DESIGN DETAILS DOCUMENT

College Name: **G.H. PATEL COLLEGE OF ENGINEERING AND TECHNOLOGY**

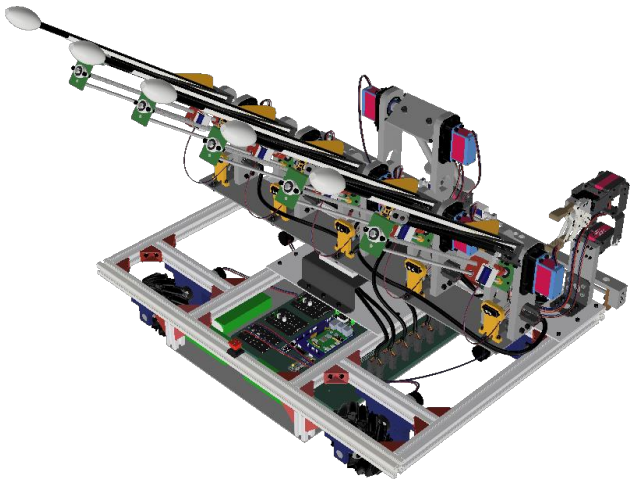


Figure 1

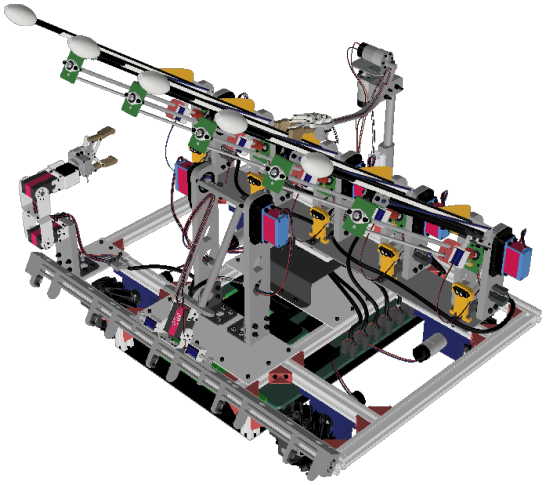


Figure 2

I. Throwing Mechanism

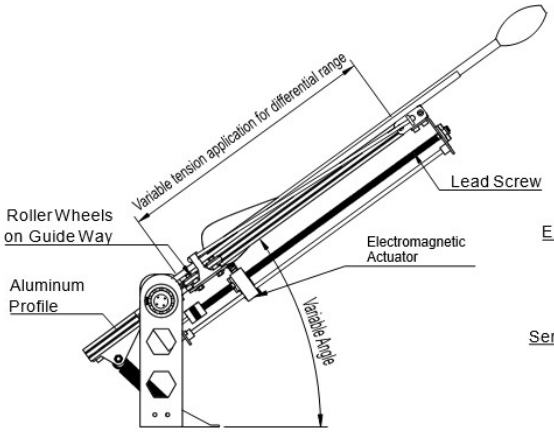


Figure 3

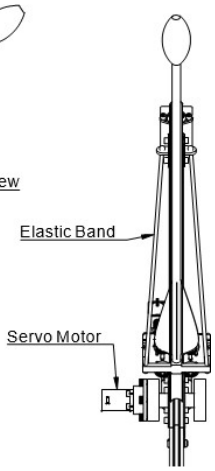


Figure 4

Figure 5

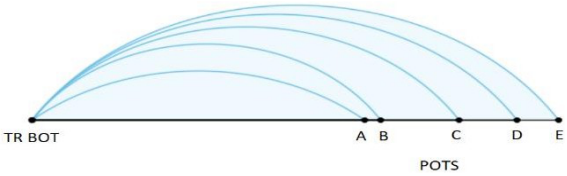
The TR bot can throw five arrows at a time. The components used in this mechanism are stepper motor, servo motor, solenoid actuator, aluminium profile with guideway, lead screw, spring and elastic band. The arrows received from the rack or ground will be placed on the throwing mechanism. Robot is supposed to throw arrows to different distances i.e., different pots. In the throwing mechanism the arrow holder is placed on a gantry tray and this tray is locked by solenoid actuator. And solenoid actuator can be pulled towards motor using stepper motor and lead screw mechanism. Pulling solenoid towards motor will stretch the elastic band and prepare it for shoot. Depending on the distance to be covered by the arrow, the band will be forced-loaded by pulling the gantry tray by required distance and the angle is set by servo

motor used to set the angle of projectile for arrow, hence, increasing the accuracy. As soon as the actuator piston release the gantry plate, the elastic band will release force to attain initial position and the arrow will be launched to the desired pot in projectile manner.
A LIDAR is used in case the game is to be played in semi-autonomous mode. Lidar will calculate the distance to which arrow is to be thrown with use of laser sensor. According to the distance, it will set the angle and force by which the arrow will be launched for projectile for arrow.

