EW Lab Report: Final Project

By
Varshanjali Sayyaparajau (201030097) & Arushi Ladha (201030005)

- **Project:** Library Bot
- **Description:** At the end of the day, the librarian usually has go from shelf to shelf to return the books to their proper positions. This bot reduces the workload of the librarian.

  The bot is to scan and decode the bar code of the book. Once the robot decodes the bar code, it will have the exact location, i.e. row and shelf of the book.

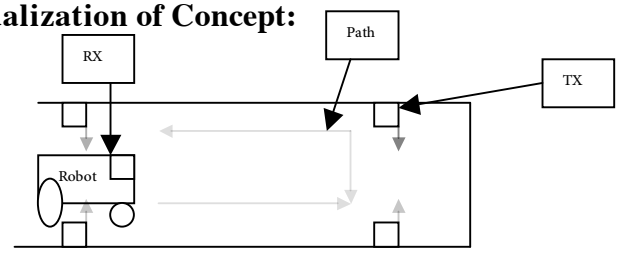
  After knowing the location of the book, the robot will start going to shelf with the help of sensors, which will help direct the bot in the right direction. After the going to the desired location, the bot will place the book in the required position (placing mechanism will not be implemented in this project) and return to its initial position with the help of sensors.
- **Concepts being implemented:**
  - Ultrasonic transmission and reception.
  - Analog to Digital Conversion
  - Frequency detection
  - Amplitude Modulation (ASK)
  - Motor control
- **Functionality:** Using the bar code reader, the robot will scan the bar code. Using certain techniques, the location (or frequency of the signal the transmitter on that shelf will be transmitting) of the book will be extracted.

Next the bot, with the help of ultrasonic sensors and receivers will go to the required position. There will be sensors on the wall and shelves, and two receptors on either side of the bot. Each transmitter will send a modulated sine wave at different frequencies. And the robot will receive the signals through the receivers and demodulate the waves, which will tell the robot its current position.

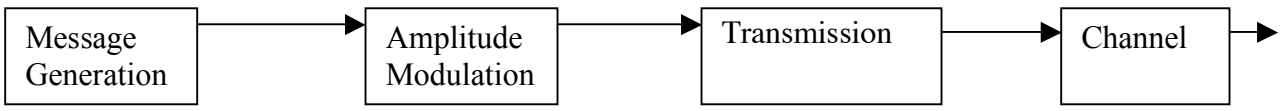
The robot will start from current position, as soon as it passes a sensor on the wall or shelf, it will stop, get the information of location, and continue to required position, i.e till it receives the signal of frequency it is looking for. Once it receives that signal, the bot will turn into the row, place the book and return.

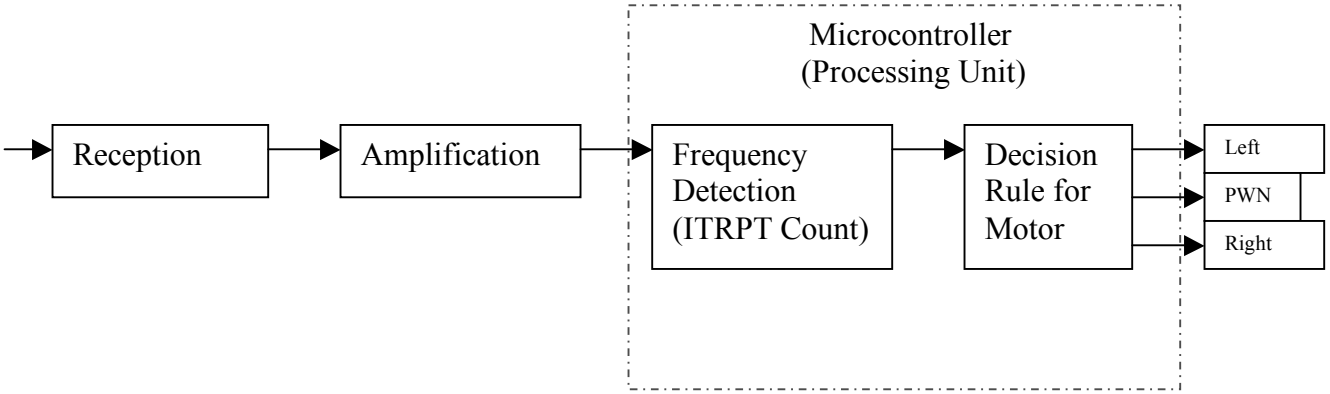
The implementation of the robot's movement is done through ADC and PWM functions using the microcontroller ATMEGA 16. The ADC function will help detect the frequencies of the received signals. And PWM will help run the motor, i.e tell how many times the motor needs to run to reach a certain distance, and during turning, when what motors need to being running and for how long.

