Novel Head Movements Controlled Car and Voice Alerts for Physically Challenged

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Abstract— The aim of this paper is to control the movements or directions of cars using MEMS technology. The purpose of this paper is to give the directions to the vehicles for physically challenged persons. Inertial sensors are quickly becoming essential components in consumer electronics, enabling features that enhance the operation of an ever expanding list of products such as laptop computers, MP3 players, digital cameras, television remotes, game controllers and mobile phones. Enabling this trend are recent innovations in Micro-Electro Mechanical Systems (MEMS) silicon sensors; in particular, accelerometers and gyroscopes. While these have commonly been used as industrial and automotive components, engineers are overcoming the obstacles that have prevented the introduction of motion sensors into Airplanes, Trains and handheld consumer products. Specifically, advances have been made that reduce cost, size and power consumption.

This paper discusses the use of inertial sensors in a few handheld applications, provides a brief technology overview of accelerometers and gyroscopes, and presents the advantages of using it as a standalone solution, or for supplementing multi-axis accelerometers for a more effective motion sensing solution. The objective of this paper is to develop a system that controls the directions of vehicle depends upon the angles of the tilt sensor then the vehicle will move in that direction. This is very helpful paper for the physically challenged.

Keywords— Advanced RISC Machine(ARM),Micro Electrical Mechanical System (MEMS), APR33A3 VIOCE CIRCUIT

I. INTRODUCTION

The main aim of this paper is to design and construct a gestures controlled voice announcement system and also a robot control by using MEMS sensor. The user can wear this device to any movable part and with the simple gestures he can request the basic needs like water, food or medicine through voice announcements and also can control robot using MEMS (Micro Electro-Mechanical Systems) technology.

MEMS is a Micro Electro Mechanical Sensor which is a highly sensitive sensor and capable of detecting the tilt. This sensor finds the tilt and operates the electrical devices and announces the basic needs depending on tilt. For example if the tilt is to the forward then the robot will move forward direction if the tilt is to the backward the robot moves backward. In the same way, if the tilt is to the left side then robot turns to left. There is a selection switch for voice mode and robot controlling mode. This device is very helpful for paralysis and physically challenged persons.

This device is portable and User can wear it to any movable part and can operate it by tilting the MEMS sensor.

This paper makes use of a APR-33A3 voice chip for audio announcements, DC motors for Robot movement, and Micro controller, which is programmed, with the help of embedded C instructions. This microcontroller is capable of communicating with all the modules. The MEMS based sensor detects the tilt and provides the information to the microcontroller (on board computer) and the controller judges whether the instruction is right movement or left movement instruction and controls the operation respectively.

II. EMBEDDED SYSTEMS

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today.

Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.)

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

Labeled parts include microprocessor (4), RAM (6), flash memory (7).Embedded systems programming is not like normal PC programming.

III. HARDWARE DESCRIPTION

The block diagram and design aspect of independent modules are considered. Block diagram is shown in Fig: 1

