Azamat Siddiqui | Bo Pang | Carol Yan
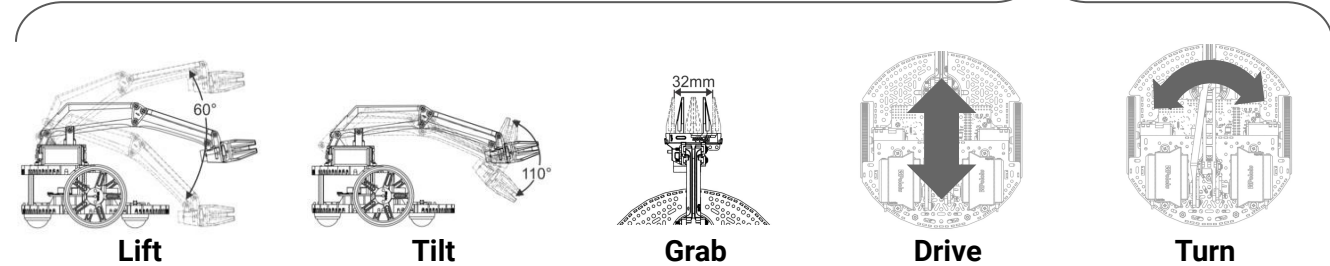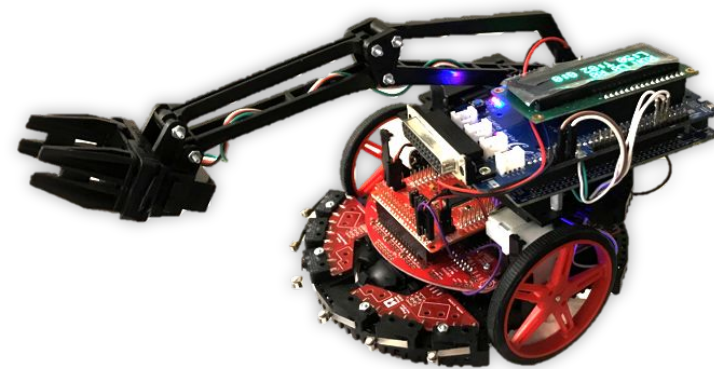
github.com/CarolNiuYan/149Projec.git
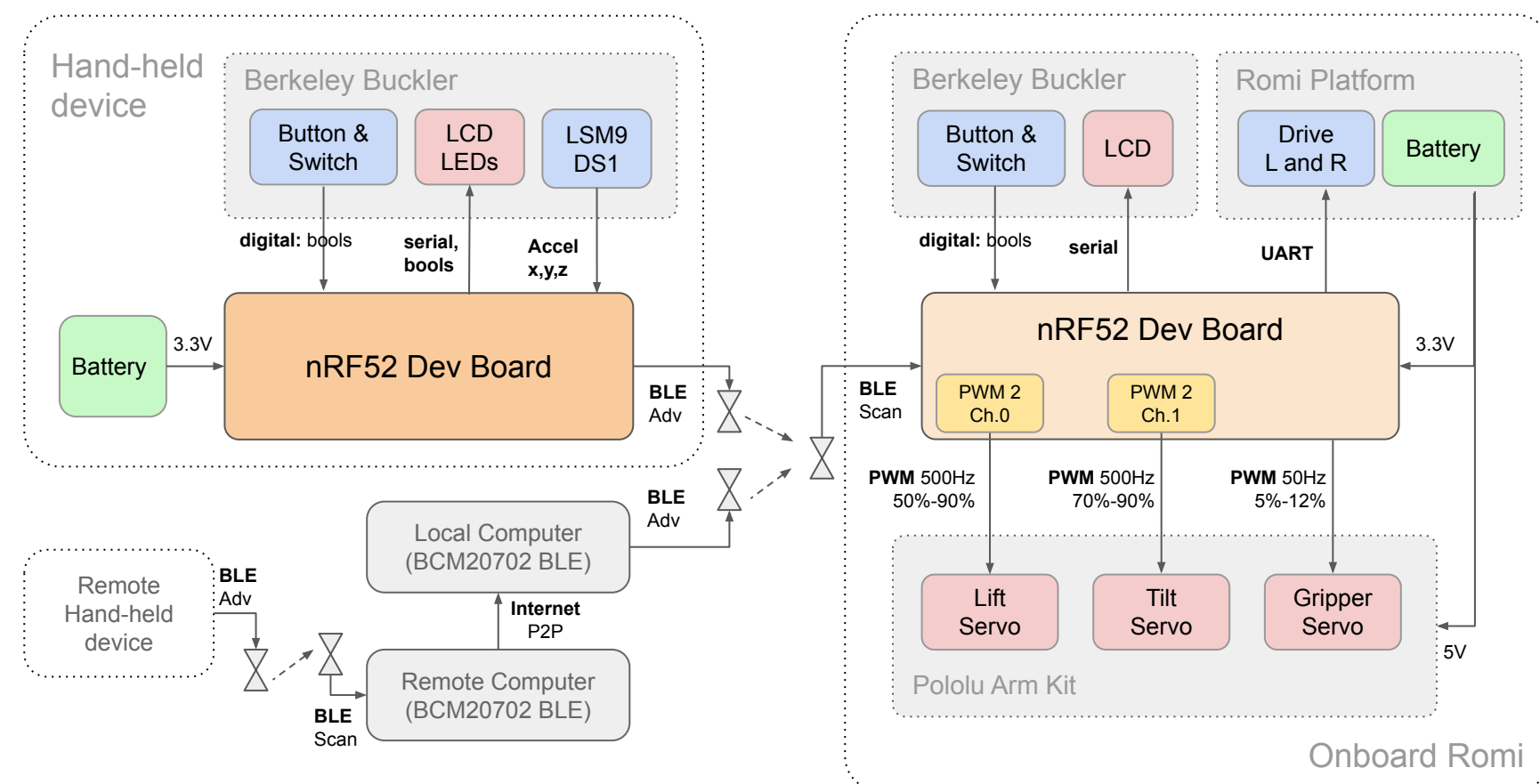
Project Purpose

