Final Product Review

Team 16
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Mapper

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Advisor: Professor Ganz
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

Department of Electrical and Computer Engineering
Block Diagram

Mapper
- Power Supply
- Camera
- LIDAR System
  - LIDAR Sensor
  - IMU
  - Raspberry Pi
  - Servos Motors
  - Servos Maestro

Navigation
- H-Bridge PCB
- NodeMCU (WiFi)
- Motors

External PC
- Application
  - Map Output
  - SLAM
  - Controller
- Camera Feed

Through phone
WI-FI
ESP8266
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
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

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<tr>
<th>Item</th>
<th>Price</th>
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<tr>
<td>RP LIDAR A2</td>
<td>$319.95</td>
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<td>SparkFun 9 DoF IMU</td>
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<td>Mapper Chassis</td>
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<td>Micro Maestro 6-Channel Servos Controller</td>
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Demo
Questions?