Project Report on

GESTURE CONTROLLED TOY CAR

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ECE 511: Microprocessors

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1. ABSTRACT

In our project we have put together a car, which is a model of the cars we drive today, and is controlled by a glove. The system will provide us the luxury of controlling a vehicle using hand gestures. The glove is worn by the user, is mounted by accelerometer and it transmits data wirelessly to the car. The basic idea is to have free control, providing better flexibility than a remote controller, thus making the system less materialistic and more prone to human control.

1.1 Motivation

The motivation of this project was that everyone has imagined being able to move an object with a flick of their wrist at their whim at some point or the other. A very natural tendency to move objects with the movement of one's hand is something of great convenience, and to be able to control a car, direction with the same gestures is every child's dream.

1.2 Solution

The basic aim of the project is to control the car without using a remote control. In order to do so, one of the many options available, best suitable for the project was to control it with hand gestures. Accelerometer is the key sensing device here used to sense the hand gestures and convert them to electrical signals which would ultimately control the car. To transmit the data wirelessly, we have used RF transmission which is the minimalist transmission media possible.

1.3 Block diagram

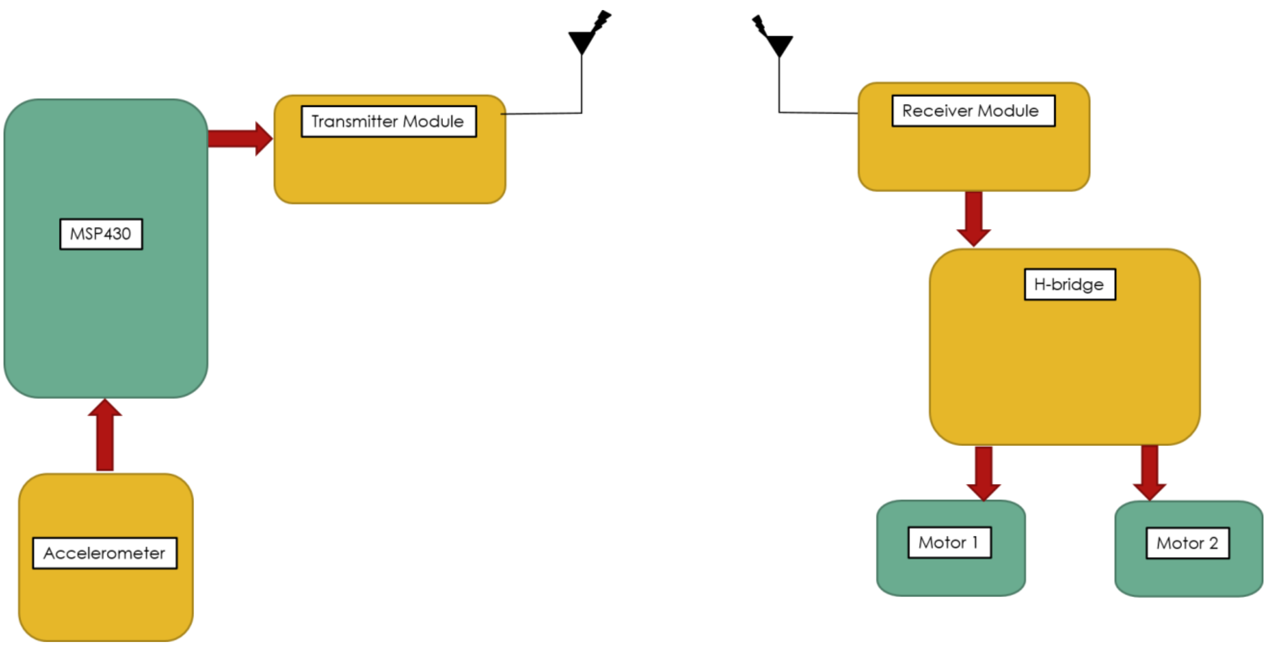

Figure 1: Block diagram of the system

1.4 System Overview

The system consists of two modules. One is the glove that senses the gestures of the hand using an accelerometer. The analog electrical signals given by the accelerometer are processed and converted to digital signal by using ADC module of MSP430. The analog values generated by the accelerometer depend on the tilt of the hand relative to the corresponding X and Y axes. These digital signals are then transmitted wirelessly through RF module to the second module. The vehicle here being the second module that interprets the signal sent in by the transmitter and modifies its motion with respect to the signal given by the hand gesture.