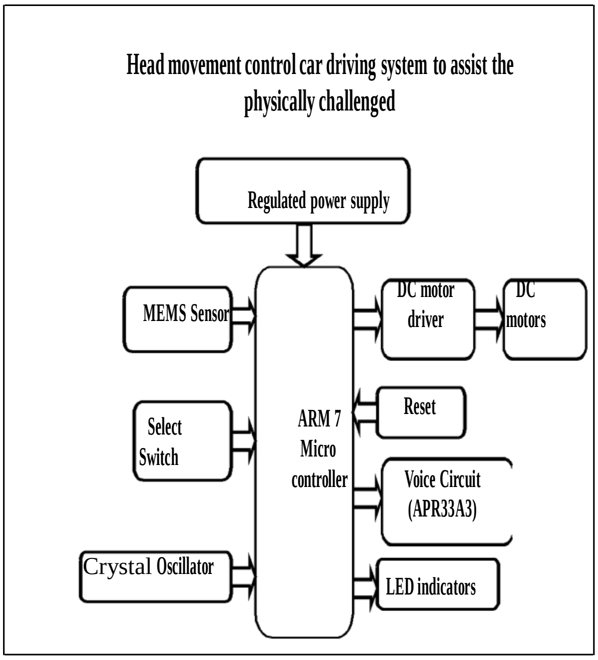


FIG 1: Block diagram of HEAD MOVEMENT CONTROL CAR DRIVING SYSTEM TO ASSIST THE PHYSICALLY CHALLENGED

MEMS sensor MMA 7260 Q

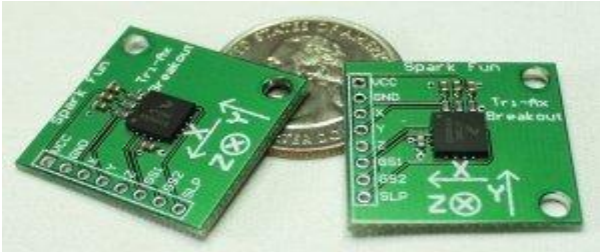


Fig 2 MEMS sensor MMA7260Q

The MMA7260Q is a 3-axis ccelerometer .An accelerometer measures acceleration (change in speed) of anything that it's mounted on. Single axis accelerometers measure acceleration in only one direction. Dual-axis accelerometers are the most common measure acceleration in two directions, perpendicular to each other. Three-axis accelerometers measure acceleration in three directions.

Accelerometers are very handy for measuring the orientation of an object relative to the earth, because gravity causes all objects to accelerate towards the earth. A two-axis accelerometer can be used to measure how level an object is.

(This would be a good place to fill in equations to calculate a body's angle from the X and Y accelerations on the body).

With a three-axis accelerometer, you can measure an object's acceleration in every direction.

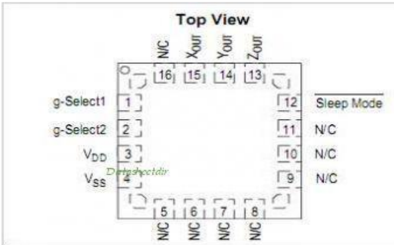


Fig3 MEMS PIN DIAGRAM

This three-axis accelerometer is essentially a carrier board or breakout board for Freescale's MMA7260QT MEMS (micro-electro-mechanical systems) accelerometer; we therefore recommend careful reading of the MMA7260QT datasheet (199k pdf) before using this product. The MMA7260QT is a great IC, but its small, leadless package makes it difficult for the typical student or hobbyist to use. The device also operates at 2.2 V to 3.6 V, which can make interfacing difficult for microcontrollers operating at 5 V. This carrier board addresses both issues while keeping the overall size as compact as possible.

Working of MMA7260Q sensor

The schematic for the 3-axis accelerometer is shown below. The device can be powered directly through the Vcc/3.3 V pin using a supply that is within the MMA7260QT's acceptable power supply range of 2.2 V to 3.6 V. Alternatively, the board can be powered by higher voltages, up to 16 V, using the VIN pin, which connects to a low-dropout 3.3 V regulator. In this configuration, the Vcc/3.3 V pin can serve as an output to be used as a reference voltage or power source for other low-power devices (up to around 50 mA, depending on the input voltage).

The sensitivity selection pins GS1 and GS2 are pulled up to the Vcc line, making the default sensitivity 6g; these pins can be pulled low by a microcontroller or through jumpers. For 5 V microcontroller applications, the lines should not be driven high. Instead, the microcontroller I/O pin can emulate an open-drain or open-collector output by alternating between low output and high-impedance (input) states. Put another way, if you are using a 5 V microcontroller, you should make your sensitivity selection I/O lines inputs and rely upon the internal pull-ups on the GS1 and GS2 lines if you want them to be high. It is always safe for you to drive these lines low.

Each of the three outputs is an RC-filtered analog voltage that ranges from 0 to Vcc. For 5 V applications, the outputs will range from 0 to 3.3 V. The 3.3 V output can be used as a reference for analog-to-digital converters to gain full resolution samples. Otherwise, your conversions will be limited to 66% of the full range (e.g. an 8-bit ADC will yield numbers from 0 to 168).

