SIMULTANEOUS LOCALIZATION AND MAPPING FOR AUTONOMOUS PLATFORMS (SLAM)

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PRESENTATION OVERVIEW

Background

Our Objective

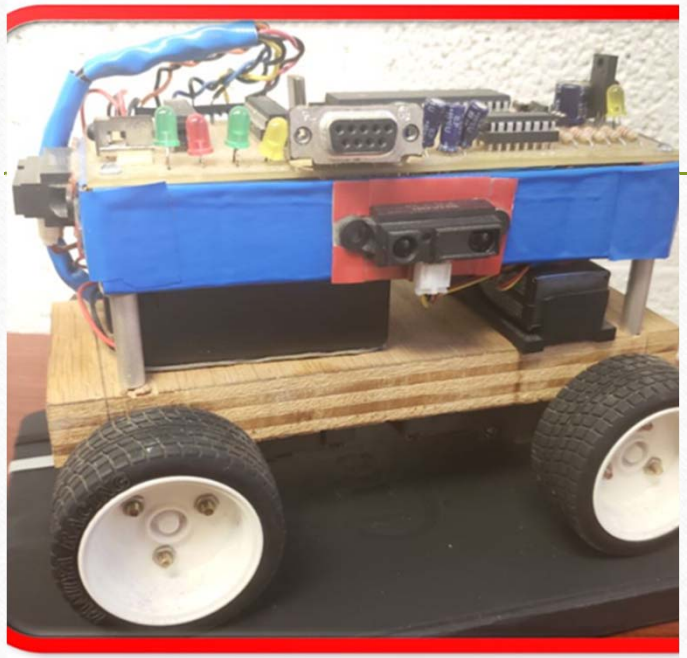
Goals

Design Details

Schematic

Next Steps

References



BACKGROUND

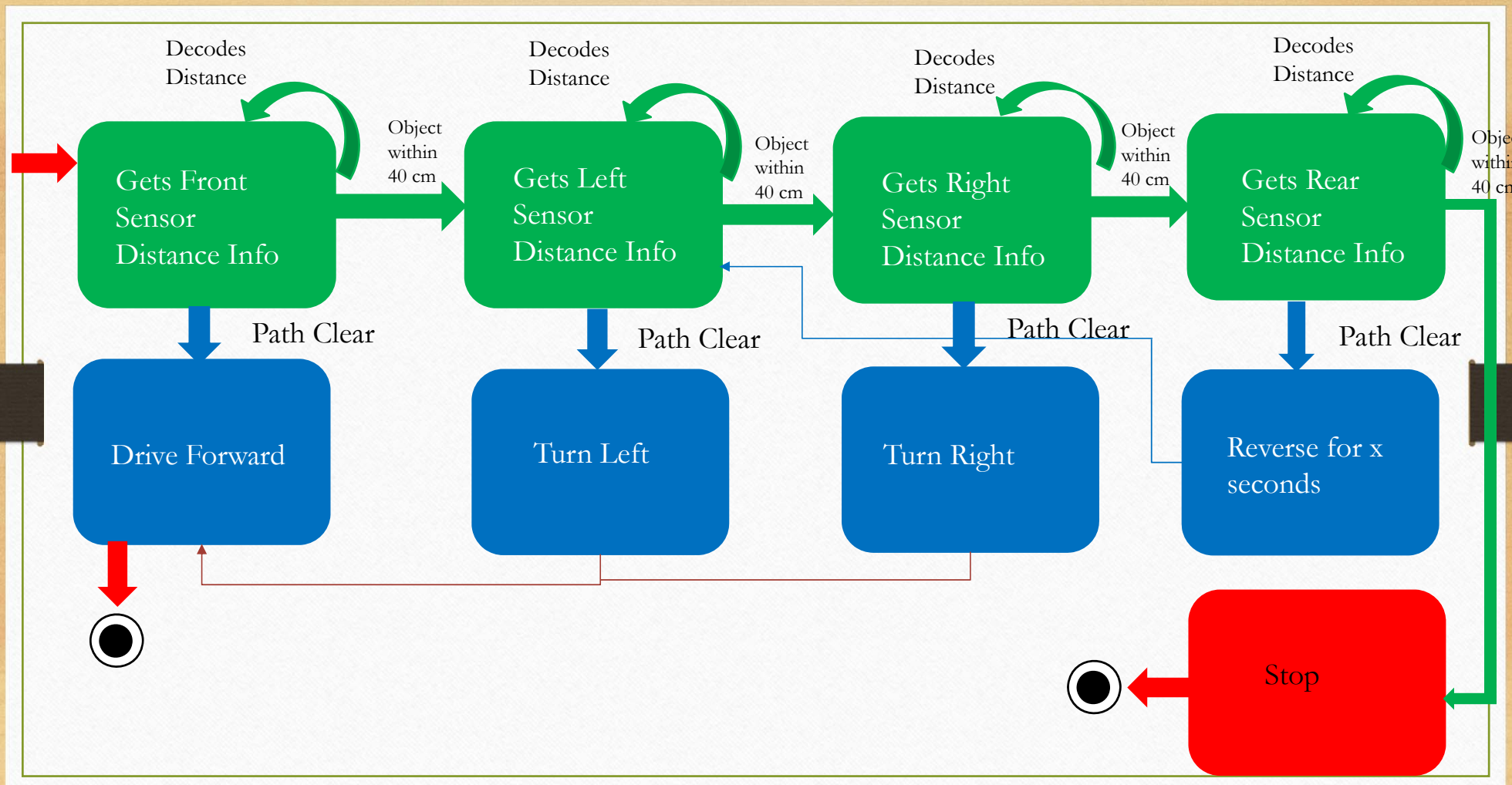
The problem with autonomous navigation is the computational burden with creating a platform that can:

