DESIGN AND ANALYSIS OF SELF STABILIZED PLATFORM

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Abstract: Nowadays, stabilization is the most important this paper presents a development self-stabilized platform. Self-stabilizing platform mechanism is specially design for establishing communication without any kind of distraction. The purpose of the mechanism is to stay in stable position even the vehicle on which it is mount upon is in constant state of motion. The self-stabilizing platform has a very unique application which make it compatible for both space and ground station. This type of platform is used in military application, hospital stretcher, hand held camera, SOTM etc. In this project a mechanism is to be prepared that continues to maintain its communication with any of its transmitter (satellite). Self-stabilized mechanism working principle is same as gimbal mechanism which is stabilized platform on individual axis rotation.

I. INTRODUCTION

The need for stabilizing mechanisms is widely spread. There is Various techniques are applied in search of the ideal solution. A common application is camera stabilization, less common are perhaps self-levelling surgery platforms. These systems share the importance of maintaining a constant position or direction relative to a point of reference, regardless of disturbance. Nowadays, lots of technologies introduced to stabilized one platform. Designers of new stabilized platform systems have begun to explore new design options for the stability of the platform. The mechanical phenomenon stabilised Platform (ISP) is employed for staying stabilization or moving of the read axis of the platform. Paper gift mechanical phenomenon stabilised Platform (ISP) with two DOF (Degree of Freedom) system with Pitch (X-Axis) and Yaw (Z-Axis). ISP has no coupling between 2-DOF. every DOF is driven by individual Servo Motor with controller supported MPU6050 which is basically working on accelerometer and gyroscope mechanism. This whole system is connecting with a microprocessor which is measures tilt of the platform and microprocessor sense it and with the help of motor it's opposite the tilt angles its stabilized the platform. The stabilization of the platform is mainly based on microprocessor and motor selection. This stabilized platform used in shipborne remote sending stabilized platform which serves an important role in shipborne remote sending system. This is basically installed between ship craft and remote sensing payload. This mechanism carries the payload on it and can effectively depress many disturbances which deteriorate the line-of-sight stability of the antenna. Thus improving line-of-sight stability and efficiency of the antenna. The effective way to obtain high resolution sensing measurement with the help of stabilization of the platform.

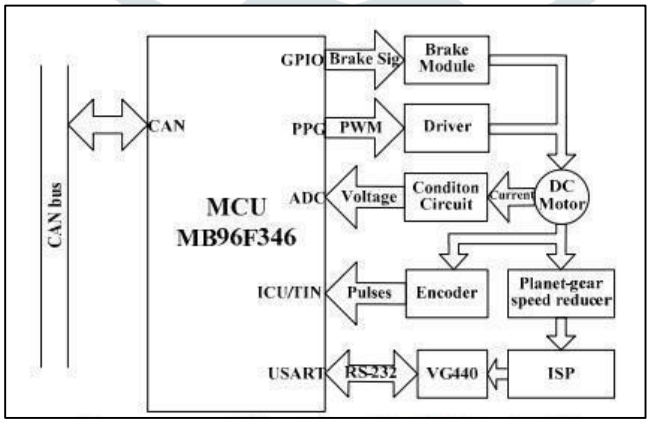

Figure 1.1: Study Self Stabilized mechanism:

II. THEORY AND MEASURES OF STABILIZED PLATFORM

This section comprises some of the works of literature used for stabilized platform mechanism techniques developed by various researchers using different methods with them improve mechanism.

Li Jianfei., 2009 [1] Designers of new stabilized platform systems have begun to explore new design options for the soundness of antenna. mechanical phenomenon stable Platform (ISP) with 2-DOF (Degree of Freedom). ISP has no coupling between 2-DOF. Each DOF is driven by individual DC Servo Motor with controller based on MPU 6050 (Fujitsu). Three closed loops of inflammatory disease rule are employed to keeping Associate in Nursing perspective of the ISP stable. the two controllers for 2-DOF driving will communicate through will bus.

