

DESIGN AND DEVELOPMENT OF GIMBAL

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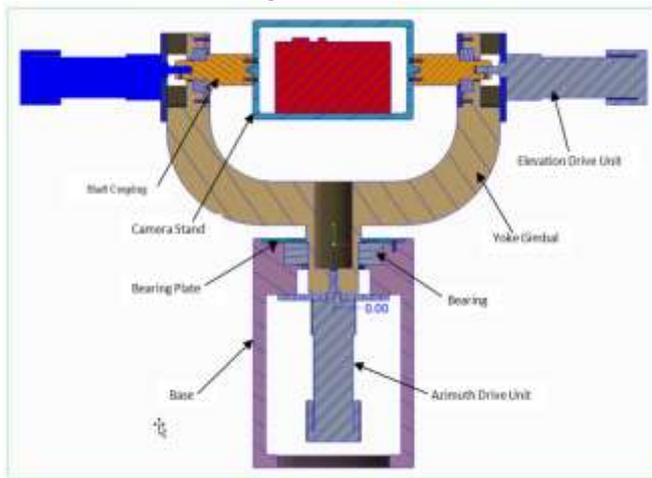
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Abstract: A Gimbal is a pivoted support that allows the rotation of an object about a single axis or multiple axis. Gimbal mount is designed according to the principles of kinematic determinacy. Vibration analysis is carried out to find out vibration of gimbal when it is actually in working condition.

I. INTRODUCTION

The Gimbal, designed and developed under this project, has two axes viz. elevation and azimuth and both the axes have been controlled by DC servomotors with encoders, hence named Two-Axes Automated Gimbal. This works on Pulse Width Modulation (PWM) control. Individual motors are used for the azimuth and elevation controls that provide stable and accurate motion for the payload. This report contains mechanical design of Gimbal.



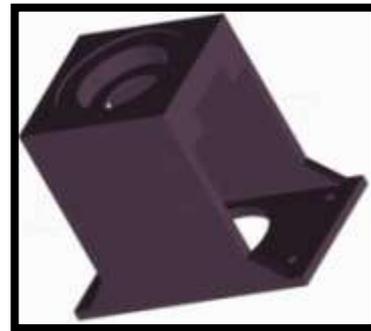
A. Material selection

Material AL 6061 T6 has been selected for the Two-Axes Automated Gimbal based on light weight, good strength and ease of availability. Some Basic Properties for the AL 6061 T6 are given below in table 2:

Physical Properties	Metric
Density	2.7 g/cc
Ultimate Tensile Strength	310 MPa
Tensile Yield Strength	276 MPa
Modulus of Elasticity	68.9 GPa
Ultimate Bearing Strength	607 MPa
Bearing Yield Strength	386 MPa
Poisson's Ratio	0.33

B. Design of Base of structure

The base is designed to ensure stability of the full system. It should sustain the weight of the elevation Assembly without the unbalancing or fluctuation. Base Structure contains azimuth motor assembly and its bearing. Extra space has been provided for electronic circuitry. Circular hole is provided in bottom of the structure for easy assemble of azimuth motor and motor-plate. It has near about 3 kg weight.



BASE STRUCTURE

C. Design of yoke

Yoke is mounted on the base through azimuth bearing. The two free ends of the yoke houses elevation bearings through which the payload holder is mounted. The elevation motor is also mounted on yoke.



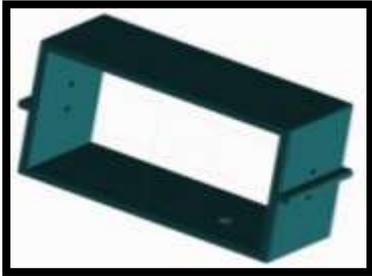
YOKE



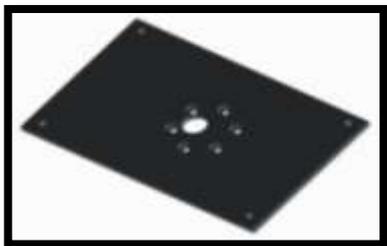
SHAFT COUPLING

C. Design of Payload Holder

The payload holder consists of rectangular frame and two shaft-couplings. These shaft-couplings are bolted to the frame. Similarly the payload, which is a camera is bolted to the frame through an open hole.



CAMERA STAND



MOTOR MOUNTING PLATE

D. Motor mounting plate

Motor was mounted on the gimbal by using this Motor Mounting Plate which is shown in.

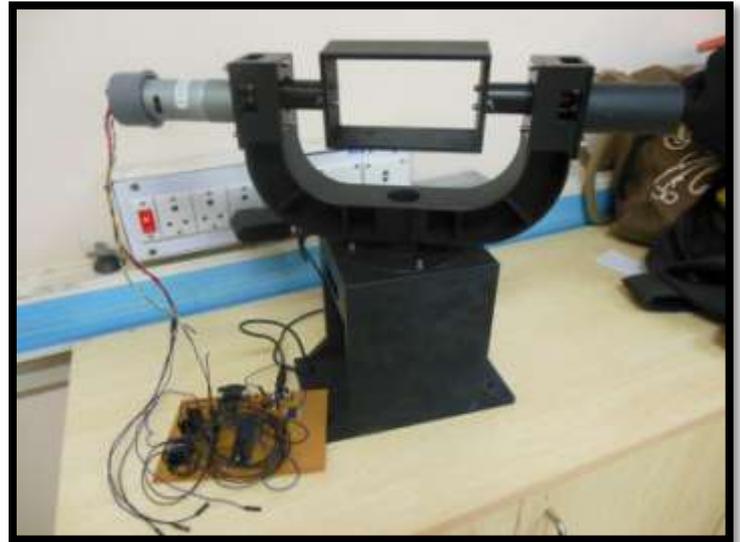
II. MODAL ANALYSIS

To estimate the natural frequencies of the system modal analysis is carried out in Proe-mechanica which is shown in fig 12 & 13. The first mode is a cantilever mode, which can not be excited by any of the two motions of the gimbal, but 2nd mode which is the twisting mode of the yoke and can be excited by the azimuth motion if it is very low. To avoid any such kind of interaction it has been kept around 104.3 Hz, which is safe.

Analysis	
Mode1	94.5 Hz
Mode2	104.3 Hz
Mode3	114 Hz
Mode4	180 Hz



Hardware realization and integration of the Gimbal



III. CONCLUSION

The mechanical design of gimbal ensures that the final product is having strong mechanical structure, rugged, ergonomically designed, compact, user-friendly, convenient to handle and meeting all specifications. The material selection, manufacturing and finishing processes will be carried out as per the requirements and established procedures.

