GYRO STABILIZER

A PROJECT REPORT

Submitted in partial fulfilment for the Mini Project – J Component

of

Measurement and Instrumentation (EEE 2004)

by

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Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF ELECTRIAL ENGINEERING

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CERTIFICATE

This is to certify that the project work entitled GYRO STABILIZER by Ashwath (17BEE0028) , Daniel (17BEE0127), Ranjan (17BEE0134) and Ayan (17BEE0244) submitted to Vellore Institute of Technology University, Vellore, in partial fulfillment of the requirement for J component of the course titled Measurement and Instrumentation EEE 2004 is a work carried out by us under my supervision. The project fulfills the requirement for J component as per the regulations of this Institute and in my opinion meets the necessary standards for submission.

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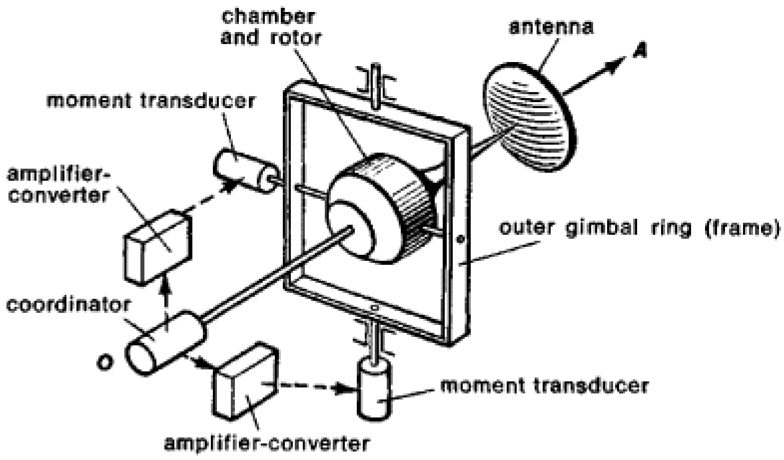
ABSTRACT

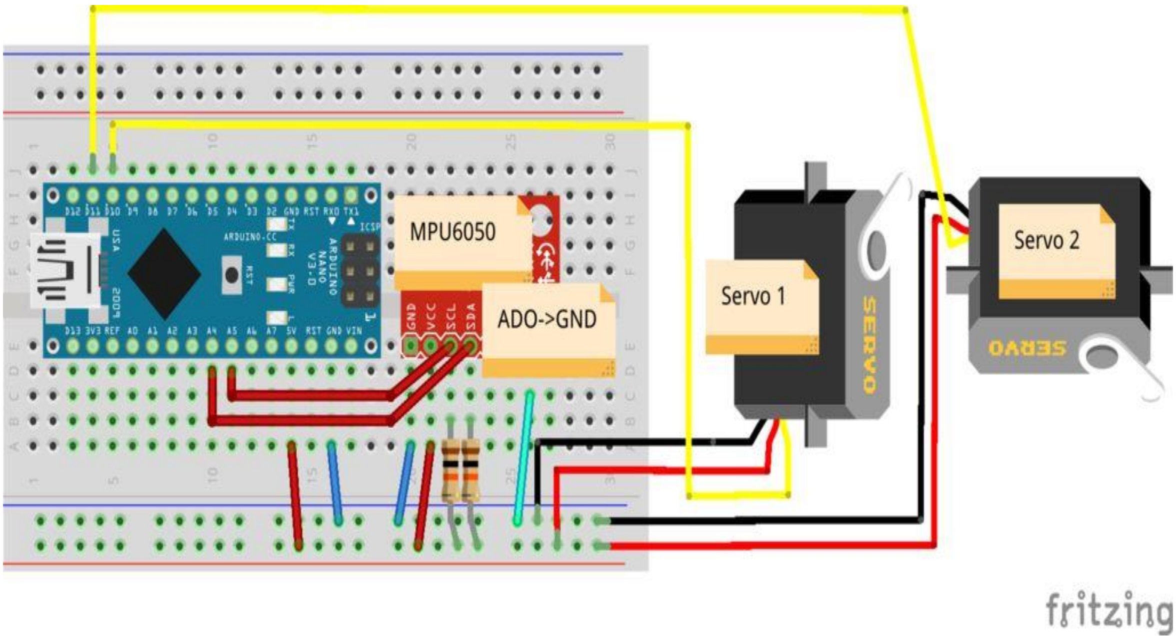
Gyroscopic device designed for stabilizing separate objects or instruments, as well as for determining the angular deviations of objects. According to their principle of operation, gyrostabilizers are divided into direct, force, and indicating types. Direct gyrostabilizers are devices in which the stabilizing properties of a free gyroscope are utilized directly. Direct gyro stabilizers are used as roll dampers on ships and as stabilizers for monorail cars (the weight and dimensions of such gyro stabilizers are very important), as well as for stabilizing the sensing elements of control systems. For example, the gyro stabilizer shown in Figure 1, which consists of the chamber and rotor, mounted in the outer gimbal ring (frame), directly stabilizes the antenna and the coordinator. The coordinator generates signals proportional to the angles of deviation of the antenna's axis from a given direction OA. These signals proceed through the amplifier-converters to the moment transducers of the correction system, which performs the automatic orientation of the antenna axis in the given direction. Gyro stabilizers of this type are called gyroscopic servomechanisms.



