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Gesture Identification Using Sensors
Future of Interaction with Smart Phones

Mr. Pratik Parmar[1]
[1]*Department of Computer engineering, CTIDS*

Abstract— Over the years from entertainment to gaming market, Gesture recognition is becoming the most powerful invention to interact with the machines especially smart phones , it is the most bright and proficient border between humans and machines. This technology is used in Smartphone's to identify the gestures made by the user and act accordingly. The paper explains how the smart phone recognizes human gestures. It also explains types of sensors. The author has also discussed sensors used for gesture identification in Smartphone.

Keywords— Gesture Identification, Human – Smartphone Interface, Accelerometer, Gyroscope, Smartphone sensors

I. Introduction

Mobile phones are the most invasive wearable computers currently available and have the potential to modify and maneuver our observations. Simultaneously Hand gestures have been the most used technique of communication used by human beings. Gesture recognition bridges both human and machine for effective and easy communication. Gesture recognition adds a whole new dimension to the multimedia. With gesture recognition as user interface to smart phones, it offers an insightful way to interact with a smart phone. After the invention of touch screens, gesture identification explored a new dimension to interact with smart phones. Some of the commonly used gestures are swipe to unlock, pinch to zoom, pull to refresh, swipe left right to go through photographs and many more. Gesture recognition permits the users to use their bodies as an input, without being paralyzed on the limited input capabilities of the smart phones. With gesture identification we can use Z axis using hand shapes which allows reality experience. To guarantee a fast acceptance rate of gesture recognition, technologies already available in mobile phones should be consumed. Features like accelerometer sensing and vibro-tactile feedback are readily accessible in smart phones, and this should filter through to most smart phones in the future.

II. How Smart Phone Recognizes Gestures?

In order to recognize the gestures from the user mobile phone uses different techniques like sensing gestures through front camera, Wi-Fi and now the most popular technique used for sensing gestures are use of sensors like gyroscope, proximity sensor & accelerometer.

III. Gesture sensor types

There are two types of gestures.

1. Offline gesture
2. Online gesture sensor

Offline gesture

Those gestures which are processed after the interaction of user with device is completed are called offline gestures. For example a gesture made to open camera on Smartphone

Online gesture

Those gestures which are processed immediately as the user interacts with the device are called online gestures. For example a gesture made to move object in a gaming application.

IV. Online Gesture Identification through sensors

The two main sensors used for identifying gestures are accelerometer & gyroscope. Accelerometer is a sensor which is skilled to measure the acceleration that a device is suffering. It is an inertial sensor which senses the acceleration due to gravity and movements of the object, with the help of it the third party applications takes the necessary steps as a result. On the other hand gyroscope which is also an inertial sensor measures the angular velocity on the 3D axes of smart phone.

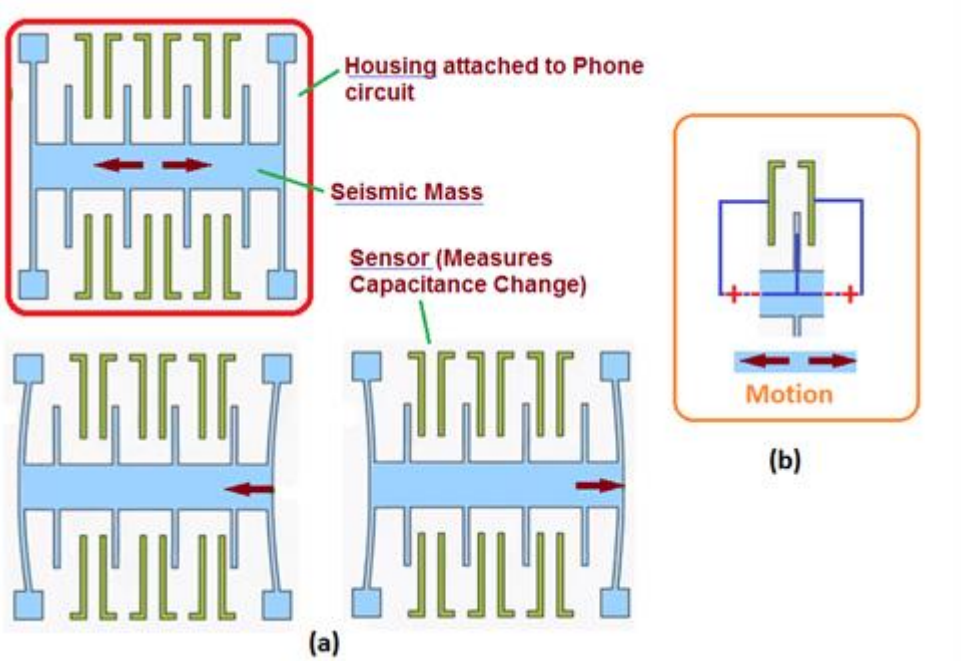
Accelerometer

This sensor detects the acceleration your phone is experiencing when you move with it. It detects the g-force associated with the movement. It can automatically orient the phone according to the position you are holding it in. The accelerometer is a very tiny chip that has extremely tiny (around 500 microns thin) moving parts made of silicon.

Actually a smart device with accelerometer is nothing but a circuit based on MEMS(Micro Electro Mechanical System), that senses or measures the forces of acceleration that may be caused due to gravity of movement or tilting action. So, it is a device to measure the speed of acceleration or movement to which it is attached. If it is employed in mobile, it will do accordingly. It also senses the angle at which it is being held via mobile.

