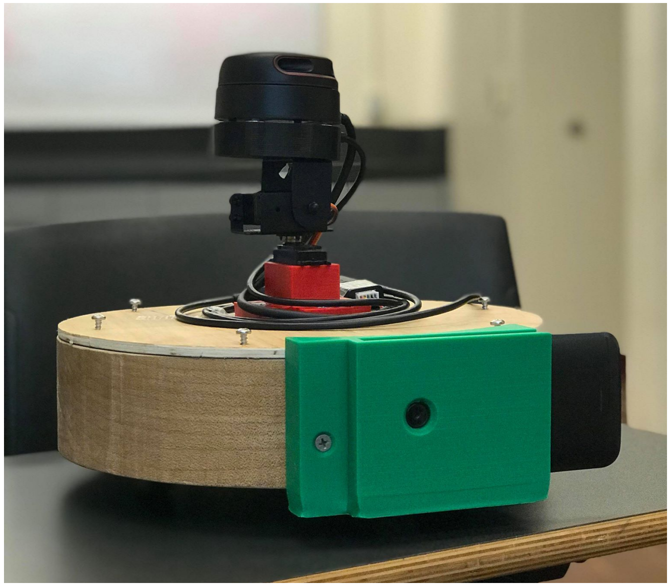
UMassAmherst

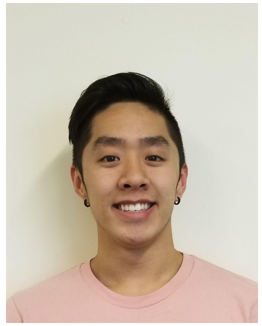
Final Product Review



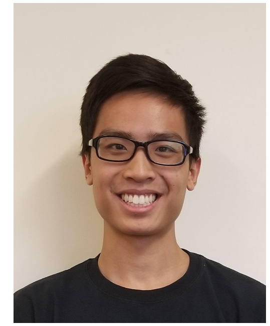
Team 16

April 17, 2019

Mapper

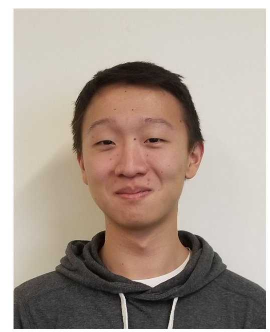


Kelvin Nguyen
ME



Marcus Le
EE

Bryan Martel
CSE



Derek Sun
CSE

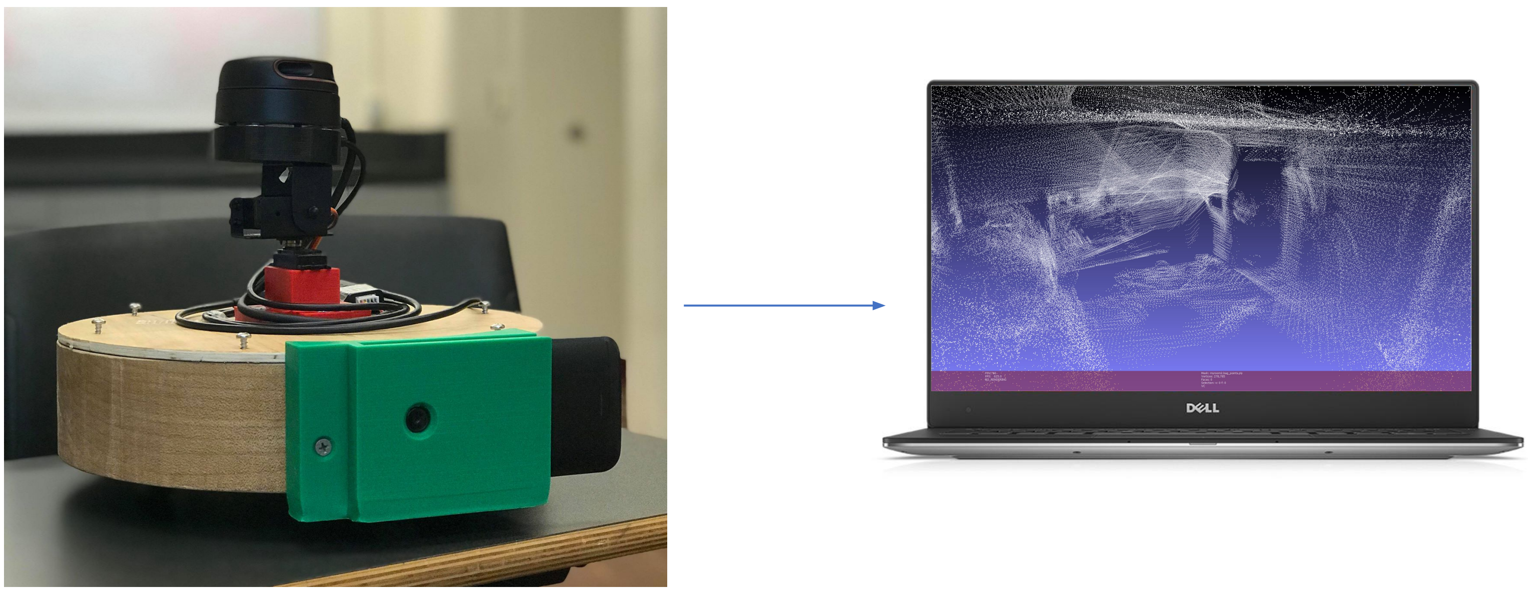
Goal

- Provide homeowners or real estate agents with the ability to post an updated model of the interior of their house

- Potential integration with virtual reality tours
  - Similar to an open house
  - Cater toward the younger, more technologically adept generation that will inevitably dominate the future real estate market

Method of Resolution

- A robot that utilizes LIDAR sensors to remotely navigate around the surrounding environment and produce a 3D layout of an indoor area
- A camera mounted on the robot will allow for live video feed to assist in user navigation



