NE223 Project Submission

Team members: Shriganesh and Vaibhav

Assumptions:

We assume that the plank is 1m x 1m in dimensions and the marble with diameter 1cm is black and nonreflective in nature.

Sensor used for detecting the ball:

We are using a Laser detecting sensor using an LDR. The circuit schematic is shown in the figure below:

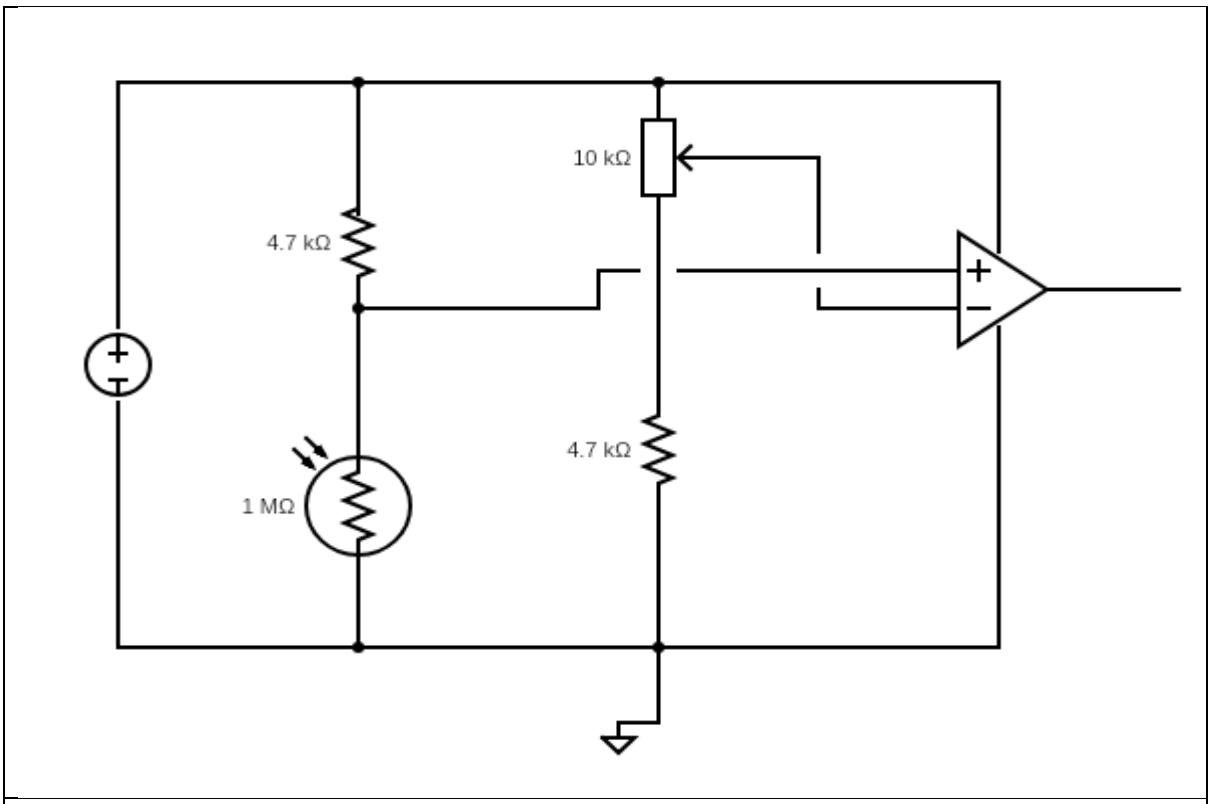


Fig 1: Circuit for light detection using LDR

LDR, 4.7k resistors and a 10kohm potentiometer are connected in a wheatstone bridge configuration and the voltage is compared using an opamp (LM741 ic).

The choice of resistance has been made keeping in mind the current drawn which is 0.34mA. If we keep low resistances, the sensitivity of the sensor decreases and the current drawn increases which is not favourable. If the resistances are too large in the middle branch, the circuit becomes vulnerable to noise where even a small change in resistance might influence the set point.

Once the circuit has been implemented, one has to manually set the threshold for the potentiometer knob based on the intensity of light falling on the sensor.

