SIMULTANEOUS LOCALIZATION AND MAPPING FOR AUTONOMOUS PLATFORMS (SLAM)

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PRESENTATION OVERVIEW

Background

Our Objective

Goals

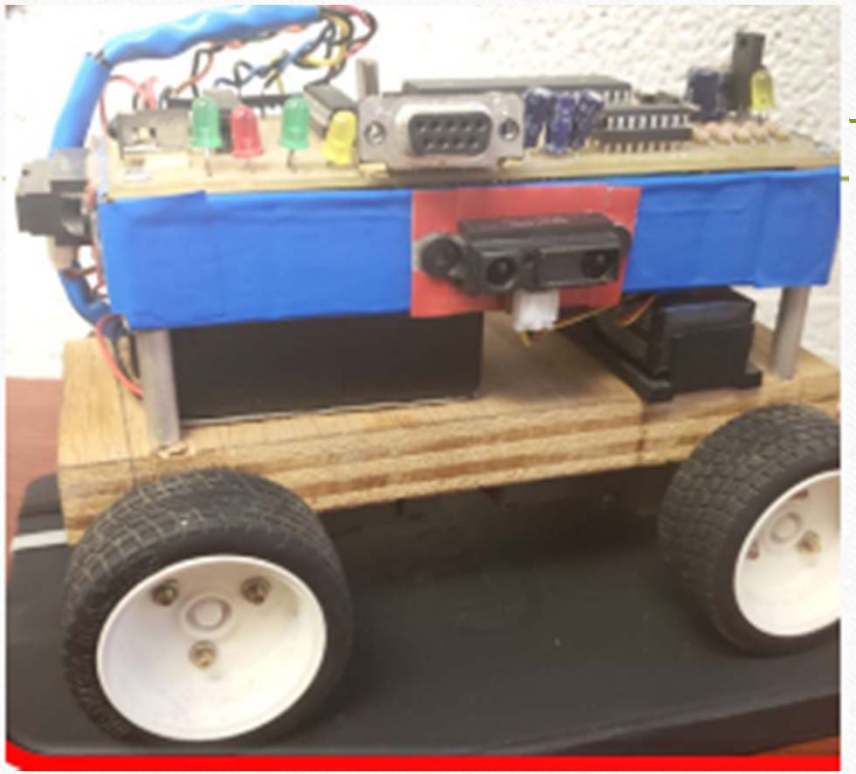
Control Algorithm

Part Details

Design Decisions

Conclusion

BACKGROUND



The problem with autonomous navigation is the computational burden with creating a platform that can:

- Detect Obstacles
- Path Plan
- Make a decision based on information from sensor arrays in real time.

Solution

Application specific FPGA based processor

OUR OBJECTIVE

Design, build, and test two autonomous wheeled platforms:

- PID
- Bang-Bang

These platforms will be made of COTS (commercial off the shelf) sensors, processors and components to establish baselines to prove our hypothesis that application specific FPGAs are the best way for SLAM on autonomous platforms.

Design Requirements

ang-Bang Platform:
Weighs approximately 5-10lbs
Uses IR short range sensor (4)
4-Wheel Drive
On-Off Control Algorithm
Wheels can drive on multiple types of terrain