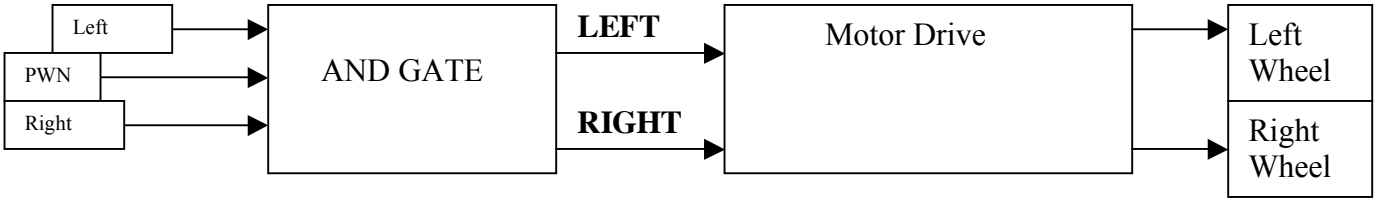
- **Visualization of Concept:**



- **Block Diagram:**







➢ **Circuits:**

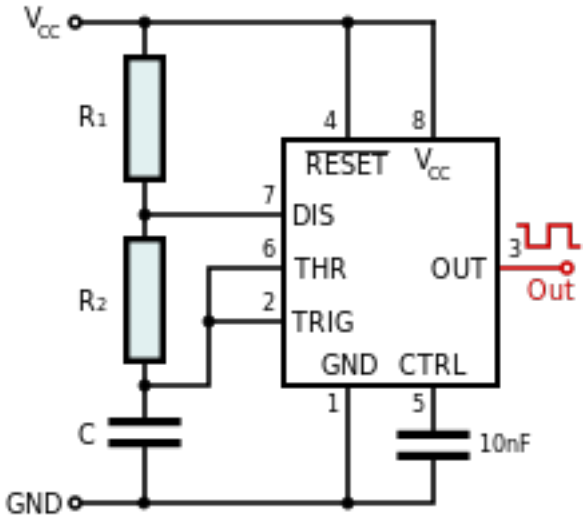


Diagram 1
$f = 1/(\ln((2)*C*(R_1+2R_2))$

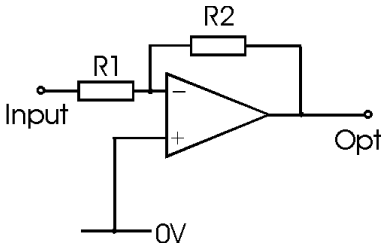


Diagram 2
Gain = - R2/R1

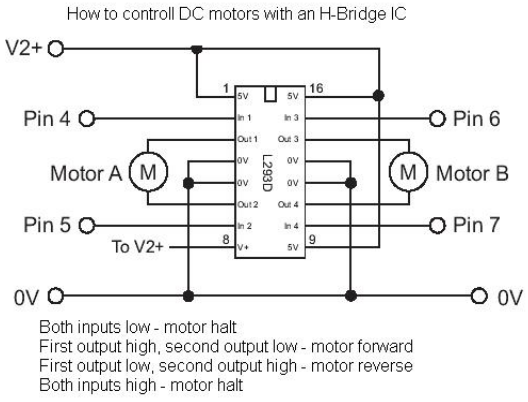
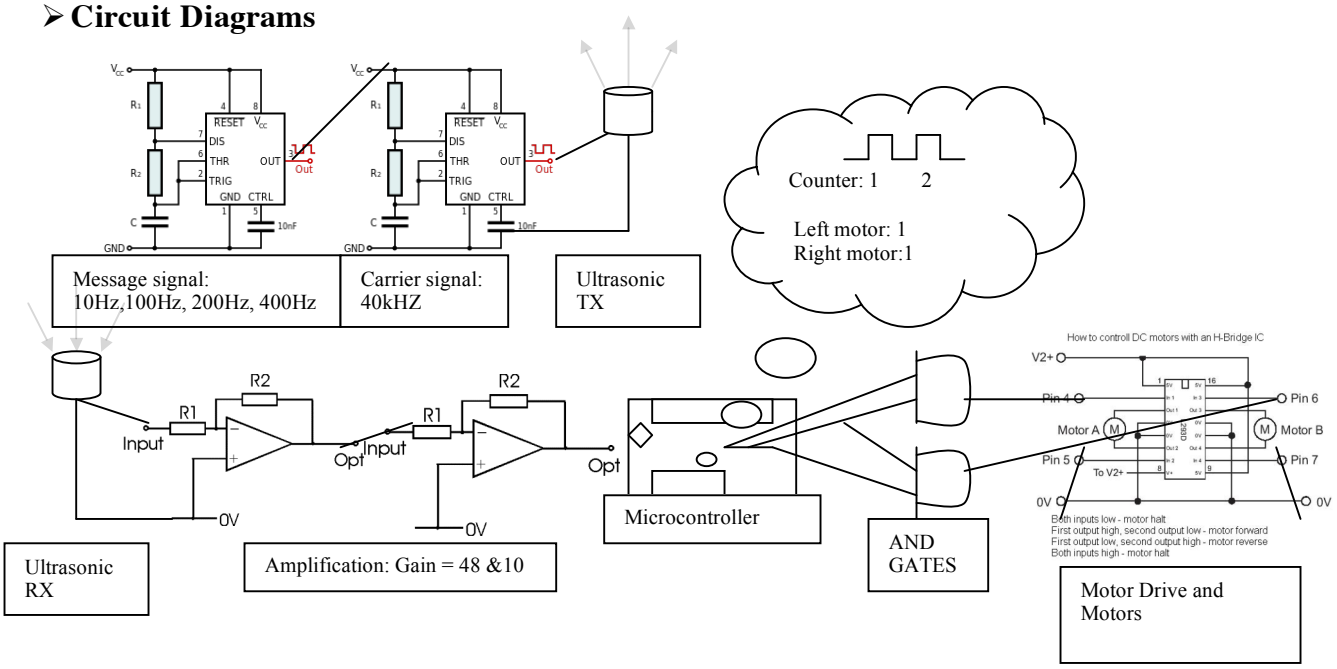


Diagram 3

➢ Circuit Diagrams



➢ Parts Implemented:

- Generation of square waves using 555 timers.
- Binary ASK modulation. For ASK we are using a switching mechanism: The process is stated below:
    - Use a 555 timer, in astable mode (Diagram 1) with a very low frequency (message signal)(10Hz, 100Hz, 200Hz, 400Hz) is used as the VCC for another 555 timer at f = 40kHz (carrier signal).
    - This gives an ASK modulated wave: when high (1), carrier is transmitted, and when low (0), no wave is transmitted.
    - Then this ASK wave is transmitted via Ultrasonic Transmitter.
- Ultrasonic Transmission and Reception.
- After reception, a amplifier with gain = 48 (Diagram 2). Followed by an amplifier of gain 10, so the wave can be given as input to the processing unit (microcontroller) to be demodulated.
- Frequency detection is part of the demodulation done in the microcontroller through a code. This step tells the robot its current position in the library, based on the frequency of the message wave sent from the transmitter on the walls. Frequency detection was done using a counter, where the number of high's or low's were counted for a particular time period. And based on that, the frequency of the message signal was detected, and from the frequency of the message signal, the robot knew its place in the library (from the inbuilt map), and the motor controls were sent accordingly based on location, i.e. whether the robot has to turn right, go straight…etc.
- Motor control using microcontroller. This step required writing a code, which will

make the motor run till it receives a signal from one of the ultrasonic transmitters. Stop there, demodulate the signal, find out its current location and move accordingly. We implemented this by giving two signals: high (1) or a low (0) signal from the microcontroller based on the message signal received. This is ANDed with PWM (from microcontroller as well) through two separate AND gates, and then those inputs are sent to the two motors that runs the robot. For example, if the robot detected a frequency of 200Hz, this indicates that the robot must turn right. So the microcontroller would send a signal 1 to be ANDed with PWM and sent to the right motor, where as a 0 will be ANDed with the PWM and sent to the left motor. This was done because we could not send two separate PWMs because the second counter was used for frequency detection.

- The motors are run from a L293D motor drive (Diagram 3).
- A switch was used to let the robot know when to start at the beginning.

➢ **References:**

- ECE lab diagram
- EW1 lab reports
- Google