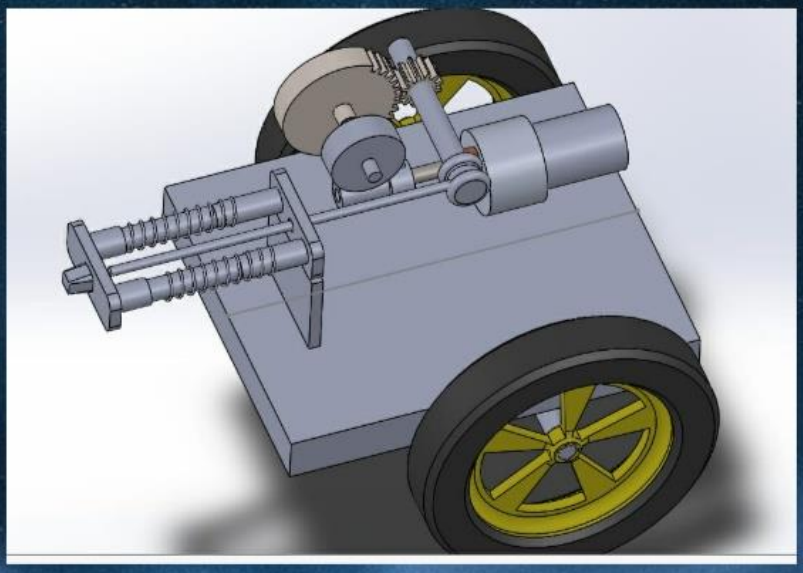
Models and Robotics Section

Srishi 2020

Hop Bot



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ABSTRACT:

Hop bot is used to jump over any obstacle of height of comparable dimension to that of the bot. Motor , springs and Gears are used for its proper functioning along with a pair of Non-motorized wheels.

MOTIVATION:

Military and disaster management teams sometimes come across such situations where they need a robot which can be operated in any terrain, could easily overcome obstacles and is efficient. There we need hop bot which occupies less space, could skip obstacles by jumping mechanism and can work in almost every terrain.

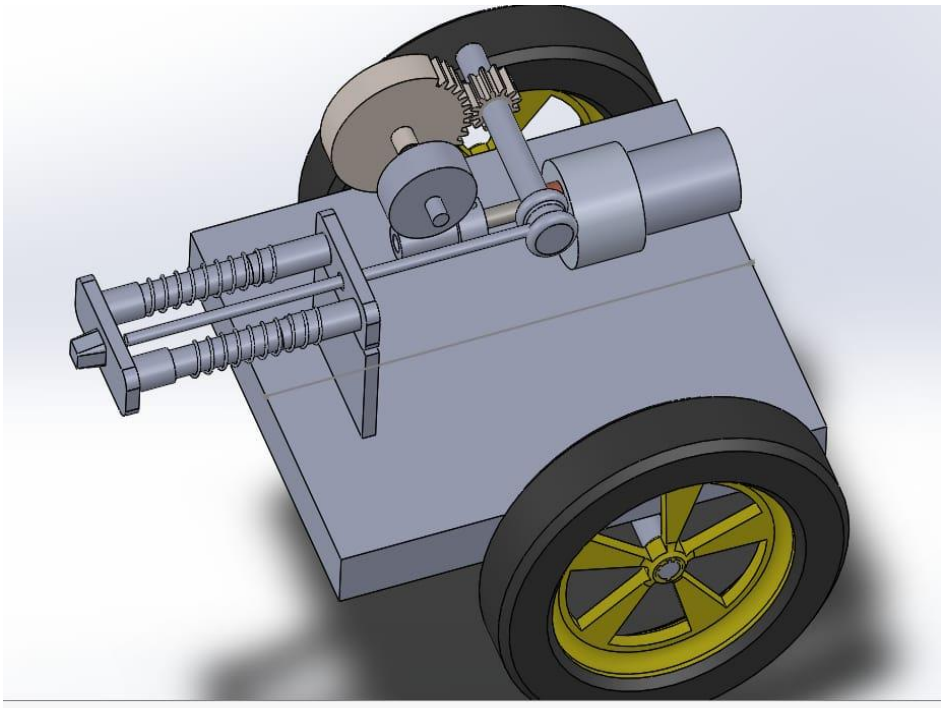
A jumping robot can cross the obstacle several times its own height and has a good ability to avoid risks. It can be applied to the occasion with complex and changeable environment, such as detection of planet surface, post disaster relief, and military reconnaissance. Military and disaster management teams sometimes come across such situations where they need a robot which can be operated in any terrain, could easily overcome obstacles and is efficient. There we need hop bot which occupies less space, could skip obstacles by jumping mechanism and can work in almost every terrain.

