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Gravitational Force Meter

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Abstract:

In this undertaking we are going to use raspberry pi Pico, display, accelerometer and Gyro sensor to act a work of measuring to do with attraction between bodies force. This is working rightly over the good power supply and group of parts. Here this helps in full of force applications of unmanned air planes and self balancing vehicles as well. Gyroscope and accelerometer are 2 basic points of so many apparatuses such as readily moved telephones, drones, millitory purposes, and so on. These 2 kind of sensors can be achieved with a single bit broken out the MPU6050. As it can keep in touch with an connection, you can use it with raspberry pi Pico. putting to use the powerful MPU6050 MEMS part of a greater unit with the turning readily toanother work raspberry pi Pico with MIcroPython.

Keywords:

MPU6050 Accelerometer Gyroscope Sensor, Raspberry Pi Pico, MicroPython code.

1.Introduction:

The MPU6050 is a Micro Electro-Mechanical Systems (MEMS) which consists of a 3-axis Accelerometer and 3-axis Gyroscope inside it. This helps us to measure acceleration, velocity, orientation, displacement and many other motion related parameter of a system or object. The MPU-6050™ parts are the world's first MotionTracking devices designed for the low power, low cost, and high-performance requirements of smartphones, tablets and wearable sensors. Raspberry Pi Pico is a microcontroller that can help so that the whole device could perform a task of measuring gravitational force.

As MPU6050 has much specifications and features so that it is very reliable and suitable sensor in this type of devices. Here some of them are mainly considered as given below :

1.3-axis gyroscope with a programmable full-scale range. 3-axis gyroscope with a programmable full-scale range.

2.16-bit analog-to-digital converters (ADCs) for both accelerometer and gyroscope, providing high-resolution data.

3.Digital Motion Processor (DMP) for on-chip motion processing, reducing the load on the host processor.

4.I2C (Inter-Integrated Circuit) and SPI (Serial Peripheral Interface) communication interfaces.

5.Power supply voltage range: 2.375V to 3.46V

6.Temperature sensor with a range of –40°C to 85°C.

7.Small package size: 4x4x0.9mm QFN.

2.Literature Survey:

Gravitational force meters are devices used to measure the gravitational force acting on an object. One way to build such a device is to use an accelerometer such as the MPU6050. Here is a literature survey on gravitational force meters that use the MPU6050:

This paper describes the design and development of a low-cost gravitational force measurement system using the MPU-6050 accelerometer. The system was designed to measure the gravitational force acting on a body placed on a cantilever beam. The authors used the MPU-6050 accelerometer to measure the tilt angle of the cantilever beam, which was then used to calculate the gravitational force acting on the body. The results showed that the system was accurate and reliable [1].

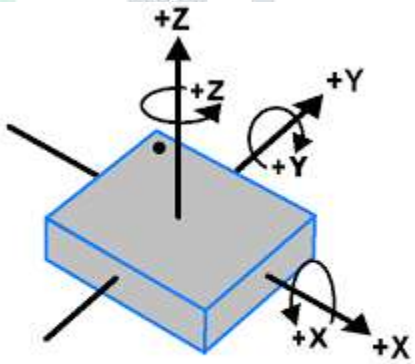
This paper presents a low-cost gravitational force sensor using a MEMS accelerometer, which is similar to the MPU-6050. The authors used the sensor to measure the gravitational force acting on a mass placed on a cantilever beam. They calibrated the sensor using a reference mass and compared the results with a commercial force sensor. The results showed that the gravitational force sensor using the MEMS accelerometer was accurate and reliable [2].

This paper presents a method for measuring the gravitational constant using a simple pendulum and a MEMS accelerometer. The authors used the MPU-6050 accelerometer to measure the angular displacement of the pendulum and then calculated the gravitational force acting on the pendulum. The results showed that the method was accurate and could be used for educational purposes [3].

This paper describes the design and fabrication of a gravitational force sensor using a MEMS accelerometer for human posture monitoring. The authors used the sensor to measure the gravitational force acting on different parts of the body during various postures. The results showed that the sensor was accurate and reliable for human posture monitoring [4].

Overall, these papers demonstrate the feasibility and effectiveness of using the MPU-6050 accelerometer for gravitational force measurement applications.

It's also important to mention that since this is an acceleration and not a force, the vehicle's mass or size doesn't matter at all. In the harsh driving rules, we specify the vehicle size (passenger car, truck/cube van, and heavy-duty truck) as a suggestion. A sports car can safely take a corner faster than a truck.



MPU-6050
Orientation & Polarity of Rotation

3.Recommendation for setting up driver feedback:

We recommend starting in the middle of the specific vehicle class and adjusting from there based on your fleet objectives and the unique aspects of your fleet. For example, if you are seeing too many harsh driving events and you want to manage that, you might select a more sensitive setting. Similarly, to closely monitor an ambulance carrying an EMT and patients in the back, you would increase the sensitivity. If we look at

the three harsh driving rules, we can do some simple calculations to find out how fast a driver would need to take a corner or accelerate from a stop sign to break these rules.

