e-Yantra Robotics Competition - 2017

Theme Analysis and Initial Implementation Strategy

Spotter Snake

TEAM ID - eYRC#440

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Preparing the Arena

Q1. Prepare the Arena for Spotter Snake and insert the image of arena here. (5)

Rules and Scoring

Q2. Spotter Snake theme consists of the following formula for scoring as in Section 7 of Rulebook:

Total Score = (600 - T) + (CR*300) + (RD*100) - (FD*50) - (P*30) - (RP*100) + B + CB

What will be your strategy to earn maximum points in a run? (5)

Various Terms of the Scoring Formula

- T = Total time in seconds taken for the run
- CR = Successful crossing of ramp
- RD = Correct detection of rodent
- FD = False detection of rodent
- P = Penalty for crashing into the rodent head or obstacles or when more than one bracket goes out of arena
- RP = Reposition penalty
- B = Bonus points of 100 awarded if the robot displays a perfect run
- CB = Bonus points of 400 for creativity

Strategy

Our primary aim would be to devise the best possible route for traversing the arena such that we complete the run in least possible time with maximum number of points. So, for any configuration, we first travel to the nearest ramp which has a rodent, detecting any rodents along the way and cross it as it carries the maximum weightage. Then we would go to the nearest rodent or ramp whichever is closer and then to the next nearest rodent and so on. In doing so, we would be able to complete the task in the least possible time. An example of the best route for the given arena :-

Worst Case Scenarios

- ❏ Maximum time taken to complete run (T=600)
- ❏ Repositioning the snake due to- (RP=3)
  1.Stuck on the ramp and hurdle
  2.Toppling
- ❏ Falling from the ramp (CR=0)
- ❏ Going out of the arena (P=1)
- ❏ Color sensor failure (FD=5, RD=0)

Total Score = (600 - 600) + (0*300) + (0*100) - (5*50) - (1*30) - (3*100) + 0 + CB
= - 580 + CB

Best Case Scenarios

- ❏ Finishing the task in less than half time (T=300)
- ❏ Crossing the ramp and hurdle successfully (CR=1)
- ❏ Successfully detect all rodents (RD=5, FD=0)
- ❏ No repositioning and no penalty (RP=P=0)
- ❏ Perfect Run (B=100)

Total Score = (600 - 300) + (1*300) + (5*100) - (0*50) - (0*30) - (0*100) + 100 + CB
= 1200 + CB

Spotter Snake Design

Q4. Designing and Constructing Spotter Snake in itself is a huge challenge. One of it is to distribute the weights (battery and circuitry) equally for stabilizing the snake robot. How would you distribute these weights in your snake robot? What were the various challenges you faced while designing the physical structure of the snake robot in Fusion 360. (5 + 5)

Weight Distribution

The main components of the circuits like servo motor arduino, receiver arduino, receiver NRF module and the colour sensor are kept in the head. The battery which is quite heavy is kept at the back as pulling is easier than pushing. The battery is kept horizontal in order to lower the center of gravity which helps in reducing the chances of toppling. An appropriate track width for the wheels is chosen such that the snake remains stable during turning.

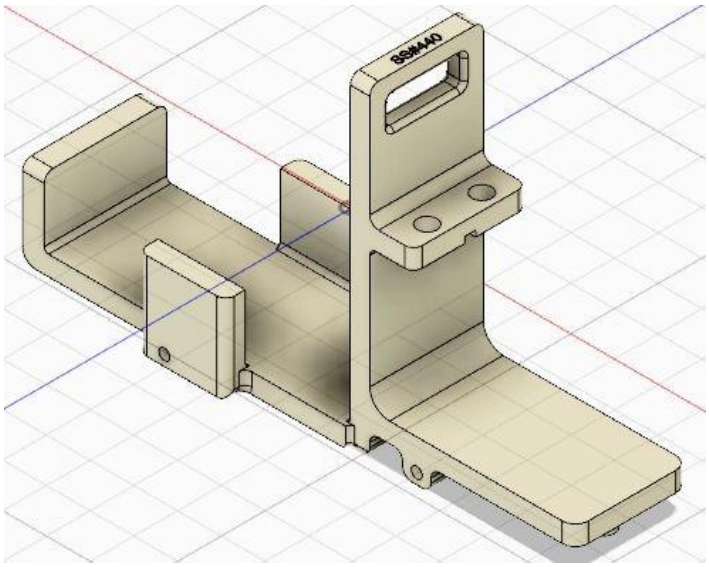
Challenges in the Design

- ❏ Accommodating servo wires.
- ❏ Wheel positioning
- ❏ Extrusion of control head holes on the bracket.
- ❏ The measurement tool does not give the shortest distance always.
- ❏ Assembly of servo and brackets was a difficult task.