While designing we took hint from the hoping of locust and grasshopper.

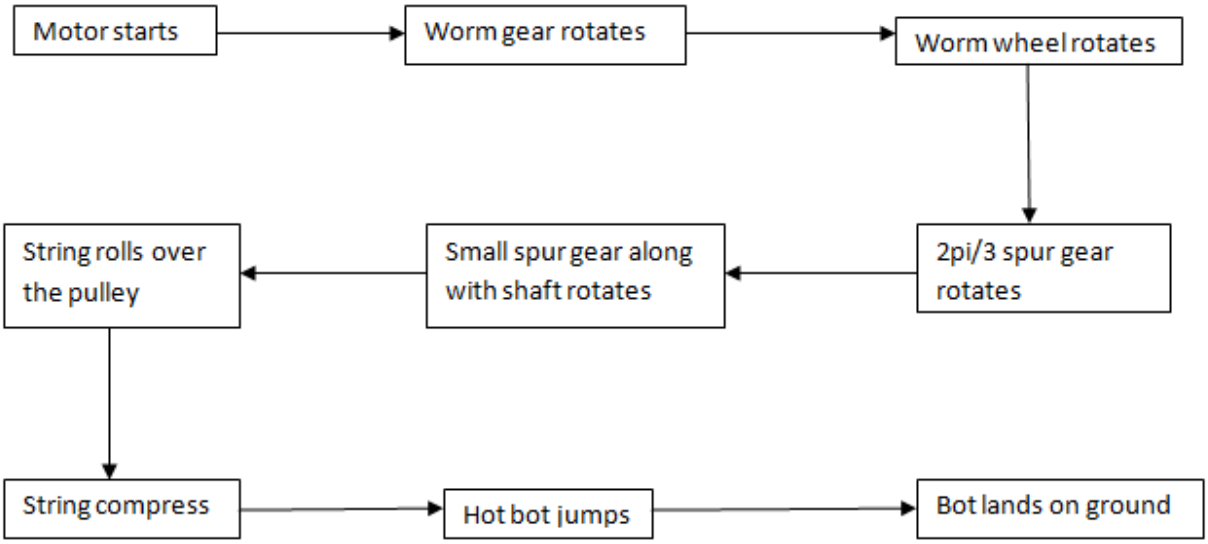
In nature, a locust will first orient its body to the desired direction with its forelegs and then propel its jumps via rapid movement of its hind legs, thereby converting stored energy to the acceleration of its body. The jumping processes of locusts have been extensively investigated. During its jump phase, the center of mass (COM) of the locust's body travels along an almost perfect line, which is parallel to the line drawn from the distal end of the tibia through the proximal end of the femur.

The elevation angle of the locust is determined by the initial position of its hind legs.

We used the springs for replacing the muscle power. The spring has the advantages of strong energy storage, fast energy release, simple structure, and simple control.



WORK FLOW:



MECHANICAL ASPECTS:

DC MOTOR:

Design: DC motors take electrical power through direct current, and convert this energy into mechanical rotation. DC motors use magnetic fields that occur from the electrical currents generated, which powers the movement of a rotor fixed within the output shaft. The output torque and speed depends upon both the electrical input and the design of the motor.

Motto of usage: Speed control and output range. DC motors offer better speed variation and control and produce more torque than AC motors.

WORM DRIVE:

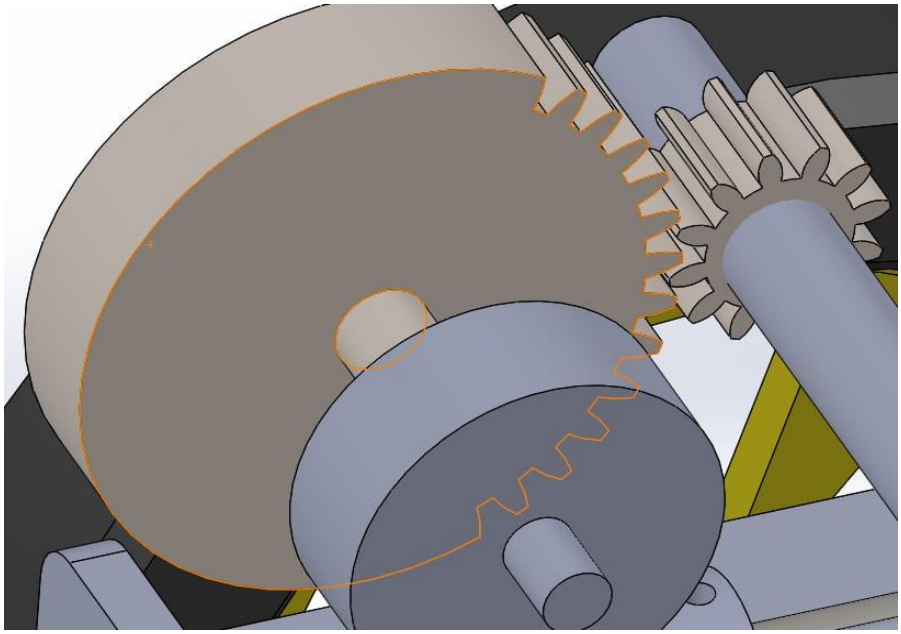
Design: Worm has two parts in which a worm gear meshes with a worm wheel. These parts together help in power transmission. The worm wheel is similar to spur gear.

