Analysis of Accelerometer Applications

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Abstract: *An accelerometer is a digital tool that measures modifications in velocity, acceleration, or vibration of a bodily object. It is typically used in various packages, along with smartphones, vehicles, aerospace, and healthcare. The accelerometer measures the acceleration of the object via detecting modifications within the capacitance, piezoelectric impact, or other phenomena resulting from the motion of the item. Here we have studied and analysed various accelerometer applications to identify their capabilities and usability, based on this we have concluded that accelerometer can be used for the design and development of an Epilepsy Patient Fall Detection and Alert System using Accelerometers.*

Keywords: accelerometer, ardunio Nano 33 BLE, applications

I. INTRODUCTION

An accelerometer is a digital tool that measures modifications in velocity, acceleration, or vibration of a bodily object. It is typically used in various packages, along with smartphones, vehicles, aerospace, and healthcare. The accelerometer measures the acceleration of the object via detecting modifications within the capacitance, piezoelectric impact, or other phenomena resulting from the motion of the item.

Acceleration has two factors; one is static pressure and the other is a dynamic force. Static force is the pressure appearing on an object (consisting of friction or gravity) and dynamic force is the pressure acting on an item at one-of-a-kind speeds (including vibration or the pressure implemented to the cue ball). In billiard video games, this is why accelerometers are used.

For example, in the prevention and protection of car accidents. When a strong force is applied to the vehicle, the accelerometer detects acceleration and sends an electrical signal to the trip computer, which then activates the airbags. There are three different types of accelerometers, and each one of them is designed to work well in a specific condition.

When two or more accelerometers are connected, they provide a different measurement of the required acceleration. Gravity pulls them apart, especially in space, the gradient of the gravity field. The gravitational force is the weak force that relies upon the gravity of the Earth. This is very different, so a gravity gradiometer is used.

Accelerometers are electronic devices that are used to measure acceleration. Acceleration can be resulting from various factors, consisting of gravity, changes in motion, or external forces. These forces can be static like gravity, or it can detect vibration and motion like many mobile phones.
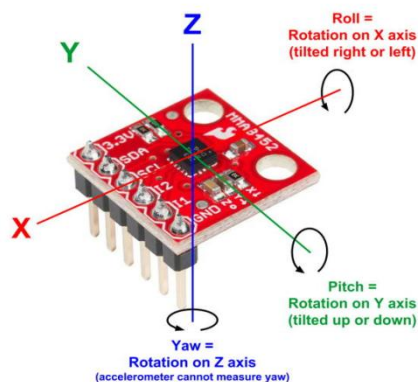

Fig .1: Accelerometer Circuit with Possible Directions

II. ACCELEROMETER WORKING

Accelerometer can be used as a "level" that will provide information about the board's position. With this application, we will be able to know what is the relative position of the board and also the degree by tilting the board up, down, left or right.

2.1 Accelerometer Uses

Accelerometer sensors are broadly used in diverse digital devices, phones and wearables, and many others may be used in many methods. Accelerometers are sometimes used as part of energy harvesting systems, whereby the motion of an object is converted into electrical energy as it moves, for example, in the case of small sensors powered by vibrations of machinery. Accelerometers are also utilized in biomedical packages where biomedical accelerometer subject sensors are often used for step counting, interest monitoring or dynamic control, these sensors are even used to monitor important signs in heart assault issues.

2.2 Accelerometer Advantages

- High impedance.
- It offers higher sensitivity.
- Easily integrated interface and robust design.
- High-frequency response.
- Due to advances in the MEMS era, it decreased itscost.
- It uses a built-in signal conditioning circuit for the measurement of capacitance.

2.3 Accelerometer Disadvantages

- **Limited accuracy:** Accelerometers are fantastically correct, but they may be now not ideal, and their measurements can be suffering from outside elements inclusive of temperature, vibration, and electromagnetic interference.
- **Confined range:** Accelerometers have a confined size variety, which means that they cannot degree extraordinarily high or low degrees of acceleration or vibration.
- **Sensitivity to noise:** Accelerometers may be touchy to noise, which can influence the accuracy and reliability of their measurements

III. APPLICATIONS

A. Gesture-Controlled Robot

The accelerometer sensor, specifically the ADXL-335 accelerometer sensor is used to move the robot in each direction. In this basically, the accelerometer is placed on the hand and when the hand is tilted in front of the robot, the robot starts to move forward until another movement is given. [1]

As a result of this project, the life of physically disabled people becomes less demanding. The main goal is to provide the user with a reliable and more natural technique for navigating the wireless robot in the environment using gestures. The proposed system will provide an intelligent system that can be controlled by hand gestures, an accelerometer works on the device, which has a transmitter and a receiver.

B. Emotion Detection

Emotion detection the use of an accelerometer is an era that makes use of records from an accelerometer to apprehend and classify emotional states based on the movement styles of the body. This era has potential applications in the diffusion of fields, consisting of intellectual health, human-pc interplay, and gaming. The accelerometer measures adjustments in acceleration and orientation of the tool or frame element and uses machine mastering algorithms to investigate this information and hit upon patterns which might be associated with unique feelings as instance, moves that are greater jittery or erratic can be related to anxiety, at the same time as slower moves can be associated with sadness or despair. [2]

Here, the researchers tried to effectively detect emotions using a gaming application that many companies can benefit from for their advertising purposes. Researchers also consider certain assumptions, but they are not always true.

