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# MEMS Accelerometer Based Gesture Controlled Java Music Player

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***Abstract***

**In this project we are using the MEMS Accelerometer MMA7660 IC. This gives the three dimensions (x, y, and z) readings of a particular object. So if we move any object in any direction then the corresponding values are noted by the accelerometer. Most of the music players are controlled through the remote controls which contain buttons. But through embedding the MEMS Accelerometer we can make music player can control by gesture performance in the air. The application of this three axis accelerometer together with suitable interfacing with the ARM7 micro controller and the music player development through coding in java which could recognize the hyper terminal input instructions can perform functions like play, stop, play back and play forward of music player controlled by gesture. We need to move the MMA accelerometer in a particular set of directions then it will recognize one of the directions like REWIND, FORWARD, PLAY and STOP and operate the songs present in the list of music system.**

**Index Terms: MEMS, Accelerometer, MMA 7660, ARM 7, LCD, PC, Music Player, Gesture, Java.**

## INTRODUCTION

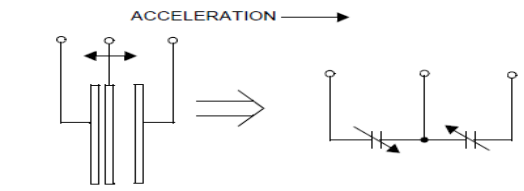
In this project we are using MMA accelerometer sensor i.e., **MMA-7660** which is a low power, low profile capacitive 3-axis accelerometer commonly called as free fall detection sensor. Because of a sleep mode pin on the accelerometer makes it ideal for the handheld battery powered electronics.

The player is coded in Java using Java media frame work which recognizes the port list from the hyper terminal devices connected and reads the commands coming from the RS-232 interface to the corresponding port. The program memory of the Arm controller is coded in such a way that it recognizes the values in the tilt register of the MMA accelerometer and sends the commands of Play, Stop, forward and rewind to the hyper terminal port connected through the Rs- 232 interface.

## LITERATURE SURVEY

The MMA7660FC is a ±1.5 g 3-Axis Accelerometer with Digital Output (I2C). It is a very low power, low profile capacitive MEMS sensor featuring a low pass filter, compensation for 0g offset and gain errors, and conversion to 6-bit digital values at user configurable samples per second. The device can be used for sensor data changes, product orientation, and gesture detection through an interrupt pin (INT). The device is housed in a small 3mm x 3mm x 0.9mm DFN package.

The Free scale Accelerometer consists of a MEMS capacitive sensing g-cell and a signal conditioning ASIC contained in a single package. The sensing element is sealed hermetically at the wafer level using a bulk micro machined cap wafer. The g-cell is a mechanical structure formed from semi conductor materials (poly silicon) using masking and etching processes. The sensor can be modeled as a movable beam that moves between two mechanically fixed beams. Two gaps are formed; one being between the movable beam and the first stationary beam and the second between the movable beam and the second stationary beam. The ASIC uses switched capacitor techniques to measure the g-cell capacitors and extract the acceleration data from the difference between the two capacitors. The ASIC also signal conditions and filters (switched capacitor) the signal, providing a digital output that is proportional to acceleration.




MMA7660FC gives the customer the capability to do orientation detection for such applications as Portrait/Landscape in Mobile Phone/PDA/ PMP. The tilt orientation of the device is in 3 dimensions and is identified in its last known static position. This enables a product to set its display orientation appropriately to either portrait/landscape mode, or to turn off the display if the product is placed upside down. The sensor provides six different positions including: Left, Right, Up, Down, Back, and Front. In Measurement

Mode the data is processed and updates the orientation positions in the TILT (0x03) register. At each measurement interval, it computes new values for Left, Right, Up, Down, Back, and Front but it does not automatically update these bits in the TILT (0x03) register. These values are updated depending on the de bounce filter settings (SR Register 0x08) configured by the customer.

In order to give the customer the ability to configure the de bounce filter, specific to their application, they can change the following bits in the SR (0x08) register, FILT [2:0]. Please see below for a more detailed explanation of how the FILT [2:0] works in conjunction with updating the TILT (0x03) register:

• If FILT[2:0] = 000, then the new values for Left, Right, Up, Down, Back, and Front are updated in the TILT (0x03) register after every reading without any further analysis.