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

Solution
Application specific FPGA based processor

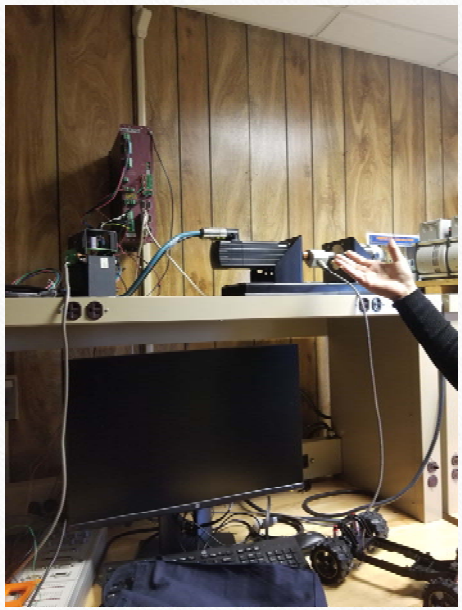
OUR OBJECTIVE

Design, build, and test two autonomous wheeled platforms, (PID and Bang-Bang) using COT sensors, processors and components to establish baselines for application specific FPGA-based SLAM autonomous platform.


Decodes Distance
Gets Front Sensor Distance Info
Object within 40 cm
Decodes Distance
Gets Left Sensor Distance Info
Object within 40 cm
Decodes Distance
Gets Right Sensor Distance Info
Object within 40 cm
Decodes Distance
Gets Rear Sensor Distance Info
Object within 40 cm
Path Clear
Drive Forward
Path Clear
Turn Left
Path Clear
Turn Right
Path Clear
Reverse for x seconds
Stop

GOALS FOR SENIOR DESIGN

- Evaluate/ Test sensors
- Generate test vectors from sensors
- Design PID and Bang-Bang algorithms (MATLab)
- Test algorithms: Use test vectors from sensors, Simulate on DSPACE using HIL
- Build autonomous platform using COTS parts
- Test and Record Baselines