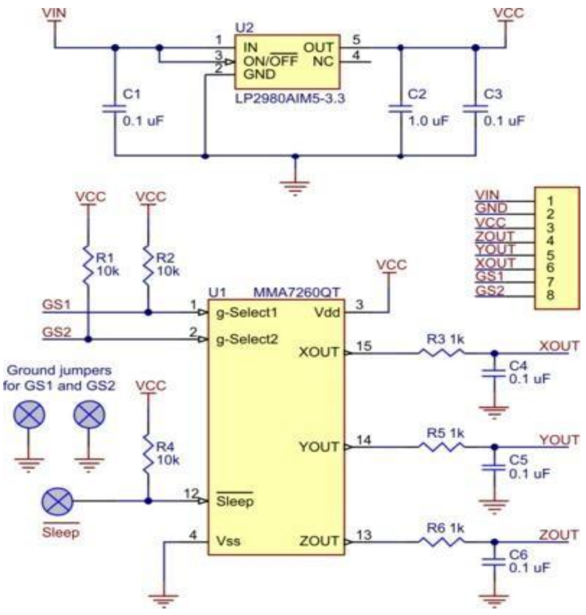


Fig 4. Working of MEMS

A 10x1 strip of 0.1" header pins and two shorting blocks are included, as shown in the left picture below. These components do not come soldered in. You can break the strip into sub-strips and solder them in as desired, or you can solder wires directly to the board for more compact installations. The shorting blocks can be used as sensitivity range selectors as shown in the right picture below, or you can simply control the sensitivity range by using a microcontroller to drive the appropriate range-selector pins low.

Pin Descriptions

These pin descriptions refer to Sparkfun's breakout board. Sparkfun has helpfully added the necesary capacitors and resistors to each output pin so you don't have to. Here is the schematic of the Sparkfun breakout_board.

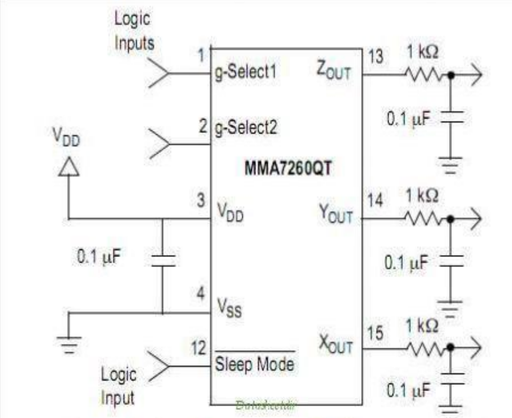


Figure 5. Accelerometer with Recommended Connection Diagram

The pins of the accelerometer are as follows:
Vcc - Voltage, 3.3V
GND - Ground
X - X axis output, 0 - 3.3V
Y - Y axis output, 0 - 3.3V
Z - Z axis output, 0 - 3.3V
GS1 - G-select 1
GS2 - G-select 2
SLP - sleep

The GS1 and GS2 pins allow you to set the accelerometer's sensitivity, depending on how much force it will be subjected to in your application. For low-force activities like measuring the tilt of an object, the lowest setting, 1.5g, is probably enough. If it's going to be attached to a crash-test dummy, you might want to set the sensitivity to the full 6G, or get a better accelerometer. To set the sensitivity, connect the GS1 and GS2 pins as follows:

GS1	GS2	G-range	Sensitivity
GND	GND	1.5g	800mV/g
GND	3.3V	2g	600mV/g
3.3V	GND	4g	300mV/g
3.3V	3.3V	6g	200mV/g

In the schematic below, the accelerometer is connected to a PIC microcontroller running on 5V, so a 3.3V zener diode and 10Kohm resistor were added to the GS1 and GS2 pins to limit the incoming voltage to 3.3V.
The sensitivity of the accelerometer can be changed on the fly, so you could connect the GS1 and GS2 pins to pins of your microcontroller and change the sensitivity by taking the appropriate microcontroller pins high or low. The sleep pin puts the accelerometer in a low-current inactive mode. To put the accelerometer to sleep, take the sleep pin low. To activate the accelerometer, take it high (3.3v). Note: I originally had a 3.3V zener diode and 10Kohm resistor connecting the sleep pin to the PIC, but I found that I had to eliminate them in order to get consistent performance. Your mileage may vary -- tigoe