Power transmission: Direction of transmission is not reversible due to friction.

Left hand and right hand worm: a right hand worm gear moves in clockwise direction regarding observer and a left hand worm gear moves in anticlockwise direction regarding observer.

Motto of usage: Worm drive was used to reduce rotational speed and transmit higher torque. They transfer motion in 90 degrees.

Mechanism: The shaft of a DC Motor is connected to worm gear and worm gear is connected to worm wheel. When the shaft of motor rotates, the worm gear starts rotating and due to meshing worm wheel also rotates and transmission takes place. And this worm wheel is connected to a spur gear of 2pi/3 teeth through a shaft.



SPUR GEAR:

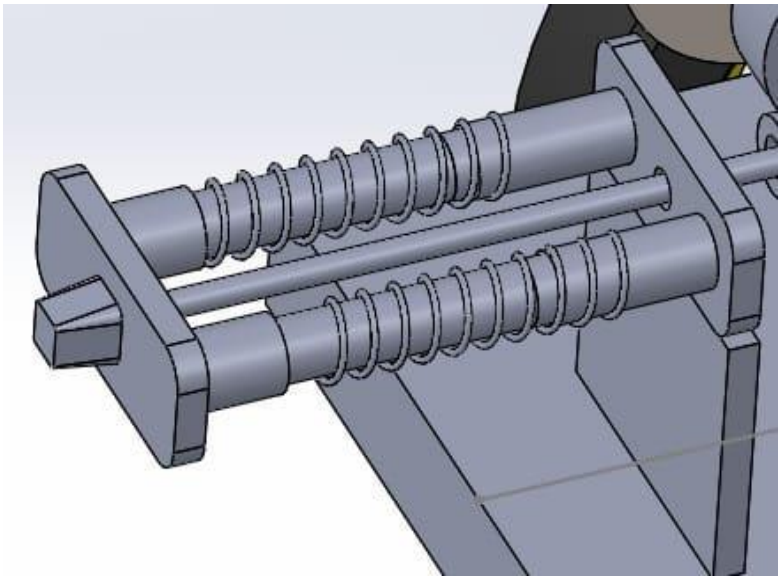
Spur gears are the most commonly used gears because of its flexibility in complex conditions.

Design: Spur gear contains a cylindrical visualization with teeth radiating. Spur gear comes with different dimensions in which their radius, pressure angle and inclination of teeth with respect to axis of rotation, diametral pitch can be changed. Gear ratio helps in power transmission.

Here we have used external spur gears.

Motto of usage: Spur gear mainly offers constant velocity ratio, don't slip. These help in transmitting large power. We have used two spur gears.

Mechanism: Worm wheel is connected to a spur gear of 2pi/3 teeth through a shaft. Gear ratio of two spur gears used is "three", Small one with full teeth and one gear with large one third of teeth. When these two gears are meshed with each other, the spring gets compressed and when the part of large gear without teeth gets in contact with small gear the bot will jump and when the teeth of large gear again comes in contact with small gear, by that time the bot will be on ground. And this process continues.



SPRING:

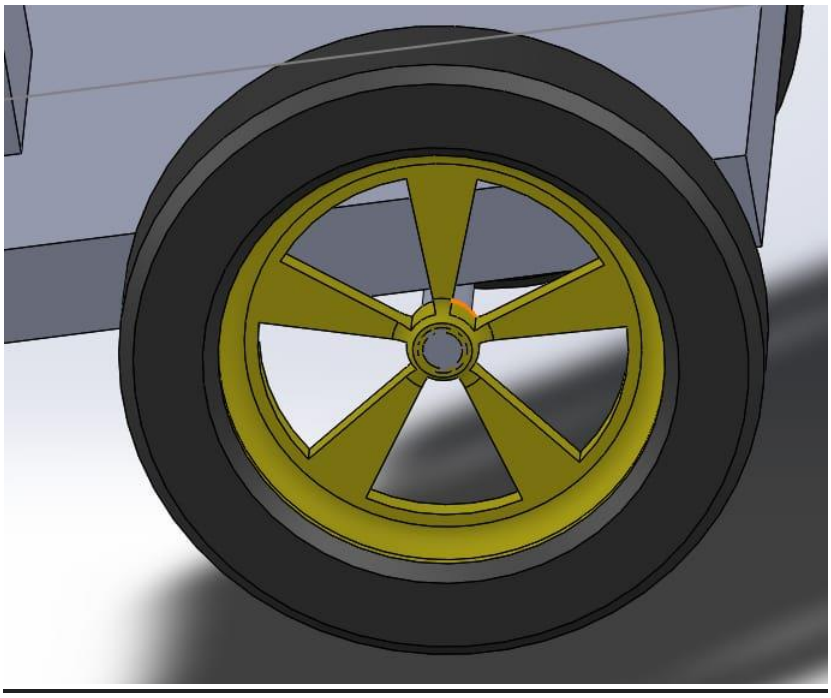
Motto of usage: To provide the required thrust.

Mechanism: The small spur gear is connected through a shaft with a string and the string rolls over the pulley. When the small gear along with the shaft rotates, the shaft tends to pull the string and the string rotates over the pulley inward and the string connected to the system of springs get compressed due to their arrangement in that way and the bot jumps and the process continues.

WHEEL:

Motto of usage: Light weight wheels of bigger dimension relative to the chassis are used so that the overall weight of the bot is low and because of the large dimension of the wheels the chassis becomes perpendicular to the ground when the gears begin to unroll to ensure

that the impact due to jump is maximum in vertical direction and hence it will move to a greater height



SHAFT:

Design: Shaft, usually in circular dimension in which its radius and length can be changed.

Motto of usage: It is a rotating machine unit. This was used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulleys and gears are mounted on it.

ELECTRICAL ASPECTS:

BATTERY :

Working: When the anode and cathode of a battery is connected to form a circuit, a chemical reaction takes place between the anode and

the electrolyte. This reaction causes electrons to flow through the circuit and back into the cathode where another chemical reaction takes place.

Motto of usage: Battery is used for electrical energy generation and this electrical energy is consumed by the motor for the rotation of its shaft

ARDUINO:

Intro: Arduino is an open-source electronic platform that relates hardware and software.

Working: Arduino boards are able to read inputs - light on a sensor, a finger on a button - and turn it into an output - activating a motor, turning on an LED.

Motto of usage: To determine and monitor the speed of a motor and sensors, this arduino was used. And this helps in giving energy to the motor and battery is connected arduino.

Position: This arduino was placed outside of the board to reduce the weight of the bot and it was connected with wires to the motor. Here *arduino uno* was used since our bot doesn't require high amount of power and lot of pins and memory space.

ACCELEROMETER:

Motto of usage: It is electromechanical device and was used to sense the vibration, orientation and acceleration of a bot.

GYROSCOPE:

Motto of usage: Gyroscope was used to determine angular velocity orientation of bot.

COST STRUCTURE:

Materials	Quantity	Cost
Arduino UNO	1	425
Accelerometer with Gyroscope	1	125
Wheel	1	-(3D Printed)
Spring	2	40
Pulley	1	-(3D Printed)
Gear	3	-(3D Printed)
DC Motor	1	300
Battery	1	925
Bolts and Nuts	1	60
Total Cost		1875

APPLICATIONS:

1. Hop bot has a strong ability to overcome obstacles.
2. It can be applied to the occasion with complex such as detection of plane surface and military reconnaissance.
3. It can be applied to the occasion with changeable environment such as post disaster.

LIMITATIONS:

1. Robot cannot move it can only jump

2. Its forwarded movement cannot be controlled that comes from jump

3. It cannot jump higher Up to a limit of 0.5m

4. Direction of bot movement cannot be controlled

FUTURE IMPROVEMENTS:

1. Changes can be made to move it in a desirable direction.

2. Jump height can be increased by using a strong motor.

3. Time interval between two simultaneous jumps can be decreased.

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REFERENCES:

1. https://www.hindawi.com/journals/abb/2017/4780160/

2. https://journals.sagepub.com/doi/full/10.5772/64200

3.https://www.google.com/amp/s/spectrum.ieee.org/automaton/robotics/robotics-hardware/salto1p-is-the-most-amazing-jumping-robot-weve-ever-seen.amp.html