ROBO V.I.K.A.S

DESIGN DOCUMENT (Stage 1)

SMT RSB ARYA VIDYA MANDIR, JUHU (MA052)

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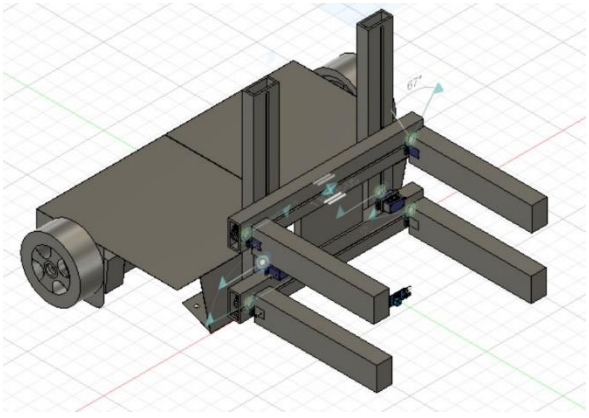
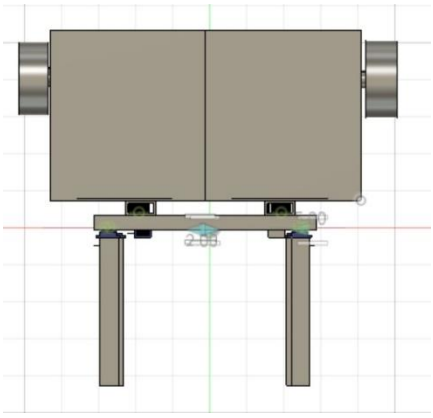
3D MODEL OF ROBO V.I.K.A.S



SIDE VIEW



TOP VIEW

THE ROBOT

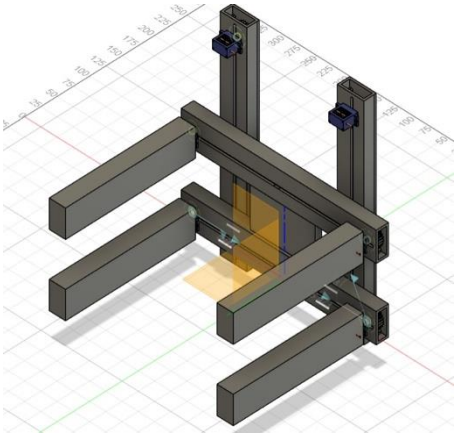
We, team V.I.K.A.S have made a robot that makes use of many mechanisms such as:

METAL CHASSIS

We have selected steel as our material to form the chassis. Steel is such a material that would be capable of withstanding the load of all the electronic parts on top of it and would still hold its position. This chassis also has holes which are perfect for the placement of motors and mounting of other electronic parts with screws, nuts, and bolts etc. This chassis has ample space for fitting all parts comfortably and is easily available along with being quite cheap.

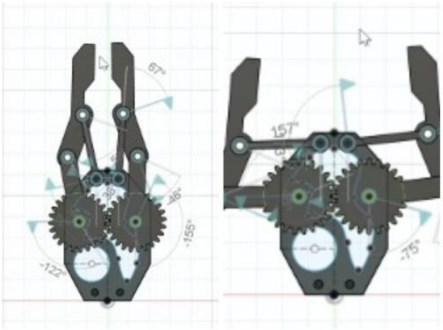
RACK AND PINION MECHANISM

By definition- A rack and pinion mechanism is a linear actuator that converts rotational motion into linear motion. It is made up of a circular gear (the pinion) that meshes with a linear gear (the rack). When the pinion rotates, the rack moves in a straight line. This is the mechanism with what our main gripper would be made of. It would have two vertical racks each with a length of 50 centimetres. It would have two horizontal movable racks (also 50cm) moving on those two vertical racks. These racks would be joined by a metal plate and would have a distance of 10 cm between them. The two horizontal racks would have two movable pinions each on each rack. This would be feasible as it would have the capability to pick up an object of any length in the range of 1-45 centimetres in length. The hands of the pinion would be a bit convex in nature and hence would be able to pick up the gate key and the trees easily. This mechanism would also be the one which would be picking up the walls and placing them in the villa. This rack and pinion would facilitate the movement of the pinion in x and y axis both at any designated position.



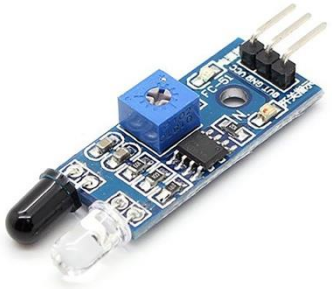
THE FINGER GRIPPER

Finger grippers are a type of robot gripper that have multiple fingers or digits that can conform to the shape of an object being grasped. We have used a finger gripper which would not exceed the length of 10 cm x 10cm in length. This gripper would have the sole purpose of placing the flag. This gripper would be stationed at one end of a horizontal rack and would be immovable in the horizontal direction but would have the full movement in the y-axis; up and down.