The major components used in the project are

- MSP430FR6989
- Accelerometer ADXL335 operating at 3.3 V
- LCD display on board MSP430
- RF transmitter of frequency 315MHz consisting of an encoder PT2262
- RF receiver consisting of decoder PT2272
- Motor driver IC L293D operating at 5V (VCC 1) and 9V (VCC 2)

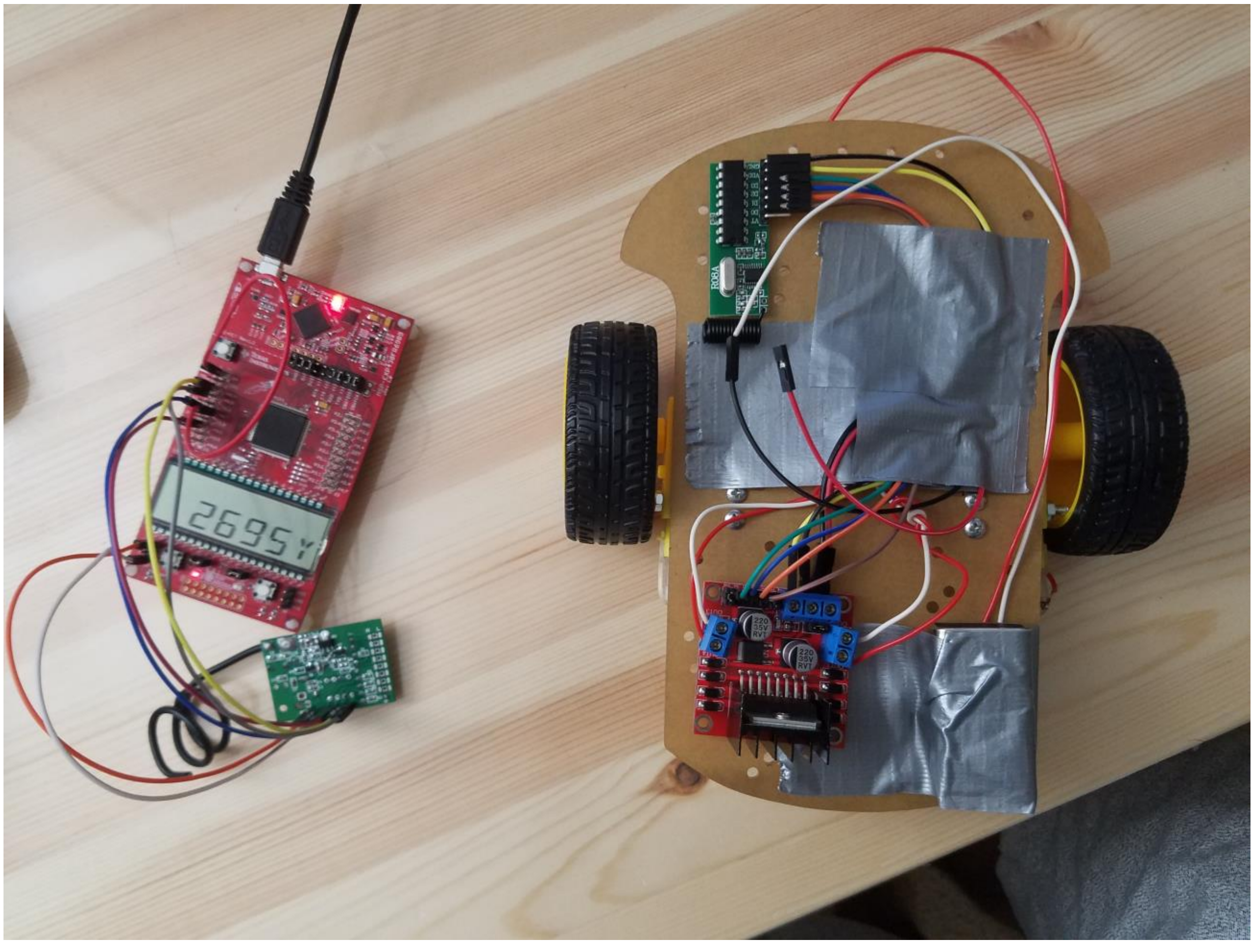

Figure 2: Overall system

2. COMPONENETS

2.1 MSP 430

MSP 430 microcontroller is the heart of the project which stores the code and the main processing is done here. The internal ADC module of MSP430 is used with a reference voltage of 2.5 V. The ADC pins on MSP430 take in the analog input from the accelerometer and convert them to digital values. These digital values are then compared to the previously set threshold value. Then the MSP430 takes a decision about the movement of a vehicle in a particular directions which is a 4 bit output. This output is then passed on to the transmitter module wherein the encoding takes place.

