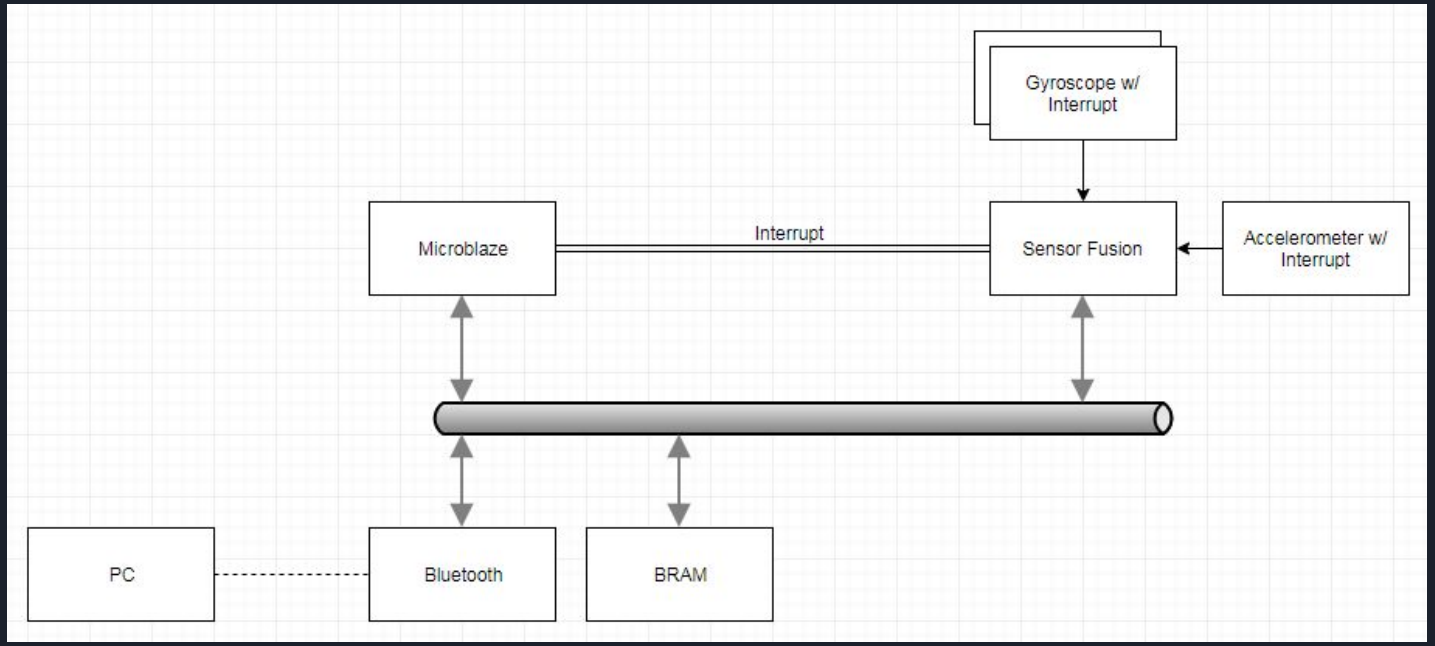


System Overview Block Diagram



- SPI interface between sensor and fusion ip
- Store program in BRAM
- store sensor raw data onto DDR Memory
- Microblaze facilitates Bluetooth communication

