HAND GESTURE RECOGNITION USING ACCELEROMETER FOR DISABLED

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Abstract:

Only way of communication for the Disabled persons who can't speak and hear is the sign language. A system has been proposed in this paper which helps in recognizing the Gestures made by disabled persons and thus helps them to communicate with others easily using the Gesture Technology. Portable device is developed in this system for making Gestures. This device contains tri-axial accelerometer motion sensor, microcontroller (msp430G Launchpad) and wireless Technology (Bluetooth). Microcontroller reads the 3-axis data of the sensor and sends wirelessly through Bluetooth to the processor when the user makes the Gesture. An Application has been developed on the processor, which will process the data and message will be displayed that the user wants to convey based on the recognized gesture. The system uses very low power of 3.3-5v.

Keywords: Motion Sensor, Low power, Gesture Technology, Disabled Persons, portable device, Accelerometer, wireless Technology.

I. INTRODUCTION

Gesture Recognition enables human to communicate naturally with the machine i.e. Human Computer Interaction (HCI). This Technology has its application in many fields like gaming, mobile phones, controlling machines etc., where the human needs flexibility. There is one section of humans, who can't talk and hear (Disabled persons). The only mode of communication for them is through sign language i.e., Gestures. But most of the people can't understand this sign language. Using this Gesture Technology, An application has been proposed and developed for the Disabled persons to convey their needs to others and also helps others to understand the needs of Disabled persons easily.

There are mainly two existing types of gesture recognition methods, i.e., vision-based and MEMS (accelerometer and/or gyroscope) based. Most of existing systems in the gesture recognition follows vision-based approaches. It requires sophisticated image processing platforms .Mostly cameras were used as input devices. Object has to be present in front of the cameras for making gestures, which limits the mobility. Power consumption is the major challenge. Due to some limitations like slower dynamic response, and relatively large data collections/processing of vision-based method is expensive as well. To overcome the limitations of vision-based method, and to strike a balance between accuracy of collected data and cost of devices, a Micro Inertial Measurement Unit is utilized in this project to detect the accelerations of hand motions in three dimensions. The proposed recognition system is implemented based on MEMS acceleration sensors. Since heavy computation burden will be brought if gyroscopes are used for inertial measurement our current system is based on MEMS accelerometers only and gyroscopes are not implemented for motion sensing.

By using the latest available hardware to reduce the cost, power consumption and also to support future enhancement has been the main objective of this project. Power consumption is the main factor for any system especially for embedded systems. Hardware has to be selected by considering overall cost, Power consumption, accuracy etc..,. And also the software (IDE) for performing communication between peripherals has to be selected by considering the speed, if any free IDE's are available and also the working Operating system like Linux which are open-source and user friendly.

II. LITERATURE SURVEY:

Since years Research work has been going on Gesture Technology in many ways for the devices to be more flexible and portable. As discussed there are two types of Gesture Recognition methods: Vision-based and MEMS based.

Much research has been done on Vision-based in the starting of this technology. Many applications for Home appliances, controlling machines has been developed using this method. In vision based method, Recognition can be done by taking Signs made by Eyes, head and hands. But because of many limitations with this method Research has been turned to MEMS method in the early years.

In the MEMS based method, mainly two motion sensors accelerometer and Gyroscope can be used for Gesture Recognition. But no methods exist using Gyroscope because of computational burden. Accelerometer is the best suitable motion sensor for Gesture recognition applications.

Using accelerometer, some researches are going to develop a portable system for the Disabled persons and also for the Handicapped people to move the wheel chair with simple gestures. One among the developed system is "MEMS Accelerometer Based Nonspecific-User Hand Gesture Recognition". But in this system process of Gesture Segmentation and Feature extraction are followed which

ISSN: 2278 – 7798

includes a long process of signal processing. But main aim of any system is to reduce the computational burden. For this the principle of accelerometer in the mobiles has been considered for the Gesture recognition using 3-axis values of Accelerometer.

III. PROPOSED SYSTEM:

The complete project is developed on Linux OS platform. Microcontroller is programmed with Energia, an IDE which has inbuilt functions available which makes programming easy. Application for Recognizing gestures was developed in Qt creator which is a full development frame work which is useful for creation applications of user interfaces for Desktop, mobile phones etc.,.