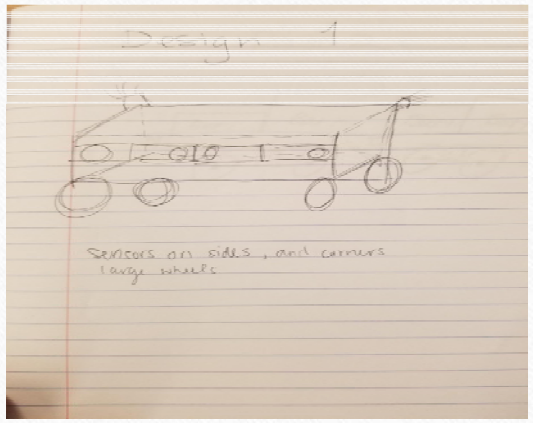
CONTROL ALGORITHMS

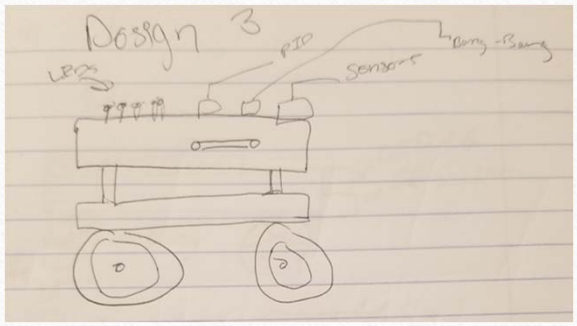
- Bang – Bang
  - Turns ON/OFF motors to respective wheels for desired output
- PID
  - Controls the trajectory and velocity of the vehicle.

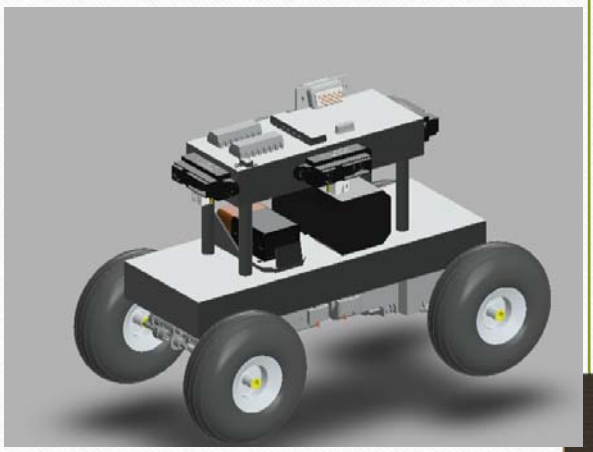
Parts

- 1x PIC16F877
- 4x Sharp GP2Y0A41SK0F IR Distance Sensor Kit
- 2x 2936 STMicroelectronics IC Motor Driver (16-DIP)
- 1x MAXIM Integrated MAX232 CPE: IC TXRX 2/2 FULL RS232 (24-DIP)
- 1x 39515 Texas Inst.: IC Linear Voltage Regulator 5V 1.5A
- 1x 1091 Fox Electronics: 20 MHZ CTS50333 Crystal Oscillator (20pF)
- 1x 1609FNA NorComp Inc.: Female Serial Port (DB9)
- 2x TAMIYA 3V Twin-Motor Gear Box
- 4x TAMIYA Sports Wheels
- 5x LEDS
- 5x 2.2KW Resistor
- 4x 1mF Capacitor
- 1x 22mF Capacitor
- 2x 20pF Capacitor.
- 1x 38 kHz Infrared Receiver Module