• If FILT[2:0] = 001 – 111, then the sensor requires the computed values for Left, Right, Up, Down, Back, and Front to be the same from 1-7 consecutive readings (depending on the value in FILT[2:0], before updating the values stored in TILT (0x03) register. The de bounce counter is reset after a mismatched reading or the TILT (0x03) register is updated (if the orientation condition is met).

## I. BLOCK DIAGRAM EXPLANATION

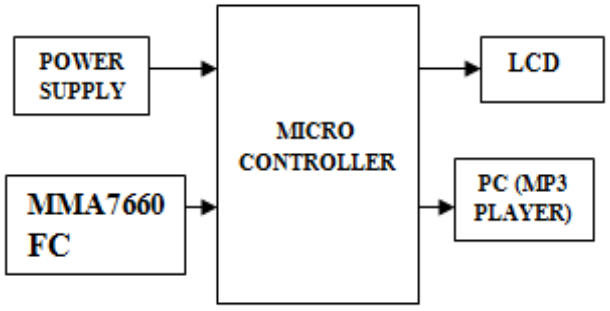



Fig 1: Block diagram of MMA Controlled Music Player

In this project we required operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed AC voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified AC voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator.

This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

The MMA accelerometer consists of a tilt register which give the orientation logic of the gesture. First the values are defined for the gesture performance and these values are fixed to the commands of the player.

The Arm controller is processed in such a way that depending up on the orientation logic performed by the accelerometer the tilt values keep on changing. These values are read through the SCL, SDA and the INT lines which are interfaced to one of the port in Arm controller LPC 2148. Apart from sending the commands to the hyper terminal the commands are also displayed on the LCD interfaced to the Arm 7 micro controller with the help of internal LCD commands.

## INTERFACING BETWEEN THE MODULES

PC is connected to the UART 0, SCL is connected to the P0.2, SDA is connected to the P0.3, and INT is connected to the port P0.1. These three pins can be connected to any of the pins in the controller and as per the connections the code and logic are maintained. The figure below shows the interfacing of the MMA accelerometer to micro controller unit.

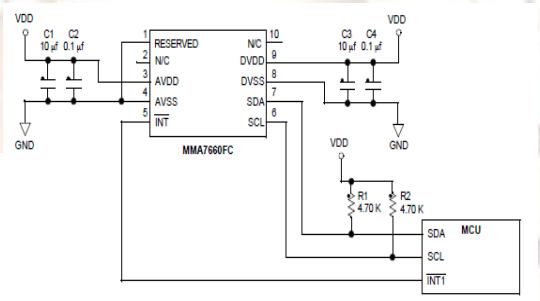



Fig 2: Interfacing of MMA 7660 to MCU

The interfacing between the LCD and the Arm 7 microcontroller is done through four data lines. The 8 bit data of the commands are divided in to two four bit data and passed through the four interfaced lines of the LCD and one of Arm 7 microcontroller port. The other two pins are dedicated for RS and EN pins of LCD. The interfacing of LCD module to MCU is shown in the figure below:

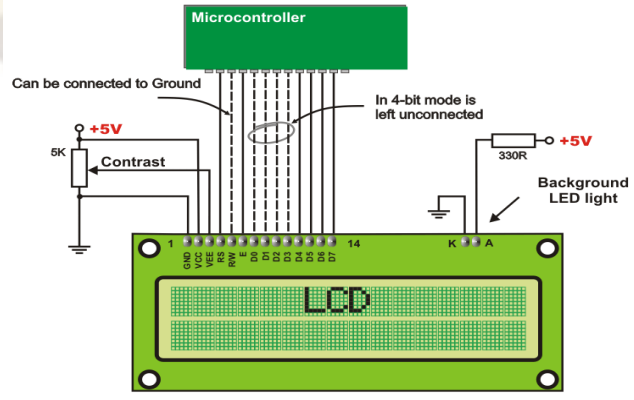


Fig 3: Interfacing of LCD to MCU

## PROJECT WORKING

This project involves the development of the music player in java. For the working of the project the minimum prerequisites for the player development are, java development kit has to be installed and the java media frame work which is a Java library that enables audio, video and other time-based media to be added to Java applications and applets. This optional library package, which can capture, play and stream the multimedia applications, has also to be installed in the PC. The code is written with the appropriate logical conditions with a better exception handling cases and build using the java compiler. The code thus build generates the following files:

comm.jar (available in lib folder of the project)
javax.comm.properties and win32com.dll (available in dll folder of the project)