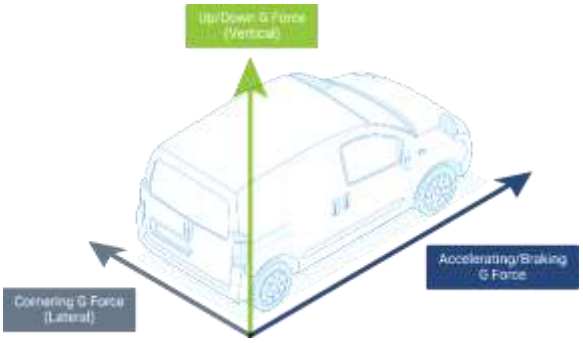
Harsh acceleration and harsh braking:

The harsh acceleration and harsh braking rules are really the same thing and measure how quickly you are speeding up or slowing down. The least sensitive setting in the default rule for acceleration is 0.43 Gs which is what a driver would experience if you accelerated from standstill to 60 km/h in 3.95 seconds. The braking rule is even more lenient and would require that you come to a complete stop from 60 km/h in 2.78 seconds, deccelerating at 0.61Gs.

Harsh Cornering:

hard, rough able to go round is a little more tricky to both work out and grip through an unreasoned feeling. Any time you change rate of motion you are undergoing an acceleration 1. When you are turning a control, this acceleration 1 is 90 degrees from the direction you are journeying, without thought or attention of how tight a turn you are making. have in mind that about turning a weight on the end of a cord. You are always pulling the weight in the direction of your hand but it never gets any nearer.

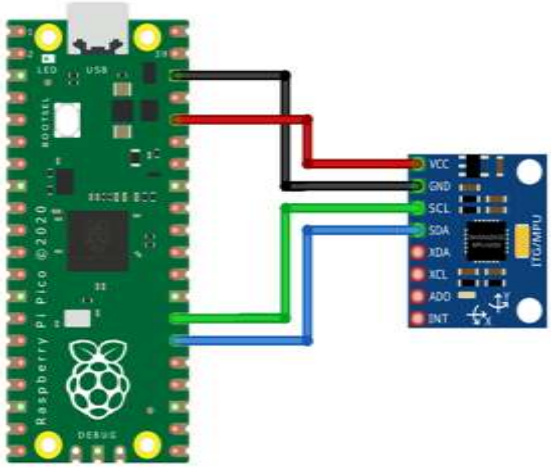
So how do we measure this? To come to a decision about the acceleration you experience in a space near where walls join, all we need is the straight line from middle to edge of the control and your rate of motion. I measured the straight line from middle to edge of a normal right turn at a where streets come together of four lane roads and found it to be about 17 metres . This suggests that if it went through this control at 32 you would break the most not hard hard, rough able to go round rule which is group at 0.47 gs .



4.Segmentation:

A)Interfacing MPU 6050 with Raspberry Pi Pico:

The connection is straight forward



Make the connections between the Raspberry Pi Pico and the MPU6050:

•Connect the VCC pin of the MPU6050 to the 3.3V (Pin 36) of the Raspberry Pi Pico.

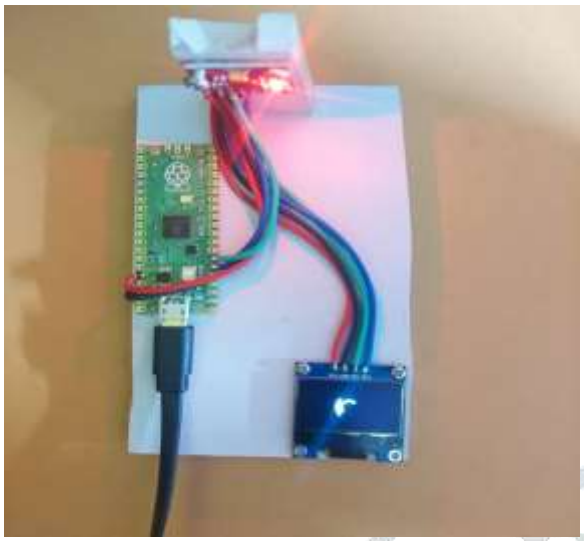
•Connect the GND pin of the MPU6050 to the GND (Pin 38) of the Raspberry Pi Pico.

•Connect the SDA pin of the MPU6050 to the SDA (Pin 1 – GP0) of the Raspberry Pi Pico.

•Connect the SCL pin of the MPU6050 to the SCL (Pin 2 – GP1) of the Raspberry Pi Pico.

Now Run the Code. After running the code, the Thonny Shell will display the Accelerometer, Gyroscope and Temperature values.

You will see the Accelerometer, Gyroscope, and Temperature values on the Shell constantly changing as you move the sensor in different orientations.



Working Model Showing Direction of G-Force.