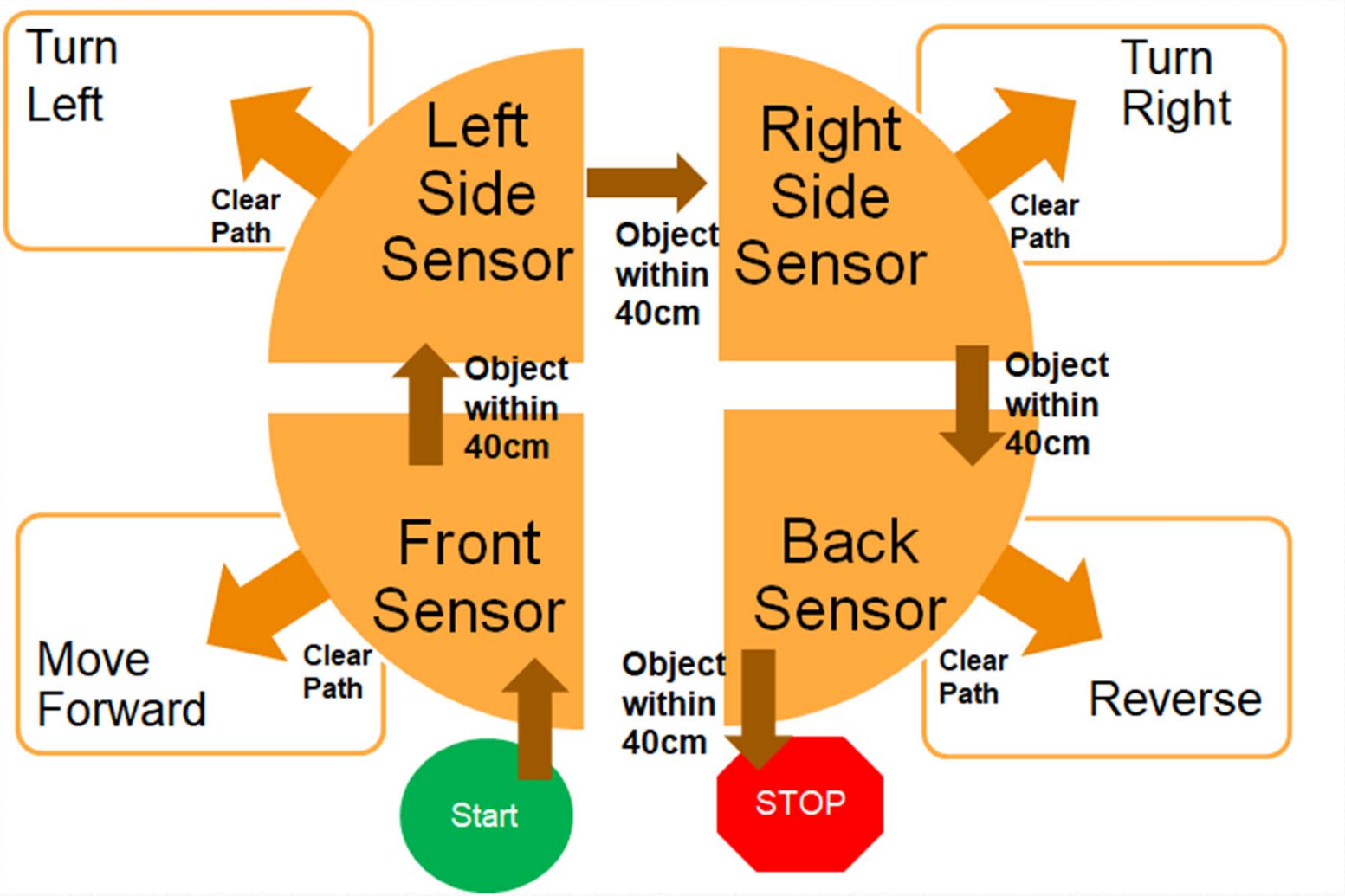
ID (Proportional Integrative Derivative) Based Platform:
Weighs approximately 5-10lbs
Uses IR short range and LiDAR long range sensor (4)
4-Wheel Drive
PID algorithm
Wheels can drive on multiple types of terrain

GOALS

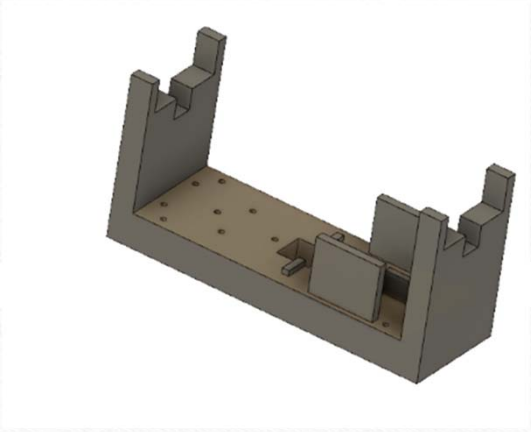
- SENIOR DESIGN 2018-2019
  - Build two autonomous platforms using COTS parts
  - Test and Record Baselines
- LONG-TERM
  - Proving application specific FPGAs are the best method for SLAM