Microcontroller Connections

To connect the accelerometer to a PIC, use this schematic*:*

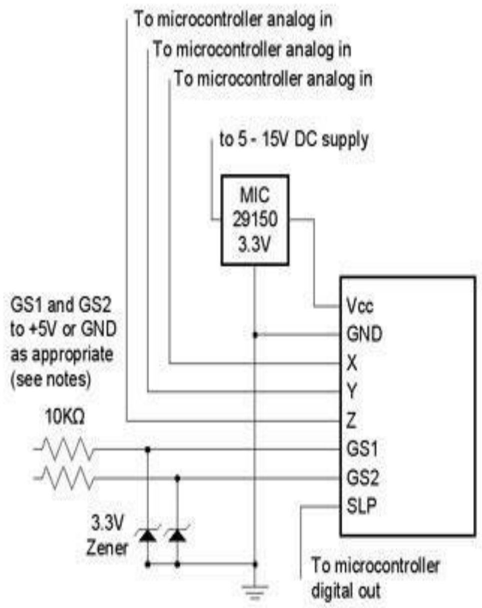
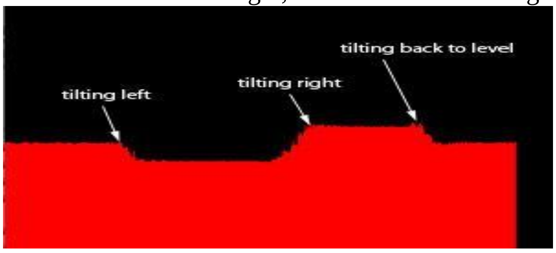


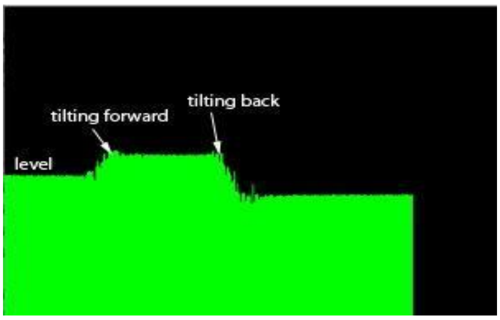
Fig 6 Microcontroller Connections

Parts list:

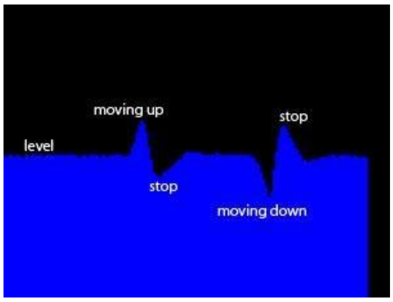
MMA7260Q accelerometer on Sparkfun breakout board
MIC29150-3.3BT 3.3V voltage regulator
2 - 10Kohm 0.25-watt resistors
2 - 1N5226B-T 3.3V zenar diodes
. This graph shows the X axis. The accelerometer starts level, and then is tilted to the left, then to the right, then level again:



This graph shows the Y axis. The accelerometer starts level, and then is tilted forward, then back, then level again:



This graph shows the Z axis. The accelerometer is kept level, but raised up in a quick motion, then lowered quickly. Moving up produces a sudden increase in force (and voltage) followed by a sudden decrease when the movement's stopped, then finally the voltage levels out again. Moving down has the opposite effect.



If you were using the accelerometer to navigate in a virtual 3D space, you'd have to factor in the sudden decelerations that occur at the end of moving up or down, or the virtual object you're moving would probably have a very bouncy movement.

Electrical Characteristics

The MMA7260Q operates on 2.2 to 3.6VDC, and uses very little current (500uA). It has three analog outputs, one for each axis. Acceleration on each axis generates a voltage from 0 to approximately 3.3V.