Parts of Snake Robot

- ❏ Tail bracket
- ❏ Servo bracket
- ❏ Head bracket

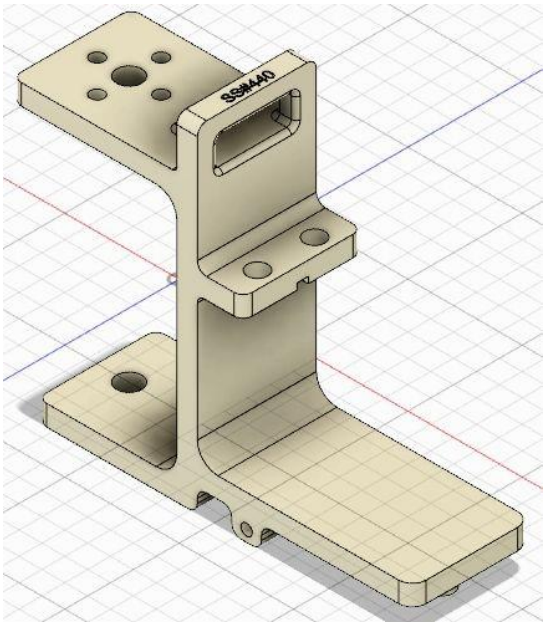
Tail Bracket



The tail bracket is designed such that the battery fits firmly without wobbling. Although the tail bracket is longer than the other brackets, its wheel base is maintained at the same value as on the other brackets so that ground clearance will not be an issue.

PROS	**CONS**
● Battery C.G low	● Pulling the body sideways due to inertia of the battery.
● Placement of the wheels for crossing the ramp.	

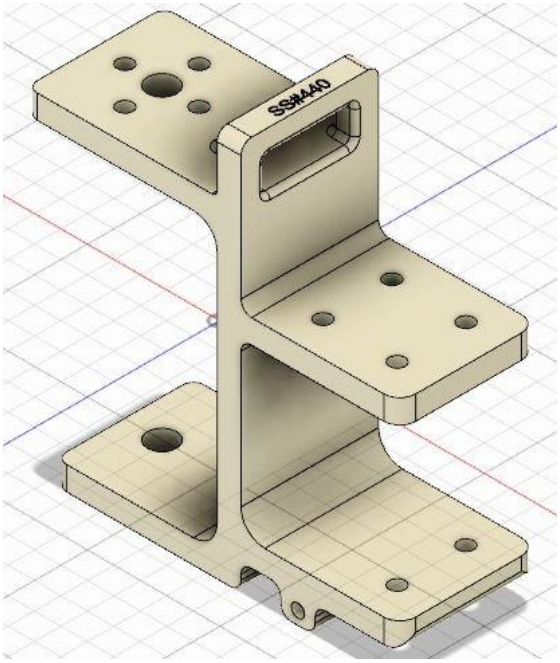
Servo Bracket



The servo brackets are designed such that minimum volume of material is consumed and each member of the bracket has functionality. We have designed the bracket such that there is no interference between any of the moving parts.

PROS	**CONS**
● The wires can be securely held in place without interfering with moving brackets.	● Due to the ground clearance and height of servo, the C.G. is higher above the ground which reduces stability.
● The wheelbase is of appropriate length such that the bracket does not get stuck on top of ramp or hurdles.	
● The ground clearance is sufficient for traversing the ramps and hurdles.	
● No interference between any of the moving parts.	

Head Bracket



The head bracket is designed such that the snake head can easily be attached and removed. The design ensures a rigid mounting of snake head.