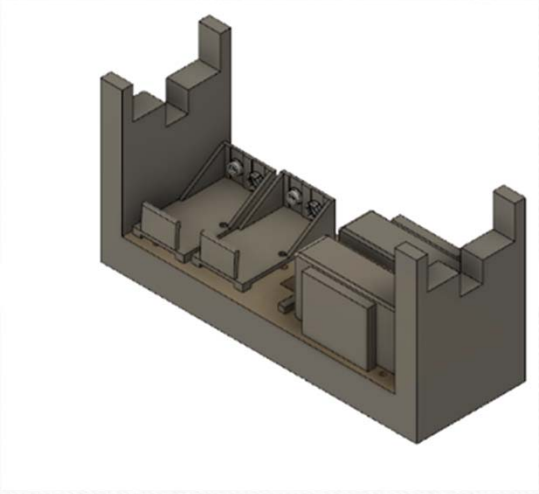
CONTROL ALGORITHMS

- Bang – Bang
  - Turns ON/OFF motors to respective wheels for desired output
- PID
  - Controls the trajectory and velocity of the vehicle.


Turn Left
Clear Path
Left Side Sensor
Object within 40cm
Right Side Sensor
Turn Right
Clear Path
Object within 40cm
Object within 40cm
Front Sensor
Back Sensor
Move Forward
Clear Path
Object within 40cm
Clear Path
Reverse
Start
STOP

