



Autonomous Wheelchair

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Project Advisor: Dr. Steven Barrett

ECE Senior Design

Agenda

- Project Overview and Background
- Hardware
 - Main circuit
 - Individual component interfacing
- Software
 - System operation code
- Problems
- Project Continuation
- Acknowledgements

Background

- Funded by an assistive technology grant from The National Science Foundation under the oversight of Dr. Steven Barrett.
- The purpose of this project is to design a system that will directly contribute to the quality of life for people with disabilities, with a special emphasis on independent living.

Overview

- This project aims to help give the user of a wheelchair the ability to move from place to place with the least possible physical effort to control the wheelchair.
- Targeted use is for someone in a wheelchair that has a disability that goes beyond the lower body.

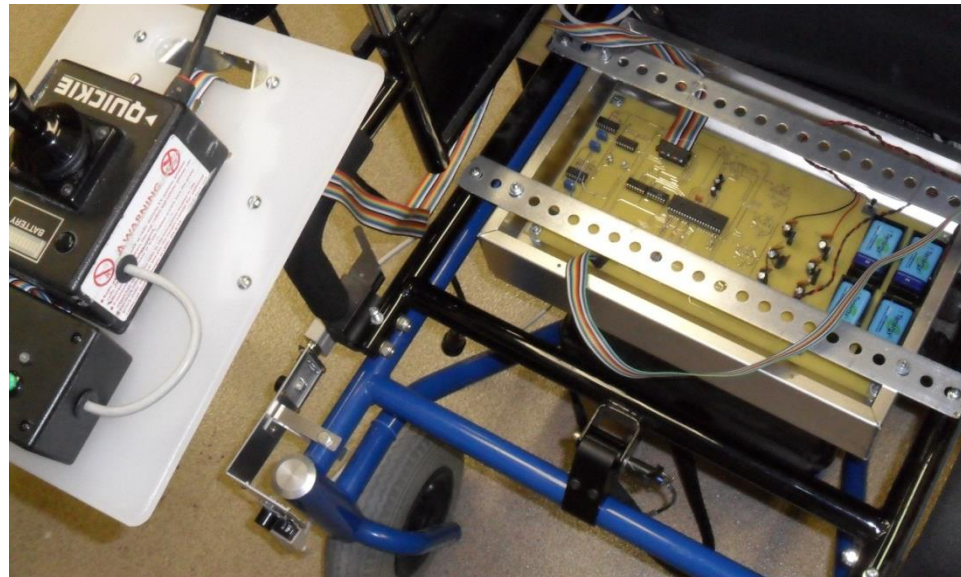
Overview

- Various sensors are used in order to create an autonomous wheelchair.