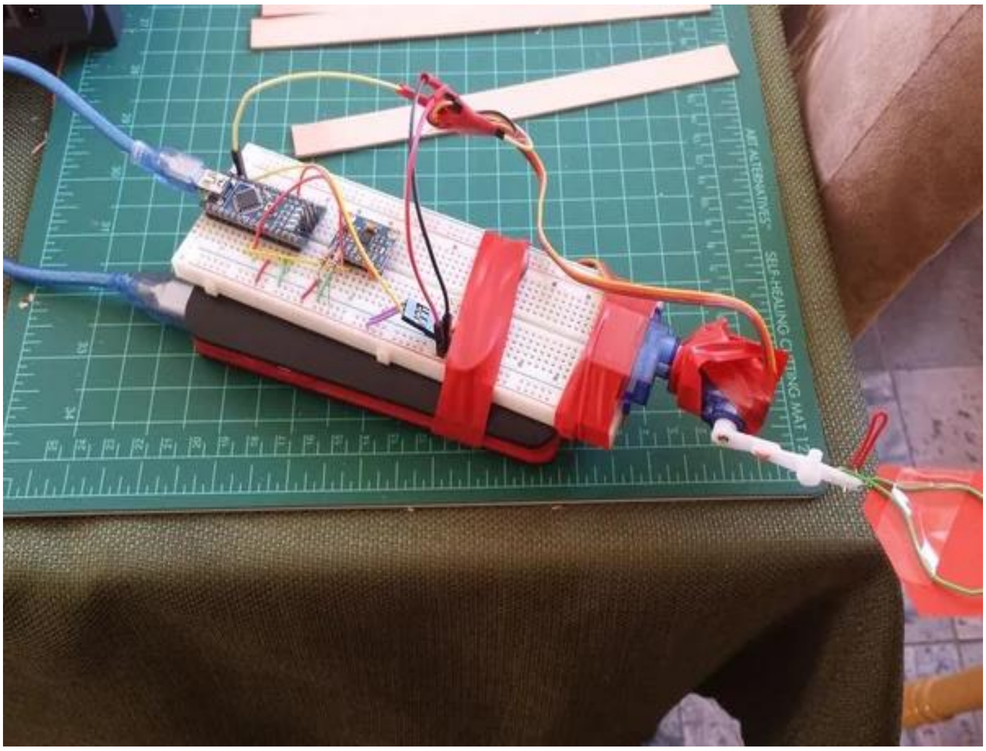
COMPONENTS USED

- 1 x 6 DOF MPU-6050 module
- 1 x Arduino Nano
- 2 x 9g Servos
- 2 x 10k Resistors
- 1 x Breadboard
- Jumper wires
- USB Battery pack