Updated System Overview



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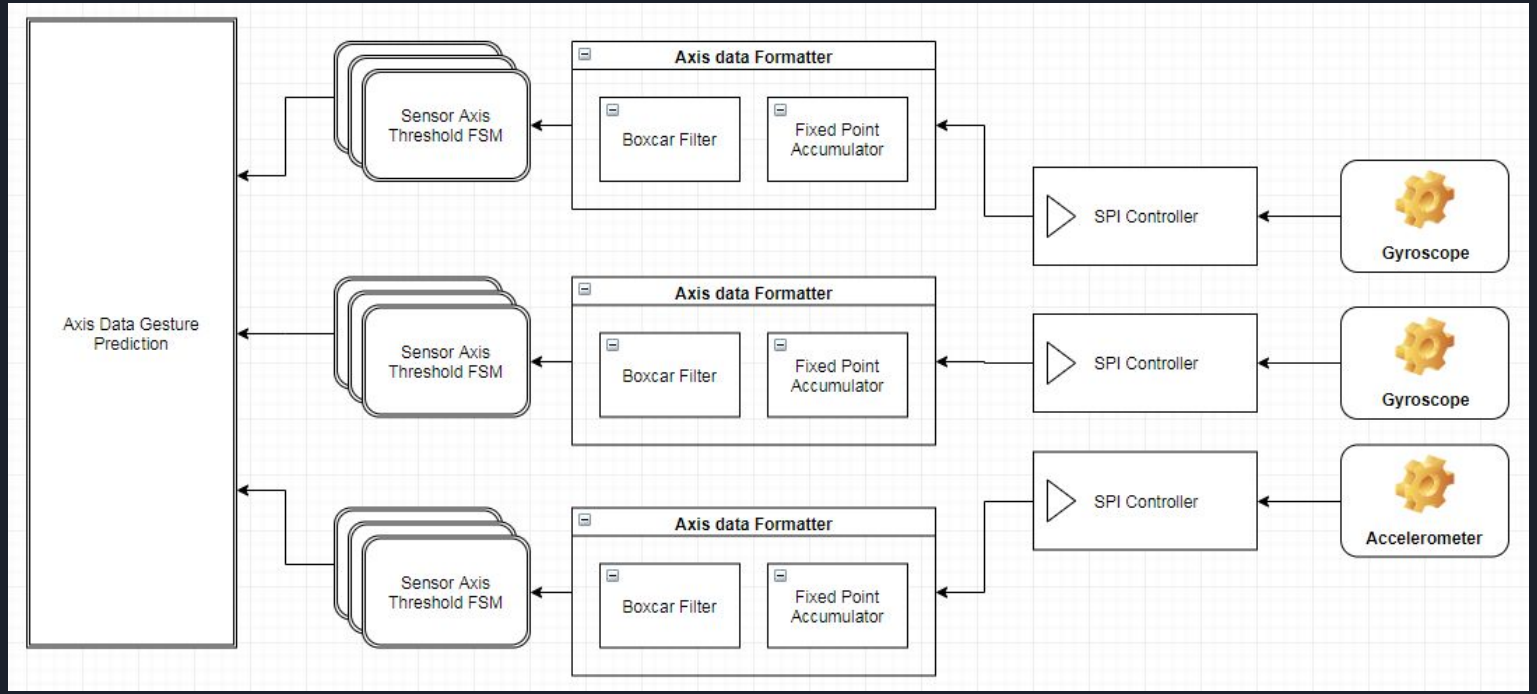
Sensor Fusion Block



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3-Axis Gyro Errors

- Only measures relative body angular velocity, not absolute pitch, yaw, and roll
- Integrator drift error
- Zero rate level

- Need method of error correction or thresholding with continuous resets

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Possible Solutions

- Fuse sensor readings (Gyro + Accelerometer), Complex Filtering
  - 6 Degrees of Freedom Inertial Measurement Unit
    - + stabilizes error
    - + accurate reading
    - - Significant Filter code (Kalmans, Madgwick)
    - - Increased resource utilization (Array multiplication and Float operations)

Possible Solutions Cont.

- FSM with sensor thresholding
  - Pseudo values for pitch, yaw, and roll
    - + Less resource utilization
    - + Easier to code
    - - Very inaccurate
    - - Less flexibility with hand movements

Possible Solutions Cont.

- Complementary filter
  - Best of both worlds
    - + Less resource utilization than advanced filter
    - + Easier to code, simple weighted sum of gyro and accelerometer data
    - + more accurate than dead reckoning
    - - Additional time to tune accelerometer data

Challenges

- Accelerometer implementation is way more complicated than expected for limited resources and documentation

- Significant error readings on zero state / still position. Need to carefully research the algorithm to balance the weights between accuracy and algorithm complexity

- Team communication problem: sync up, integration

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Achieved so far

- Gyro reading with integrators/ filters
- Accelerometer reading with integrators/ filters
- Block design with MicroBlaze, BRAM, packaged sensor AXI IP
- Bluetooth example setup

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Future Plan

- We are way behind schedule, so each team member should devote more on project.

- Sensor IP and Microblaze integration finish in this week and start sensor fusion alogrithm test ASAP

- Bluetooth module validation finished before for next milestone. Leave UI design and overall test/debug in the last week

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