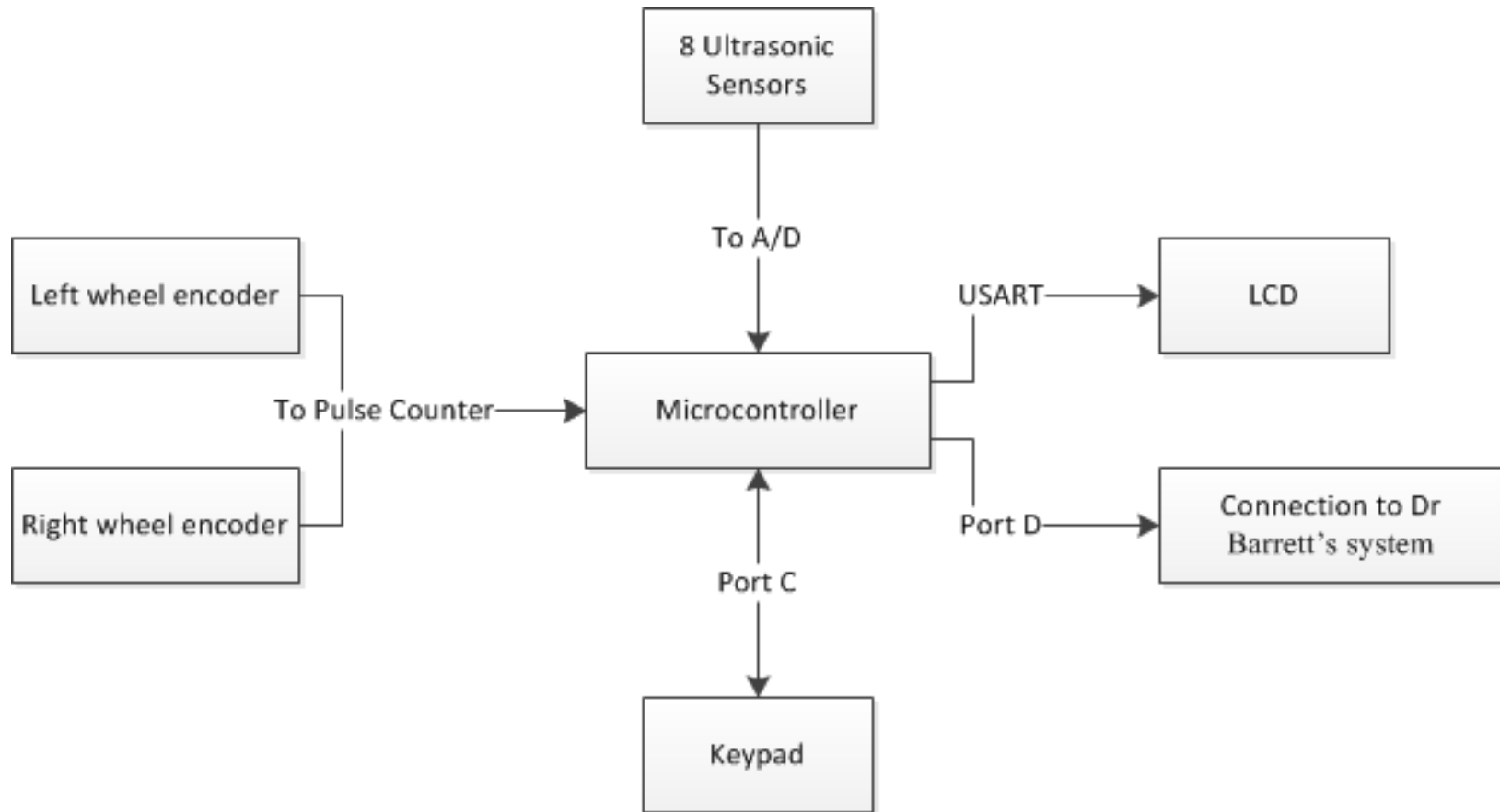


Motor Interface

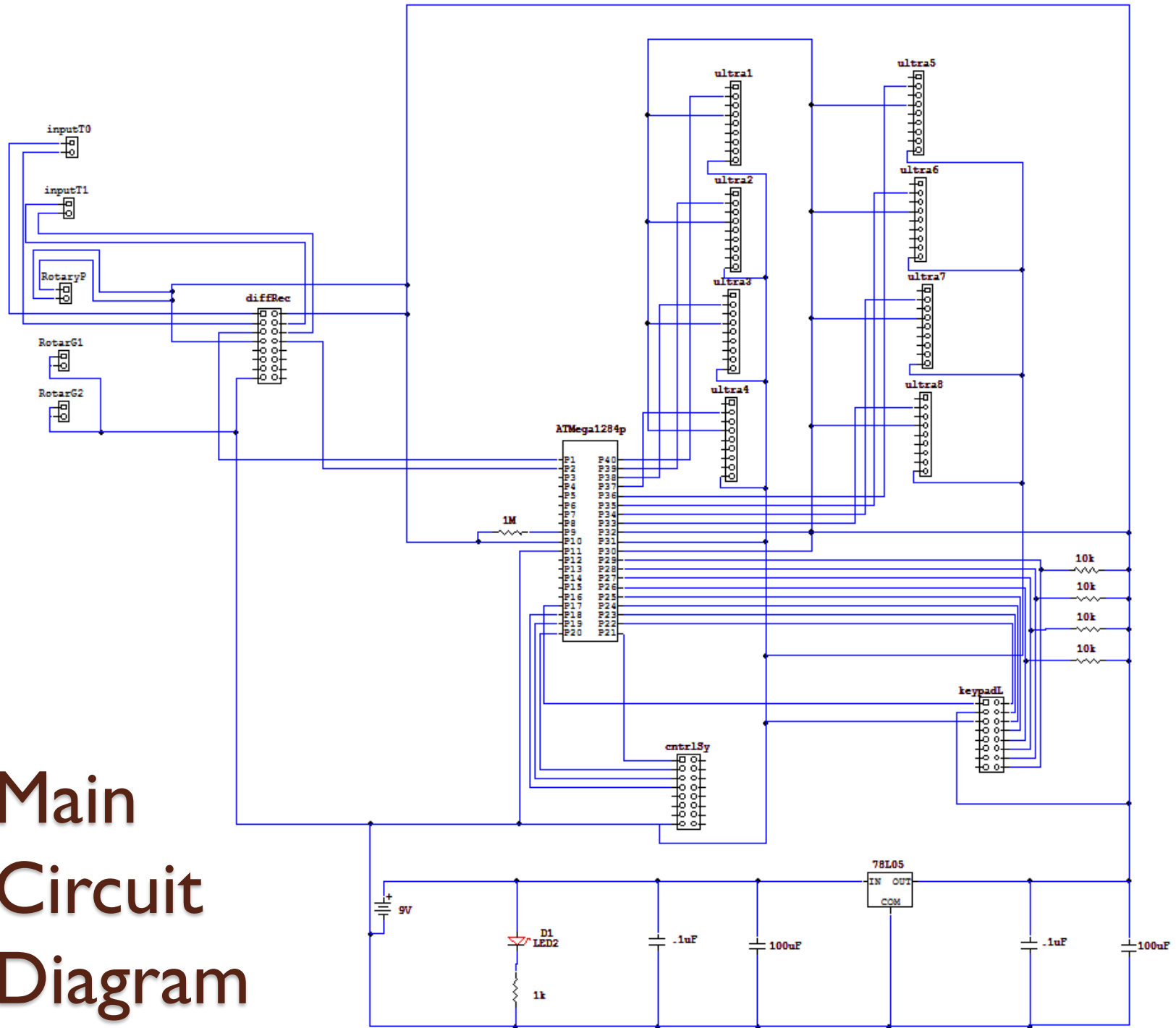
- Dr. Steven Barrett reverse engineered the joystick on the wheelchair to find which signals it sends to the motors.
- He was able to create a system that converts 4 digital inputs into two analog signals to control the wheelchair motors.