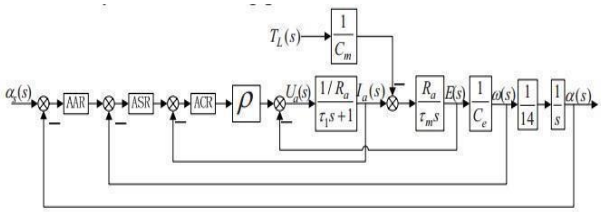

Figure 2.1: Controlling system loop

Model of DC motor controller has 2 input of the mathematical model of motor 1) armature voltage 2) load torque. TL(s) is regarded as a disturbance input. The closed-loop system consists of three regulators which are AAR (Automatic angle regulator) ASR (Automatic speed regulator) ACR (Automatic current regulator). Model of DC motor controller has 2 input of the mathematical model of motor 1) armature voltage 2) load torque. TL(s) is regarded as a disturbance input. The closed-loop system consists of three regulators which are AAR (Automatic angle regulator) ASR (Automatic speed regulator) ACR (Automatic current regulator). The motor is connected to Associate in Nursing integrated planetary gear speed reducer with reduction ration of 14:1. cut back the speed is adequate the rotation speed of the lean angle of ISP. the lean angle α(s), motor speed ω(s) and coil current I(s) is measured to accomplish 3 control system management in MCU.

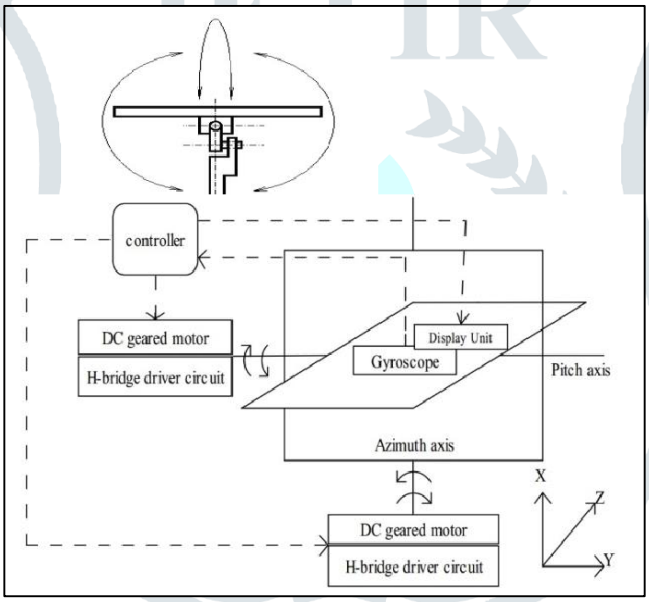

Figure 2.2: control diagram for mechanism

The constant position is created by mechanism and its command of tilt angle is given by MPU6050 by Vladimir Popelka [2] there is one micro-chip which sends a command to the microprocessor for further reaction in the stabilized platform, the communication between sensor and Key selection parameter is the speed of position (reaction time), carrying capacity and precision. And the sensor is used MEMS gyroscope and accelerometer in one package – MPU6050. The System control focus is set only for using single chips so there is two option of single chips.1) 8-bit core single chip: it can be AVR (frequently used as an Arduino), PIC or older 51-core family processor but this processor is relatively too slow data processing. It wants more machine cycle for processing one value bigger than 8bits. 2)32-bit core single chip: it is probably the biggest representative in the field of the embedded device are an ARM processor. They allow use modern programming techniques, control performance, they can speed up calculation and data processing, using DMA, nested vector interrupt. This is an image of MPU6050 where there are 3 translation motion and 3 angular motion where the output signal is formed in X-Y-Z axis tilting in angle. Which is sensed by the microprocessor and its command to motor rotate for the stabilized platform.

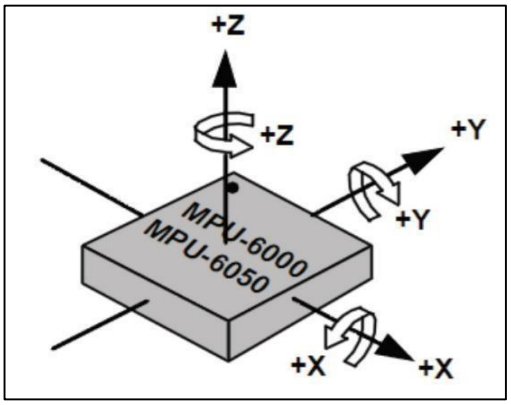

Figure 2.3: MPU 6050 chipset (gyroscope+accelerometer)

Discuss about combined terminal control of the gyro-stabilized platform (GSP) in the "coarse" alignment mode providing the required precision and "softness" of GSP turn from the arbitrary initial position to the pre-set final state, by V.M Nikiforov [3] The stages of control are described. The mathematical simulation of the combined terminal of the GSP is carried out. Conclusion on the application of combined terminal control of GSP is drawn.

