WIRELESS CONTROLLED ROBOT ARM USING MOBILE DEVICE SENSORS

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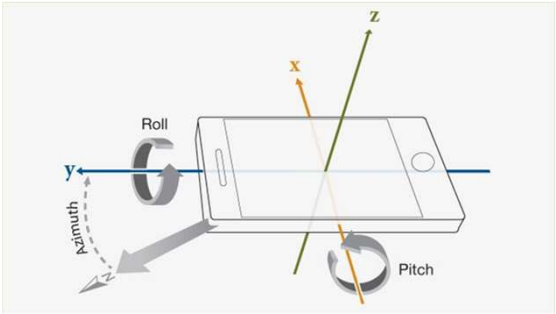
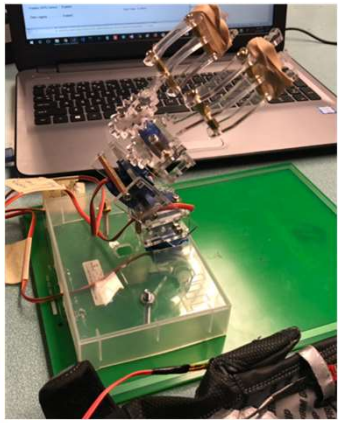
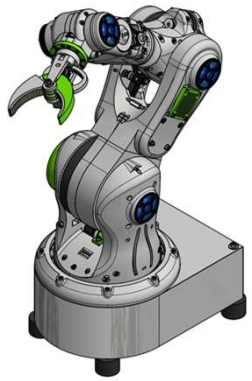
ECE 5620: Embedded System Design
Fall 2017







OUTLINE

- Introduction
- Mobile device sensors
- Accelerometer
- Sensors data streaming
- Connecting mobile device to computer
- Flex sensor & Servo motor
- Interfacing flex and servo to the Arduino
- Control of robot arm
- Algorithm flowchart
- Block diagram of communication and control
- Matlab GUI
- Overcoming challenges
- Future developments
- Conclusion
- Video demo

INTRODUCTION

- Robotic arms are usually controlled in two limited options:
  - Autonomous

    -works self-sufficiently based on the algorithms and program that is continuously carried out without variation
  - Semi-autonomous

    -Live input is used for real-time control of the robot

    -Most commonly used control systems are

    voice recognition

    tactile or touch

    motion controlled

INTRODUCTION CONT.

- Real-time controller example:

  Joysticks

Disadvantages:

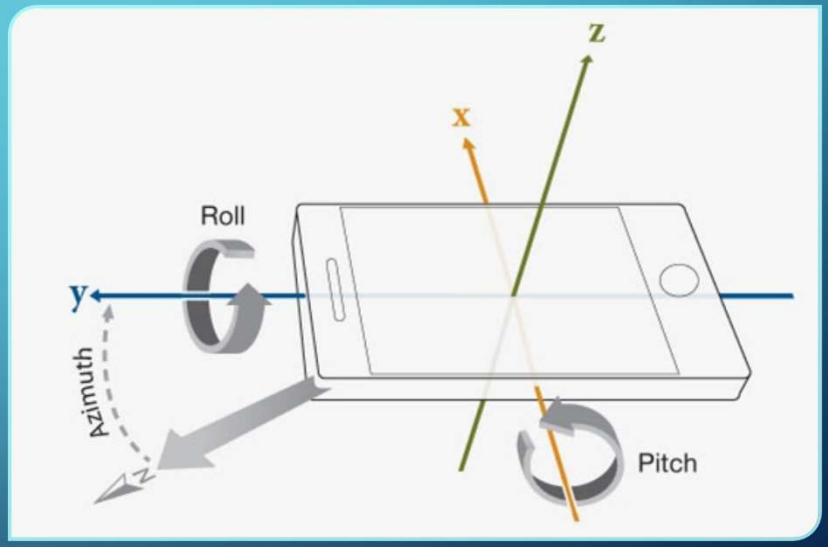
- Unintuitive
- Time consuming to train and excel in robot manipulation

INTRODUCTION CONT.