Calculations:

Given Data:- Weight of arrow(m) = 107 gm;
Distance of pots from shooting position:-

A	6216 mm
B	6514 mm
C	7979 mm
D	9062 mm
E	9838 mm



Maximum elongation of elastic (x)= 300mm
Equation used: $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$ …(1) Energy Conversion equation;

where, 'k' is string constant.

$d = \frac{v^2 \sin 2\emptyset}{g} \rightarrow v^2 = \frac{d*g}{sin2\emptyset}$ … (2) Trajectory equation for arrow;

Putting eq. (2) in eq. (1), we obtained

$$k = \frac{m}{x^2} * \frac{d*g}{sin2\emptyset}$$

For optimum solution $\emptyset = 45°$
$g = 9.8\ m/s^2$
x = 300 mm
m = 107 gm

Thus, after substituting the values final equation is: $k = 11.65 \cdot d$ Kg/s^2
Maximum distance to be covered $(d) \cong 9838$ mm $\cong 9.84m$

$\rightarrow \quad k = 114.636 \cong 115\ ^N/_m$

II. Table Pushing Mechanism and Arrow Interception Mechanism

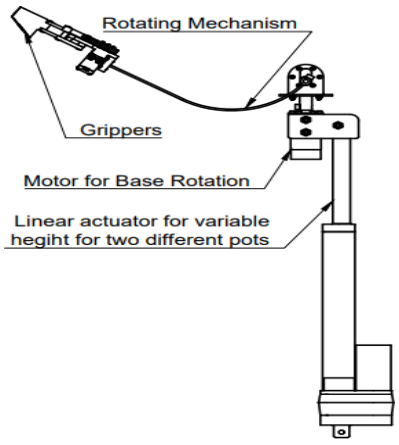


Figure 6

On the back side of the DR robot, a linear actuator is mounted vertically. At the end of the actuator's piston, a waving mechanism is placed with two motors and gripper to intercept opponent's arrows and to push the pot table. To cover all the planes two motors are used, which are responsible for rotation of mechanism along imaginary vertical and horizontal axis. The gripper mechanism will pick up an arrow loaded in the throwing mechanism and will use it as a rod to intercept opponent's arrows. The same mechanism is used to push the table so that it rotates the pot, preventing opponent's arrow to fall into the pot. Linear actuator is used to vary the height of the mechanism so that it can reach the table of different heights (type II and III pots) with accuracy.

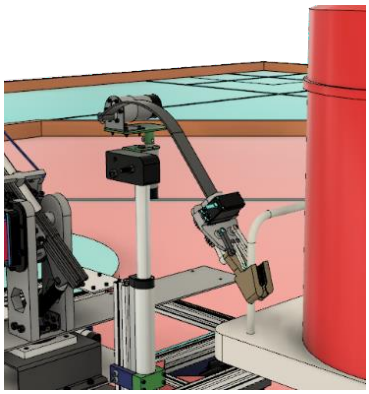


Figure 7

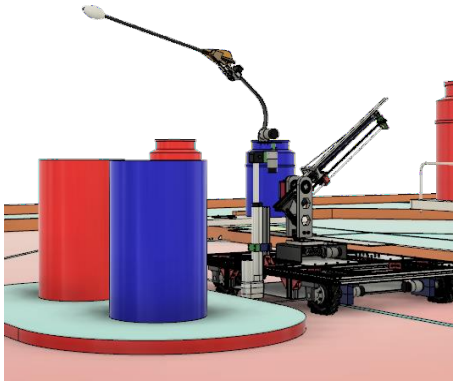


Figure 8

This mechanism is capable of diverting opponent's arrow from going into the pot by blocking its projectile. Also, it is going to perform the task of rotating the pot table to defend opponent's arrow from entering the pot.