CIRCUIT DIAGRAM



PICTURE OF THE WORKING MODEL



ARDUINO CODE

```
#include <Servo.h>
#include "I2Cdev.h"
#include "MPU6050_6Axis_MotionApps20.h"
#include "MPU6050.h"
#if I2CDEV_IMPLEMENTATION == I2CDEV_ARDUINO_WIRE
#include "Wire.h"
#endif

#define LED_PIN 13
bool blinkState = true;

Servo Servo1;
Servo Servo2;

int Servo1Pos = 0;
int Servo2Pos = 0;

float mpuPitch = 0;
float mpuRoll = 0;
float mpuYaw = 0;

MPU6050 mpu
uint8_t mpuIntStatus;
uint8_t devStatus;
uint16_t packetSize;
uint16_t fifoCount;
uint8_t fifoBuffer[64];
Quaternion q;
VectorInt16 aa;
VectorInt16 aaReal;
VectorInt16 aaWorld;
VectorFloat gravity;
float ypr[3];
#define PITCH   1
#define ROLL
#define YAW   0
// ================================================================
// ===                      INITIAL SETUP                       ===
// ================================================================

void setup()
{

  Servo1.attach(10);
  Servo2.attach(11);
  delay(50);
  Servo1.write(0);
  Servo2.write(60);
  delay(500);
  Servo1.write(180);
  Servo2.write(120);
  delay(500);
  Servo1.write(0);
  Servo2.write(90);
  delay(500);
```

```
#if I2CDEV_IMPLEMENTATION == I2CDEV_ARDUINO_WIRE
  Wire.begin();
  TWBR = 24;
#elif I2CDEV_IMPLEMENTATION == I2CDEV_BUILTIN_FASTWIRE
  Fastwire::setup(400, true);
#endif

  Serial.begin(115200);
  while (!Serial);
    Serial.println(F("Initializing I2C devices..."));
  mpu.initialize();

  Serial.println(F("Testing device connections..."));
  Serial.println(mpu.testConnection() ? F("MPU6050 connection
successful") : F("MPU6050 connection failed"));


  Serial.println(F("Initializing DMP"));
  devStatus = mpu.dmpInitialize();

  mpu.setXGyroOffset(118);
  mpu.setYGyroOffset(-44);
  mpu.setZGyroOffset(337);
  mpu.setXAccelOffset(-651);
  mpu.setYAccelOffset(670);
  mpu.setZAccelOffset(1895);

  if (devStatus == 0)
  {

    Serial.println(F("Enabling DMP"));
    mpu.setDMPEnabled(true);


    Serial.println(F("Enabling interrupt detection (Arduino external
interrupt 0)"));
    mpuIntStatus = mpu.getIntStatus();

        packetSize = mpu.dmpGetFIFOPacketSize();
  }
  else
  {
    Serial.print(F("DMP Initialization failed code = "));
    Serial.println(devStatus);
  }

    pinMode(LED_PIN, OUTPUT);

}


// ================================================================
// ===                    MAIN PROGRAM LOOP                     ===
// ================================================================

void loop(void)
```

```
{
  processAccelGyro();
}



// ================================================================
// ===                 PROCESS ACCEL/GYRO IF AVAILABLE          ===
// ================================================================

void processAccelGyro()
{

  mpuIntStatus = mpu.getIntStatus();
  fifoCount = mpu.getFIFOCount();

  if ((mpuIntStatus & 0x10) || fifoCount == 1024)
  {
    mpu.resetFIFO();
    Serial.println(F("FIFO overflow!"));
    return;
  }

  if (mpuIntStatus & 0x02)    {
      if (fifoCount < packetSize)
      return; //  fifoCount = mpu.getFIFOCount();
    mpu.getFIFOBytes(fifoBuffer, packetSize);

    fifoCount -= packetSize;

    mpu.resetFIFO();

    mpu.dmpGetQuaternion(&q, fifoBuffer);
    mpu.dmpGetGravity(&gravity, &q);
    mpu.dmpGetYawPitchRoll(ypr, &q, &gravity);
    mpuPitch = ypr[PITCH] * 180 / M_PI;
    mpuRoll = ypr[ROLL] * 180 / M_PI;
    mpuYaw  = ypr[YAW] * 180 / M_PI;

    mpu.resetFIFO();

    blinkState = !blinkState;
    digitalWrite(LED_PIN, blinkState);

    mpu.resetFIFO();

    Servo1.write(-mpuPitch + 90);
    Servo2.write(mpuRoll + 90);
    delay(10);


    mpu.resetFIFO();
 }
 }
```

APPLICATIONS

- **Ship stabilizing gyroscopes are a technology developed in the 19th century and early 20th century and used to stabilize roll motions in ocean-going ships. Their function is similar to reaction wheels in spacecraft - they provide stability via production of torque. It lost favor in this application to hydrodynamic roll stabilizer fins because of reduced cost and weight. However, since the 1990s, there is renewed interest in the device for low-speed roll stabilization of vessels (Seakeeper, etc.). Unlike fins, the gyroscope does not rely on the forward speed of the ship to generate a roll stabilizing moment and therefore can stabilize motor yachts while at anchorage. (Been used in the World War I transport USS Henderson as well as the as the Italian passenger liner SS Conte di Savoia)**

- **Stabilization of unstable bodies such as two-wheeled monorails, twowheeled cars, or unmanned bicycles. It has been speculated that gyroscopically stabilized monorail cars would have economic advantages with respect to birail cars, enabling the cars to take sharper curves and traverse steeper terrain, with lower installation and maintenance costs. A two-wheeled, gyro-stabilized car was actually constructed in 1913**

- **Stabilization of platforms-The platform consists of parallelogram, cardan frame and two contra- rotating gyroscopes. The whole system is described with five generalized coordinates and with two cyclic coordinates. We created a prototype of platform, which rotate around one axis. The prototype is designed with respect to a simple way to extend the rotation about the second axis and parallelogram. The rotary frame is driven by the gyroscope. Pneumatic motors are used to actuating gyroscopes. Pneumatic springs are used to actuating rotating frame. This paper shows also control system of platform and it introduces reached results of stabilization.**

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