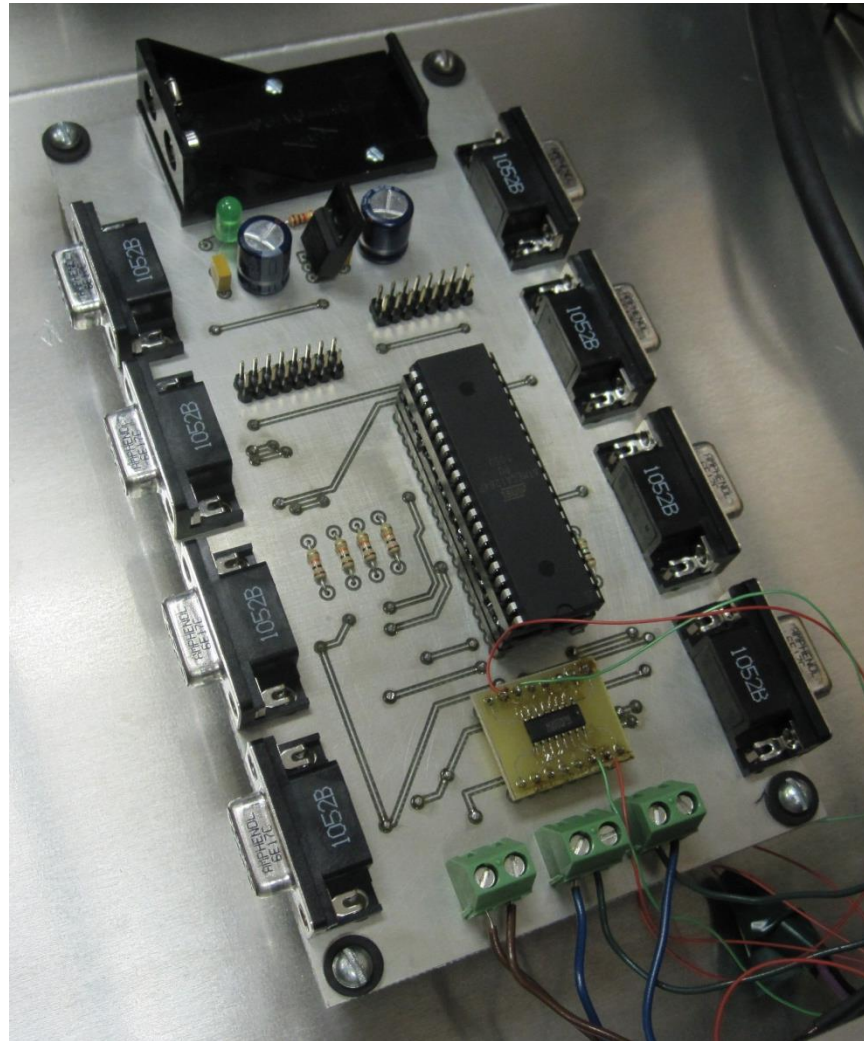
Hardware Structure Diagram



Main Circuit Diagram

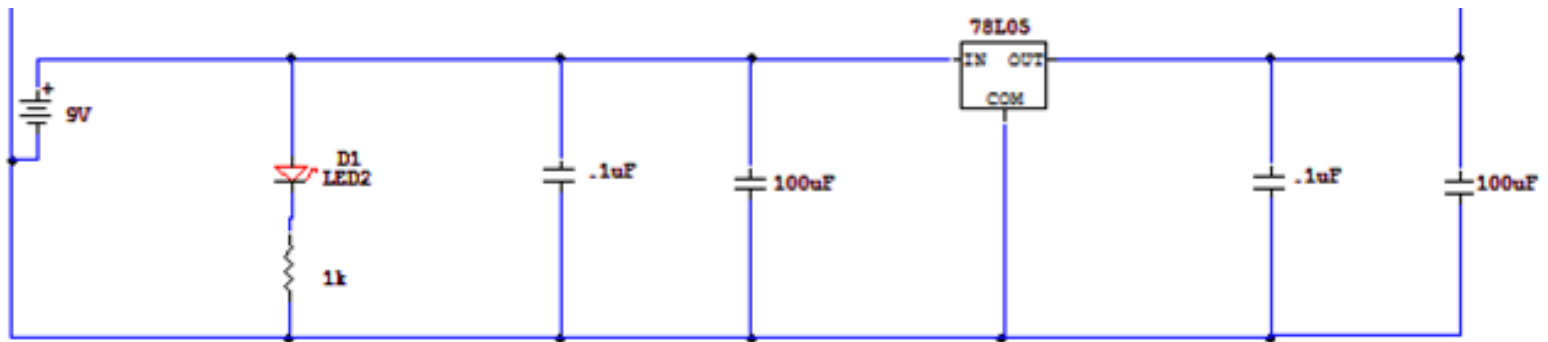


Main Printed Circuit Board

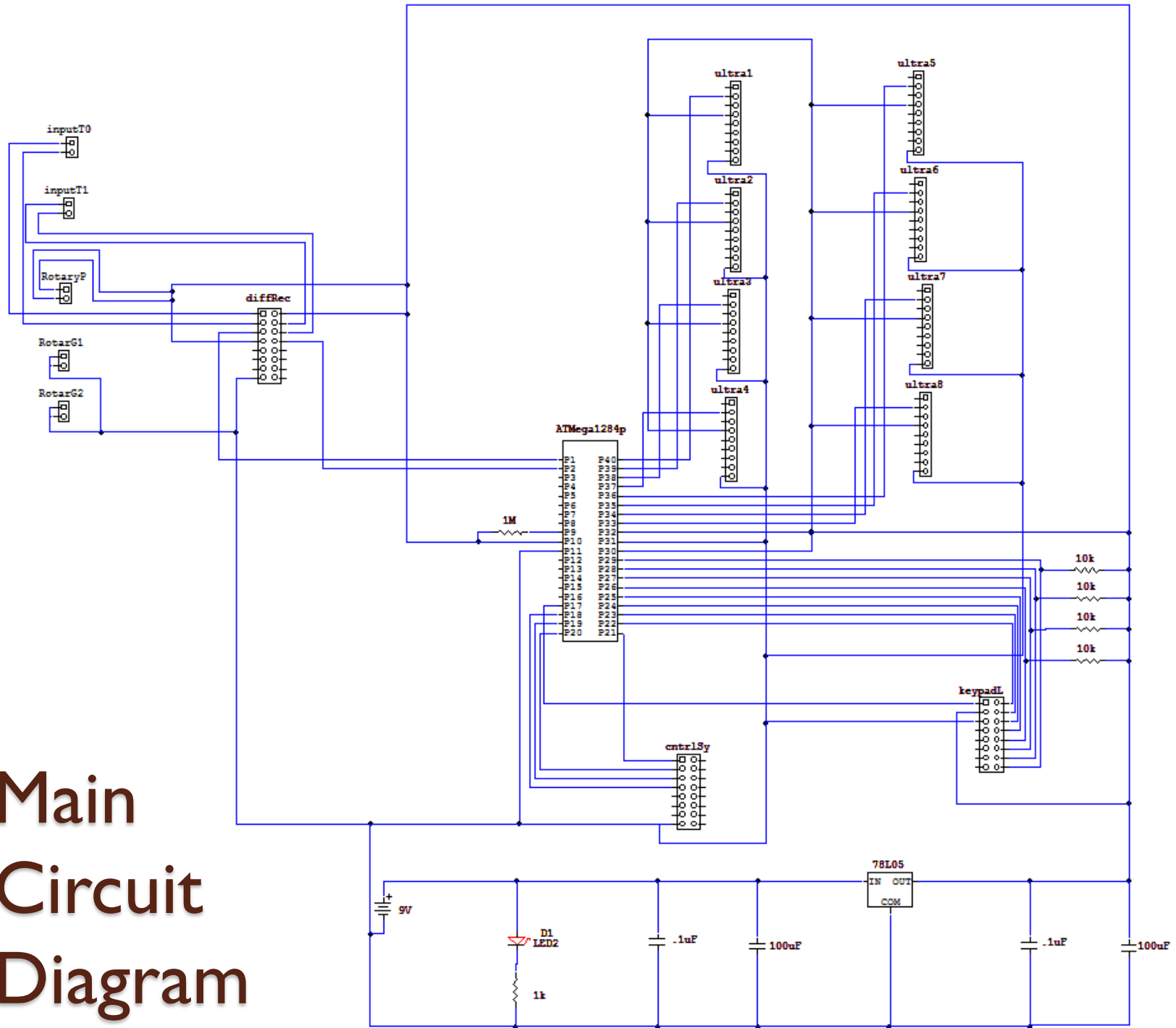


Power System

- Derived from the power system on the wheelchair motor interface designed by Dr. Steven Barrett.
- 7805 regulator brings down our 9 volt battery to 5 volts.
 - Dropout voltage of 2 volts

