

EMG/IMU-Controlled Robotic Arm

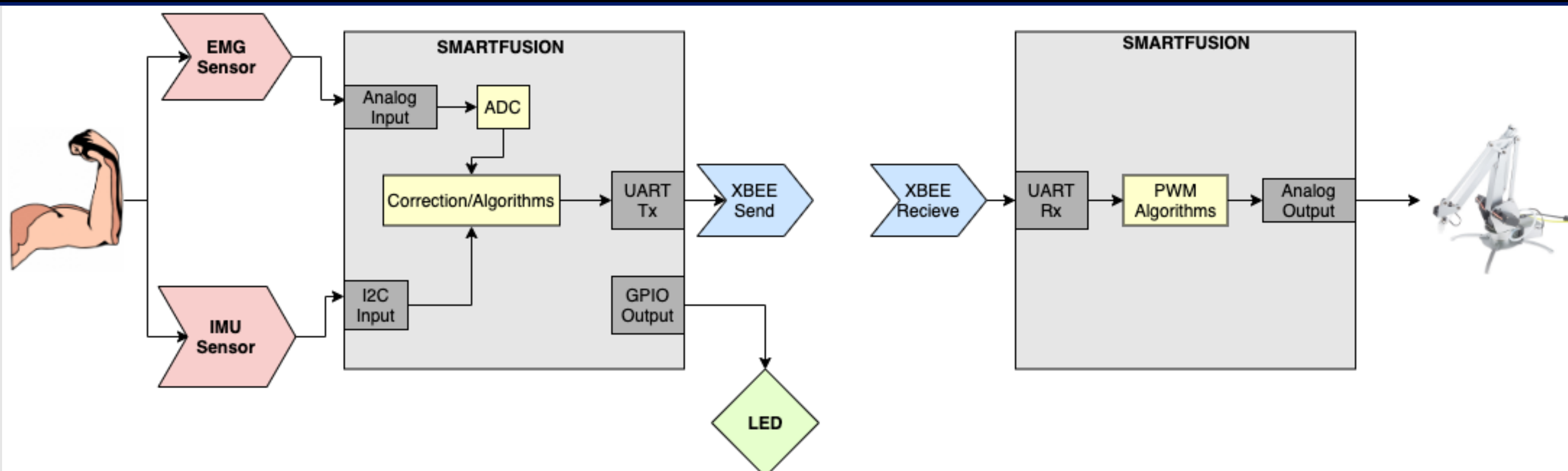
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Introduction: Robotic Arm Controlled by Human Arm

- EMG signals measure electrical currents generated in the muscle during activity
- Prosthetic limbs can be controlled using EMG signals read from another part of the body
- We attempt to generate robotic hand movement using EMG signals from the forearm
- Hand location can be moved by robotic arm using data from inertial measurement units

System Overview: Components, Computation, and Communication

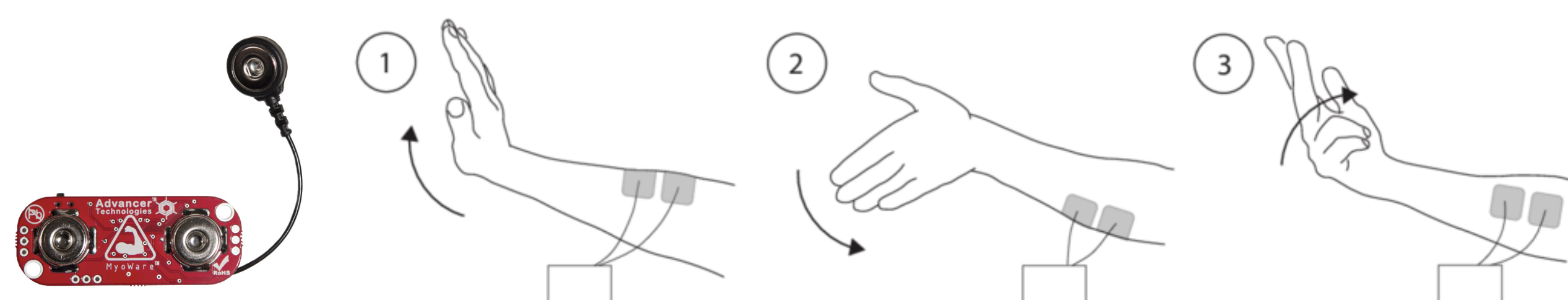
1. EMG and IMU sensors data from a person's arm
2. Robot arm parameters are calculated and sent wirelessly
3. Received parameters are used to move servos on robotic arm accordingly