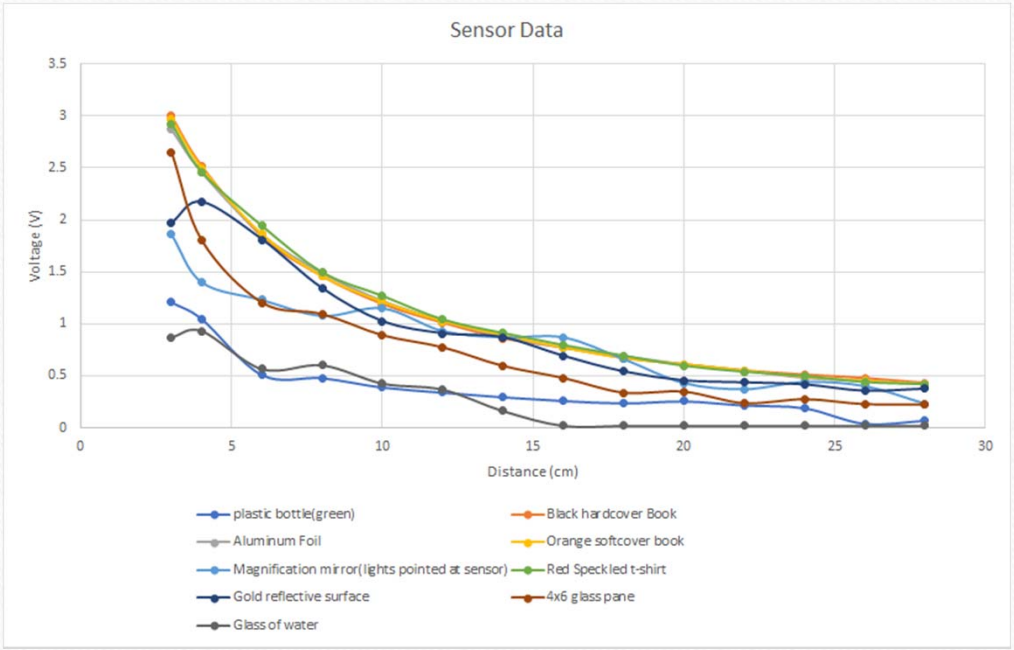
DESIGN DECISIONS





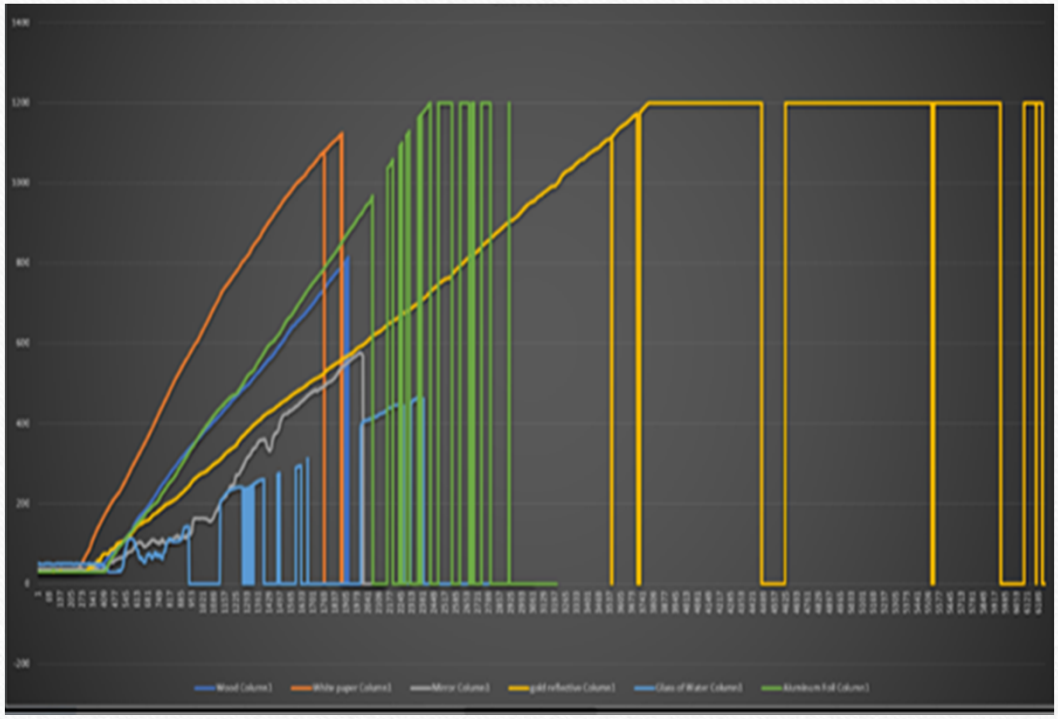
IR Sensor Details

Distance Measuring Sensor Unit
Measuring distance : 4 to 30 cm
Analog output type