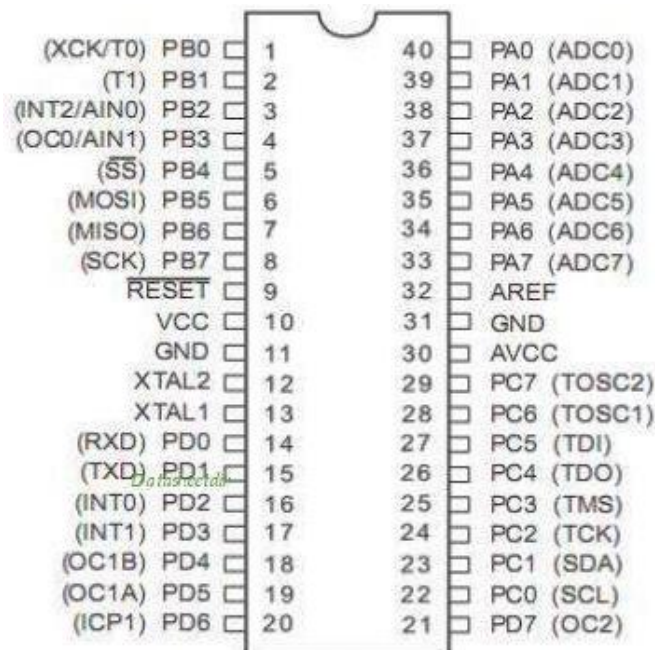


Main Circuit Diagram

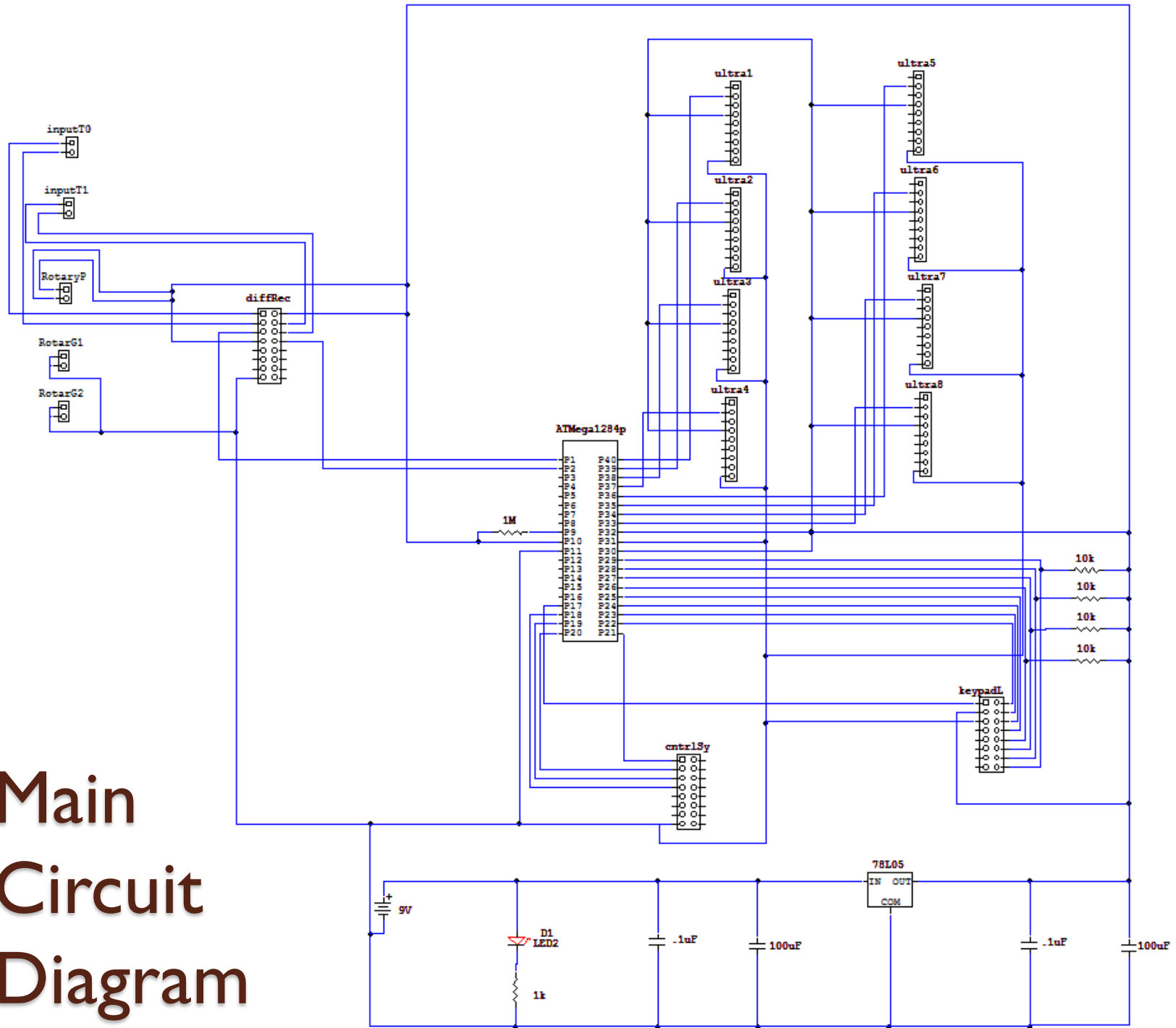


Microcontroller

- Atmega1284p
 - 40-pin DIP package
 - Contained all interfaces to peripherals that we required

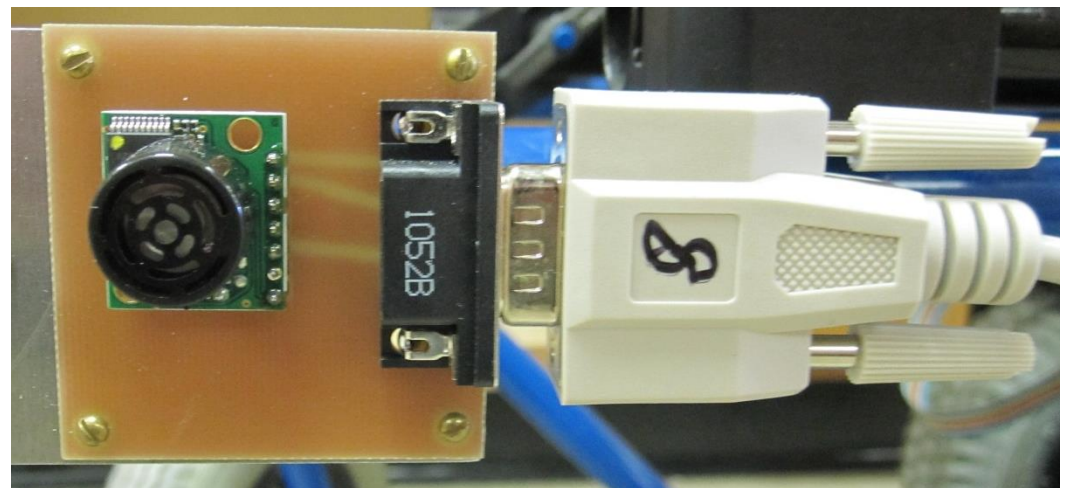
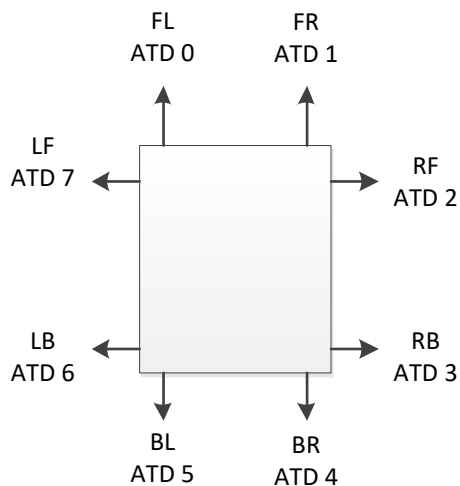