Decision output bits	Direction in which the car moves
0100	Right
0010	Left
0110	Forward
1001	Backward

Table 1: Output port bits of MSP 430 corresponding to direction

2.2 Accelerometer

An accelerometer is a device that measures proper acceleration. The proper acceleration measured by an accelerometer is not necessarily the co-ordinate acceleration (rate of change of velocity). Instead the accelerometer sees the acceleration associated with the phenomenon of weight experienced by any test mass at rest in the frame of reference of accelerometer device. It is a kind of sensor which gives an analog data while moving in X, Y and Z direction. Here in this case we use only X and Y directions as there is no need for the car to move in the Z direction. The X output is determined by the tilt of hand in up & down direction while the Y output is determined by the tilt of hand in sideways direction. The X and Y axis outputs of Accelerometer are connected to the ADC inputs, P8.6 and 8.5 of MSP430 respectively.

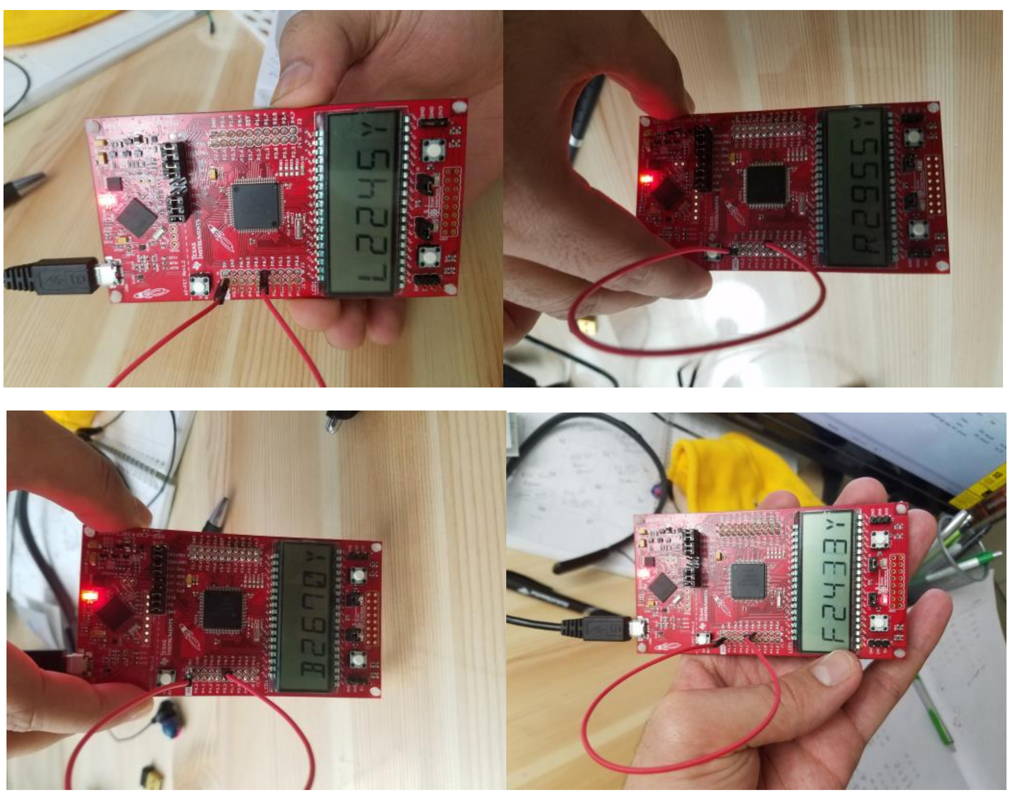

Figure 3: Accelerometer values when tilted in the left, right, forward and backward directions (clockwise)

2.3 LCD Display

The on-board LCD display on MSP430 is used to display the digitally converted analog values of the accelerometer tilt in X and Y directions. An LCD library was used from the sample code obtained from Texas Instruments official website. The display can show only one value at a time i.e. either X or Y direction values. A button on the board is used to toggle between the values of both directions.