C. Enriching Heart Monitoring

Huge volumes of medical facts from frame sensors and advanced medical equipment must be processed and analysed by way of green structures. Consequently, they request to enhance the present ECG sign to add important information to the interpreter including ECG and accelerometer data. The accelerometer facts processing plan presents data about the affected person's pastime in addition to ECG records. [3]

It is an optional item that shows the relationship between actual and predicted position, and activity. It also provides the user with additional real-time information for better interpretation of ECG data. The model is suitable for users who use less strength like extra low-power sign processors or low-power radio communications with smartphones, such as personal devices.

D. Image Stabilization

The photograph stabilization machine makes use of algorithms to analyze the facts collected through the accelerometer and regulate the movement of the digital camera's photo sensor or lens to counteract any movement brought about by blur or distortion. While the digicam is moving, the digicam will pause vibrations to take a photograph. When the digicam continues to be, the picture is captured. The application of picture stabilization is glogger VS2.[4]

In this project, the researchers used high-precision gyroscopes inside the electronic photo stabilization device, not simplest solving the complex problem of the use of the movement vector size algorithm in digital photograph stabilization, however additionally may be universally prolonged. In addition, strong accuracy can be substantially expanded. All in all, it is a worthwhile endeavor.

E. Accelerometer and Surround Sound Technology: Making Touch Screen Mobile Devices Accessible

We discover the concept of the use of a mixture of surround sound and accelerometer era to allow blind Customers to efficiently manipulate touch display screen gadgets. They discussed the challenges concerned with representing icons and the usage of sound and offered a layout framework that helps solve some of those issues. [5]

It is very useful for the blind to use the mobile touch screen effectively and this device also reduces reliance on others.

F. Drowsiness Detection System

A drowsiness detection gadget in an accelerometer is a generation that makes use of an accelerometer to hit upon while a driver is becoming drowsy or falling asleep while driving. The device works by using reading the movement facts accumulated by using the accelerometer and the use of algorithms to locate patterns which can be indicative of drowsiness. They used an accelerometer and a gyroscope.[6]

The principal gain of this tool is low energy intake and high accuracy. This also allows for lowering the demise price going on because of site visitor accidents that motivate drowsy drivers.

G. Human Activity Recognition

Activity popularity has received popularity in the field of wearable applications. Some of the regions which have benefited from the development of interest recognition are scientific fitness and tracking. The goal of the researchers become to recognize the consumer's interest in using a tool worn at the wrist. Human pastime popularity using an accelerometer is a technology that uses facts from an accelerometer to stumble on and perceive the sortof physical interest being completed by way of a person. This generation is commonly utilized in wearable gadgets, consisting of health trackers and smart watches, to tune and monitor bodily activity carried out via the purchaser. As soon as the activity is anticipated, it calculates the corresponding calories burned in keeping with interest.[7]

This tool could be very convenient for docs to constantly reveal sufferers. It facilitates to better hit-upon and screen sports which include strolling, brisk on foot, strolling and jumping. Additionally, the accuracy furnished by this device is better compared to others.

IV. POSSIBLE APPLICATIONS

Epilepsy is a set of neurological proceedings considered via Epileptic Seizures; it is far experienced by means of 1% to 2% of the global population. 30% of the instances do now not reply to medications or surgeries. Therefore, the ability of an epilepsy-affected person calls for continuous monitoring with seizure detection methods. The first step in improving epilepsy treatment is to do a precise analysis, considering that epilepsy isn't the simplest ailment with one motive and one treatment, but as an alternative a ramification of diseases with one-of-a-kind treatments that specify themselves as epileptic crises.

There are many health issues in today's time but the most common and frequent is falling. Each year an estimated 6,84,000 individuals die from falls globally of which over 80% are in low and middle-income countries.

Epilepsy is mainly caused due to a sudden increase or decrease in heart rate, dizziness, light-headedness, blurred or double vision, and foot pain. As per the above-described problem statement, there is no effective epilepsy patient fall detection system to aware the nearby people and relatives. There is also not any system for the analysis of patient falls as per the various parameters of the doctor. Epilepsy is a neurological disorder marked by the sudden loss of consciousness.

To overcome this, it is possible to design and develop an "Epilepsy Patient Fall Detection System using an Accelerometer" for the development of the above-said fall detection system, an accelerometer and gyroscope can be used to detect the human body position across the coordinates (x, y and z) and the body tilt angle of the faller. By coupling the accelerometer with the gyroscope, the accuracy of the system can be improved.
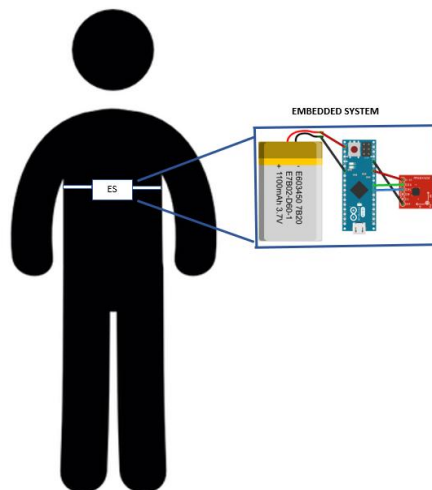

Fig.2: Person with Accelerometer

V. CONCLUSION

In this study, we have understood basic information about an accelerometer and analyzed various applications of an accelerometer. The analysis discussed the various application possibilities by using an accelerometer. This study and analysis motivate us to select an accelerometer for the development of the "Epilepsy Fall Detection System."

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