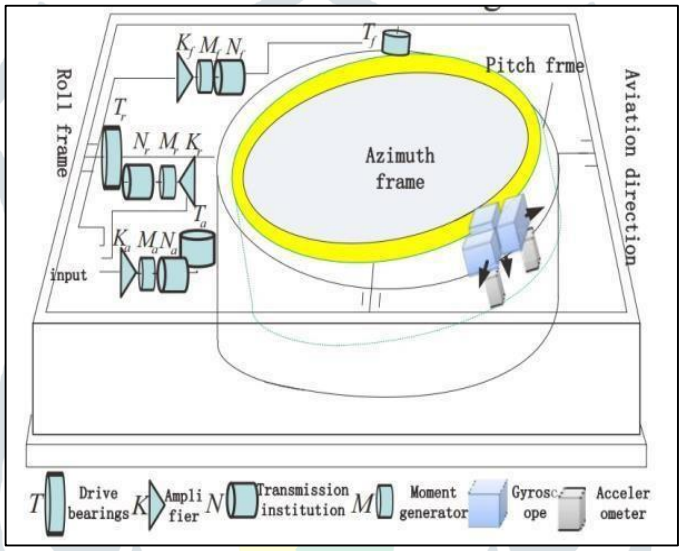

Figure 2.4: 3 Axis Gyro Mechanism

The proposed combined terminal control includes two stage where first stage the platform is controlled according to terminal law (feedback), when GSP rotates by a certain angle exceeding the required angle and the second stage involves programmed reverse rotation of GSP to the desired position at the same time GU SE moves from the technological limit stop to zero position under the effect of gyroscopic torque. This combined terminal control allows to avoid dynamic rebound of the gyrostabilizer and reduce weight and dimension characteristics due to the elimination of additional hardware.

$$M_{\alpha}^{u}(t) = \frac{30 \,.\, J_{gp\,.}\left(\alpha_k - \alpha(t)\right)}{(t_k - t)^2} + \frac{10 \,.\, J_{gp} \,.\, \left(2.\omega_{\alpha_k} - \omega_{\alpha}(t)\right)}{(t_k - t)} \quad + k_{g\alpha\,.}\omega_{\alpha}(t) + H_{gb}\,.\omega_{\beta}(t)$$

According to the installation characteristics of gyro and measuring instrument on the frame for mobile remote sensing stabilised platform, a dynamic measuring theme is bestowed, during which measuring instrument is that the main element and gyro is that the support. relinquishing frequency of the complementary filter to characteristics of the measuring noise and Kalman filter is style supported the complimentary filter by Xu Yang [4]. To validate the performance of the complementary Kalman filter was experienced for airborne remote sensing stabilized platform and result that the levelling accuracy of the platform has been greatly improved in both static and dynamic condition.

Airborne remote sensing stabilized platform consist of roll frame, pitch frame, azimuth frame. Two accelerometers installed in the pitch frame of airborne remote sensing stabilized platform are used for level angle calculation when there is no POS. The

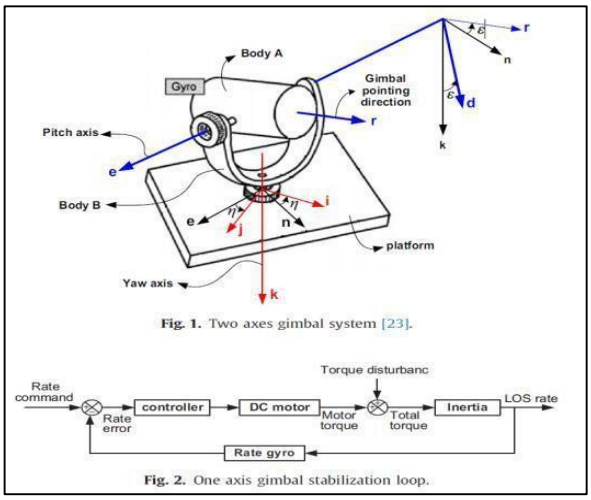

Fig. 1. Two axes gimbal system [23].

Fig. 2. One axis gimbal stabilization loop.

gyroscope is installed in azimuth frame (azimuth gyroscope) and pitch frame (pitch and roll gyroscope), which detect the frames rotating angular velocity, produce the speed loop feedback system.