Main Circuit Diagram

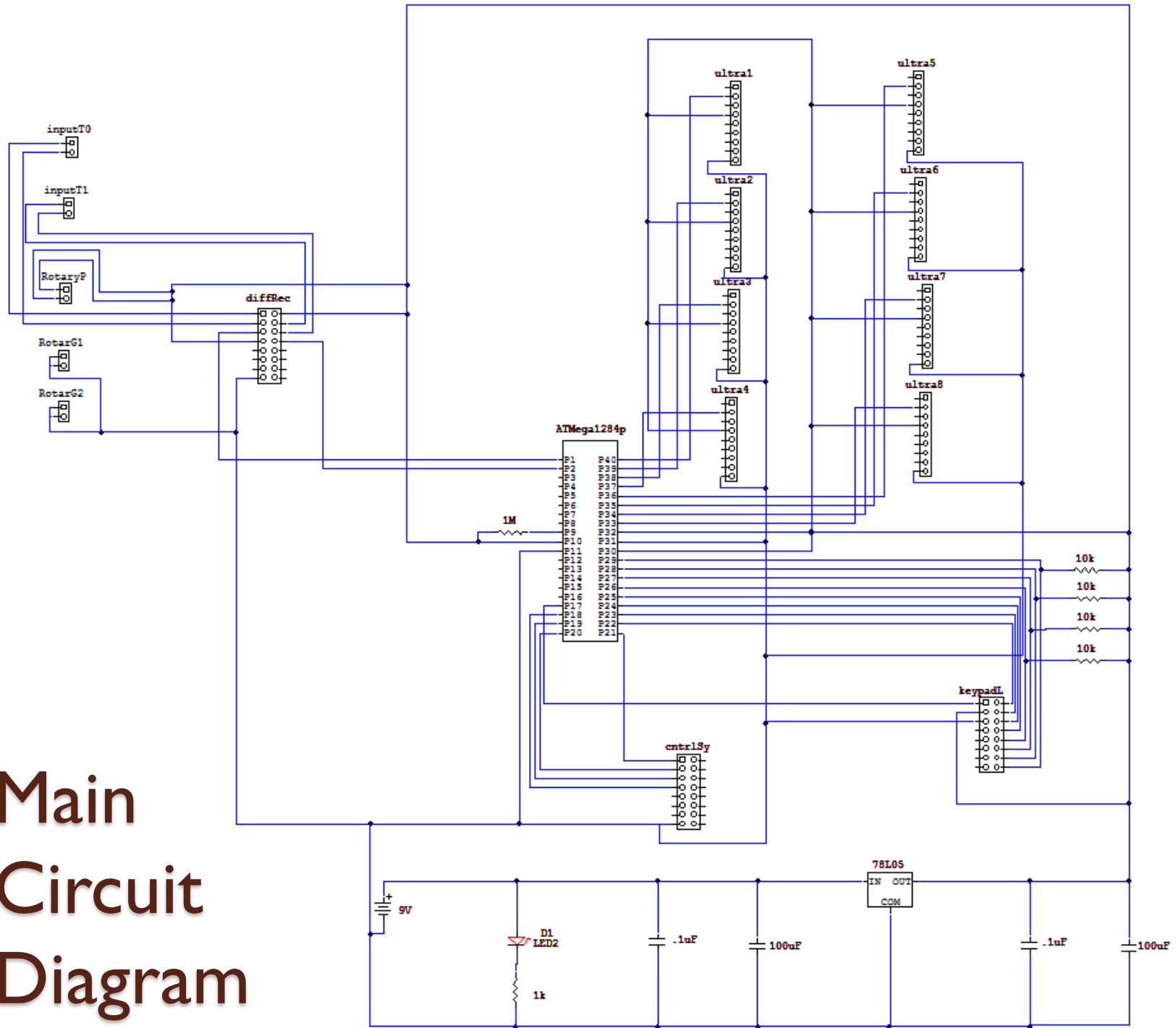


Ultrasonic Sensors

- Designed small printed circuit boards (PCBs) to connect the sensors to serial cables which relay information back to the main PCB.
- Output an analog signal between 0 and V_{cc} that we tied into the A/D onboard the microcontroller.
- Resolution of one centimeter from 20cm to 765cm.



Main Circuit Diagram



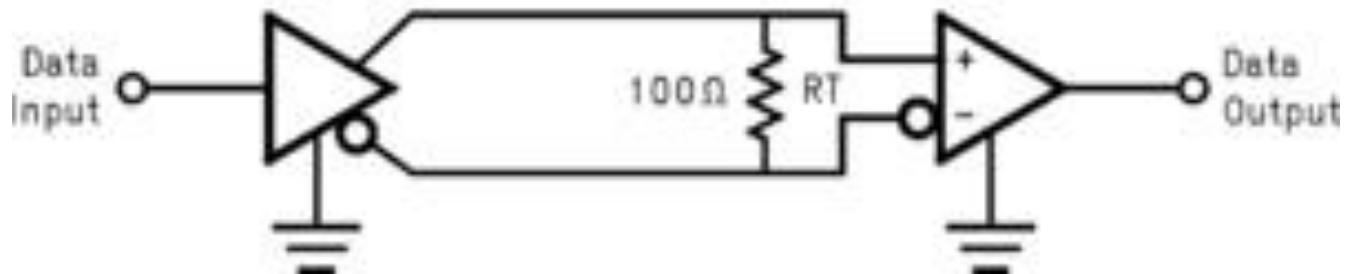
Incremental Rotary Encoder

- We are able to track both distance and direction using two incremental rotary encoders.
- Resolution of 360 pulses per rotation and 0.222 cm per pulse in our application.
- Both output to a differential receiver package.

