

Barcode Reader

Project Report

EP 315

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Guidance

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DEPT. OF PHYSICS

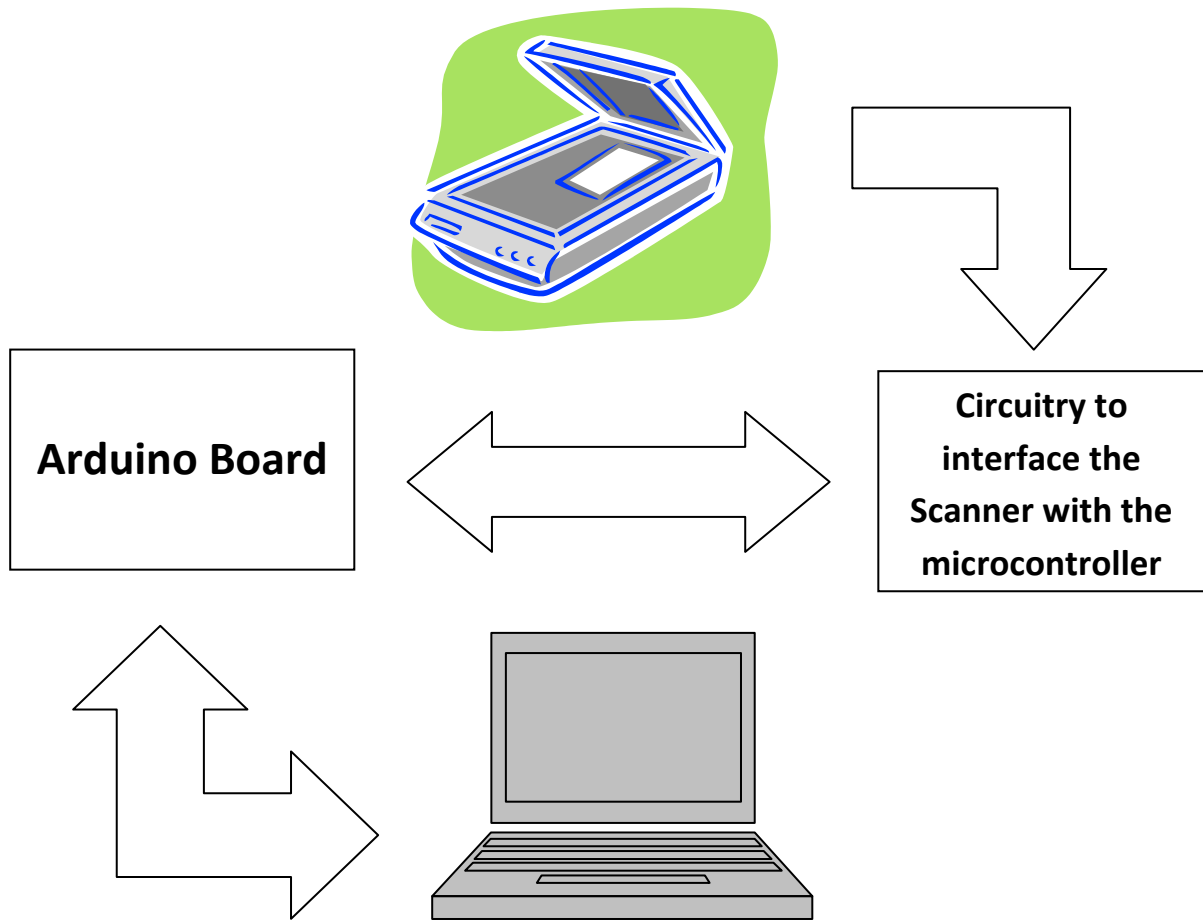
IIT BOMBAY

DECEMBER 2009



Block Diagram

The block diagram of the barcode reader is shown in the figure below.