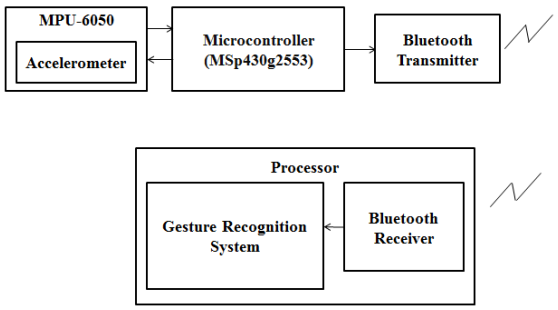


Fig1 Block diagram for proposed system

a. MOTION PROCESSING UNIT (MPU-6050)

The MPU-6050 Motion Processing Unit is the world's first motion processing solution for handset and tablet applications, game controllers, motion pointer remote controls, and other consumer devices. The MPU-6050 has 3-axis MEMS gyroscope, a 3-axis MEMS accelerometer, and a Digital Motion Processor (DMP).

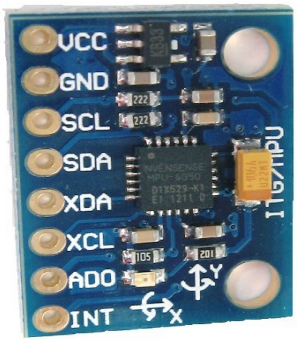


Fig2. MPU6050 IC

The MPU-6050 has three 16-bit analog-to-digital converters (ADCs) for digitizing the gyroscope outputs and three 16-bit ADCs for digitizing the accelerometer outputs. For precision tracking of both fast and slow motions, they feature a user-programmable gyroscope full-scale range of ±250, ±500, ±1000, and ±2000°/sec (dps) and a user-programmable accelerometer full-scale range of ±2g, ±4g, ±8g, and ±16g.

For power supply flexibility, the MPU-6050 operates from VDD power supply voltage range of 2.375V-3.46V.

b. MICRO CONTROLLER (MSP430g2553):

The MSP-EXP430G2 Launchpad is an inexpensive and simple evaluation kit for the MSP430G2553 Value Line series of microcontrollers. The MSP-EXP430G2 Launchpad comes with an MSP430G2553 device by default. The MSP430G2553 has the most memory available of the compatible Value Line devices.

The MSP430 has one active mode and five software selectable low-power modes of operation.

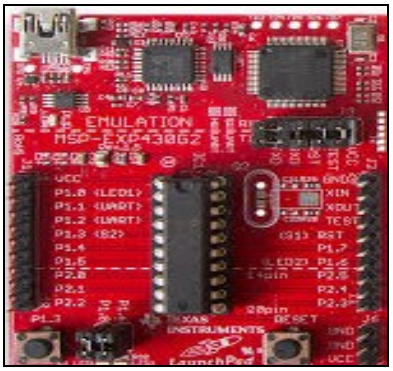


Fig3. MSP430g2553 Launchpad

c. BLUETOOTH MODULE:

HC-05 module is an easy to use Bluetooth SPP (Serial Port Profile) module, designed for transparent wireless serial connection setup. It is used for converting serial port to Bluetooth. The HC-05 module can build a connection to other modules. The response time for HC-05 less than 300 ms

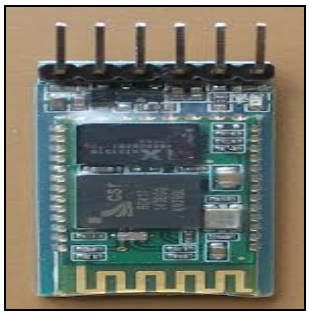


Fig4. HC-05 Bluetooth module

IV. WORKING OF PORTABLE DEVICE

SCL and SDA pins of MPU-6050 IC are connected to I2C communication pins of MSp430 Launch pad. Power supply to MSP430g2553 board is enough for MPU-6050 also as the power supply is 3.3-5V for both.