- Instead of using a remote control with buttons or a joystick, the gestures of the hand are used to control the motion of the robot holding or mounting a cell phone

Advantages:

- Allows the user to use natural, intuitive motion
- Significantly reduce the learning curve for arm manipulation

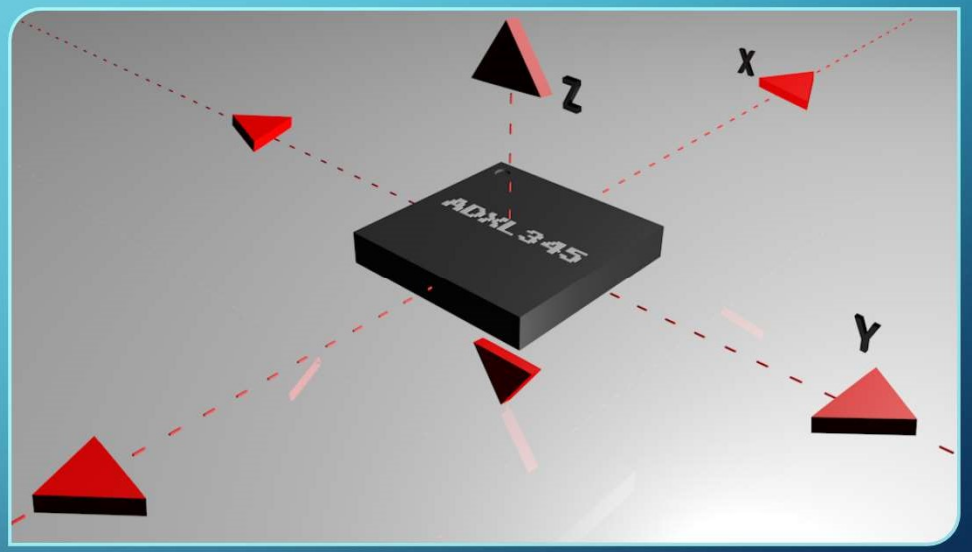


MOBILE DEVICE SENSORS

- Smartphones today come with a wealth of sensors to facilitate a better user experience
  - Proximity Sensor
  - Accelerometer and gyroscope
  - Digital compass
  - Barometer
  - Biometrics
  - Augmented & Virtual Reality

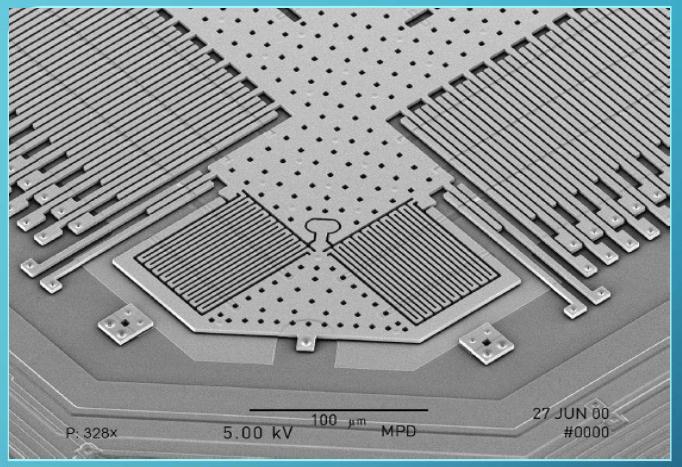
ACCELEROMETER

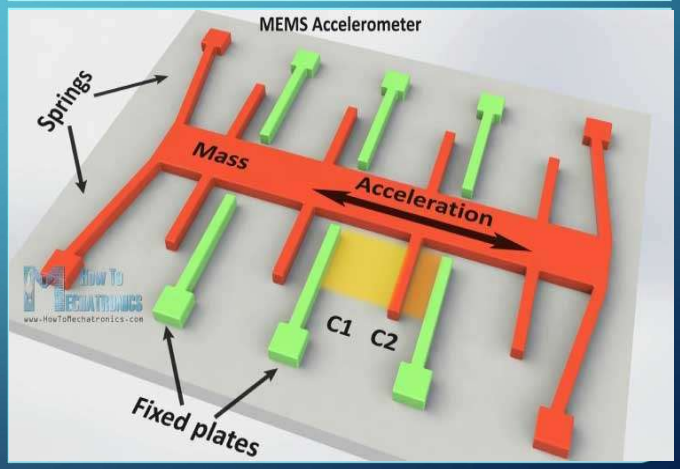
- Electromechanical devices that sense either static or dynamic forces of acceleration
  - Static forces: gravity
  - dynamic forces: vibrations and movement
- Low power
- Current range in micro or milli amps
- Force range: ±1g up to ±250g