Hardware:

Hardware consists of mainly 3 parts

1. **Scanner**
2. **Arduino Board**
3. **Computer**

The circuit diagram of the hardware part is shown below

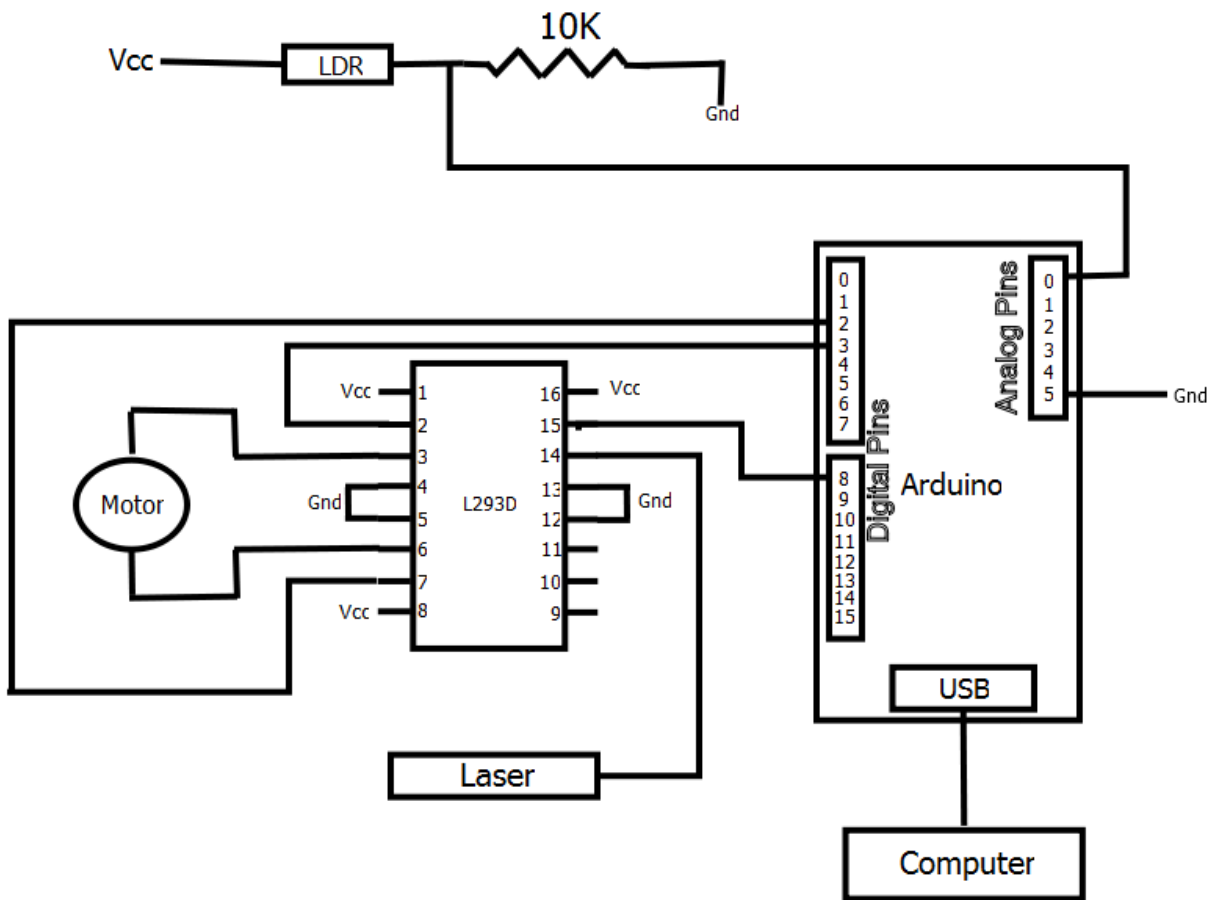


Figure 1: Circuit Diagram

Scanner:

Scanner consists of the following parts

1. **Control Circuitry:** This consists of L293D IC, and two resistors. Two channels of L293D are used to drive the clockwise and anticlockwise rotation of the motor. One of the rheostat is used to control the brightness of the laser. The other rheostat is connected in series with the LDR (Light Dependent Resistance), which is used to sense the intensity of the reflected laser light. When the intensity of the reflected laser light is high, resistance of LDR is low and hence the voltage drop across the rheostat is high and when the reflected intensity is low, resistance of LDR is high and hence the voltage drop across the rheostat is low.