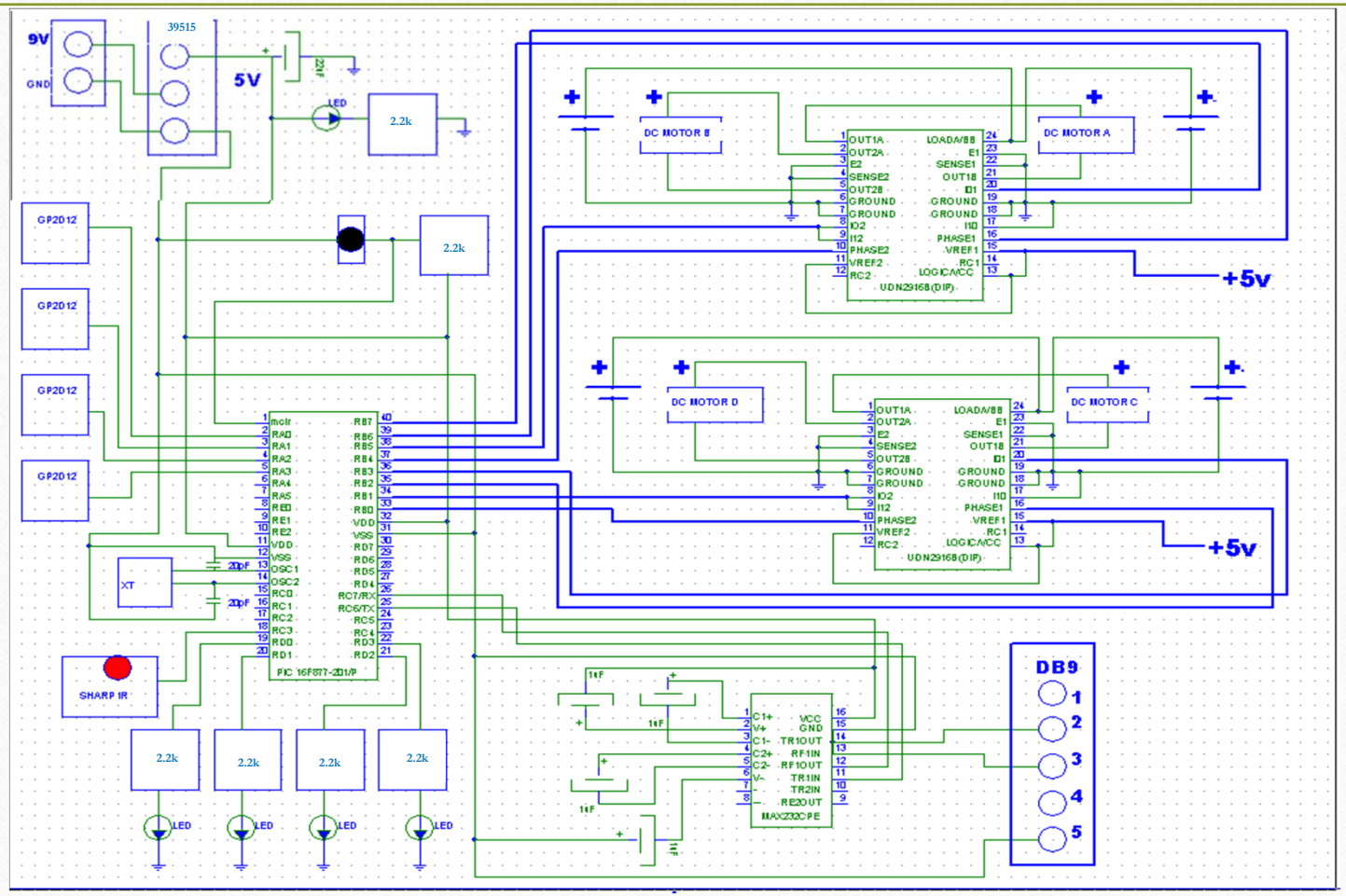
DESIGN DECISIONS

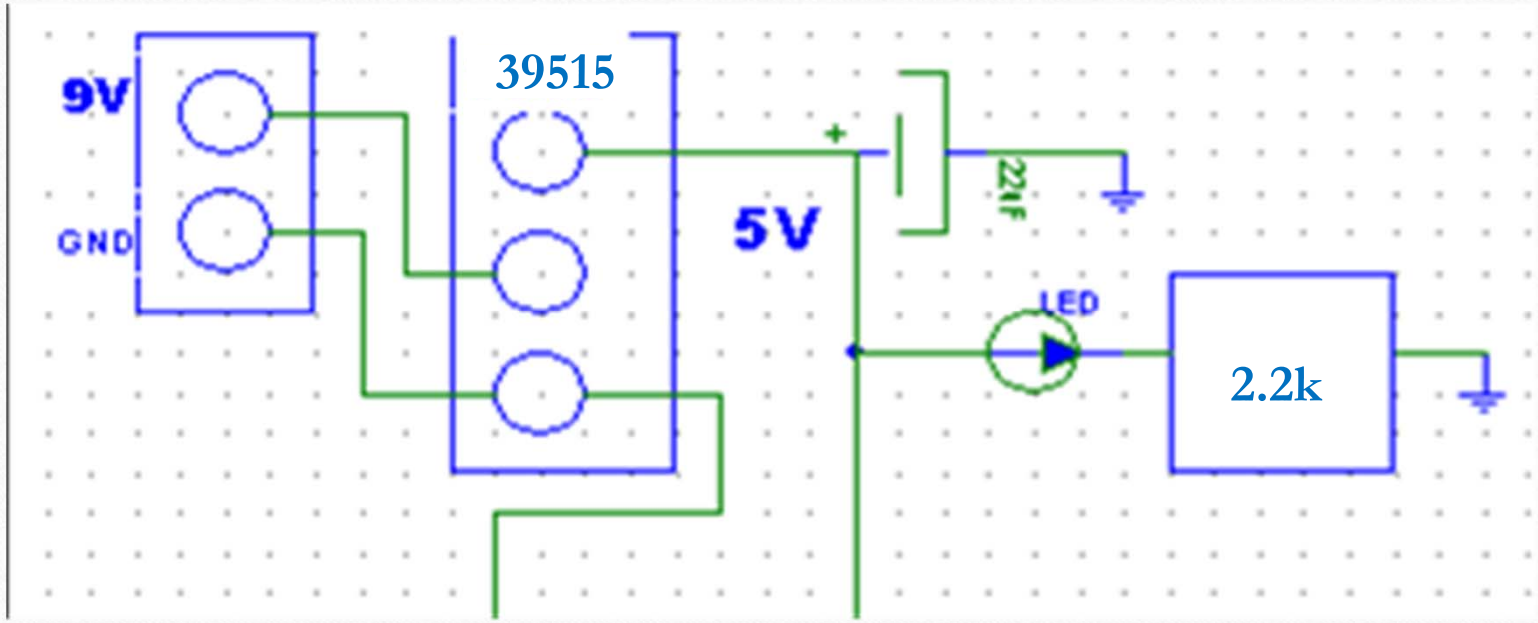






	Weight	Design 1	Score(max: 5)	Agg. Score	Design 2	Score(max: 5)	Agg. Score
Manuverability	3	2 wheel(rear wheel) drive	2	6	4 wheel drive	4	12
Weight	4	18-25 lbs	3	12	18-22 lbs	3	12
Power Usage	4	3 Batteries	2	8	2 Batteries	3	12
Aesthetic	1	N/A	5	5	N/A	2	2
Situational Awareness	4	2 sensors on the front	2	8	1 sensor on each side	4	16
Adaptability	5	N/A	3	15	N/A	4	20
TOTAL:				**69**			**94**