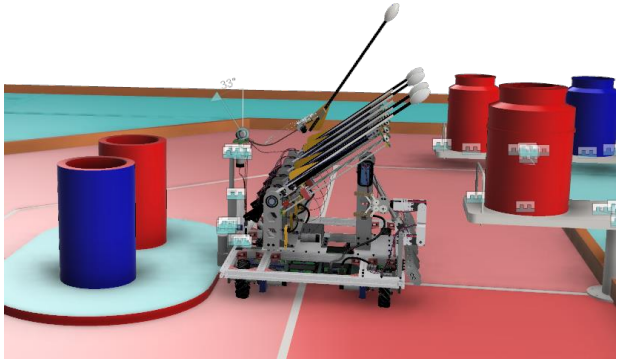


Figure 9

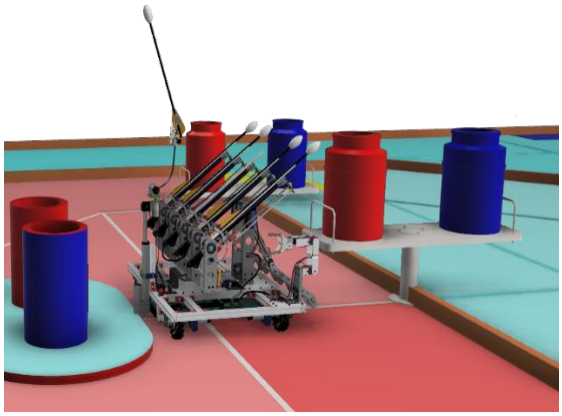


Figure 10

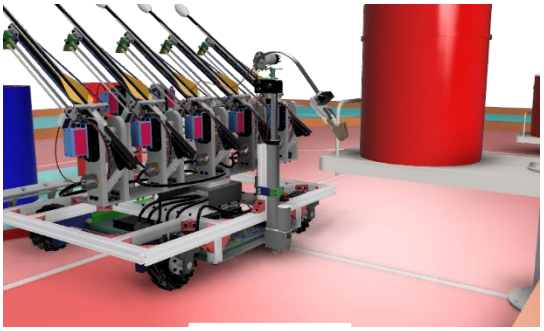


Figure 11

III. Arrow pick and pass

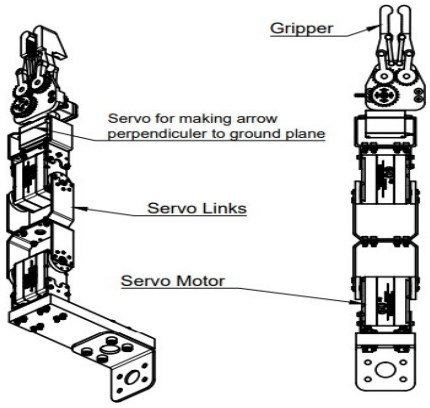


Figure 12

This mechanism carries out the task of picking up the dropped arrows. It will pick up the fallen arrows, align them perpendicular with respect to the ground surface and will load it in the throwing mechanism with the help of multi-gripper mechanism used to receive arrow from arrow rack. The mechanism will work as human arm and will align the arrow to the gripper mechanism and gripper mechanism will take arrow from the arm and load it to the throwing mechanism without any error.

Arrow which are dropped on ground can be handled in three ways as follows:
1. Arm of DR robot to Arm of TR robot.
2. Throwing the arrow in the outer area.
3. DR robot will drive to outer area and throw the arrow by itself into the pot