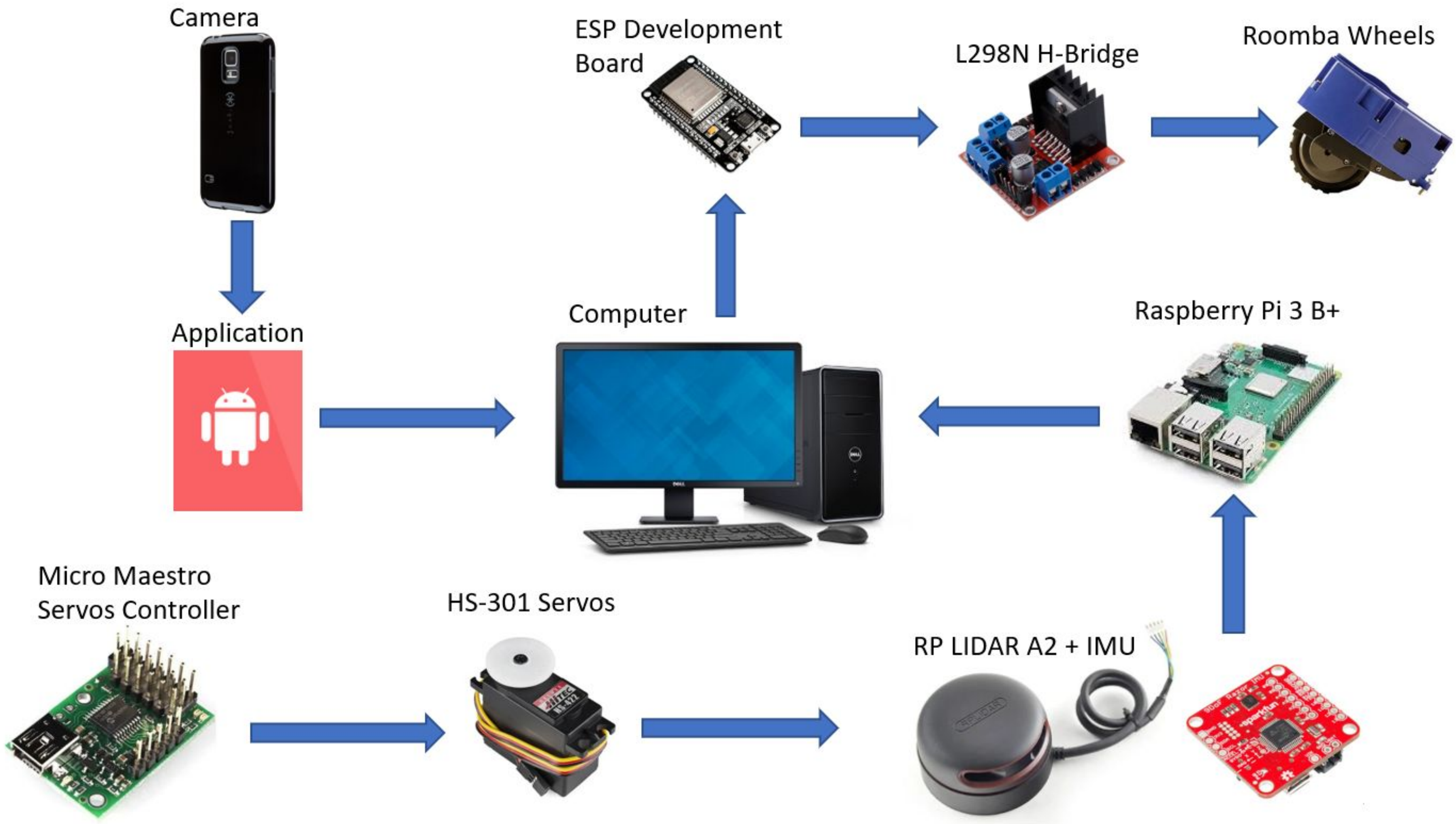
Requirements Analysis: Specifications

- Speed of up to 3mph
- Effective detection range of 15ft
- Approximately 12 pounds