ACCELEROMETER

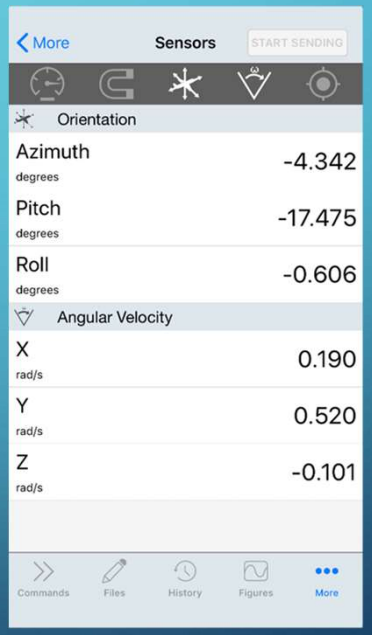
- Contain capacitive plates internally.
- Acceleration can be determined from the changes in capacitors due to relative moves of plates

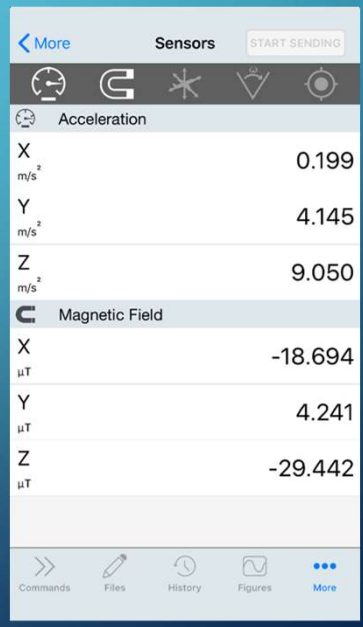




SENSORS DATA STREAMING

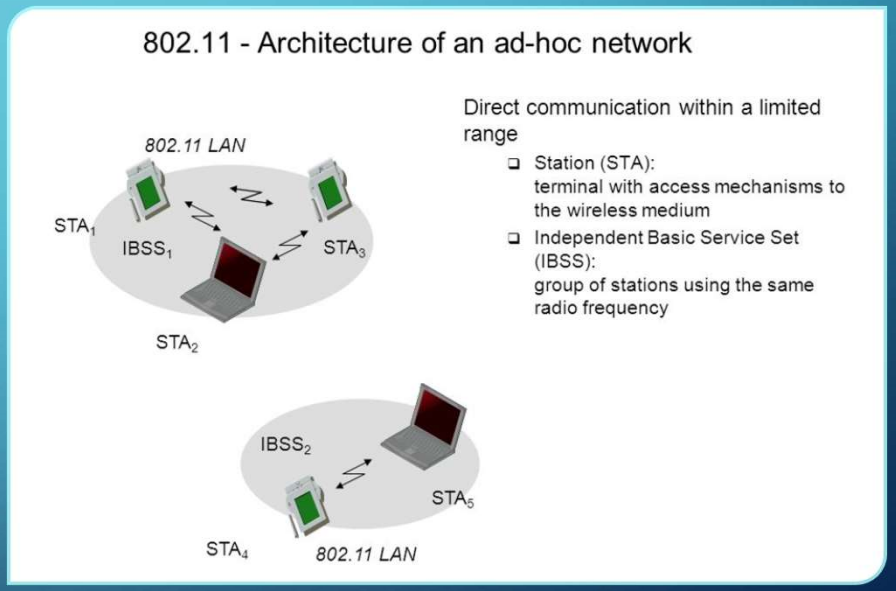
- In order to communicate
- Orientation sensor is being chosen to control yaw-pitch-roll of the robot