Using gestures, remotely control Romi & Romi's arm

Features

- Connect handheld device to Romi via BLE
- Using hand gestures (Roll and Pitch) to fine-control Romi (drive, or arm lift, tilt and grab)
- Collaboratively control Romi over Internet

Lift **Tilt** **Grab** **Drive** **Turn**

System Architecture

Hardware Design

Arm driver

The Romi's arm is controlled by 3 servo motors via PWM signals. The Lift & Tilt motors need persistent power (PWM inputs) to keep arm position, so we used dedicated PWM generators for them.

Structure

The arm assembly is rear-mounted to best balance Romi. It lifts 200g before stumbling.
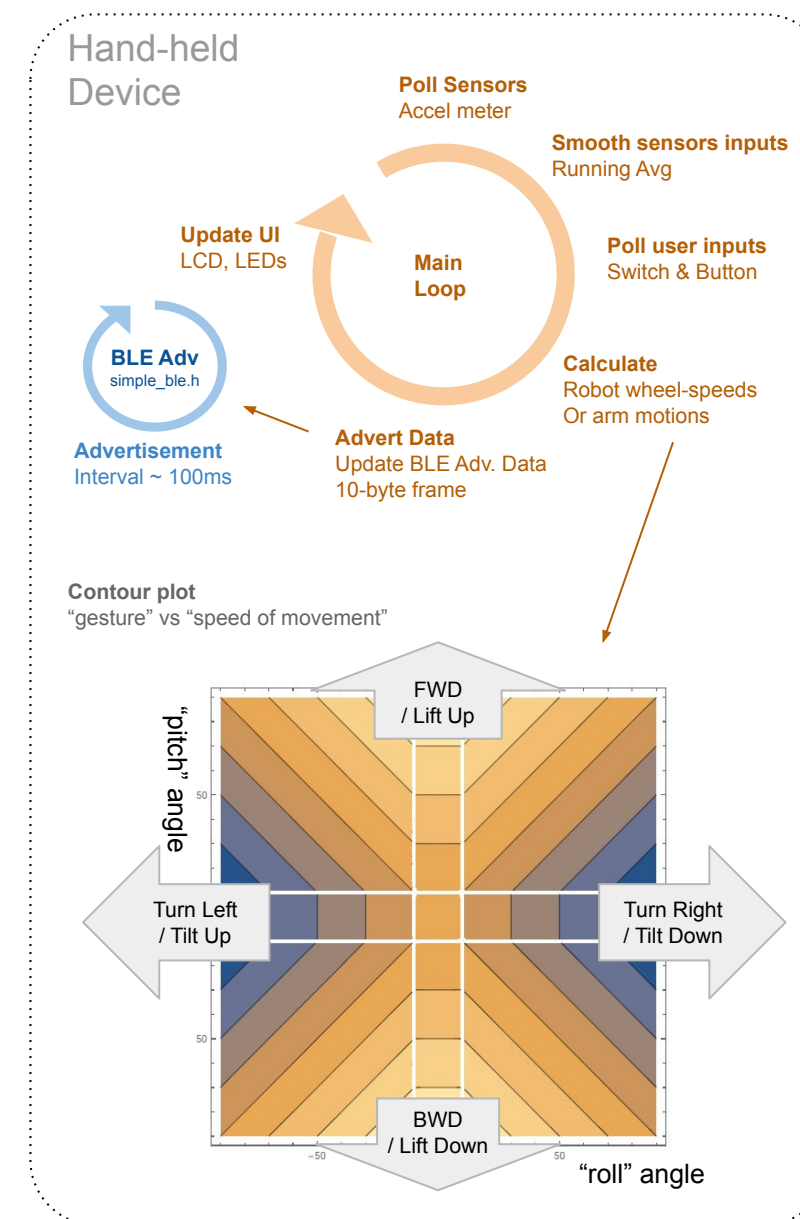
Power supply

The Romi's arm draws about 5V-4A at the worse case. The 5V-7A DC-DC module on Ti-launchpad is adequate.