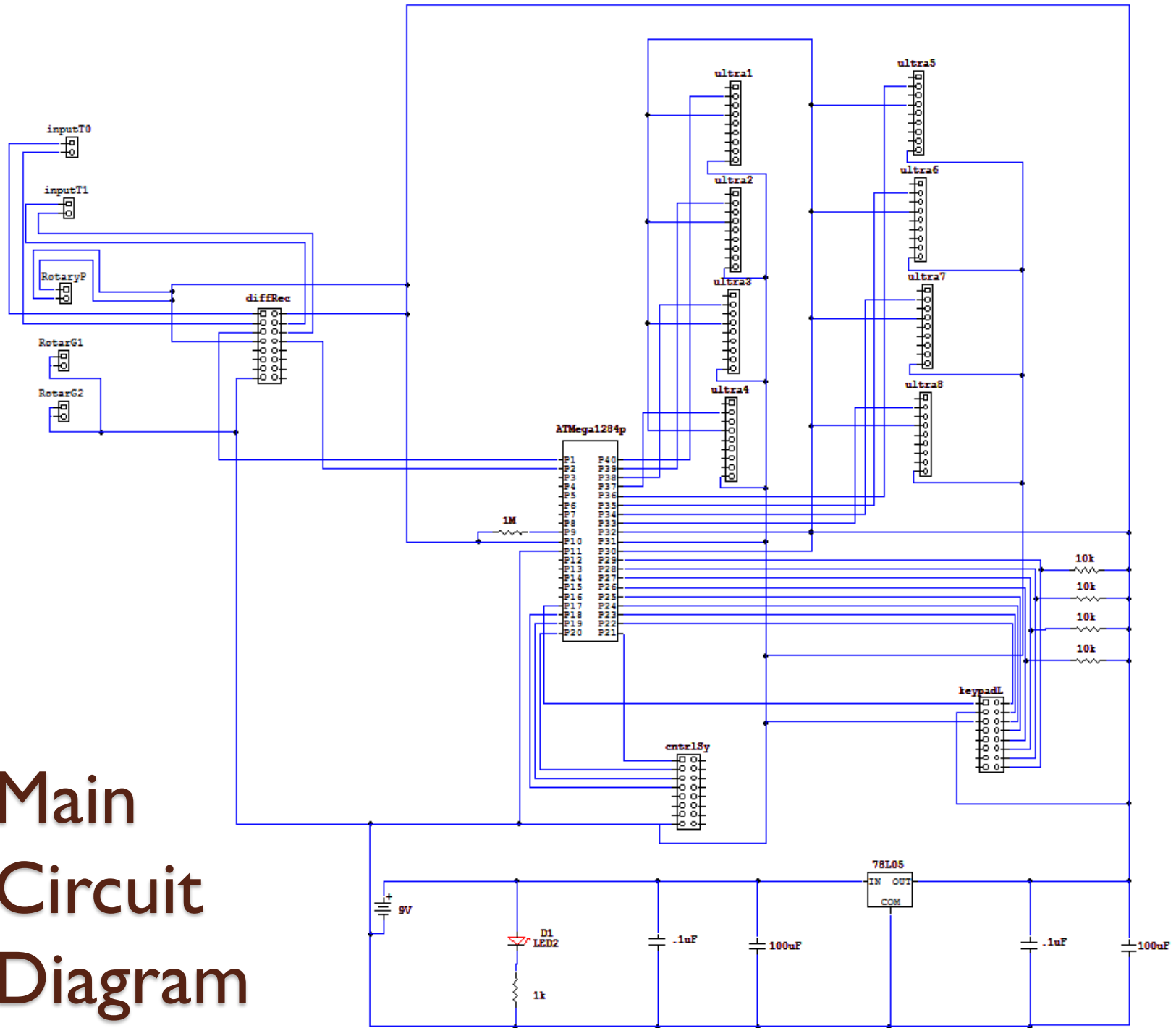


Differential Receiver

- Used for the line driver output of the rotary encoders.
- Effectively cancels the noise in the line coming out of the rotary encoders.

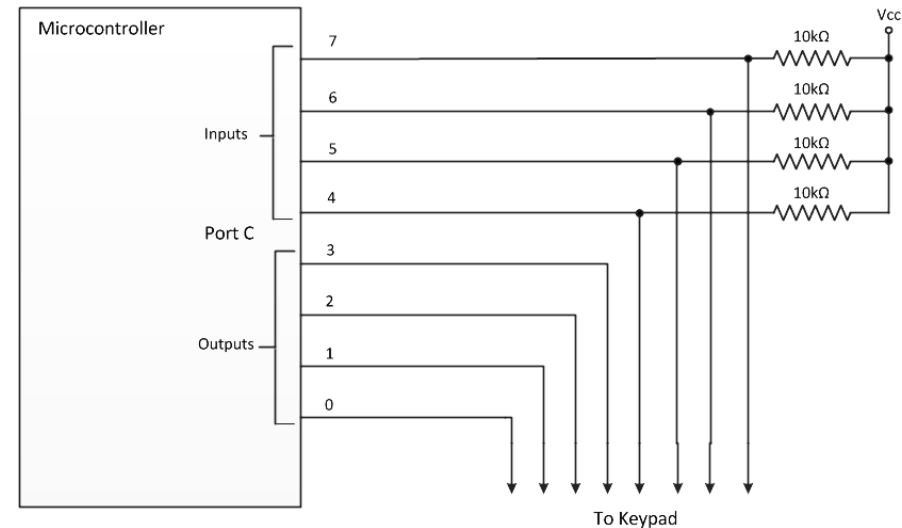
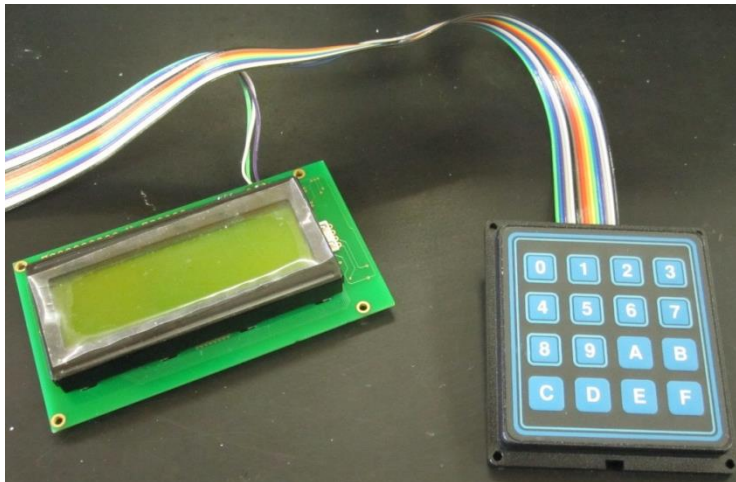