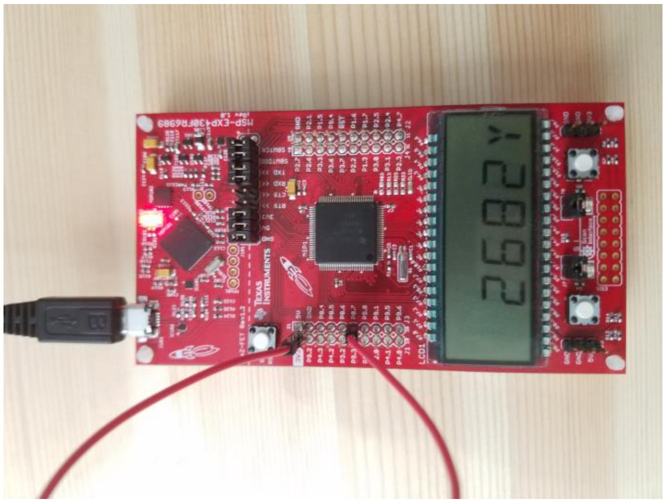

Figure 4: LCD Display

2.4 RF Transmitting module

The decision made by the microcontroller is available at the output pins- P4.0, P4.1, P4.2 and P4.3. These pins are connected to the data input pins of the encoder (PT2262) present in the transmitter module. The encoder converts these parallel data to serial data and pass it on to the transmitter.

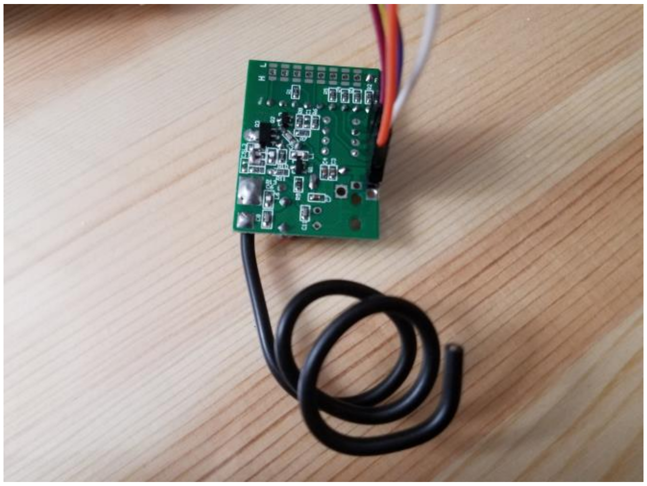

Figure 5: Transmitting module

2.5 RF Receiving module

The receiving module is mounted on to the chassis of the vehicle. The serial data received from the transmitting module is converted back into parallel data by the decoder (PT2272) present in the receiving module. This parallel data is passed on to H- Bridge motor driver IC

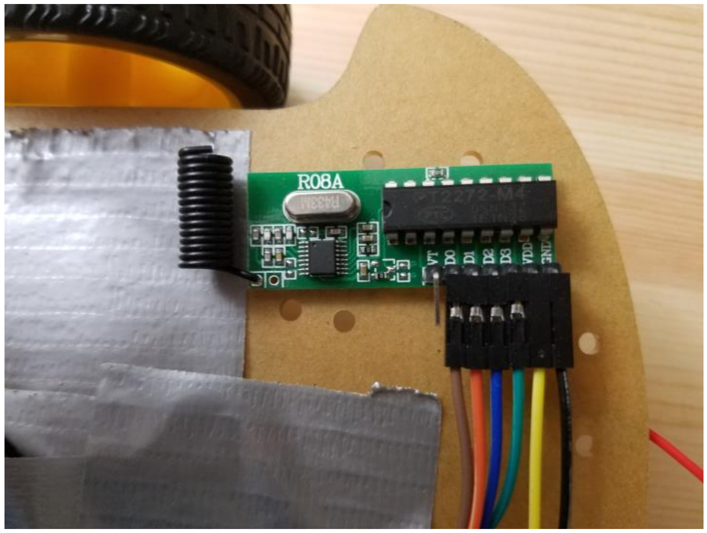

Figure 6: Receiving module

2.6 Motor Driver IC and chassis

The motor driver IC receives the data sent from receiving module and is responsible for the running of motors on the chassis. It has two power inputs VCC1 and VCC 2, running at 5V and 9V respectively.