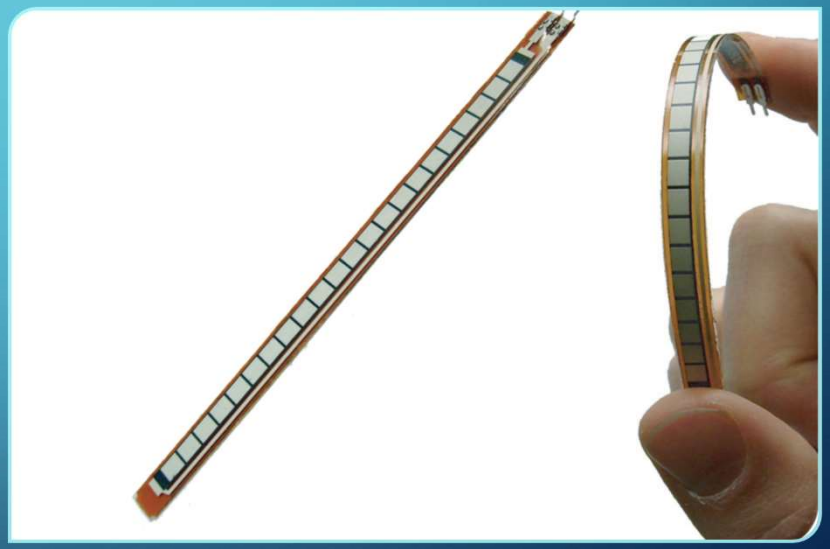
CONNECTING MOBILE DEVICE TO COMPUTER

- MATLAB Connector is used to set up the connection between MATLAB interfaces in pc and mobile app.
- The pc and mobile device are interacting on ad-hoc mode, aka base station



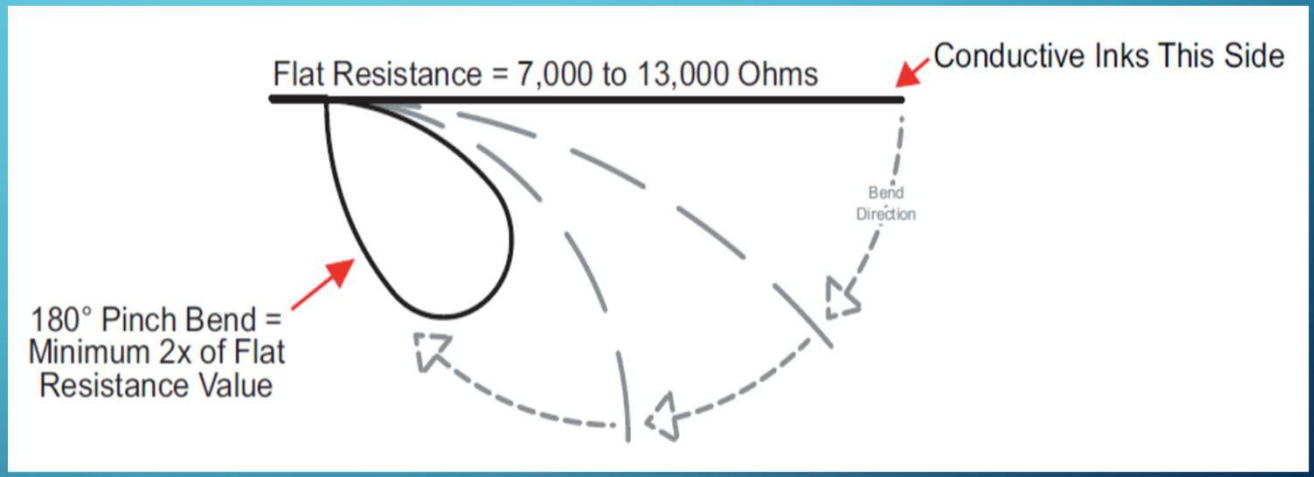
FLEX SENSOR

- Measures the amount of deflection or bending
- Resistance ≈ bending.



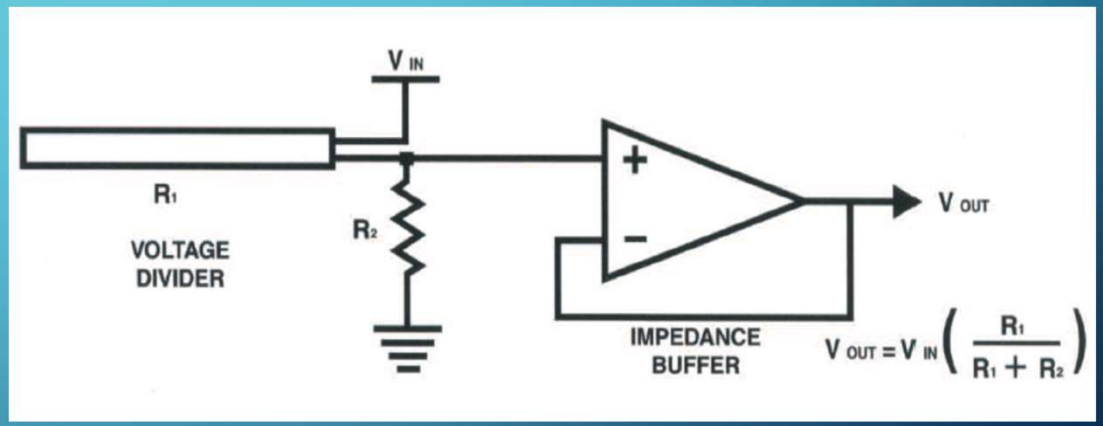
FLEX SENSOR CONT.