Working principle of accelerometer

Following figure shows the working principle:



The figure (b), a cutout of figure (a), shows change in capacitance as a result of change in position of Seismic mass, when smart device is tilted or changed in orientation. This will recognize the change

in gravitational pull by changing the current equivalent to capacitance change. This is the working principle of Smartphone accelerometer.

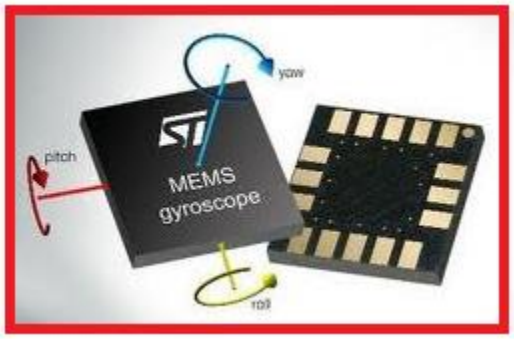
The principle of accelerometer is using inertial force. Try to imagine a box with six walls, a ball is floating in the middle of the box because no force is added to the ball (e.g., the box may be in the outer space). When the box moves to the right direction, the ball will hit the left wall. The left wall is pressure sensitive that it can measure the force of hitting applied to the left wall; therefore, the acceleration can be measured. Because of gravity, when the box is placed at earth, the ball will keep pressing the bottom wall of the box and give constant ~9.8 m/s2 acceleration. The gravity force will affect the measurement of accelerometer for measuring speed or displacement of an object in a three-dimension. The gravity force must be subtracted before any measurement. However, the gravity force can be taken as an advantage of detecting the rotation of a device. When a user rotates his Smartphone, the content he/she is watching will switch between portrait and landscape. As Figure 2 shows, when the screen of Smartphone is in a portrait condition, -axis will sense the gravity; when the screen of Smartphone is in a landscape condition, -axis will sense the gravity. According to this, users can rotate their screens without affecting their reading experiences.

Gyroscope

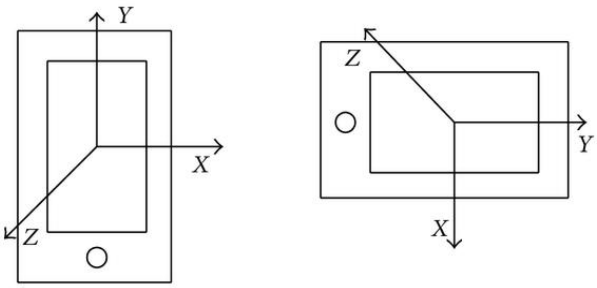
A gyroscope is a device that uses Earth's gravity to help determine orientation. Its design consists of a freely-rotating disk called a rotor, mounted onto a spinning axis in the center of a larger and more stable wheel. As the axis turns, the rotor remains stationary to indicate the central gravitational pull, and thus which way is "down."

In fact, gyroscope is more of an orientation tool for Smartphone, rather than the accelerometer. .This sensor's function is to maintain and control the position, level or orientation based on the principle of angular momentum. It also detects the roll, pitch and yaw motions. Yaw, Roll and Pitch are the angular moments seen from three axes i.e. X, Y and Z. Using MEMS (Micro Electrical and Mechanical System) technology, gyroscopic sensors helps in navigation purpose and detecting the gesture recognition systems used in Smartphone's.

Mechanically, a gyroscope is a spinning wheel or disk in which the axle is free to assume any orientation. Although this orientation does not remain fixed, it changes in response to an external torque much lesser and in a different direction than it would be without the large angular momentum associated with the disk's high rate of spin and moment of inertia. The device's orientation remains nearly fixed, regardless of the mounting platforms motion because mounting the device in a gimbals minimizes external torque



Gyroscope



Screen rotation(coordinates)

Gyroscope is a very sensitive device; it is good at noticing the spin movement. Same as accelerometer, gyroscope returns three-dimensional values; the coordinate system is as Figure shows. The value gyroscope returns is angular velocity which indicates how fast the device rotates around the axes.

Accelerometer and Gyroscope together

When used together, a gyroscope and accelerometer provide a six-axis interpretation of movement through space. This is especially useful Smartphone's, because it can filter the unintended ambient movement and vibration of a user's hand, allowing for a more accurate measurement of intentional movements. It is valuable to understand the basic functions of a gyroscope and accelerometer to comprehend the manner in which these devices complement one another in combined operation.
When a gyroscope and accelerometer are combined, it is possible to simultaneously measure acceleration and gravitational placement in the X, Y, and Z axis. This combination results in a total of six orientation measurements at all times. There are numerous advantages to having six directional measurements available to system processors, and many consumer device producers have taken note of this. By combining a gyroscope and accelerometer, it is possible to better stabilize cameras for clearer pictures, gaming applications can better interpret user motions for greater realism, and navigation applications can more accurately guide users by measuring their movements. A gyroscope and accelerometer are used together to create a more accurate measurement of overall movement and location through space by providing constant, cross-referenced measurements of spatial placement and acceleration.

V. Conclusion

Gestures sensors are enhancing the user experience compared to what is available today. The paper described how gesture identification works and it also covered the basic of sensors used in gesture identification.

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