Main Circuit Diagram



Keypad and Liquid Crystal Display

- Keypad used to gather control commands from the user.
- 20x4 Serial LCD used to display current status information about the system.
 - USART transmission



Software

- Three different modes of operation:
 - 0 : Idle – Wheelchair does nothing
 - 1 : Manual Control – Controlled by user but the system can stop the wheelchair from driving too close to obstacles
 - 2 : Wall-Follow – Autonomously follows the right wall, keeping it within a certain distance and navigating around obstructions

Software

- Main program polls in a infinite loop to control the wheelchair.
- Each time through the loop it first checks the keypad and determines what mode to be in.
- Next it reads in all the inputs from the various sensors.
- The last decision it makes is to determine what the wheelchair should do next based on what mode it is in and the data from the inputs

Software

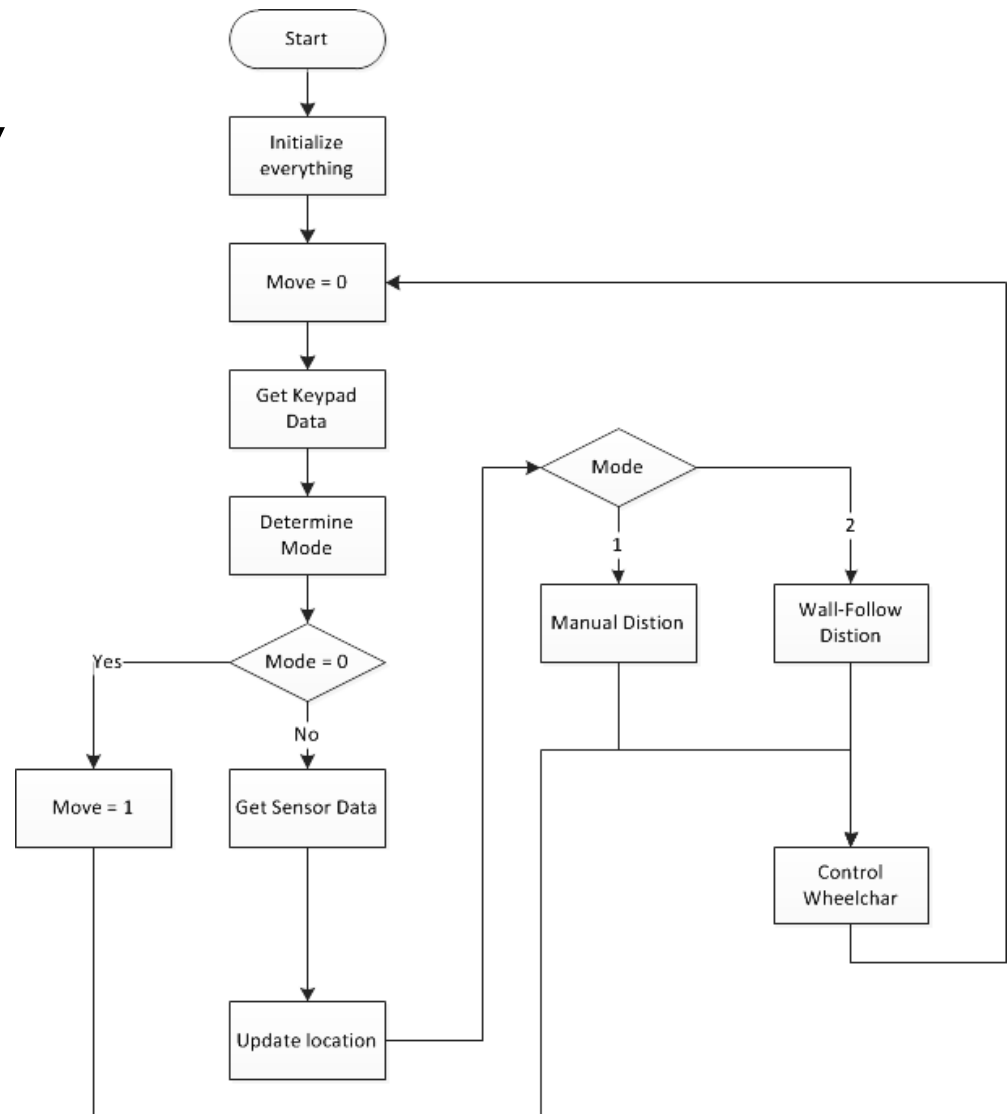
UML activity diagram for main code:

Mode

1. Idle

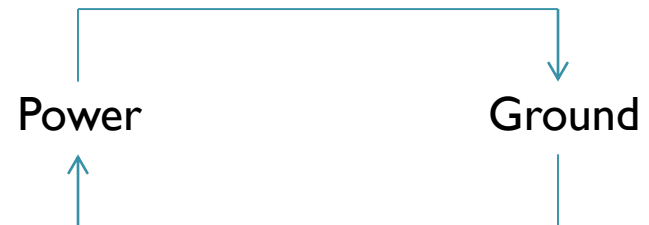
2. Manual

3. Wall-Follow



Problems

- PCB design
 - 3 shifted pins on the microcontroller base
 - Much of the board without power
 - Missing 2 wire connectors
- Serial LCD
 - Baud rate
 - Faulty operation



Project Continuation

- Software Mapping
- Pathing
- Improved sensors

Special Thanks

- Dr. Stanislaw Legowski
- Dr. Steven F. Barrett
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- George Janack
- Mike Schilt
- Becky Meza
- The National Science Foundation

Questions