9V
GND
39515
5V
LED
2.2k
GP2D12
GP2D12
GP2D12
GP2D12
2.2k
DC MOTOR B
DC MOTOR A
DC MOTOR D
DC MOTOR C
UDN2916B(DIP)
+5v
+5v
XT
20pF
20pF
PIC 16F877-20I/P
SHARP IR
2.2k
2.2k
2.2k
2.2k
LED
LED
LED
LED
1uF
MAX232CPE
DB9
1
2
3
4
5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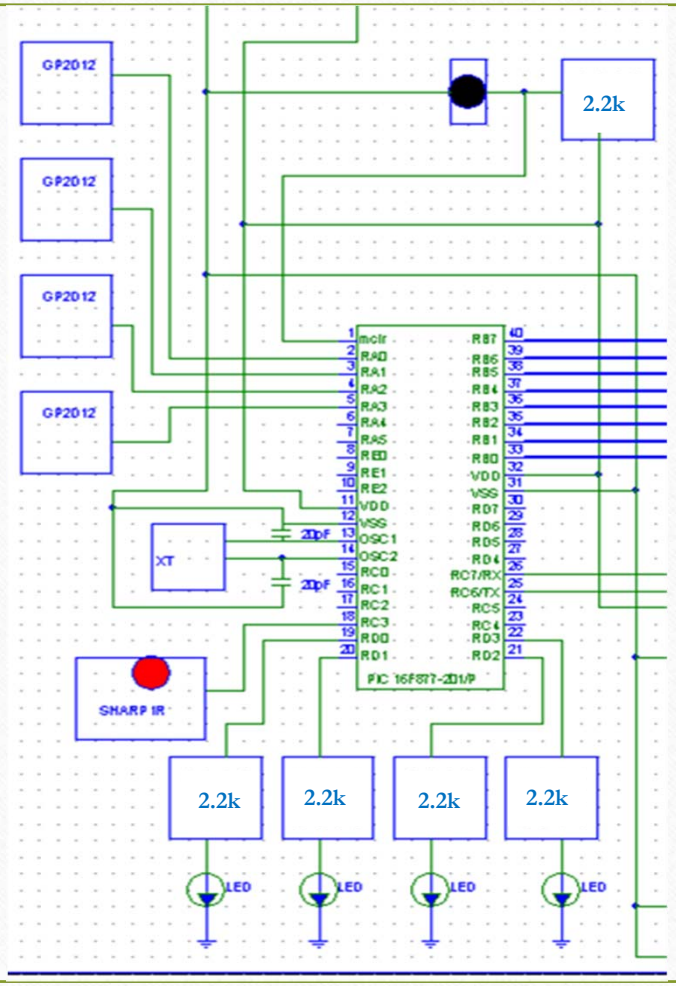
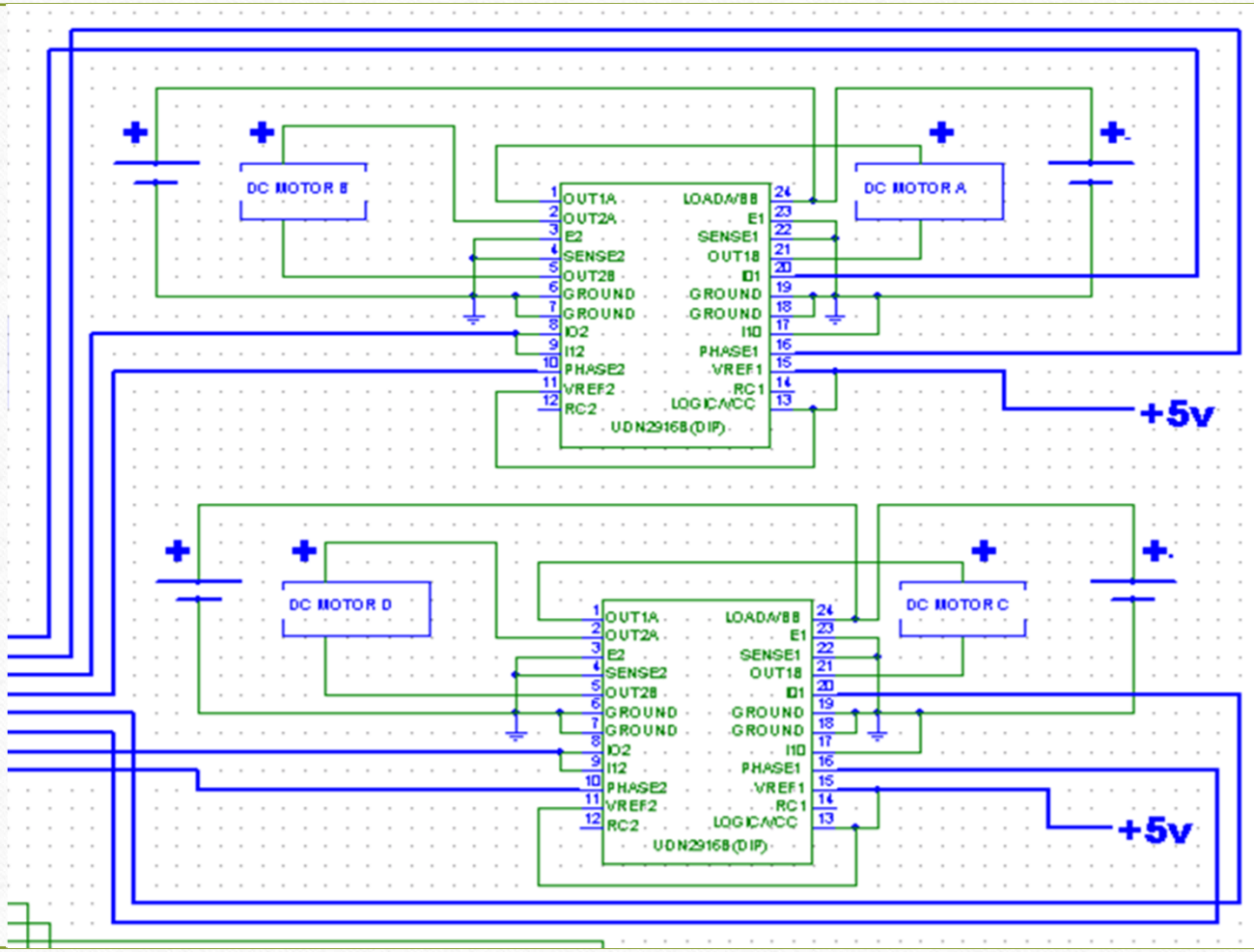
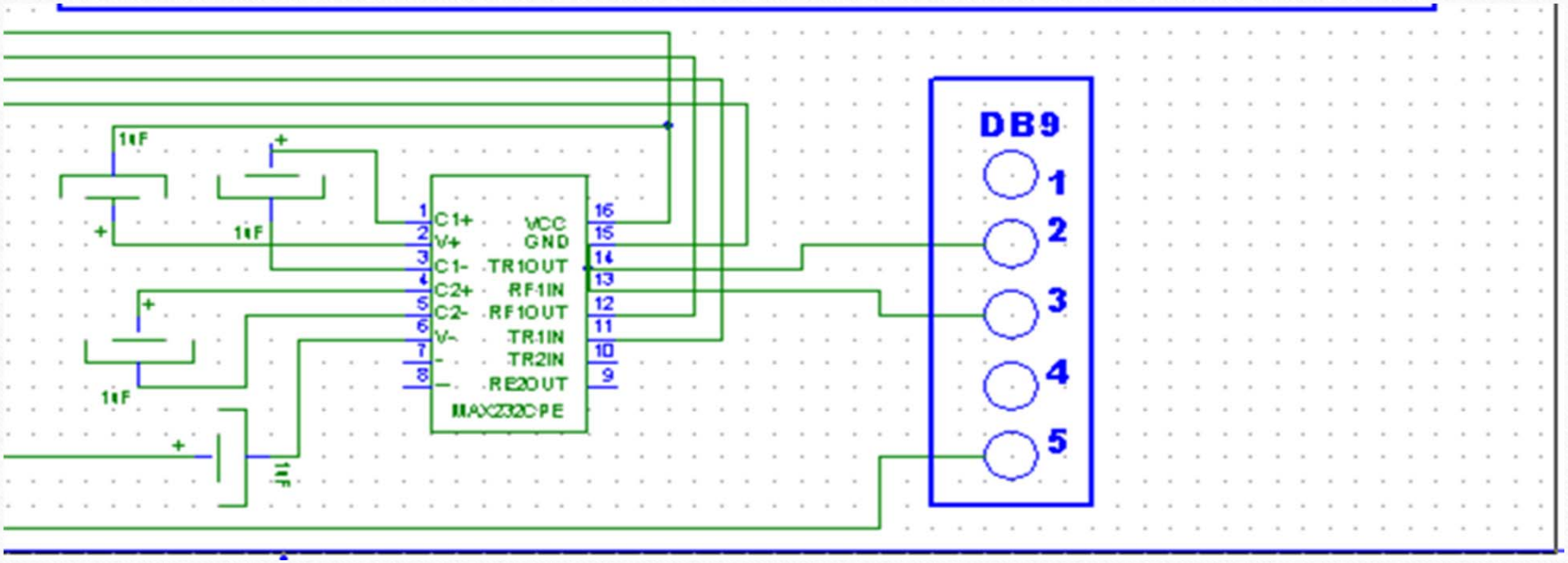
GND
39515
5V
+
22uF
LED
2.2k