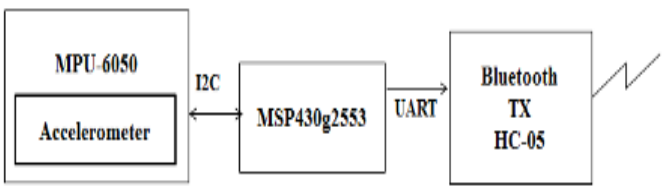
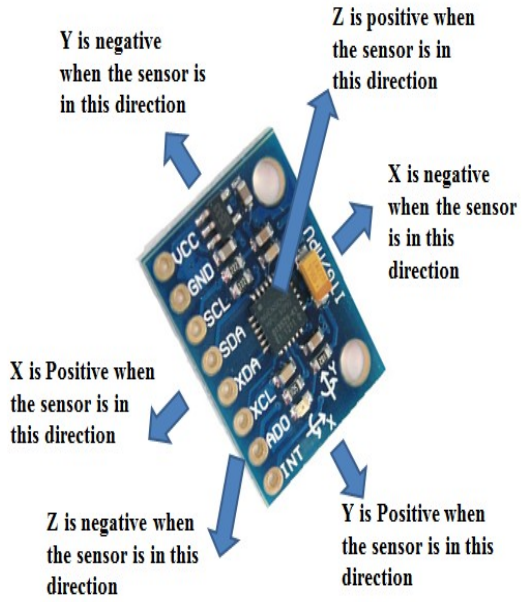


Fig5. Portable device Block diagram

ISSN: 2278 – 7798

V. ALGORITHM FOR GESTURE RECOGNITION

The principle of Accelerometer in smart phones has been used as the basic principle to our Recognition algorithm. With these 3- axis, 8 Gestures can be represented. When the Sensor is in Static position on the surface, y-axis value will be read as '0' because of 'g' value. But that is the ideal which is not possible in real situations. So, y value will be read as some -ve value nearer to 0. When the Sensor is in downward direction, Z-axis value becomes positive. In this way when the sensor changes its direction, axis values will be changed.



3-axis→ 8 Gestures

When Z is positive:	When Z is negative:
1. X positive, Y Positive	1. X positive, Y Positive
2. X positive, Y negative	2. X positive, Y negative
3. X negative, Y positive	3. X negative, Y positive
4. X negative, Y negative	4. X negative, Y negative

Fig 6. Principle of Recognition algorithm

Step1: Start the Transmitter by providing power supply to all the modules of it from the power supply circuit.
Step2: Once the supply is given, MSP430 starts communication with MPU-6050 by sending the slave address.
Step3: After the slave address has been sent, some registers of MPU-6050 like Power management resgister, WHO_AM_I register of MPU-6050 has to be programmed.
Step4: Now, the registers of Accelerometer (X, Y, Z-axis registers) are read.
Step5: These values are sent to the Processor through Bluetooth.

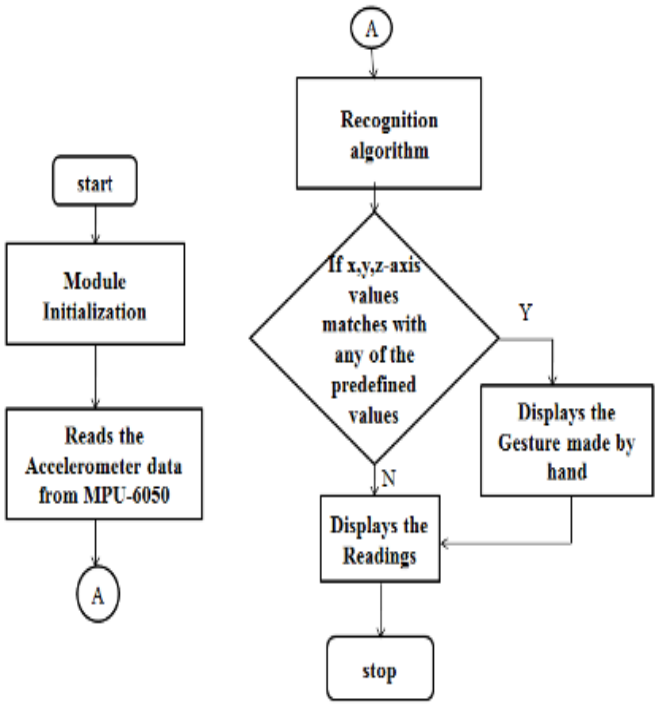


Fig7. Flow chart of the Hand Gesture Recognition system

VI. RESULTS

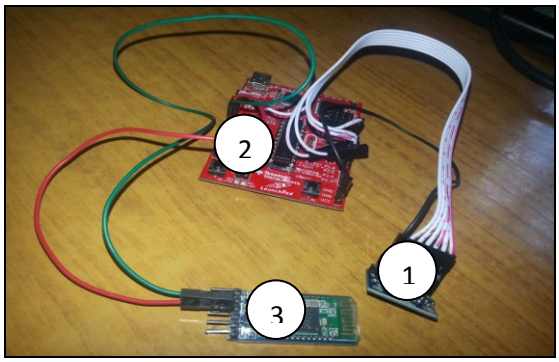


Fig8. Portable Device

(1. MPU-6050. 2. MSP430g2553 3. HC-05)