- Resistance change:
  7 – 13 Kohms



FLEX CONNECTIVITY TO ARDUINO

- Pin1 is connected with both the resistor and Analogue pin A0.
- Pin2 with 5v section on the breadboard.



SERVO MOTOR

- Rotary actuator or linear actuator
- Precise control of
  - angular or linear position
  - velocity
  - acceleration

CIRCUIT DIAGRAM OF SERVO AND FLEX INTERFACING

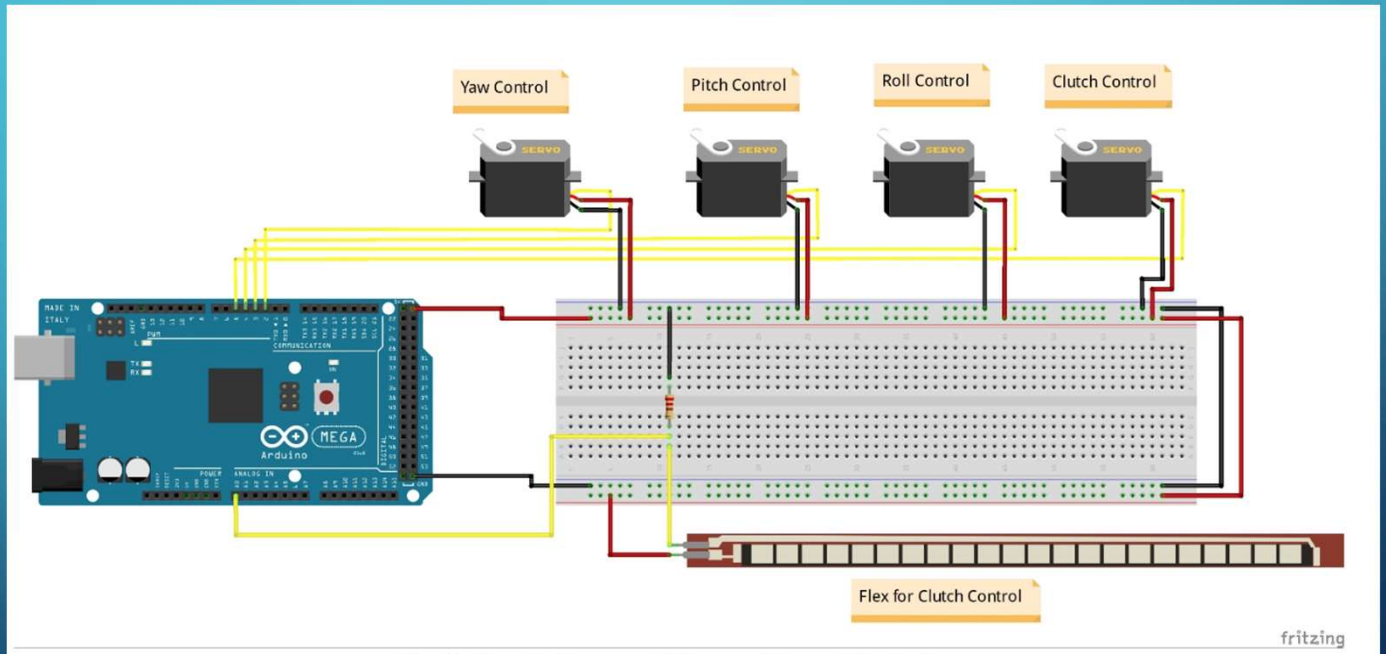