When there's no acceleration on a given axis, the output for that axis outputs half the supply voltage, or about 1.65V. With acceleration in a positive direction along the axis, the output voltage for that axis rises. With negative acceleration along the axis, the voltage goes down. In other words:

at rest the voltage is in the middle;

at full forward acceleration, the voltage is at its highest;

at full backward acceleration, the voltage is at its lowest.

Applications

Accelerometers are real workhorses in the sensor world because they can sense such a wide range of motion. They're used in the latest Apple Power books (and other laptops) to detect when the computer's suddenly moved or tipped, so the hard drive can be locked up during movement. They're used in cameras, to control image stabilization functions. They're used in pedometers, gait meters, and other exercise and physical therapy devices. They're used in gaming controls to generate tilt data. They're used in automobiles, to control airbag release when there's a sudden stop. There are countless other applications for them.

D.C. Motor

A dc_motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).

Fig 7:DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. The termination points are called the commutator, and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

Operation

The DC motor you will find in modem industrial applications operates very similarly to the simple DC motor described earlier in this chapter. Figure 12-9 shows an electrical diagram of a simple DC motor. Notice that the DC voltage is applied directly to the field winding and the brushes. The armature and the field are both shown as a coil of wire. In later diagrams, a field resistor will be added in series with the field to control the motor speed.

When voltage is applied to the motor, current begins to flow through the field coil from the negative terminal to the positive terminal. This sets up a strong magnetic field in the field winding. Current also begins to flow through the brushes into a commutator segment and then through an armature coil. The current continues to flow through the coil back to the brush that is attached to other end of the coil and returns to the DC power source. The current flowing in the armature coil sets up a strong magnetic field in the armature.

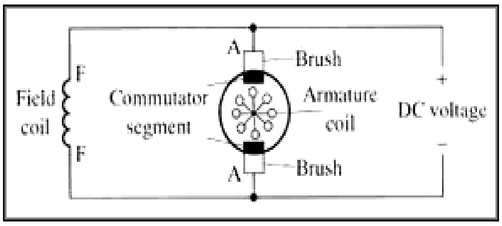


Fig 8: Simple diagram of DC motor

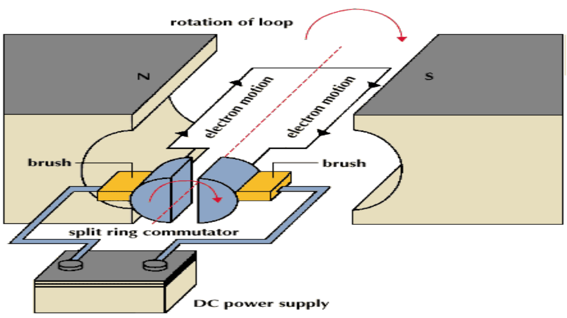


Fig 9: Operation of a DC Motor

The magnetic field in the armature and field coil causes the armature to begin to rotate. This occurs by the unlike magnetic poles attracting each other and the like magnetic poles repelling each other. As the armature begins to rotate, the commutator segments will also begin to move under the brushes. As an individual commutator segment moves under the brush connected to positive voltage, it will become positive, and when it moves under a brush connected to negative voltage it will become negative. In this way, the commutator segments continually change polarity from positive to negative. Since the commutator segments are connected to the ends of the wires that make up the field winding in the armature, it causes the magnetic field in the armature to change polarity continually from North Pole to South Pole. The commutator segments and brushes are aligned in such a way that the switch in polarity of the armature coincides with the location of the armature's magnetic field and the field winding's magnetic field. The switching action is timed so that the armature will not lock up magnetically with the field. Instead the magnetic fields tend to build on each other and provide additional torque to keep the motor shaft rotating.

DC Motor Driver

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN.When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs.

When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293, external high-speed output clamp diodes should be used for inductive transient suppression. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation. The L293and L293D are characterized for operation from 0°C to 70°C.