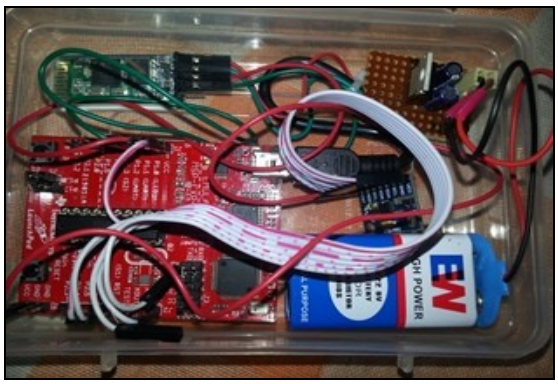


Fig9. Portable device with a power supply of 5v

ISSN: 2278 – 7798

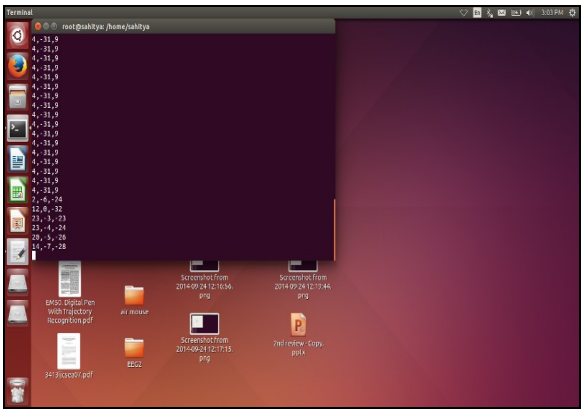


Fig10. X.Y.Z-axis values that read from the sensor to the Processor

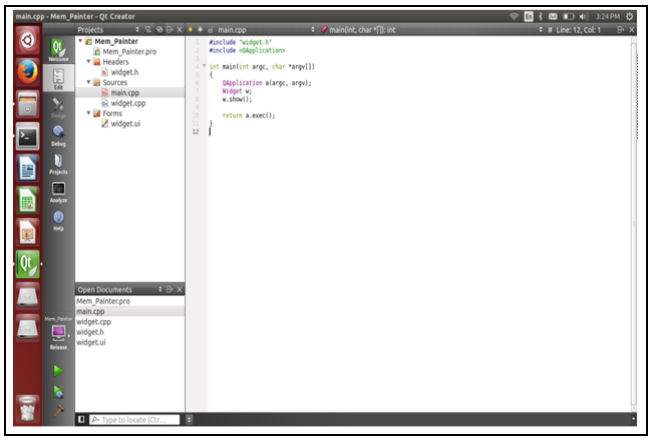


Fig11. Application developed in Qt creator for Gesture Recognition

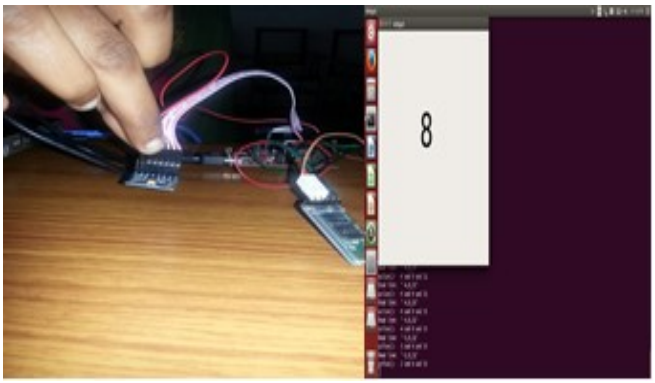


Fig12. 8 displayed for the Respective Gesture

VII. CONCLUSION

Taking the advantage of MEMS Technology, an application has been developed for the Recognition of Hand-Gesture. Low power Design: 3.3V-5V for the Portable device. New Technology of MPU-6050 has been used, which has the scope to use it completely along with gyroscope of it for future enhancement applications.

IX. REFERENCES

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ISSN: 2278 – 7798