Fig. 6: Circuit diagram of Flex and Servo Interfacing

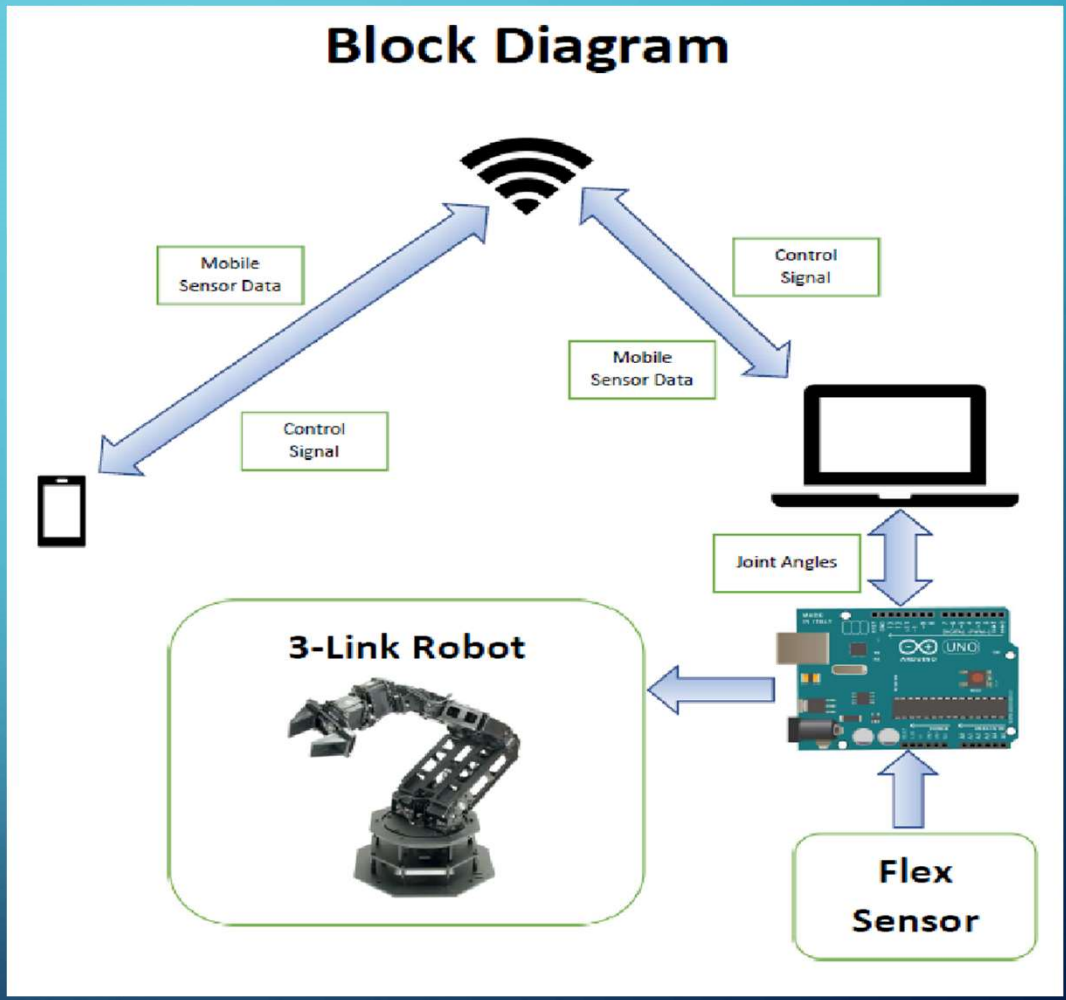
TABLE OF CONTENT FOR SERVO

Servo	Actuation Purpose	Working Range
Servo1	Z- axis rotation control	45 to 135 deg
Servo2	y- axis rotation control	53 to 126 deg
Servo3	x- axis rotation control	45 to 135 Center 90 deg
Servo4	Clutching and Declutching	13.5 to 36 deg