We use a 650nm 5mW Laser available for purchase in amazon.

We use a total of 63 of such sensors to form a grid of Lasers(62) in order to locate the ball and to detect the catching of the ball(1). Refer fig 2 for illustration.

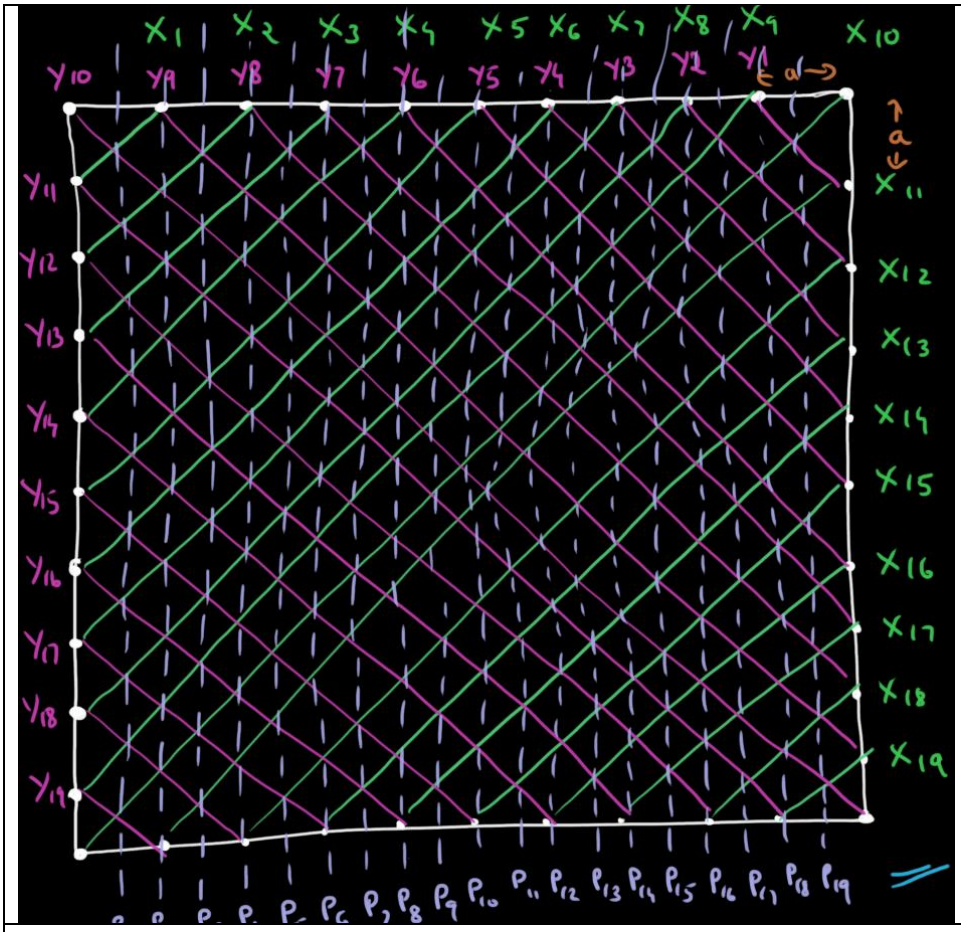


Fig 2: Illustration of sensor grid (note here we have not shown 63 sensors but only 38 for the sake of illustration)

Circuit block diagram:

Fig 3 shows the circuit block diagram for our system. We are using two Arduino unos in our system. Arduino 1 is interfaced to the sensors using 8 units of parallel-in serial-out shift registers of size 8 bits each (CD4021 IC) connected in cascade. So it takes the 64 bit data serially from the sensors, calculates the current position of the ball using an algorithm(developed by us), and generates an interrupt signal to Arduino 2 in order to send a target position for the motor to move. This target position is sent via serial communication.