5.Discussion:

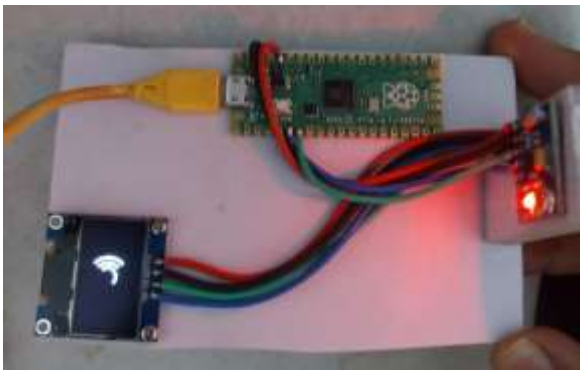
The MPU6050 mini project report demonstrates the feasibility of using an MPU6050 sensor to build a g-force meter. The MPU6050 sensor is a highly sensitive device that can accurately measure accelerations in three dimensions, making it ideal for applications that require precise measurement of acceleration.

By combining the MPU6050 sensor with a microcontroller, it is possible to create a simple and effective g-force meter that can be used in a variety of applications, such as in motorsports or aerospace. The report provides a clear and detailed explanation of the process of building the g-force meter, including the hardware and software components required, as well as the steps involved in programming the microcontroller.

Overall, the MPU6050 mini project report highlights the potential of using sensors and microcontrollers to create innovative solutions for measuring physical phenomena, and serves as a valuable resource for anyone interested in exploring this field.

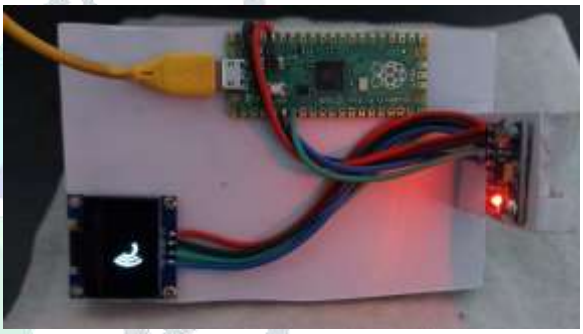
Result:

Fig.1



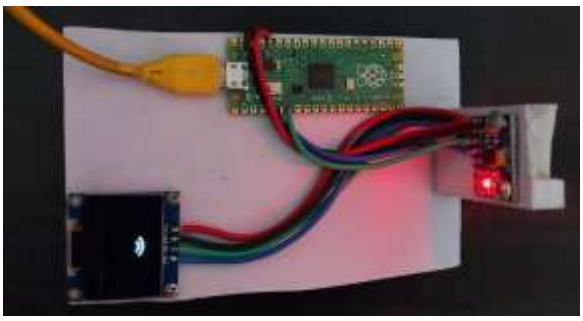
A.In above picture it is clearly showing forward direction so we can conclude that G-Force is towards front direction. In this situation G force meter is forced along front direction and it senses the force towards forward direction and diplay shows forward direction indications.

Fig.2



B.In above picture it is clearly showing backward direction so we can conclude that G-Force is towards reverse direction. In this situation G force meter is forced along backward direction and afer sensing the force vector it clearly shows indication of backward direction.

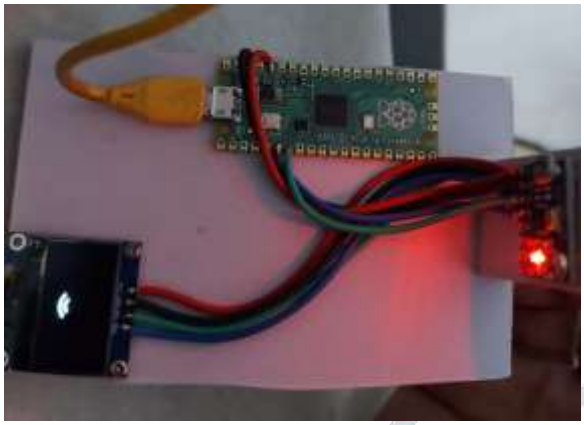
Fig.3



C.In above picture it is clearly showing Right direction so we can conclude that G-Force is towards right direction. In this situation G force meter is forced

towards right side directions and after sure sensing it indicates the right arrow on the display.

Fig.4



D.In above picture it is clearly showing left direction so we can conclude that G-Force is towards left direction. In this situation G force meter is forced towards left hand side direction and after successfully sensing the left hand side force it indicates left arrow on the display.

6.References:

1. Design and Development of Low-Cost Gravitational Force Measurement System Using MPU-6050" by S. Sahu et al. (2019).

2. A Low-Cost Gravitational Force Sensor Using MEMS Accelerometer for Undergraduate Experiments" by H. Y. Wang et al. (2018)

3. Measurement of the Gravitational Constant Using a Simple Pendulum and a MEMS Accelerometer" by J. M. Ortiz et al. (2018)

4. Design and Fabrication of a Gravitational Force Sensor Using MEMS Accelerometer for Human Posture Monitoring" by S. Kim et al. (2016)