Implementation: EMG, IMU, Bluetooth, and Servos

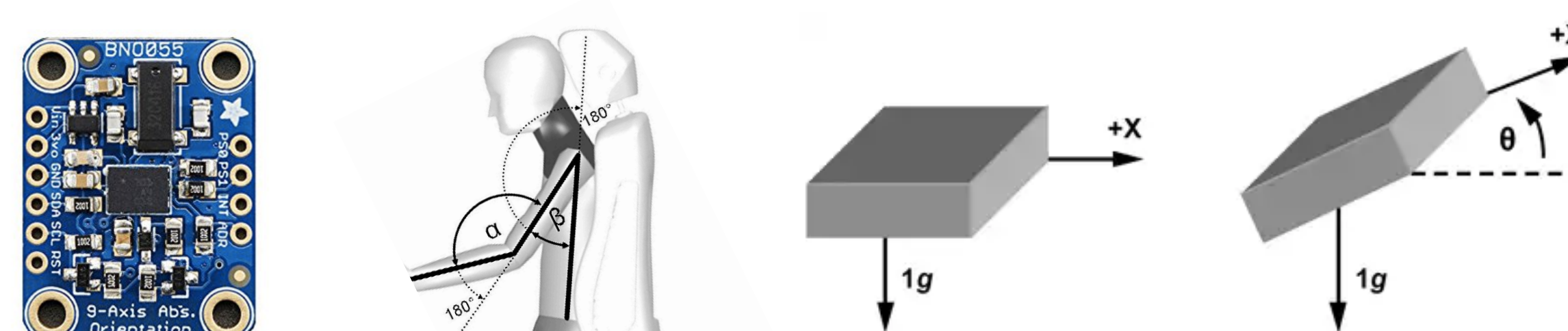
EMG: MyoWare Muscle Sensor

- When the wrist bends or hand grips, different muscles in the forearm contract
- MyoWare reads this activity as EMG signals from electrodes on the surface of the forearm
- Analog signals converted to digital by ADCs on SmartFusion board
- Calculations are done on converted signals to determine wrist bend angle and if hand grips



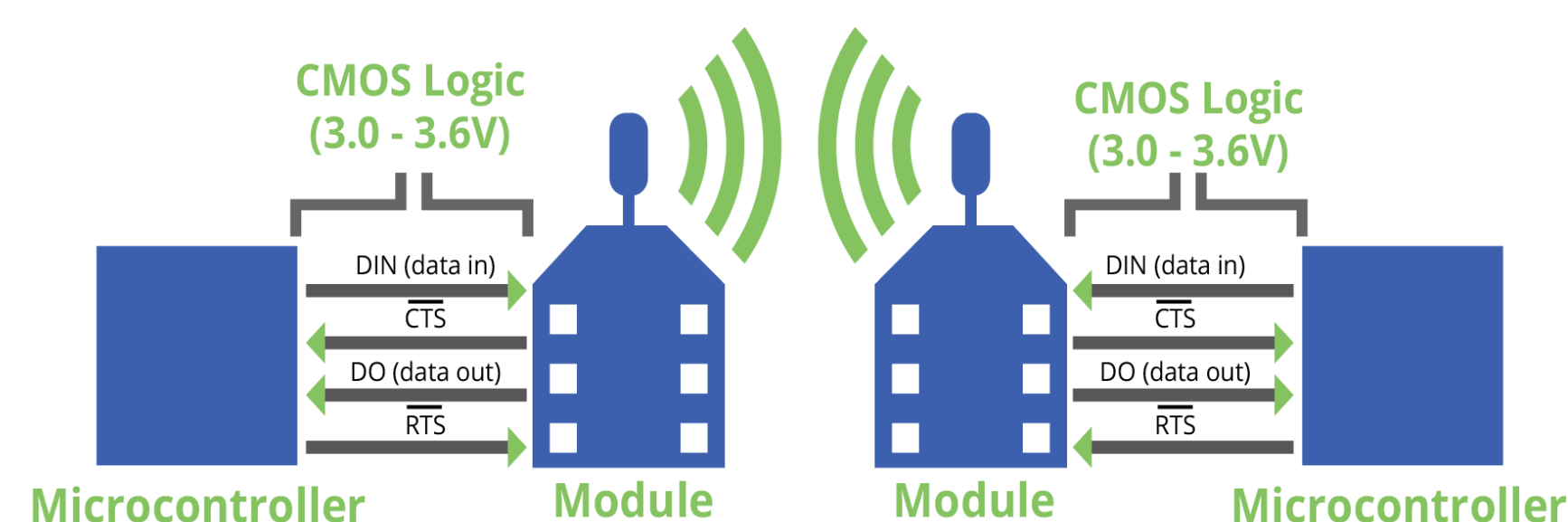
IMU: BNO055 Absolute Orientation Sensor

- IMU provides 3-D gravity vector relative to the sensor orientation
- Attached IMUs to upper arm and wrist
- Using vector math, 2 IMUs provide 3 angles:
 - 1) Risen shoulder angle
 - 2) Elbow bend angle
 - 3) Wrist rotation angle
- Angles sent to SmartFusion using I2C



Bluetooth Communication: Xbee Modules

- Uses UART serial interface to connect to smart-fusion boards
- Packages EMG and IMU angles from smart-fusion_1 into a buffer and transmits them it wirelessly to smart-fusion_2
- Angles are unpackaged by smart-fusuon_2 and used by servo control algorithms



Servo-Controlled Robotic Arm

- Each servo is controlled using Pulse-Width Modulation (PWM)
- As angles are read from the XBee, they are mapped to corresponding PWM signals for each servo
- New target PWM signals are written to the analog output of the smart-fusion