- Approximately 2 hours of battery life
- Durable enough to withstand minor collisions

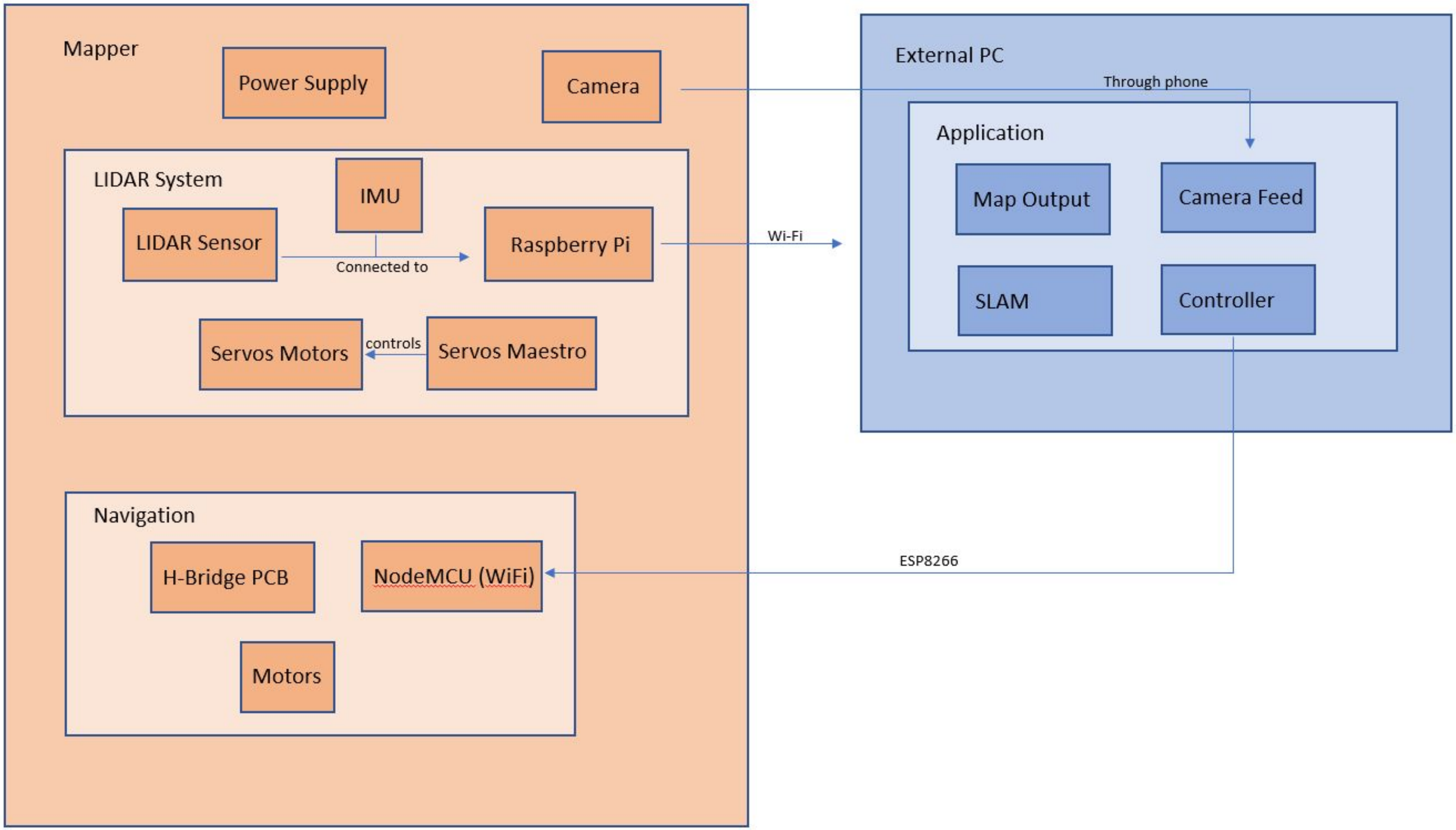
Requirements Analysis: Inputs and Outputs

