Team 19
Construction Marking Robot

C. Baez, J. Gibbs, K. Howard, D. Portis, B. Roberts

Need Statement

"The construction industry is in need of a means of **increasing** efficiency and productivity as well as **reducing** the amount of time and error that goes into laying out floor plans manually."

Goal Statement

"Implement a 'proof of concept' high precision marking robot that will lay out the preliminary floor plan of a construction site, **increasing** efficiency and productivity of the layout process."

Objective:

- Add functionality to robot to receive a CAD file of a floor plan and convert it into useable coordinates
- Design, fabricate, and implement a marking mechanism
- Make the robot able to navigate autonomously, avoid obstacles, and generate an error report

Design Requirements:

The final product must be able to:

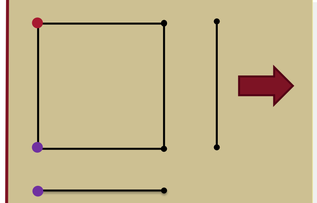
- Make marks within ½ " accuracy
- Be easily portable
- Mark on concrete
- Mark across 100 sq. ft. within 10 minutes
- Navigate autonomously

Design Features:

- Pointor® software for CAD to coordinates
- Raspberry Pi 2 for computation
- Pioneer 2 Mobile Robot for platform
- Trimble Robotic Total Station for localization
- Lidar for obstacle avoidance
- Gantry System for marking

Pointor® software:

- Reads in CAD (dxf file type)
- Analyzes the CAD structure
- Replaces lines with endpoint coordinates
- Able to export point list to a text file

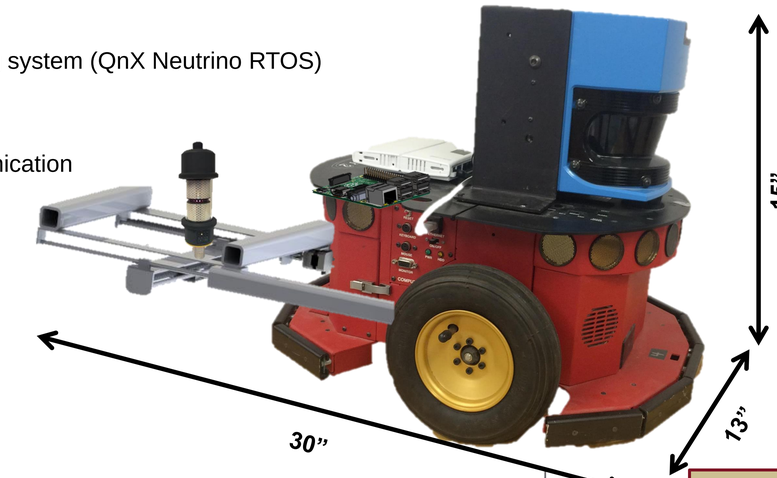


Point list: Layout_1a

Code	X	Y	Z	Desc	Flags
0	22.0000000000	11.0000000000	0.0000000000	0	
1	22.0000000000	6.0000000000	0.0000000000	0	
2	0.0000000000	6.0000000000	0.0000000000	0	
3	10.0000000000	6.0000000000	0.0000000000	0	
4	0.0000000000	6.0000000000	0.0000000000	0	
5	0.0000000000	16.0000000000	0.0000000000	0	
6	0.0000000000	16.0000000000	0.0000000000	0	
7	10.0000000000	16.0000000000	0.0000000000	0	
8	10.0000000000	6.0000000000	0.0000000000	0	
9	10.0000000000	16.0000000000	0.0000000000	0	
10	0.0000000000	0.0000000000	0.0000000000	0	
11	3.0000000000	0.0000000000	0.0000000000	0	

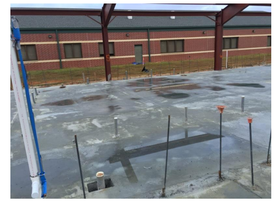
Pioneer 2-DX:

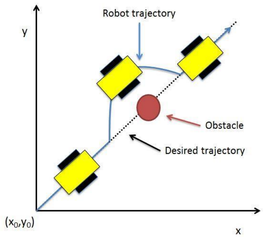
- Runs on real-time operating system (QnX Neutrino RTOS)
- Differentially steered
- Driven by two DC Motors
- Router for wireless communication
- Robot total weight = 13.5kg



Lidar:

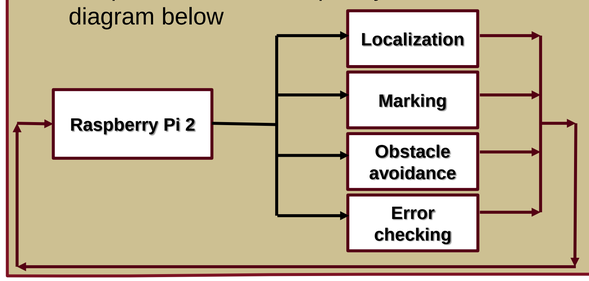
- More accurate than sonar and IR sensors
- Internal mirror rotates 180°
- May need to adjust the vertical orientation for the near future
- Used for obstacle avoidance





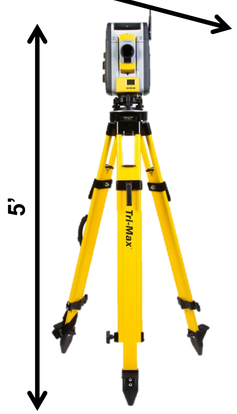
Raspberry Pi:

- Specifications: 900MHz quad-core CPU, 1 GB RAM, 40 GPIO pins
- Will run high level code that sends text file to robot
- Controlling marking mechanism and executes movement functions in response to external sensors
- Will operate on Windows 10 IoT Core OS to run programs and executable files
- Responsibilities for Raspberry Pi 2 can be seen in the diagram below



Robotic Total Station:

- Calibrates via triangulation with two structures of known location
- Tracks and measures the ***exact position*** of an external prism within ±0.01"
- Measures horizontal and vertical angles as well as slope distance
- Verifies points are being marked ***accurately***
- Contains file of layout in internal memory

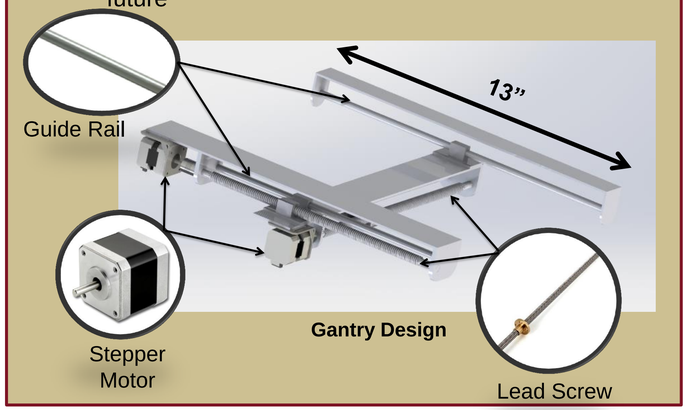


Future Work:

- Field testing of robot & Lidar
- Interfacing systems
- Further total station research
- Finalizing movement functions

Gantry System:

- Gantry design comprised of two linear translation systems
- System will be made up of a lead screw driven by a stepper motor, guided by linear rails
- Modular design allows for changing markers in the future



For more information:
http://eng.fsu.edu/me/senior_design/2016/team19/

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