Features of L293D:

600mA Output current capability per channel
1.2A Peak output current (non repetitive) per channel
Enable facility
Over temperature protection
Logical “0”input voltage up to 1.5 v

APR33A3 VIOCE CIRCUIT

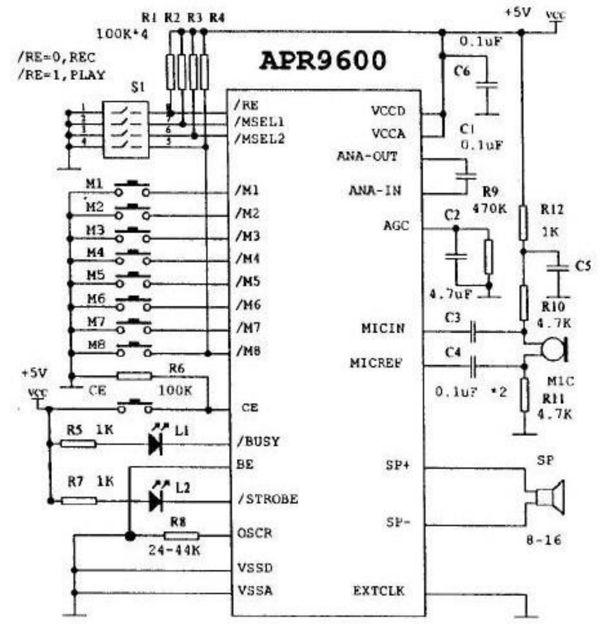
APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage technique. Recorded sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60 second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz.
TheAPR33A3has a 28 pin DIP package. Supply voltage is between 4.5V to 6.5V. During recording and replaying, current consumption is 25 mA. In idle mode, the current drops to 1 □A. TheAPR33A3experimental board is an assembled PCB board consisting of anAPR33A3IC, an electret microphone, support components and necessary switches to allow users to explore all functions of theAPR33A3chip. The oscillation resistor is chosen so that the total recording period is 60 seconds with a sampling rate of 4.2 kHz. The board measures 80mm by 55mm.

APR9600

Pin-out of theAPR33A3is given in Figure 1. A typical connection of the chip is given in Figure 2 (This is the circuit diagram of the module). Pin functions of the IC
are given in Table 1. During sound recording, sound is picked up by the microphone. A microphone pre-amplifier amplifies the voltage signal from the microphone. An AGC circuit is included in the pre-

amplifier, the extent of which is controlled by an external capacitor and resistor. If the voltage level of a sound signal is around 100 mV peakto- peak The analogue voltage is then written into non-volatile flash analogue RAMs. It has a 28 pin DIP package. Supply voltage is between 4.5V to 6.5V. During recording and replaying, current consumption is 25 mA. In idle mode, the current drops to 1

APR33A3circuit diagram:



APR33A3module

The circuit diagram of the module is shown in Figure 2. The module consists of anAPR33A3chip, an electrets microphone, support components, a mode selection switch (-RE,MSEL1, MSEL2 and – M8) and 9 keys (-M1 to –M8 and CE). The oscillation resistor is chosen so that the total recording period is 60 seconds with a sampling rate of 4.2 kHz. Users can change the value of the ROSC to obtain other sampling frequencies. It should be noted that if the sampling rate is increased, the length of recording time is decreased. Table 3 gives the details. An 8-16 Ohm speaker is to be used with the module. Users can select different modes using the mode selection switch. The module is measured 80mm□55mm. Connection points (0-8, C and B) can connect to other switches or external digital circuits. In this cased, on-board keys M1 to M8 and CE are by-passed.

Using theAPR33A3module

Parallel mode recording and replaying

Record sound tracks

This is an example of recording 8 sound tracks. The mode switch should have the following pattern: MSEL1=1(switched to left-hand side of the mode selection switch), MSEL2=1 (left-hand side). –M8=1 (left-hand side). RE=0 (right-hand side). The maximum length of the 8 tracks is 7.5 seconds. Press –M1 continuously and you will see BUZY LED illuminates. You can now speak to the microphone. Recording will terminate if –M1 is released or if the recording time exceeds 7.5 seconds. Similarly, press –M2 to -M8 to record other sound tracks. INTEC DATA SHEETSAPR33A3sound recording module Intec Associates Ltd.