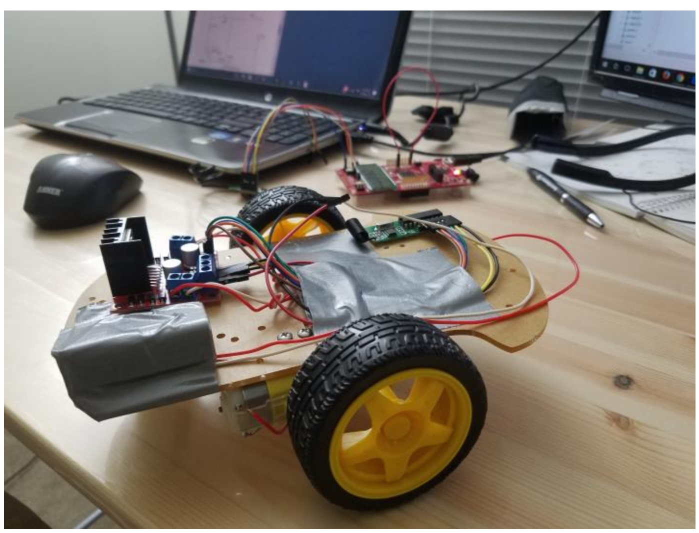

Figure 7: Chassis of the vehicle

3. SOFTWARE-HARDWARE CONFIGURATION

The code for this project is responsible for accepting the analog values from the accelerometer, configuring the internal ADC module of MSP430 and using it to convert the analog values to digital values. The code continuously checks these values and updates the decision at output ports. When digital values cross the threshold, corresponding output decision bits are changed. The sample code obtained from Texas Instruments official website is modified and used for the above.

The transfer of decision made by the MSP430 to the Motors can be mapped as shown in the below table

MSP 430	TX	RX	L298N
2.0	13	D0	IN1
9.3	12	D1	IN2
4.2	11	D2	IN3
4.3	10	D3	IN4

Table 2: Pin mapping from MSP430 to motor driver IC

4. RESULTS

All the components were acquired and stand-alone testing of components was done successfully. The analog values of the accelerometer were successfully acquired and converted to digital values using MSP 430. Threshold values were set accordingly for respective directions. Successful wireless communication was established and 4 bit data was transmitted. The receiving module received transmitted data successfully which is used to drive the vehicle.

4.1 Lessons learned

We learned that the ADC programming was a challenging task. Wireless transmission using RF transmission is sometimes unreliable and proper configuration of transceiver was utmost important. We also learned that components should be ordered well in advance due to the delays in shipping & delivery.

4.2 Achievements

We finished the whole project without using a second microcontroller on the receiving module. The work was compartmentalized and every part of the work was successfully completed according to schedule. The proposed results were achieved in time without any delay and compromises. Using another wireless transmission medium was a backup plan in case the RF transmission failed. Fortunately, data was successfully transferred using RF transmission and there was no need to use the backup plan.

5. CONCLUSIONS

A toy car or a small vehicle can be driven with mere hand gestures. The project has a lot of scope in the future and can be improvised for real time applications like automobile industry, automation industry, military applications etc.

6 APPENDIX

6.1 Division of work

Onkar Randive was responsible for the interfacing of accelerometer with the microcontroller.

Devang Motwani was responsible for the ADC setup of MSP 430 and the decision making of the microcontroller.

Saurabh Deshpande was responsible for the RF transmission module interfacing and its working.

Siva Shashank was responsible for the interfacing of the motor driver IC and the chassis of the vehicle.

6.2 List of components

Component	Model	Quantity
MSP 430 Launchpad	MSP430FR6989	1
Accelerometer	ADXL 335	1
Transmitter	Generic	1
Receiver	Generic	1
Motor driver IC	L298N	1
Encoder	PT2262	1
Receiver	PT2272	1
DC motors	Generic	2
Power supply	Portable Phone Charger	1

Table 3 : List of components

6.3 Open Source Code

MSP Driver library was obtained from the below link
http://www.ti.com/tool/mspdriverlib