IR SENSORS

In our robot we would have three Infrared sensors. One placed at the far left, one placed at the far right, and one placed at the centre. The centre one would be detecting the main path of the straight movement of the bot. The left sensor would detect any black line on the left side and would prioritise the movement of it to the left than straight. The right IR sensor would do the same thing just for the right side. These IR sensors would be only required for line following and would not be required in the villa task.



SERVO MOTOR

We have selected 6 servo motors which all would be required for the movement of the rack and pinion mechanism. A servo motor is a self-contained electrical device that uses a gear train, shaft encoder, and control logic to precisely control the position and movement of parts of a machine. A servo motor helps a rack and pinion system by converting angular position into linear position. The servo motor we have used is of 4.8-6 volts. Its power is approximately 17 oz/in. It would have the function to help in the movement of rack and pinion. It would be controlled by a wireless controller.

BO MOTOR

A BO motor, or battery-operated motor, is a compact, lightweight, DC geared motor that's ideal for battery-powered applications. We are using this motor as it is perfect for the speed and durability of the robot. It is cheap and compact. For this robot we would be using the L shaped BO motor with 100rpm, VDC: 3-12, Shaft 8.5mm. Two of these would be used in the locomotion of the bot.

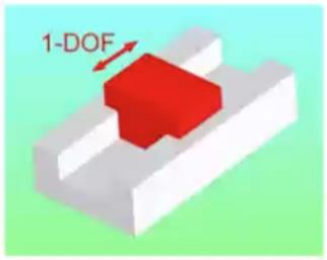
CASTOR WHEELS

Castor wheels are small, swiveling wheels that are typically mounted to the bottom of furniture, equipment, or other objects to make them easily movable. These can rotate 360 degrees, allowing for flexible movement in any direction. They would be mainly needed for the movement of the bot in the left and right direction. It hence also helps in the free movement of the bot.

MECHANICAL WHEELS

Standard wheels, also known as drive wheels, are the most common type of wheel used in robotics and we have used them in our bot. The reason for this is that they are Cost-effective, Energy-efficient, mechanically simple, high-speed potential and easy application.

PRISMATIC JOINTS



A prismatic joint is a type of joint that allows two links to move along a common axis, while preventing rotation. This is used to carry out the action of sliding and movement. In our bot this joint would be used in the movement of the horizontal racks and the movement of the pinions on the horizontal racks.

THE BILL OF MATERIALS

Sr.no.	Description	Specification	Quantity	Price in rupees
1.	12 V battery		3	5400
2.	BO Motors	100 rpm, VDC-3 to 12, Shaft-8.5mm	2	100
3.	Caster Wheels	1.5cm diameter	2	200
4.	Servo Motors	4.8V, 150 grams, plastic, 0.12 s/60deg, 17 oz/in stall torque	7	1330
5.	Arduino UNO	Microcontroller, R3 with cable	1	375
6.	IR Sensors	2 to 30 cm detection distance, 35deg detection angle	3	200
7.	BO Motor Wheels	6.5cm diameter	2	100
8.	Chassis	Metal, 10.5cmx11.5cmx4.7cm	2	300
9.	Motor Driver	1.298N, 2 Amperes, 5V	2	380

10.	Rack And Pinion	6 gears, 2 pneumatic joints, 4 racks This all would be 3D printed	1	5000
TOTAL:				13305

THE MECHANISM

PLANT AND GATE KEYS PUSHING MECHANISM

The bot would first manually move towards one gate key and the rack and pinion would grab the gate key and would align to the black track. From there onwards the bot would move on the black line automatically and the IR Sensors would detect the black line, and the left IR sensor would help in the movement of the bot to the left and the right IR sensor to the right.

The bot would then place the gate key at the designated position. We would then manually press a button on the controller and the bot would rotate 180 degrees. It would again reach to another gate key and then to the two press to align them like the gate key. The rack and pinion system would be of significant use here since it can grab any size and shape of the key or tree and place it freely in any coordinate.

WALLS, ROOF AND FLAG PLACING MECHANISM

After the gate key and the trees are placed at their designated position, the bot would next move to the walls to fully build the villa. The bot would pick up the walls with the rack and pinion mechanism. Due to the rack and pinion mechanism being 50cm in length, it has the capability to pick up objects of all dimensions <50cm.

THE CALCULATIONS

BATTERY SELECTION

2 DC Motors + 6 Servo Motors

TIME: 3 hrs

CURRENT= 2(500)+7(500) = 1000+3500 = 4500

$$\Rightarrow \frac{20}{100} * 4500 = 900$$

$$\Rightarrow 4500 + 900 = 5400$$

$$\Rightarrow 5400 * 2 = 10800$$

VOLTAGE		CURRENT
5	--------	2000
x	--------	10800

Voltage = $\frac{10800*5}{2000}$ = 27 ≈30V

DIMENSIONS: 46 cm × 48 cm × 32 cm

WEIGHT: ≈1kg

DRIVE: 4 WHEEL DRIVE

ACTUATORS INTEGRATED:

- BO MOTOR
- SERVO MOTOR
- CLAW GRIPPER
- RACK & PINION

SENSOR: 4 × IR SENSOR

WALLS, ROOF, PLANT, GATE KEY: RACK & PINION

FLAG: RACK & PINION