- Input
  - LIDAR sensor data
  - Inertial measurement unit data
  - Camera data
  - User navigation control
- Output
  - Live video feed
  - Map data

System Overview



Block Diagram



Proposed FPR Deliverables

Mapper completed

- Wireless maneuverability of robot
  - User controls sent through Wi-Fi to Mapper
  - LIDAR and IMU sensor data relayed back to PC
  - Camera feed sent back to PC
- 3D SLAM
  - 2D map generated and viewable in Rviz
  - Point cloud viewable in Meshlab
  - Mesh generated from point cloud
- Component integration
  - Functional PCB integrated into Mapper
  - All hardware and circuitry fits neatly in Mapper

Actual FPR Deliverables

✓ Mapper completed
- ✓ Wireless maneuverability of robot
  - User controls sent through Wi-Fi to Mapper
  - LIDAR and IMU sensor data relayed back to PC
  - Camera feed sent back to PC
- ✓ 3D SLAM
  - 2D map generated and viewable in Rviz
  - Point cloud viewable in Meshlab
  - Mesh generated from point cloud
- ✓ Component integration
  - Functional PCB integrated into Mapper
  - All hardware and circuitry fits neatly in Mapper

FPR Responsibilities

- Kelvin (ME)
  - Optimize pan & tilt system, finalize robot chassis, design phone mount, mount all components
- Marcus (EE)
  - Create PCB, Wi-Fi robot control, integrate all components
- Derek (CSE)
  - 3D SLAM, Wi-Fi data transfer, Wi-Fi video feed, PC application
- Bryan (CSE)
  - 3D SLAM, Wi-Fi robot control, PC application

FPR Deliverable (Wireless Maneuverability)

User controls sent through Wi-Fi to Mapper

- NodeMCU reads UDP messages sent from PC application
- PC application → NodeMCU → motors