6.4 Schematic

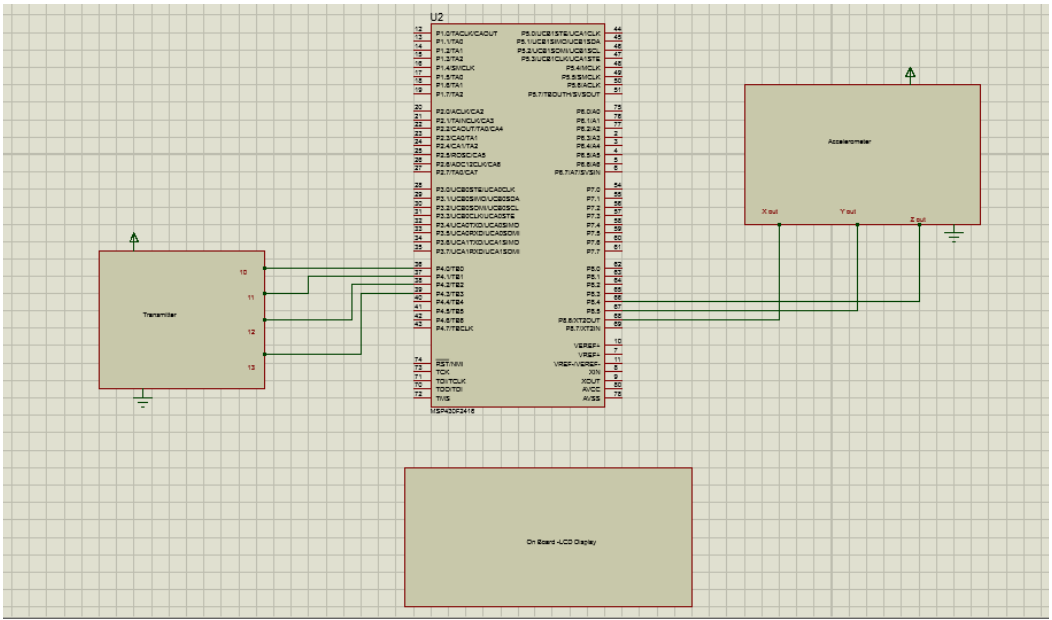

Figure 8: Schematic of transmitting side

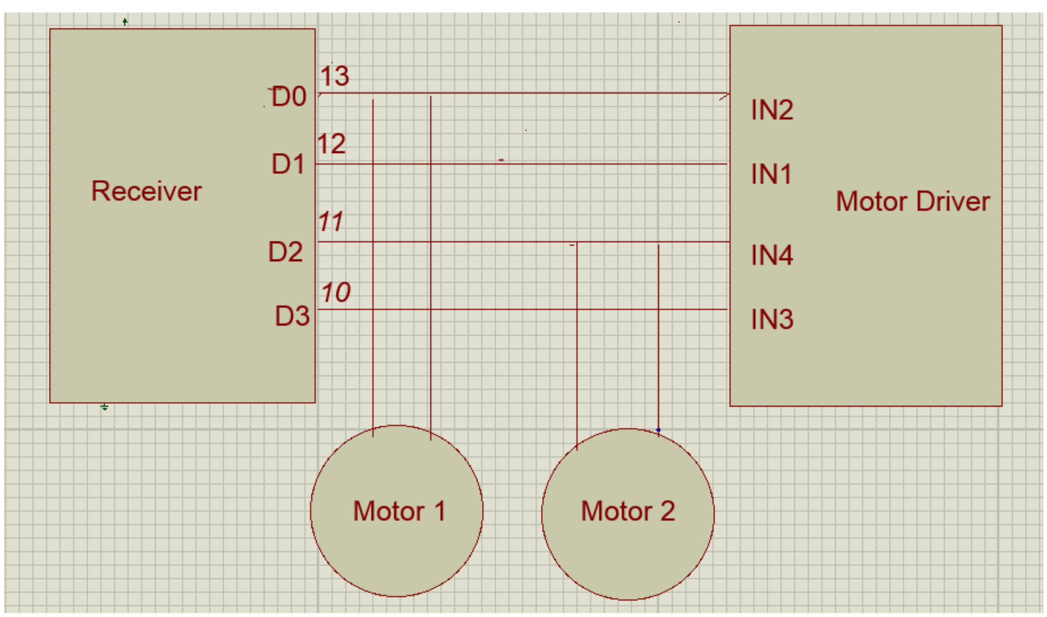

Figure 9: Schematic of receiving side