GP2012
GP2012
GP2012
GP2012
2.2k
mclr
RA0
RA1
RA2
RA3
RA4
RA5
REO
RE1
RE2
VDD
VSS
OSC1
OSC2
RC0
RC1
RC2
RC3
RD0
RD1
RB7
RB6
RB5
RB4
RB3
RB2
RB1
RB0
VDD
VSS
RD7
RD6
RD5
RD4
RC7/RX
RC6/TX
RC5
RC4
RD3
RD2
PIC 16F877-20I/P
XT
20pF
20pF
SHARP IR
2.2k
2.2k
2.2k
2.2k
LED
LED
LED
LED


DC MOTOR B
DC MOTOR A
DC MOTOR D
DC MOTOR C
OUT1A
OUT2A
E2
SENSE2
OUT2B
GROUND
GROUND
IO2
I12
PHASE2
VREF2
RC2
LOADA/BB
E1
SENSE1
OUT1B
IO1
GROUND
GROUND
I1O
PHASE1
VREF1
RC1
LOGICA/CC
UDN2916B(DIP)
+5v
+5v


1uF
1uF
1uF
C1+
V+
C1-
C2+
C2-
V-
VCC
GND
TR1OUT
RF1IN
RF1OUT
TR1IN
TR2IN
RE2OUT
MAX232CPE
DB9
1
2
3
4
5

NEXT STEPS

Remainder of semester

Build Bang-Bang controlled platform

Next semester

Design and build PID controlled platform

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 Science 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.