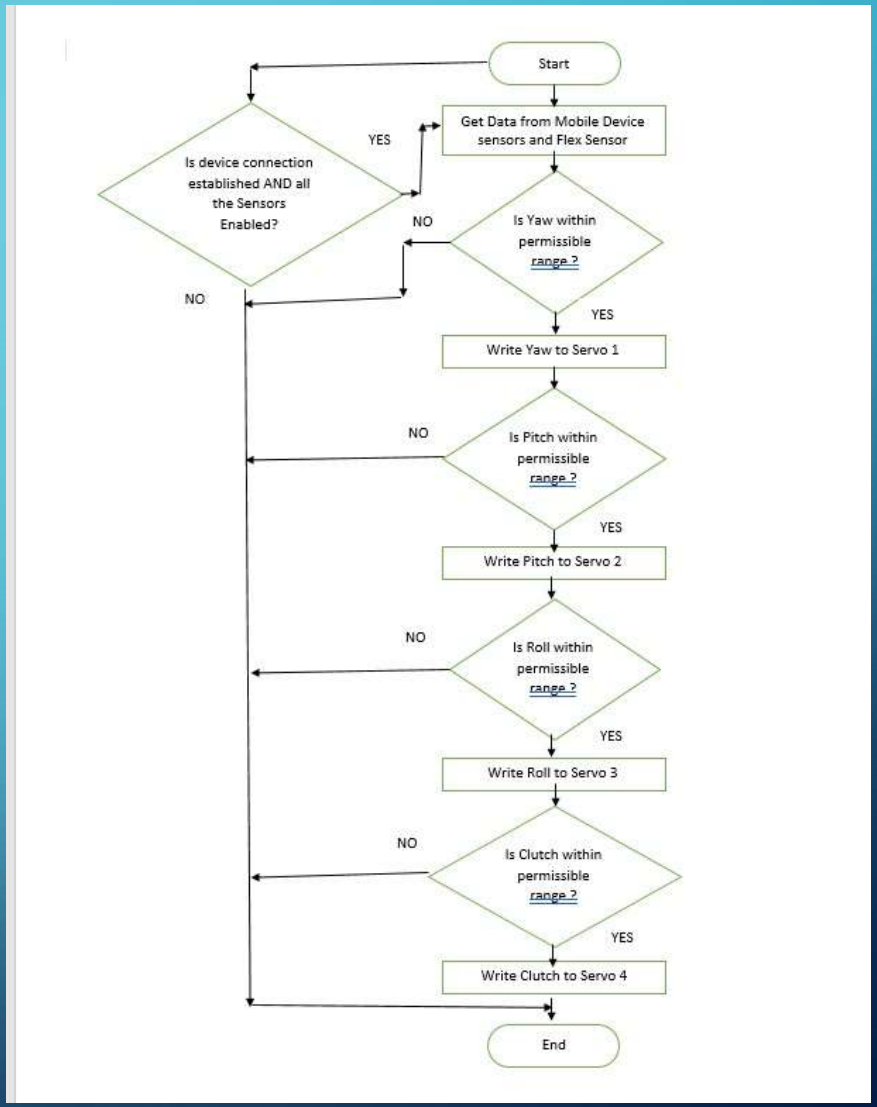
CONTROL OF ROBOT ARM

- The arm is controlled by joint angle data obtained from accelerometer of mobile device
- The sensor data is written to serial port using MATLAB
- Arduino takes those joint angles in and writes them to the servos