- Put win32com.dll in C:/Program Files/javasoft/jre/bin
- Put javax.comm.properties in C:/program files/javasoft/jre/lib
- Put comm.jar in C:/program files/javasoft/jre/lib/ext

The gesture recognized by the MEMS with the help of the x, y and z co-ordinate values can be read through the tilt register with the address location of (0x03) register. The data from the Tilt register is sent through the SDA line of the MMA 7660 to the MCU. The code logic for operating the player is written in the Arm 7 LPC 2148 micro controller which is shown below:

```
while(1)
{mask=IOPIN0 & 0X00000002 ;
if(mask==0x00000000)
{x=i2cgetc(0x03);
 y=x&0x40;
 if(y==0x00)
{
y=x&0x1c;
if(y==0x04)        { LCDstr("FORWARD", 0x80);
sendstr("FORWARD"); }
        elseif(y==0x08){    LCDstr("REWIND   ",
0x80); sendstr("REWIND"); }
        elseif(y==0x14){ LCDstr("PLAY   ", 0x80);
sendstr("PLAY");  }
        elseif(y==0x18){ LCDstr("STOP   ", 0x80);
sendstr("STOP");  }
        gap(200); } }}
```

The coding in to the LPC 2148 micro controller is developed and dumped using keil u vision3 software. The power supply connections are produce to the MMA 7660 for the operation of the kit along with the ARM 7 development board.

## CONCLUSION

The project **"Development of Music player in Java and controlling it through the gesture performance with the help of MEMS Accelerometer"** has been successfully designed and tested.

Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

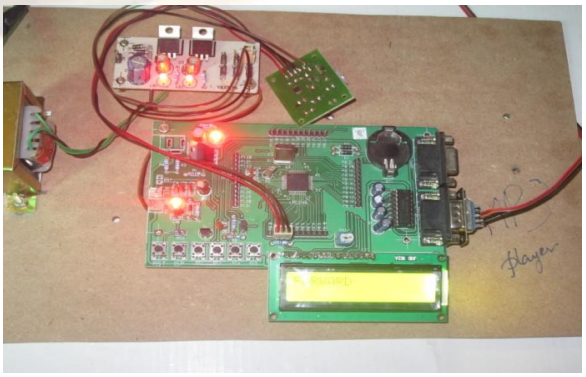
## RESULTS AND DISCUSSIONS

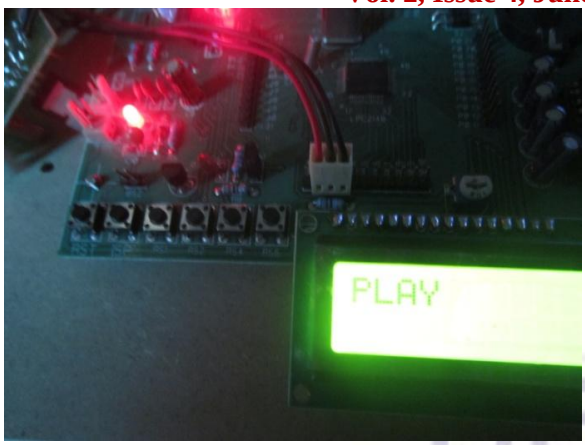
The purpose of the project to operate an MP3 Player by our gesture performance in the air by using MEMS Sensor is achieved. Experiment shows the application of three-axis accelerometer which can realize the functions like play, stop, play back and play forward of MP3 player controlled by gesture. The applications of this project could be done at

1. Homes
2. Parties
3. Functions, etc...

The future enhancement of this project is to integrate the MEMS Accelerometer device in to Nano scale IC which could be easily operated through embedding the IC in to any electronic gadgets.

The result of the project is shown in the below pictures:





## ACKNOWLEDGMENT

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