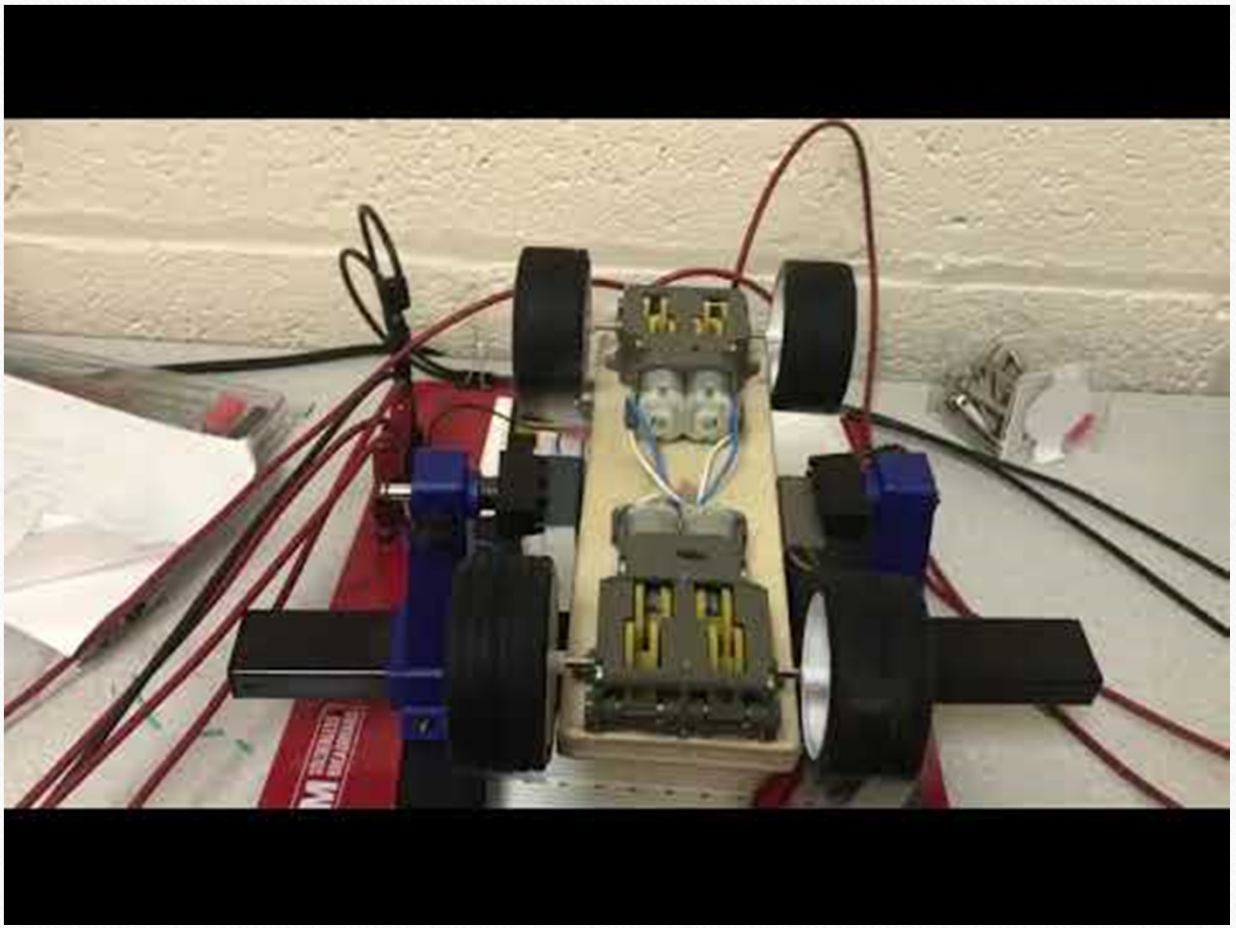


LiDAR Sensor Details

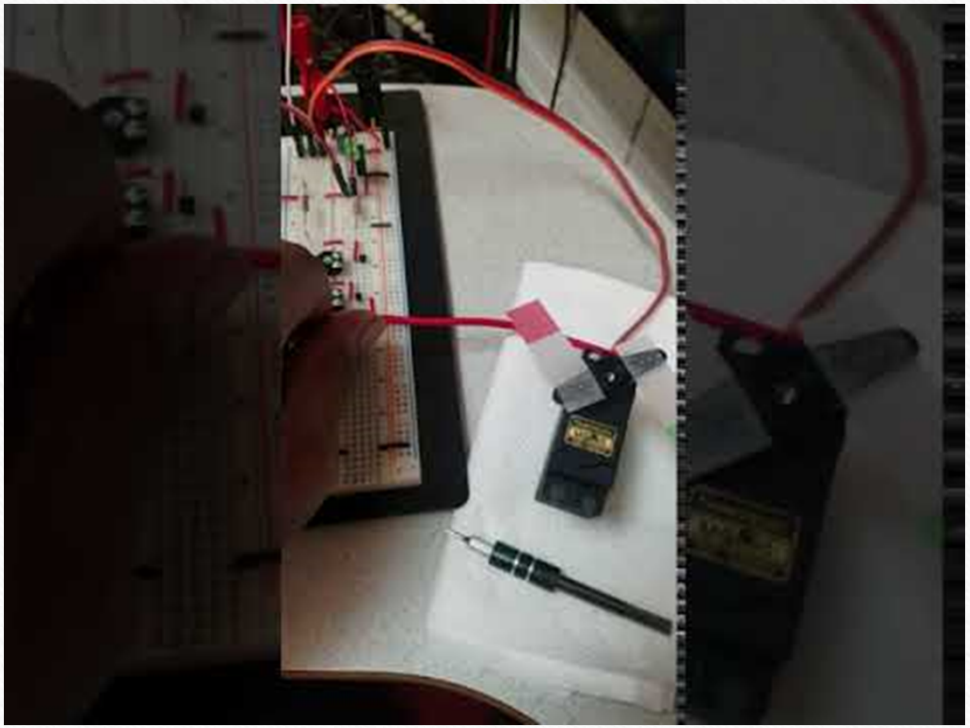
Mini LiDAR Module



PIC 16F877 Simulation with DC Motors



Tuning the Servo Motor



Future Work

Given more time, the PID algorithm could be developed, and both platforms could be used to establish baselines for autonomous controls. Next years Senior Design group can:

- Test different types of sensors
- Have a different algorithm
- Test different drives (2-W, 4-W)
- Add a camera
- Test different sensors

Conclusion

The completion of this project resulted in just the Bang-Bang platform. The Bang-Bang can be used to establish baselines to prove FPGA processors are the best method for autonomous platforms. Given more time the PID algorithm would be developed and both platforms could begin being used for baselines.

REFERENCES

"FPGA-based controllers and SLAM processors for autonomous navigation and task completion." Dr. Michaela E. Amoo

S. Surendharan and J. Jenifer Ranjani, "Environment Concious Navigation System Using PID Controller." Indian Journal of Scienc and Technology, Vol 9(48): December 2016.

K. H. Ang, G. Chong, and Yun Li, "PID Control System Analysis, Design, and Technology." IEEE Trans. Control Systems Technology. Vol 13(4), July 2005.