The reason for using a separate Arduino for controlling the motor is to make sure that the motor keeps moving even when we compute

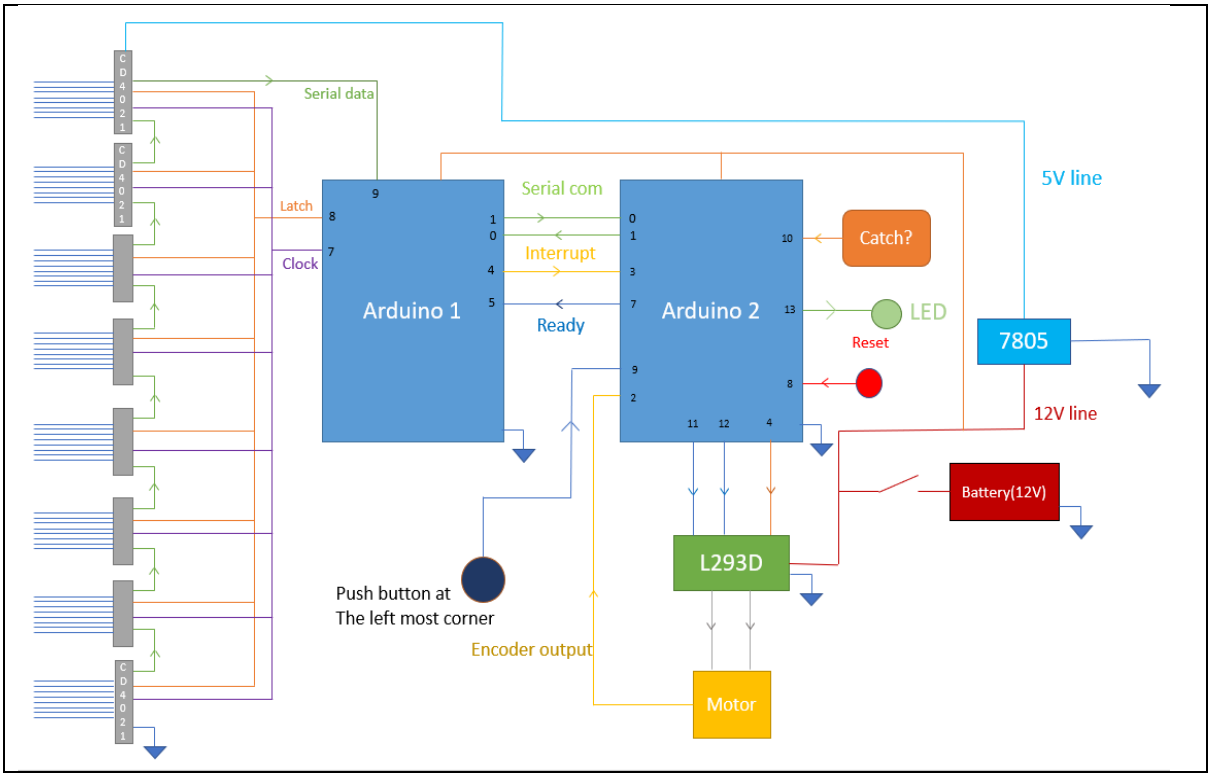


Fig 3: Circuit block diagram

The next position of the ball. The motion of the motor is interrupted only when new target position is available. This increases the chance of motor not missing to catch the ball. We could have done all this using one microcontroller if it had internal counters to generate interrupts which is not present in Arduino system.

Arduino 2 is interfaced with the motor via a motor driver (L293D module), a reset push button, a sensor which detects if the ball has been caught or not(laser detector),encoder data line from the motor and a pushbutton set up at the left most corner to calibrate the system initially or on reset.

7805 voltage regulator is used to supply 5v to all the sensors and CD4021 ICs

12V Lipo battery (3 cells, 2200 mAh) is used for main supply.

FSM:

Fig 4 and 5 shows the FSM for Arduino 1 and Arduino 2 .