Serial mode recording and replaying

Record sound tracks sequentially

This is an example of recording sequential sound tracks. The mode switch should have the following pattern: MSEL1=0(switched to right-hand side of the mode selection switch), MSEL2=0 (right-hand side). –M8=1 (left-hand side). RE=0 (right-hand side). Press CE first to reset the sound track counter to zero. Press and hold –M1 down and you will see BUZY LED illuminates. You can now speak to the microphone. Recording will terminate if –M1 is released or if the recording time exceeds 60 seconds (in this case you will run out the memory for your next sound track). Press –M1 again and again to record 2nd, 3rd , 4th and other consecutive sound tracks. Each sound track may have different lengths, but the accumulated length of all sound tracks will not exceed 60 seconds.

Replay sound tracks sequentially

Now make RE=1 (switched to Left-hand side of the mode selection switch) while keep other switches at the same location. Toggle –M1 (press key and release) causes the 1st sound track to be played once. Toggle –M1 again and again will play the 2nd, 3rd, 4th and other consecutive sound tracks. Press CE to reset the sound track counter to zero.

Record sound tracks with forward control

The mode switch should have the following pattern: MSEL1=0(switched to right-hand side of the mode selection switch), MSEL2=0 (right-hand side). –M8=0 (right-hand side). RE=0 (right-hand side). Press CE first to reset the sound track counter to zero. This mode is rather similar to the above sequential sound recording. The only difference is that after –M1 is pressed and released, the sound track counter does not increment itself to the next sound track location. To move to the next sound track, –M2 should be toggled. So if –M1 is not toggled again and again without toggling –M2, sound will be recorded at the same sound track location.

Replay sound tracks with forward control

Now make RE=1 (switched to Left-hand side of the mode selection switch) while keep other switches at

the same location. Toggle –M1 (press key and release) causes the 1st sound track to be played once. Toggle –M1 again and again will still play the 1st sound track. Once –M2 is toggled, the sound track counter is incremented and the next sound can be played. Press CE to reset the sound track counter to zero.INTEC-DATA_SHEETSAPR33A3sound recording module Intec Associates Ltd.
4. Sampling rates

4. SOFTWARE DESCRIPTION

This project is implemented using following software's:

a. Express PCB – for designing circuit
b. Keil u vision compiler - for compilation part
c. Proteus 7 (Embedded C) – for simulation part.

DESCRIPTION

In this chapter, schematic diagram and interfacing of ARM LPC 2148 microcontroller with each module is considered.

The above schematic diagram of HEAD MOVEMENT CONTROL CAR DRIVING SYSTEM TO ASSIST THE PHYSICALLY CHALLENGED explains the interfacing section of each component with micro controller and DC motor. Crystal oscillator connected to 9th and 10th pins of micro controller and regulated power supply is also connected to micro controller and LED's also connected to micro controller through resistors.

The detailed explanation of each module interfacing with microcontroller is as follows:

Interfacing crystal oscillator and reset button with micro controller

Fig 5.2: explains crystal oscillator and reset button which are connected to micro controller. The two pins of oscillator are connected to the 9th and 10th pins of micro controller; the purpose of external crystal oscillator is to speed up the execution part of instructions per cycle and here the crystal oscillator having 20 MHz frequency. The 1st pin of the microcontroller is referred as MCLR ie.., master clear pin or reset input pin is connected to reset button or power-on-reset.

RESULTS

The main aim of this project is to design and construct a gestures controlled voice announcement system and also a robot control by using MEMS sensor. The user can wear this device to any movable part and with the simple gestures he can request the basic needs like water, food or medicine through voice announcements and also can control robot using MEMS (Micro Electro-Mechanical Systems) technology

Conclusion

Integrating features of all the hardware components used have been developed in 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 with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

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