When Pin 2 of L293D is given 0V and Pin 7 is given 5V using Arduino, clockwise rotation of the motor sets in, and reversing the voltage applied to the pins, motor's direction of rotation can be reversed. By applying 0V or 5V to the Pin 15 of L293D, the laser can be either switched off or switched on.

2. **Semiconductor Laser:** This is used to shine the laser beam on the barcode. The white region of the barcode reflects the light more compared to the black regions

3. **Motor** : This is used to sweep the Barcode Card across the laser

Microcontroller:

This serves the key role in controlling the hardware and sends the data received from the scanner, at the same time carries out the functions based on the instructions received from the computer by establishing a serial communication.

Computer:

This is the heart of our project. All the required codings are done in MATLAB which uses computer serial port to communicate with Arduino. Computer stores the information of the user accounts and their barcode. If the barcode on the card matches with that of the barcode stored in computer memory, then computer opens the corresponding user account in GUI where one can edit the user profile and other information. If the barcodes do not match, then an error message is displayed. If one wants to create a new account, a new barcode is inserted into the scanner and the 'Create New Account' button is clicked on the MATLAB GUI. This reads the barcode and stores in its memory along with the other details.

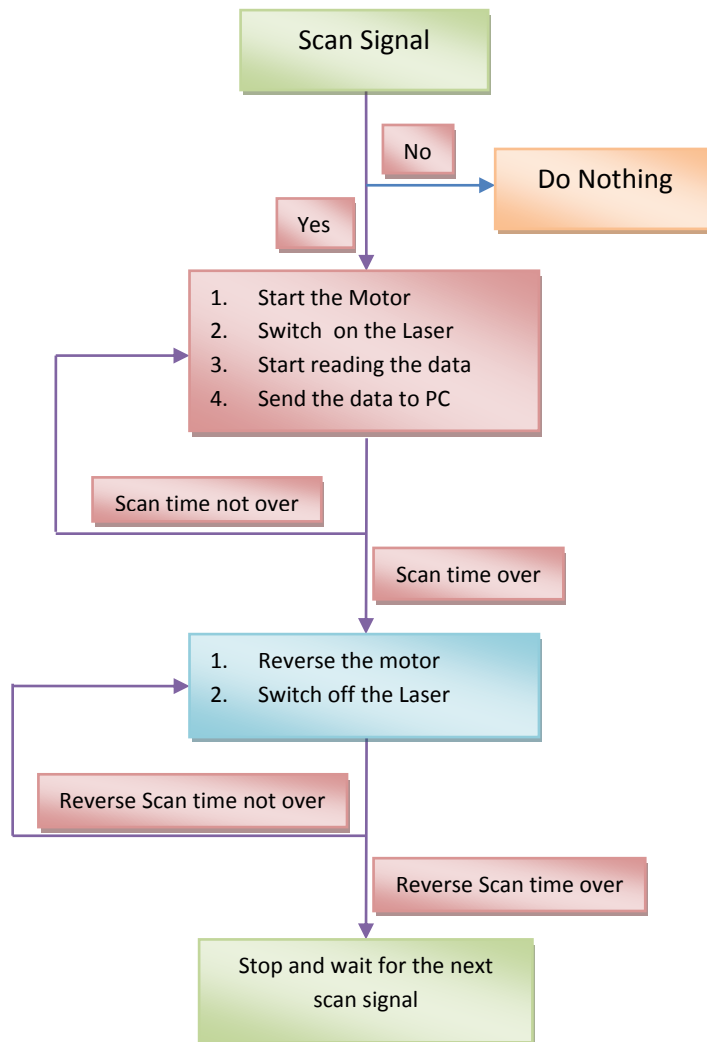
Software

Arduino Program:

Arduino program is used to control the motor, laser and receiving and transmitting the signal to the computer. The barcode consists of dark and white vertical strips. All the strips have the width which is the integral multiple of the predefined minimum width (unit width). Now, the reflected laser light from these strips on the barcode are made to fall on the LDR and the voltage drop across the resistance is measured through analog Pin 0 of the Arduino board (uses 10 Bit ADC, so 1023 corresponds to $V_{cc} = 5V$). The motion of the card across the laser tip is divided into N number (in our program, $N=1000$) of time intervals. We define the voltage margin V_{mar} for the analog pin 0 such that, voltage above V_{mar} corresponds to logic 1 and voltage less than V_{mar} corresponds to logic 0.

When the command from the computer to start the scan reaches the microcontroller through the serial port, the program switches on the laser, sets the voltages of the terminals of the motor to initiate the scan. The arduino program counts the number of time intervals between the two successive changes in the logic observed from the analog Pin 0. This process is executed for every strip on the barcode. The no of time intervals corresponding to every strip is sent to the computer running MATLAB code for further processing. When the maximum time limit is reached, this process stops and the program switches off the laser and reverses the voltage to the terminals of the motor so that the card sweeps backwards and finally comes to halt at the original position.

The Arduino program flow is shown in the picture below.



In the above schematic, **Scan time** is the time during which the card sweeps across the laser and the reading the barcode take place

Reverse scan time is the time during which the card moves in the reverse direction and reaches the original position.

MATLAB Program:

This is the place where the most important tasks of the barcode reader take place. This program includes the necessary codes required for the GUI (partly made using MATLAB GUIDE Toolbox), codes for the identification of the barcode, codes for controlling the microcontroller and sending and receiving the data through the serial port of the computer.

A scan can be initiated by clicking on the 'Scan' button in MATLAB GUI. By clicking on these, MATLAB sends a cue to the microcontroller board to start the scan. And once the scan is started, it starts receiving the data from the MuC.

MATLAB receives the width of each strip in terms of the number of intervals (n_1, n_2, n_3, \dots etc) as explained earlier. Now, these numbers have errors due to the imprecision in the measurement. So we define an error bound Δn (got by trial and error). So, if the number lies between the actual $n \pm \Delta n$, then it is considered as that number. This process is done for every strip on the barcode. Now if this matches with the barcode which is already stored in the computer memory, then the user account corresponding to that barcode is opened. Otherwise, an error message is displayed. In case, we want to create a new account, we just insert a new card and scan it. The program has an option to create a new account by clicking on the 'New Account' button. By doing this, the program stores the barcode in its memory.

We have also implemented a MATLAB code to generate the barcodes. The barcodes are generated with their patterns randomized, but each strip is an integral multiple of the predefined minimum width. One of such randomly generated Barcode is shown below

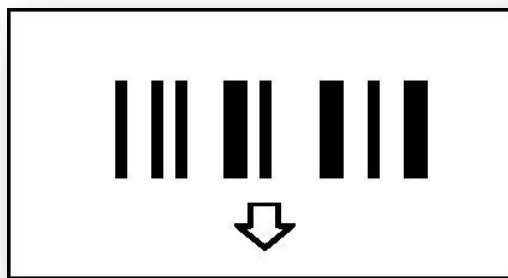


Figure 2: Barcode

The code of the above barcode is {1,2,1,1,1,3,2,1,1,4,2,2,1,2,2}

Task Division:

Arjun Hegde: Most of the hardware part, i.e. building the laser scanner and its circuitry and part of microcontroller coding and MATLAB coding.

Safeer C: Part of the Microcontroller coding and also most of the coding in MATLAB (Creating GUI and processing).

Nikhil Jain: Making the barcodes and part of the hardware.