Figure 13

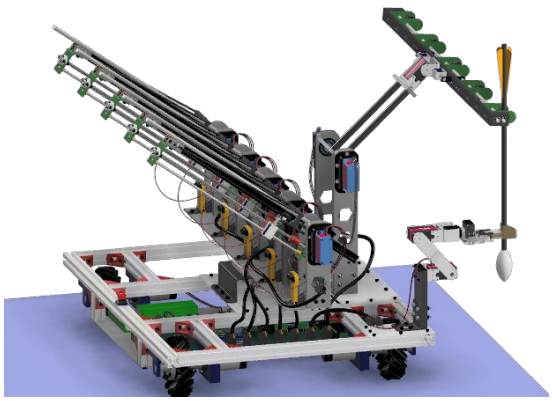


Figure 14

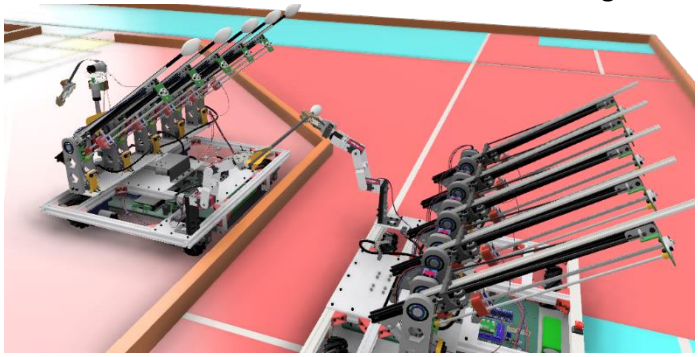


Figure 15

IV. Arrow receiving

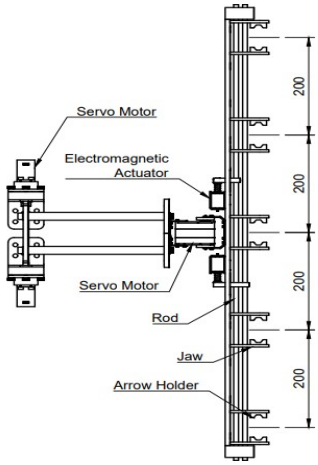


Figure 16

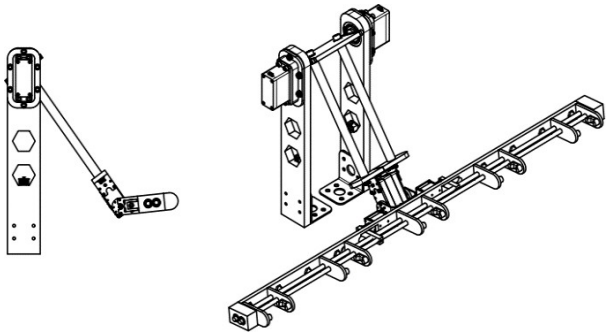


Figure 17

This mechanism consists of two parallel rods, front rod and rear rod, on which grippers are mounted. It works with the help of two solenoid actuators. Right jaws of all grippers are mounted on the front rod and all the left jaws are mounted on the rear rod. The two solenoid actuators will control moment of the parallel rods in such a way that both the rods will always have an opposite linear moment to each other. This will lead to the opening and closing of the grippers. There are five grippers mounted on these rods which makes the TR robot capable of loading five arrows at a time in five respective mechanisms. This whole mechanism is supported with two more links which are controlled by servo motors, which helps the mechanism to level the grippers with the arrows in the rack, hence it can easily pick up the arrows from rack.

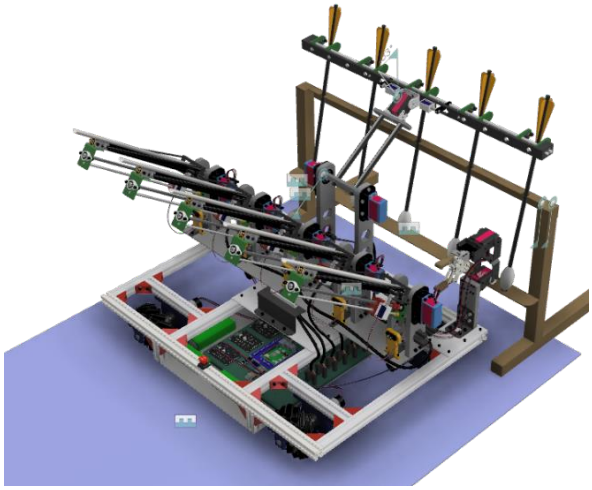


Figure 18

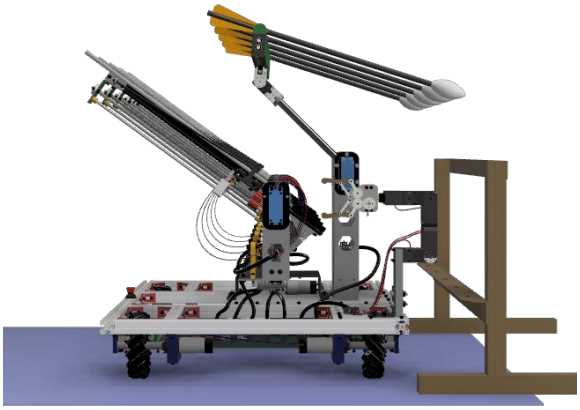


Figure 19

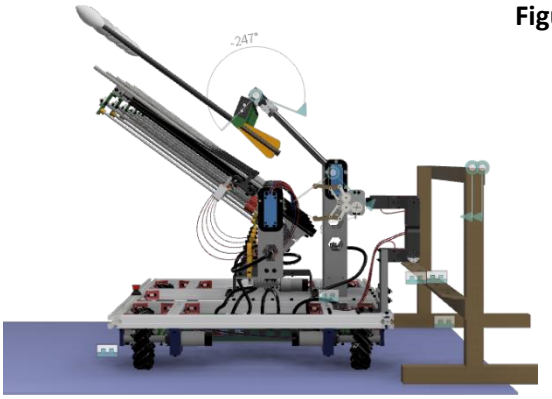


Figure 20