CUBLI

Motivation

Every idea has a motivation behind it. For this idea, it was more of passion for robotics and mechanics rather than motivation. The beauty of physics and its laws can be used efficiently to build many huge machines and even small things like Cubli.

Broad Vision

This can be used to make self stabilizing bots. The main use of it is for locomotion in places where the gravitational force is low i.e. other planets. The motion of this cube will not be heavily dependent on the frictional force, which is very less in places of low gravity.

Theory of Implementation

The cube can balance on its edge or its side using the principles of conservation of angular momentum. Once balanced, it will remain at the stable equilibrium position even in presence of external forces. This happens by producing torques to cancel out the external torques about the balance point. There will be wheels which will rotate with the required angular velocity. With the help of sensors, we will be able to analyze the real time position of the object and thus calculate the torque required to be given to the wheels to balance the body.

Implementation

We first design the frame in SolidWorks, after which we place the gyroscope, motor and reaction wheel to measure and cause the angular displacement respectively. An arduino(microprocessor) will be used to decide the rotation of motor based on inputs from the gyroscope and what motion the user wants. Once implemented in 2-D, we will implement it in all three directions by using 3 motors and reaction wheels.

Demonstration

At the end of the project, our Cubli should be able to stand on its edge and vertex without any external support. If time permits and if we are equipped with sufficient knowledge, we will try and make the Cubli move from one point to other. But our main aim will be to make the Cubli stand on its own. We will also try to make it rotate about the vertical body diagonal once it stands on the vertex.

Timeline

Week 1:

- **Understanding properly the functioning and dynamics of the Cubli**

- **Designing the Cubli on SolidWorks**
- **Making the 2-D prototype**

Week 2:

- **Rectifying designing mistakes (if any)**
- **Making the 3-D prototype that stands on the edge**

Week 3:

- **Making the 3-D prototype that stands on the vertex and rotates**

Week 4:

- **Understanding the process of locomotion of the Cubli**
- **Implementing locomotion into the Cubli**

Week 5:

- **Implementing locomotion into the Cubli**
- **Controlling the motion of the Cubli**

Week 6:

- **Buffer week**

Requirements

We will require the following parts:

- **Metallic frame for both the 2-D prototype and the 3-D prototype**
- **High angular velocity motors**
- **Wheels**
- **Sensors to detect the position of the body (Gyroscopes)**
- **Immediate brakes for the wheels**
- **A few basic electrical components (Including a microprocessor)**
- **A few basic mechanical parts**
- **Batteries**
- **Gear boxes**

We will also require mentorship in understanding the functioning of the sensors and a few other things.

Estimated Cost

Depends mainly upon the cost of sensors, motors, batteries, gear boxes, etc.

Rs 1500 for Arduino

Rs 2100 for motors

Rs 1000 for flywheel

Rs 400 for other electrical components

Rs 1000 for frame

Rs 500 for sensors

Rs 400 for other mechanical requirements

Rs 1000 for battery

Rs 300 for gear boxes

Rs 500 for miscellaneous

This amounts to Rs 8700. Please note that this is an upper estimate and it is unlikely to go higher than this.

References

https://www.youtube.com/watch?v=n_6p-1J551Y

http://robohub.org/swiss-robots-cubli-a-cube-that-can-jump-up-balance-and-walk-across-your-desk/

https://www.youtube.com/watch?v=bMuCACqwI4s&feature=youtu.be