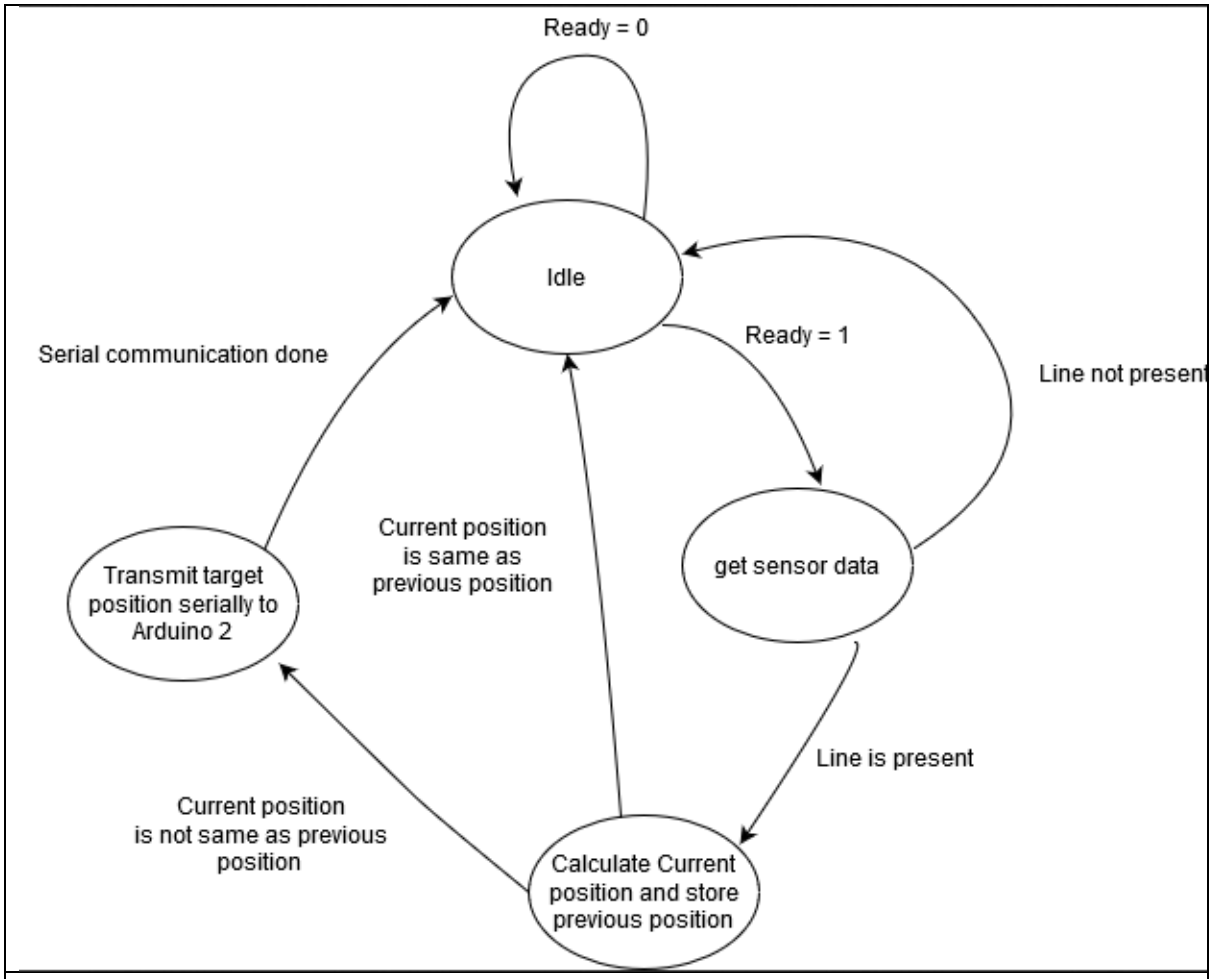


Fig 4: FSM for Arduino 1

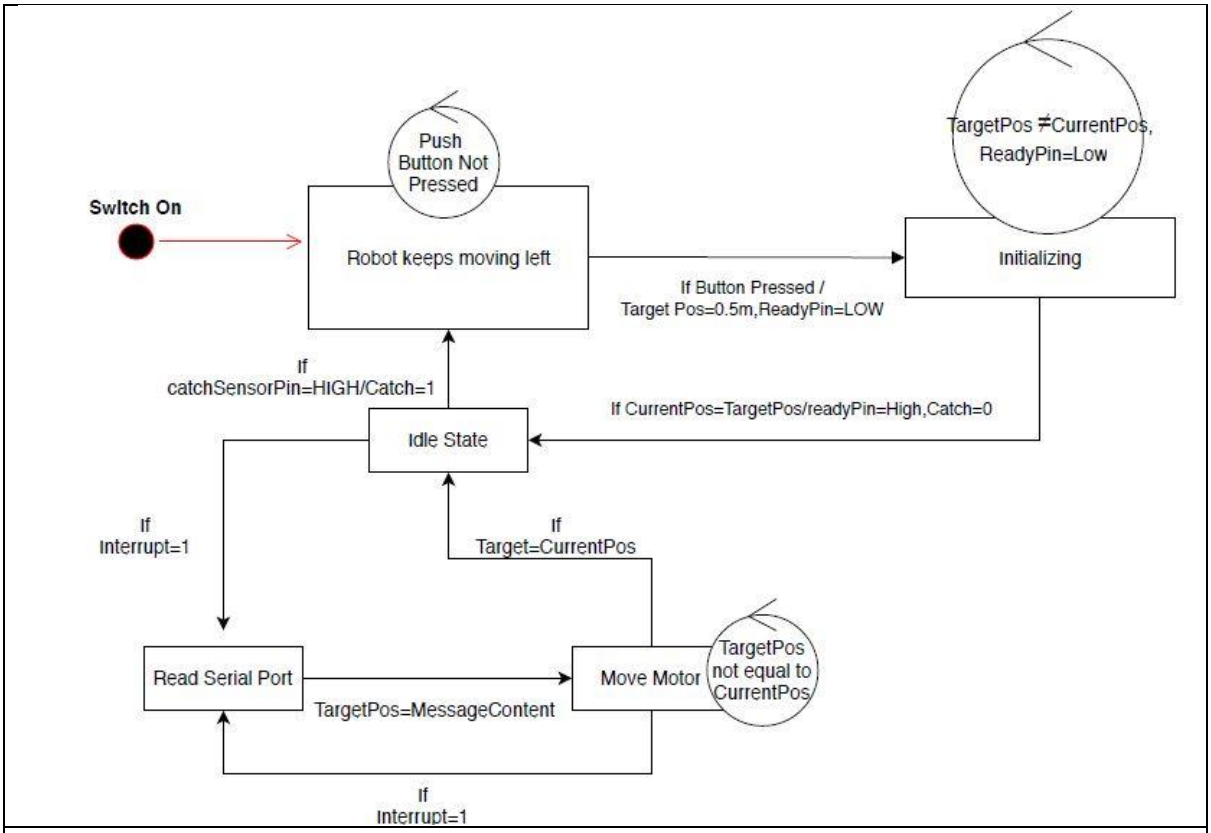
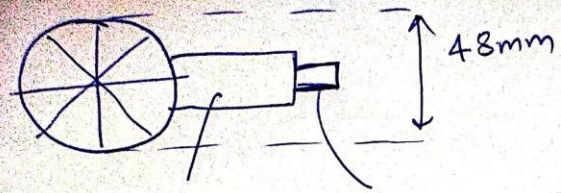


Fig 5: FSM for Arduino 2

Calculations for Encoder is shown in fig 6:

The code will be submitted along with this document and the algorithm will be explained in detail during the teams meeting.



1 motor rotation → 3 ticks of encoder

1 wheel rotation → 200 rotation of motor

1 wheel rotation → 600 ticks of encoder

1 wheel rotation = πD

$= \pi \times 48mm$

$= 150,79$

$\approx 151\ mm$

(No slipping) 151 mm distance → 600 ticks of encoder

1 mm distance travelled = $\frac{600}{151} \approx 4$ ticks of encoder

Fig 6: Calculations for encoder.

S.No	item	qty	cost	total
1	Arduino Uno	2	399	798
2	Motor with encoder	1	527	527
3	L293D module	1	125	125
4	Lipo Battery (3S 2200mAh)	1	1549	1549
5	650nm Laser	63	480 for 10	3024
6	LDR	63	10	630
7	4.7k resistors	200	1 for 4	50
8	10k pot	63	13	819
9	LM741 op amp ic	63	14	882
10	push buttons	2	5	10
				8414

Fig 7: Bill of materials