Spotter Snake Control

Q5. For controlling snake robot wirelessly, you have to design a joystick. How are you going to design the joystick? Explain the hardware and software used for construction of joystick. (10)

Components of the Wireless Joystick

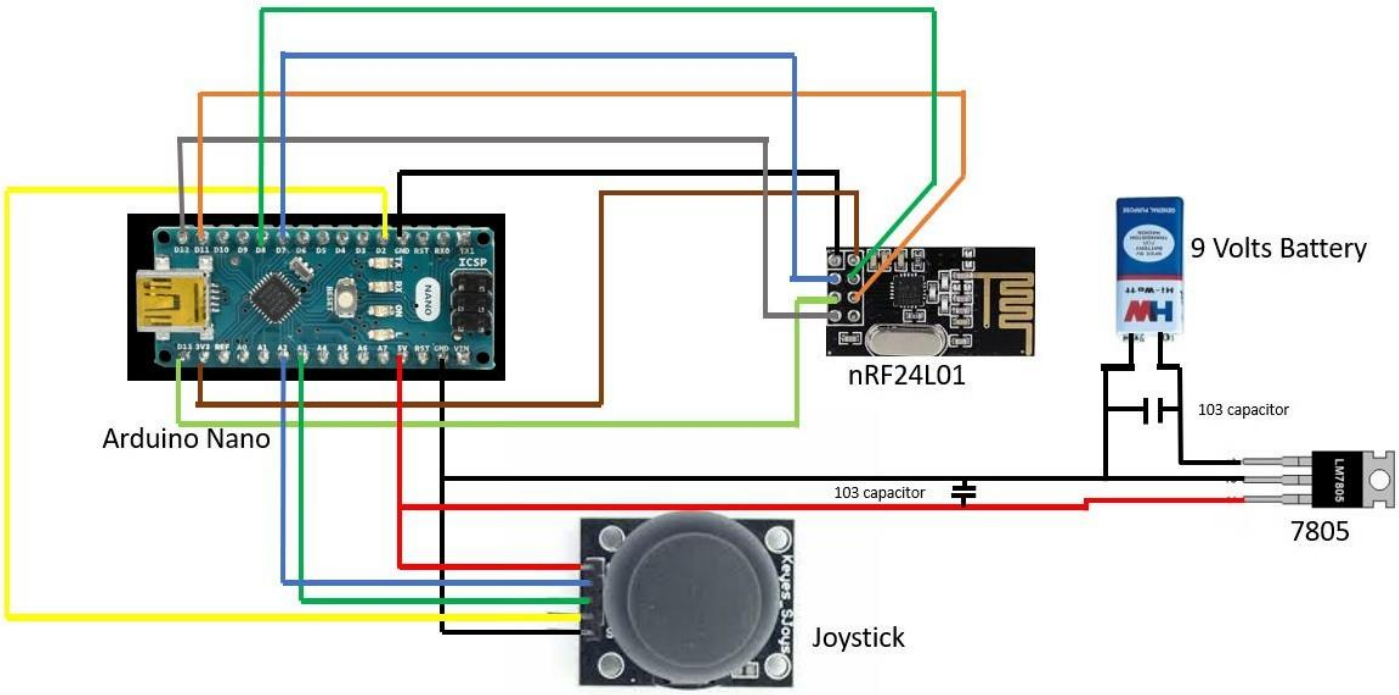
- Joystick module
- Arduino Nano
- NRF24L01 module
- LM7805
- 9 volts battery