Live streaming

Romi has an onboard camera (actually an iPod) to provide live video stream, for better remote controllability.

Software Design

Contour plot
"gesture" vs "speed of movement"

Control Features

Affine mappings

The gesture inputs are mapped to Romi's motion by affine functions; results in smooth & fine control on driving (or arm movement) speeds.
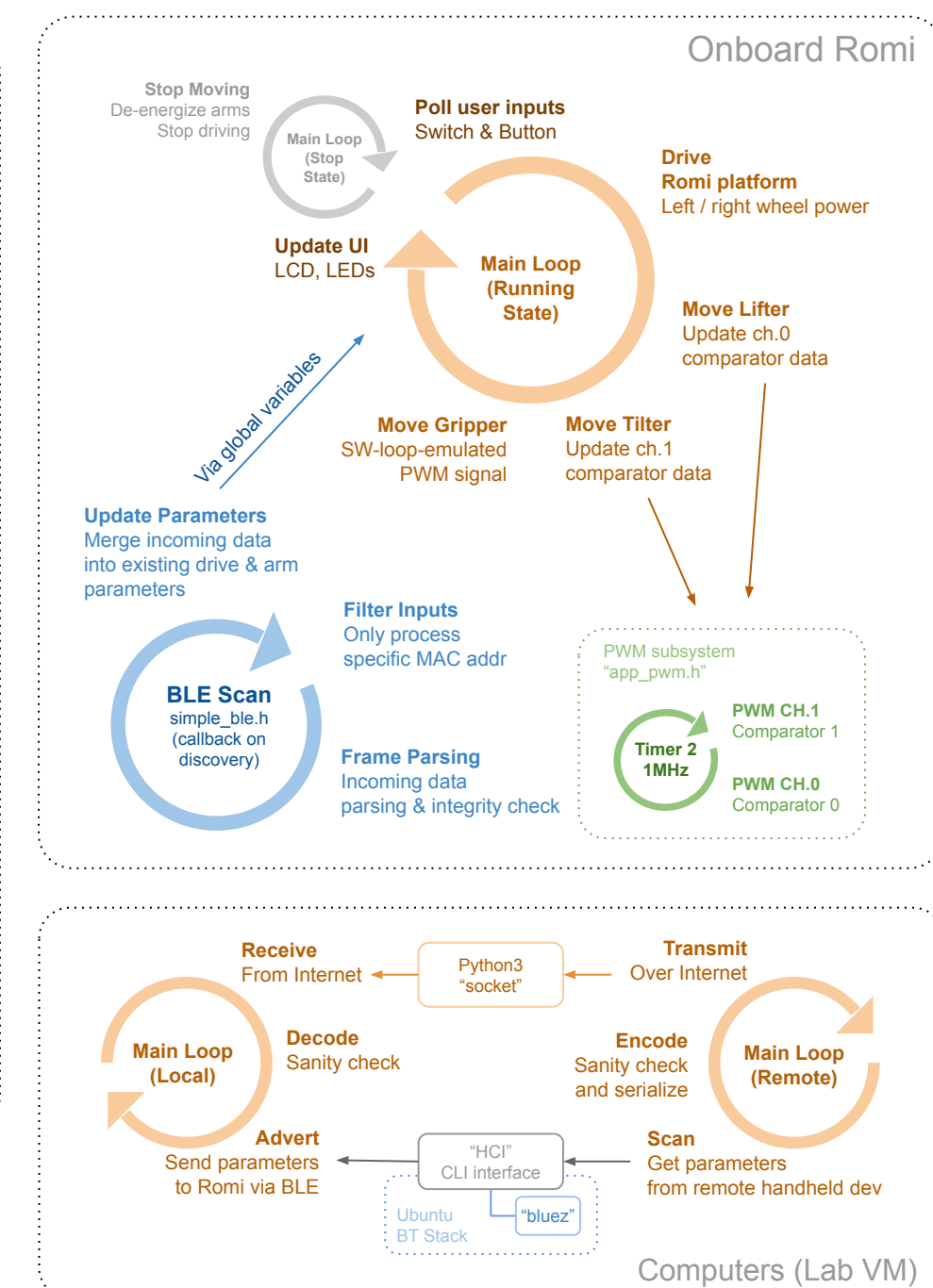
Smooth control

- Sample gesture with a running average.
- Romi also smoothens abrupt changes on received control parameters (for arm).
- BLE runs at ~8Hz (local)

N-1 controllability

Romi's multiple actions can be controlled simultaneously by multiple sources.

- Romi listens to multiple BLE adv. sources.
- Romi merges control parameters sent by each source into its own copy.

Connection to Course Topics

- Hierarchical State Machines.
- Concurrent composition of state machines
- Modeling of the arm system
- Execution time analysis of BLE driver code stack
- Discrete data sampling and processing
- Interrupts and timers

Enhancements (if time allows)

- Faster BLE scanning on BT dongle - currently the BLE dongle on remote computers scans slowly.
- Position feedback from servo motors - Romi's arm position can be obtained by reading servos' voltage feedbacks. This helps control the gripper.