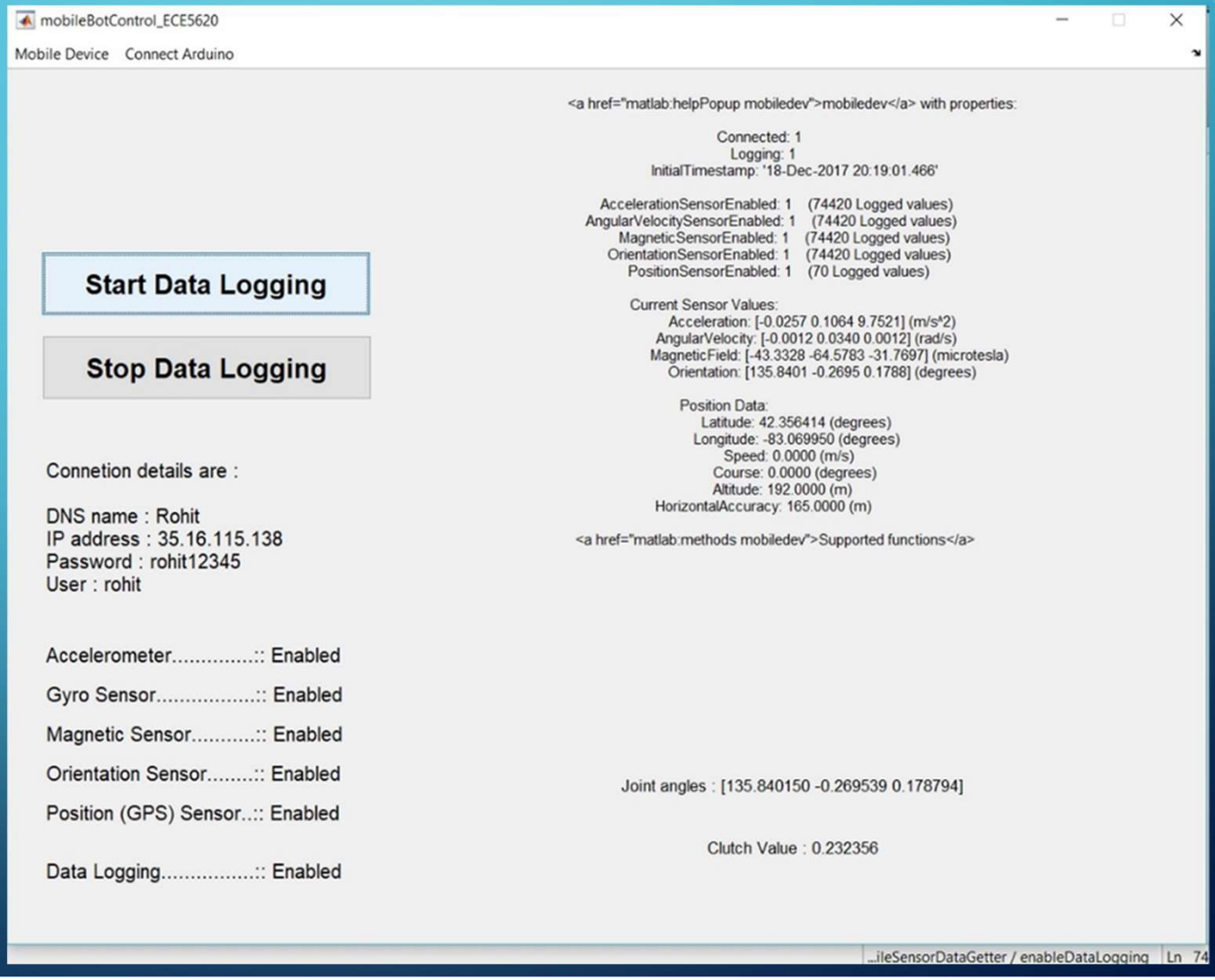
BLOCK DIAGRAM OF COMMUNICATION AND CONTROL



ALGORITHM FLOWCHART



MATLAB GUI


mobileBotControl_ECE5620
Mobile Device
Connect Arduino
Start Data Logging
Stop Data Logging
Connetion details are :
DNS name : Rohit
IP address : 35.16.115.138
Password : rohit12345
User : rohit
Accelerometer.....:: Enabled
Gyro Sensor.....:: Enabled
Magnetic Sensor.....:: Enabled
Orientation Sensor.....:: Enabled
Position (GPS) Sensor..:: Enabled
Data Logging.....:: Enabled
mobiledev with properties:
Connected: 1
Logging: 1
InitialTimestamp: '18-Dec-2017 20:19:01.466'
AccelerationSensorEnabled: 1 (74420 Logged values)
AngularVelocitySensorEnabled: 1 (74420 Logged values)
MagneticSensorEnabled: 1 (74420 Logged values)
OrientationSensorEnabled: 1 (74420 Logged values)
PositionSensorEnabled: 1 (70 Logged values)
Current Sensor Values:
Acceleration: [-0.0257 0.1064 9.7521] (m/s^2)
AngularVelocity: [-0.0012 0.0340 0.0012] (rad/s)
MagneticField: [-43.3328 -64.5783 -31.7697] (microtesla)
Orientation: [135.8401 -0.2695 0.1788] (degrees)
Position Data:
Latitude: 42.356414 (degrees)
Longitude: -83.069950 (degrees)
Speed: 0.0000 (m/s)
Course: 0.0000 (degrees)
Altitude: 192.0000 (m)
HorizontalAccuracy: 165.0000 (m)
Supported functions
Joint angles : [135.840150 -0.269539 0.178794]
Clutch Value : 0.232356
...ileSensorDataGetter / enableDataLogging
Ln 74

OVERCOMING CHALLENGES

- Slow Data exchange rate(Latency)
- Maximum value of pitch to 90^0
- Loss of Wi-Fi Connection

FUTURE DEVELOPMENTS

- Use of Bluetooth Shield
- Voice Recognition
- Addition of Camera for Object Detection
- Track x-y-z coordinates using accelerometer
- Use of Parallel Systems to Write the Joint Angles

CONCLUSION

- Managed to acquire sensor data as discussed in sensor data streaming
- successfully implemented the task using:
  - ✓Arduino Mega 2560 : To control servo and get data from flex sensors.
  - ✓Flex : to sense the bending of fingers for clutching and declutching.
  - ✓Servo: to actuate the joint angle of robot arm.

VIDEO DEMO

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THANKS FOR YOUR ATTENTION