Various Inputs of the Joystick

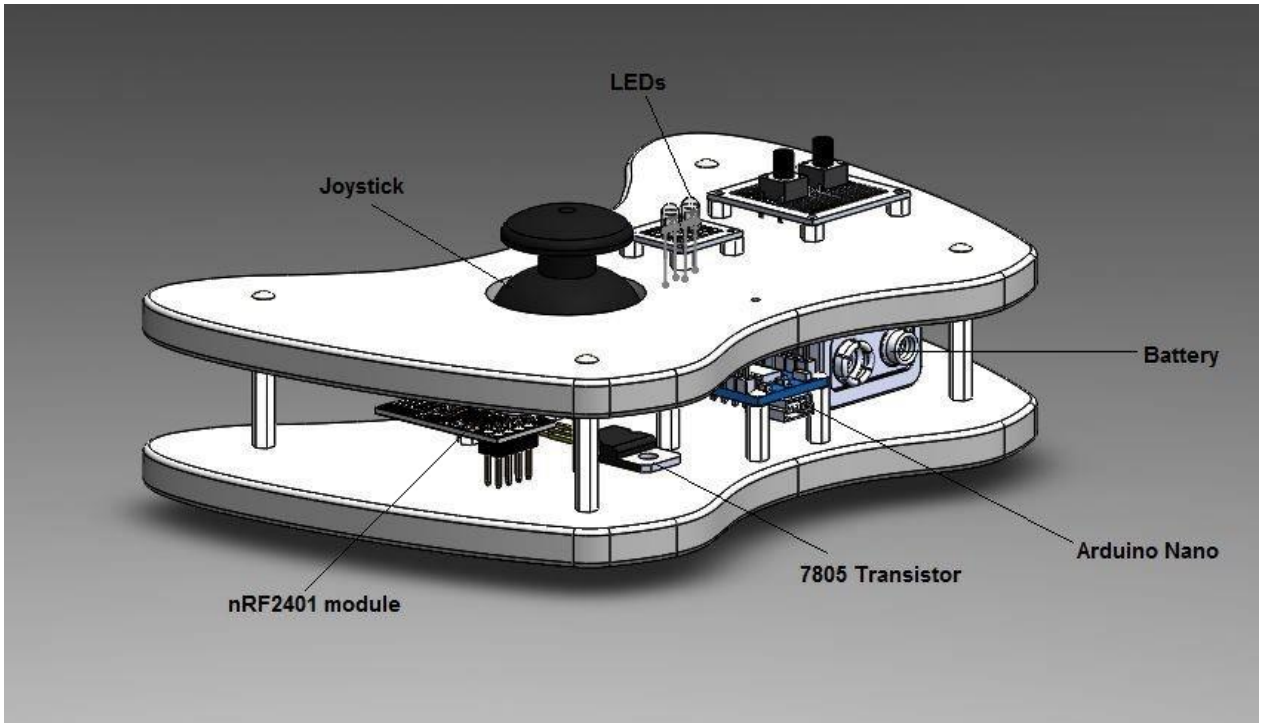
- Forward motion
- Backward motion
- Right turn
- Left turn

Joystick Hardware Design

The components in the joystick include an arduino nano, nRF24L01 module, joystick module and a 9 volt battery. The CE and CS pins of nRF module are connected to D7 and D8 pins of the nano board. The SCK, MOSI and MISO pins of the nRF module are connected to their respective pins on the nano board. The components are powered by a 9 volt battery.



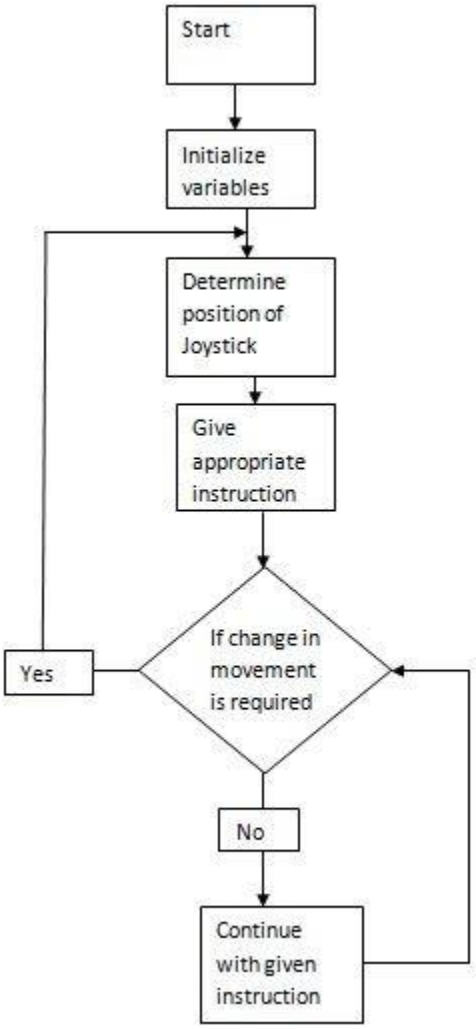
Circuit diagram of the joystick



3D model of the joystick

Joystick Software Design

- **JOYSTICK**



After initializing the variables, the position of the joystick module is obtained. Depending on the position of the joystick, a corresponding set of statements instructing the snake to move in a specific direction are executed. If there is a change in position of joystick, a different set of statements are executed.

- **Push Button for Buzzer**