Figure 2.5: Line On Sight Vector

We are a target to stabilized and pointing the line-of-sight by isolation the disturbance by sensor due to the operational environment by Maher Mahmoud Abdo [6] present two-axis gimbal platform and therefore the relation between force and derivation exploitation Lagrange equation considering base angular motion and dynamic mass unbalance. All performance is undertake using MATLAB simulation. The optical instrumentality has found wide utilized in several vital applications like image process, guided missiles, chase system, navigation system. Optical sensing element axis should be accurately pointed from a movable base to a set or moving target so sensors light-of-sight is strictly controlled. The stabilization is typically provided to the device by suspending it on the inner gimbal of 2 axes gimbal system as shown in Fig. 1. A rate gyro set on the inner gimbal is used to live the angular rates within the 2 planes of interest. The gyro outputs area unit used as feedback to force motors associated with the gyro to supply boresight error pursuit and stabilization against the bottom angular motion. The overall control system is constructed utilizing two identical stabilization loops (Fig. 2) for the inner (elevation) and outer (azimuth) gimbals. The system of 2 axes gimbal system Associate in Nursing attempt tries to align the device optical axis in elevation and angle planes with a line connexion the device and target that is termed the road of sight (LOS) so the device optical axis is unbroken nonrotating in a mechanical phenomenon house despite force disturbances that have an effect on the elevation and angle widget and essentially caused by the bottom angular motions that are typically obligatory by the operative environment. Therefore, the stabilization loop should isolate the sensing element from the angular base motion and disturbances that disturb the aim-point, i.e. the output rates of stabilization loops should follow bound input rate commands in order that the speed error is formed zero.

Development of self-stabilized platform using different equipment like ATMEGA328 microcontroller and motor and IMU by Shalaka Turalkar [7], the controller has been designed to maintain the platform at an initially selected angle when the support structure orientation changes, the software has been designing to and written with logic which converts analogue data of

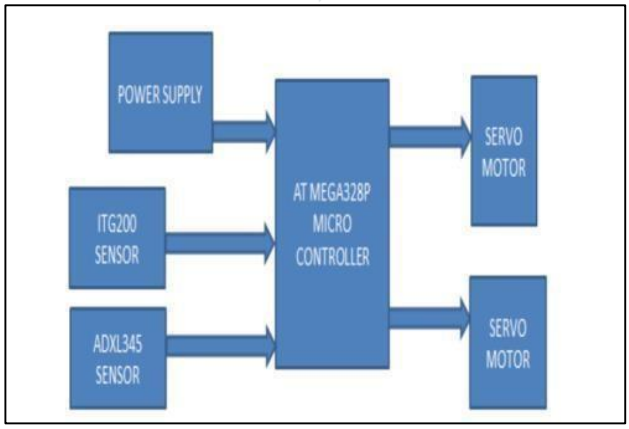

Figure 2.6: component connection system

IMU sensor to the digital signal to control the motor to boost the understanding of digital management devices and the way it is accustomed balance a platform. Also, this paper is beneficial to analyse however closed-loop system systems is used together with accelerometers and gyro sensors to stabilize the platform. during this paper, stabilization is going to be accomplished by victimization associate degree ATMEGA-328P microcontroller associate degreed an Islamic Group of Uzbekistan unit (a

measuring device sensor) which supplies feedback to 2 servo-motors. the aim is additionally to review however the system reacts to each unsymmetrically associate degreed an unsymmetrically placed objects on the platform. To simplify the theoretical model is considered with the object is placed on the middle of the platform and tested.

Gyroscope error concentrates in the low-frequency band and accelerometer error is bigger in high frequency, so they can be complementary with each other in the frequency domain. Therefore, using High and Low pass filter respectively take out gyroscope's signal and accelerometer's signal can realize the angle estimation in the whole frequency band. A complementary filter whose handover frequency is a fixed value cannot be balanced the dynamic and static performance very well. While the adaptive Kalman filter can recursive the noise matric R array online. The size of the noise matrix R array can reflect the current operation state of the system to a certain degree, and show the condition of the accelerometer. At the same time, the measured rate of the result θo can also reflect the current motion state of the system directly. Therefore, the complementary filter based on the basic method, with the R matrix and measurement rate of θ0, can correct &, and make the system get a good filter result in complex and changing motion state. To validate the effectiveness of the Kalman Filter based on the complementary filter, the experiment is conducted on airborne remote sensing three-axis stabilized platform. The platform can send out the output data of the level angle calculated by the control PC and the output data of the attitude reference of the POS through the serial port.