LIDAR and IMU sensor data relayed back to PC

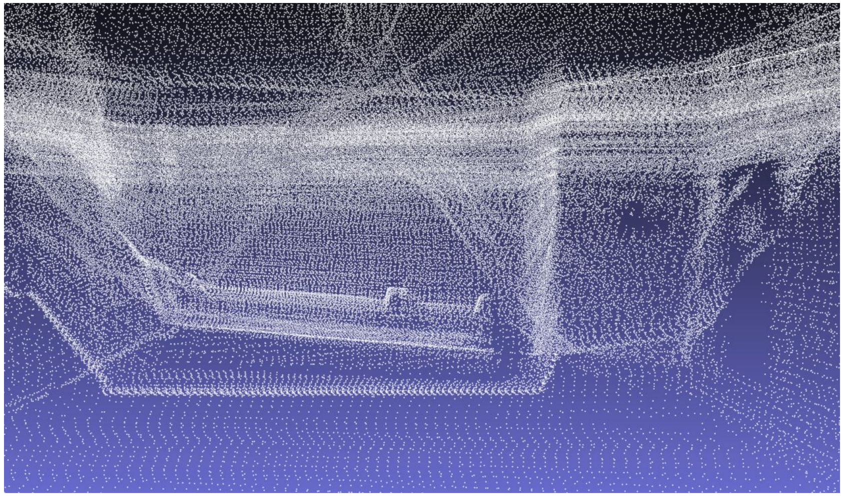
- Raspberry Pi 3 B+ running Ubuntu Server 18.04 with ROS
- ROS master (PC) launches nodes on remote machine (RPi)
- Raspberry Pi publishes ROS /scan and /imu to master
- Raspberry Pi 3 B+ → PC → SLAM

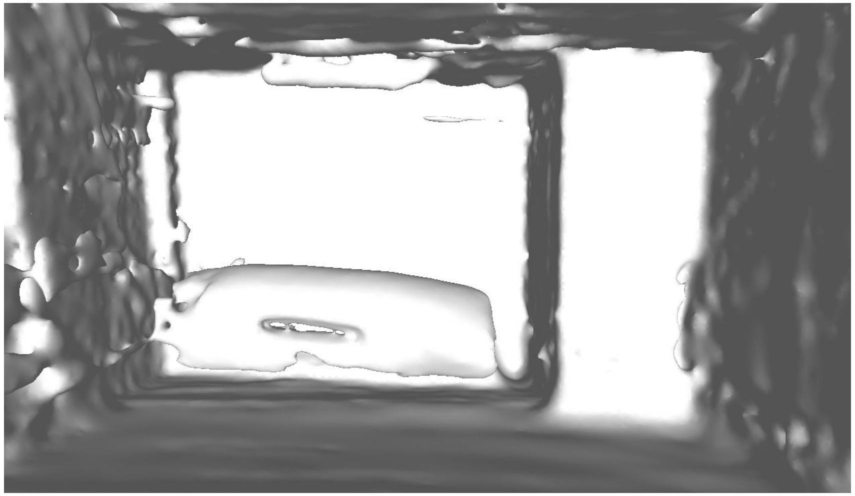
Camera feed sent back to PC

- Phone’s Android application sends captured frames to PC application
- Phone → Android application → PC application

FPR Deliverable (3D SLAM)

- Rviz
  - Generated 2D map
  - Robot trajectory/path
- Meshlab
  - Generated point cloud
  - Reconstructed mesh





FPR Deliverable (Component Integration)

Functional PCB integrated into Mapper

- H-bridge PCB created using Altium Designer
- Connects to the NodeMCU to send signals to the wheel motors

Connecting subsystems

- LIDAR Sensor and IMU data is sent through the Pi to the laptop
- Laptop able to send controls over to the NodeMCU
- Camera feedback displayed on the laptop

All hardware and circuitry fits neatly in Mapper

- Top: LIDAR Sensor, Servos, IMU
- Inside: H-bridge, NodeMCU, Maestro servos controller, batteries
- Under: Raspberry Pi, batteries

What we plan to bring to Demo Day

- Completed Mapper on display

- Video that shows Mapper fabricating 3D model of a room
  - Controller for the robot
  - Video feedback
  - Current map that is being created
  - Marker that shows where the robot is relative to the room
  - 3D output mesh layout

Costs

RP LIDAR A2 –	$319.95
SparkFun 9 DoF IMU –	$34.95
Mapper Chassis –	$26.50
Micro Maestro 6-Channel Servos Controller –	$19.95
HiLetgo ESP8266 NodeMCU –	$8.39
Custom PCB –	$27.56
Raspberry Pi 3 Model B+ –	$38.10
MicroSD –	$11.99
S3362-ND Connectors –	$5.59
Total	**$492.98**

Demo

Questions?