

Embedded

Points: 40

Event Type: Medium Prep Team Event

Problem statement:

Task 1) A device that consists of 3 servo motors that can rotate a cube attached to it about the x,y and z axis. The description of the cube is mentioned below. The device will be held in the hand and will have push buttons to control the servos that rotate the cube. You may refer this: <https://www.youtube.com/watch?v=MCYJAYlXBdA>

Task 2) An external torque (tilt the device about x, y, and/or z axis) will be applied to the device. In this case the cube's orientation with respect to earth frame should remain the same irrespective of the orientation of the device.

Task 3) To display the real time orientation of the hand-held device on a laptop (wirelessly) and calculate/plot the deviation in real time by choosing suitable reference axes.

The same device should be able to achieve all 3 tasks.

The device should be a hand-held device which will consist of 3 push buttons to rotate the cube held by the device about X,Y and Z axis. (task 1)

When the hand-held device is tilted about the X,Y and/or Z axis, the cube held by the device should not change its orientation with respect to the earth frame. (task 2)

For the purpose of evaluation, the structure of the cube used for the above tasks is as follows:

- 1) The cube will consist of 3 orthogonally placed laser diodes which will receive power from the device. The design and connections should be robust enough to keep the laser diodes powered at all times.
- 2) The cube should be lightweight and small in size so that it can be rotated by standard servo motors.



The laser beams will emerge from the 3 openings as shown in the figure.

The purpose of using laser diodes is to keep track of the orientation of the cube by tracking the laser pointer when projected on 3 orthogonal surfaces.

Hardware to be used:

- 1) Servo motors to rotate the cube
- 2) MPU 6050 placed on the device to measure the orientation of the device and provide feedback (required for task 2) and plotting(for task 3)
- 3) Arduino
- 4) ESP to wirelessly send the data of the MPU and display it in real time on a laptop

General Rules :

- The participating team must necessarily register themselves for the event.
- You will be issued components only after you have submitted an abstract of your idea.
- The teams must adhere to the spirit of healthy competition.
- Judges reserve the right to disqualify any team indulged in misbehavior.
- In case of a tie, there will be on spot tiebreaker.
- In case of any dispute, the judge's decision would be the final decision.

Team Structure:

- Team may comprise of students from any batches.
- Maximum **4 members** are allowed per team. All the members of a team should belong to the same pool.
- Maximum **2 teams** allowed per pool.

Judging criteria:

- 1) For task 1, maximum marks will be awarded for controlled rotation about all 3 axes and partial marks for rotations about 1 / 2 axis.
- 2) For task 2, the location of the laser pointer projected on the 3 surfaces will be the judging criteria. The maximum deviation of the pointer from the reference level, the delay in settling at a particular orientation and the steady state deviation from the reference level in all 3 directions will be calculated for each team. Points will be awarded on a relative scale by comparing the above metrics for each team.
- 3) For task 3, marks will be awarded for real time plotting of MPU data, calculation of deviation from the reference direction and visualization of this data in a creative manner.
- 4) Robustness of hardware design will be judged.

Bonus points: Your device is able to set a particular orientation of the cube apart from the standard position (which is parallel to the ground) and lock the cube orientation in this location. Here “lock” means keep the cube steady in this particular orientation irrespective of the tilting motion of the device. For better understanding refer the video on this website.

<https://www.evogimbals.com/blogs/evo-blog/how-does-a-3-axis-gopro-or-dslr-gimbal-work>

Use of joysticks for task 1 is also allowed.

Controlling the cube remotely besides the mandatory joystick/ push button based control for task 1 will fetch bonus points.

Any other creative thinking in terms of software and hardware(compact prototype made on GPB with proper soldering) will also fetch bonus points.

Marking Scheme:

Max Points:

Judging Criteria	Points
Task 1	20
Task 2 (only one axis)	50
Task 2 (two axes)	80
Task 2 (all 3 axes)	120
Task 3	50
Bonus	30
Accuracy	30

(Only 1 among task 2 1-axis, task 2 2-axes and task 2 3-axes will be considered)

Applications:

This device is widely used in drones where its required to keep the camera steady irrespective of the orientation of the drone.

Keep calm and stay focused !

You can't always control the wind, but you can control your sails.

-Dr. Bob Chope