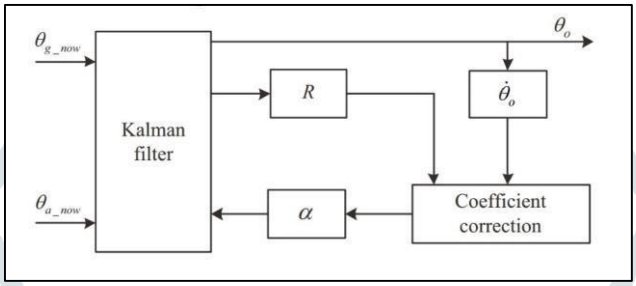

Figure 2.7: Kalman filter diagram

Experimental analysis of the phenomena of stability of a 2-dimensional gizmo structure platform mistreatment MEMS-based rotating mechanism detector by Saugato Dey [5]. Gyro is placed on the gimbal structure platform to live the angular tilt. the strategy uses formal logic management technique to style the stabilizer. 2 DC gear motors are accustomed management the AZ Associate in Nursing pitch position of the structure an H-bridge motor driving circuit is employed to drive the dc geared motor. Design a 2-dimensional stable platform (pitch axis and azimuth axis) using the MEMS-based rotating mechanism sensing element. The platform is made by implementing the idea of the gimbal. widget ar basically hinges that enable freedom of rotation concerning one axis. By incorporating bearing and motor we have a tendency to nearly bring home the bacon resistance behaviour of the platform. For a measure of the lean angle error of the platform, we have a tendency to used the MEMS-based rotating mechanism sensing element. MEMS gyro has some outstanding blessings together with low-cost, little volume, light, less power dissipation, fast startup and shock resistance. as a result of electronically evoked noises, resistance forces and gradient sampling, MEMS rotating mechanism knowledge includes random drift. to boost the signal of the MEMS gyro, the Kalman filter is enforced. formal logic primarily based Open loop management is introduced into the system to realize a stronger accuracy and improve the speed of response. The pitch and angle axis of the platform square measure controlled by victimization 2 DC-geared motors driven by the H-bridge circuit. The H-bridge circuit drives the motor in each dextral and anticlockwise direction to nullify error angle.

Very sensitive component of the ship's antenna tracking system as the weakest chain of the maritime mobile-satellite service(MMSS) it is also presented as the complete component of Ship Earth Station, such as antenna system
and transceiver with peripheral and control subsystem independent of ship motion. The MSA system is generally mounted on a platform, which has two horizontally, stabilized axes (X and Y), achieved by using a gyrostabilizer or sensors such as accelerometer or gyrocompass units. The stabilized platform provides a horizontal plane independent of mobile motion such as roll or pitch. For example, all mobiles have some kind of motions, but ship motion has seven components during navigation such as roll, pitch, yaw, surge, sway, heavy, and turn, shown in Figure 2. Turn means a change in ship heading, which is intentional motion, not caused by wave direction, and the other six components are caused by wave motion. Surge, sway, and heave is caused by acceleration.

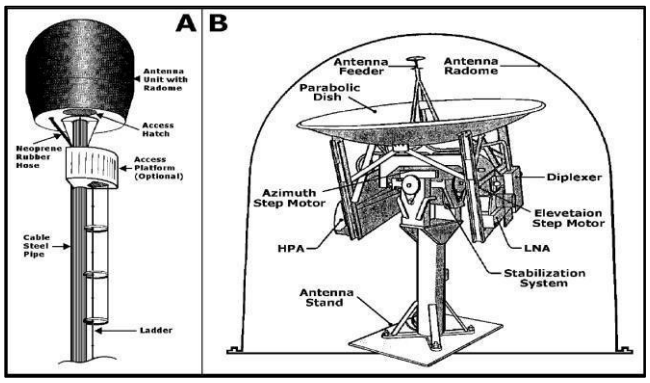

Figure 2.8: Antenna mounted mechanism

It is obvious that shipborne MSA configuration needs to be compact and lightweight. These requirements will be difficult to achieve because ship's directional antenna has quite heavy components for stabilization and tracking, and because the compact antenna has two major electrical disadvantages such as low gain and wide beam coverage. Therefore, a new generation of powerful satellite transponders with high EIRP and G/T performances should permit the effective design of more powerful, compact and lightweight MSA for ship applications. On the other hand, new physical shapes of random and less weight of components are very important requirements in connection with compactness and lightweight, which will permit easier installation and regular maintenance of ship antennas.

III. CONCLUSION

From this paper we are conclude that the mechanism of selection based on the criteria is fulfilled and we finalized mechanism is gimbal platform which is controlled by motor. Others mechanism like swesh plate, pneumatic and piezoelectric has some internal disadvantage like piezo has max 2-degree correction and pneumatic has more weight so we finalize gimbal platform mechanism and also shows how to gimbal platform work with mechanism and different components with connection so that we can do further research.

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