

Arduino Base Capacitive Proximity Sensor With Midiplayer

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Abstract: Capacitive sensing is a noncontact technology suitable for detecting metals, nonmetals, solids, and liquids, although it is best suited for nonmetallic targets because of its characteristics and cost relative to inductive proximity sensors. In this paper extension of capacitive proximity sensor is shown. The extension is an increase in sensitivity to detect the small changes in capacitance associated with objects at a certain distance from, instead of coming in contact with, the electrode. The sensitivity is a function of the electrode size, ground coupling, and the measurement mechanism. For the proximity capacitive sensing Arduino is a best tool for making such kind of project work that can sense and control more of the physical world than your computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Here in this project we have used Arduino board which contain Atmel MEGA32U4 microcontroller. The ATmega32U4 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32U4 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. In this paper, I am presenting one project which can sense live human or conductive material from distance by proximity capacitive touch sensor controllers MPR121 and plays .mp3 file using this audio codec Ic VS1053b through SD card & 3.5 mm jack Speaker.

Keywords: Capacitive proximity sensor, Midi player, Arduino board, Q matrix E- Field base measurement, speaker.

I. INTRODUCTION

Arduino base proximity sensor with midi player is a part of (1) Internet of Things application (2) Distance sense or touch base kiosk system.

The basic idea behind this research is to sense the object and that sense plays the command or music. Capacitive distance sensor senses the live object which is near to the plate or next device & that device can work depend up on the audio input given from speaker. All commands are already inside the given SD card that is predefined. So depend up on speech next device can act on that. In this Project we have use capacitive proximity sensor that can work on the base Q matrix E- Field of distance sense of live part & it play the sound which is already in SD card.

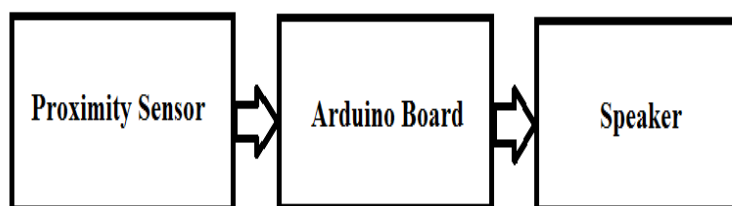


Fig 1: Block diagram of Arduino based distance proximity sensor.

Block diagram of this project work can be shown by Fig.1. Here proximity sensor can detect from distance of 5 to 20 cm. Arduino board has 12 proximity sensor which can connect from wire with the help of copper plate. Proximity detection distance can be different for different material and size of the plate and also change by changing the code of program.

Arduino board has microcontroller, capacitive proximity and audio codec cheap VS1053b which is connected with SD card. For audio output speaker is connected with the board.

1. Internet of Things application (IOTs):

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator or other connected devices. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing internet infrastructure.

Fig 2. Shows the basic block diagram of application of the board. IOTs are the part of future application. One of the best example of this work can be explained by this block diagram.

Proximity sensor sense the live human touch and it gives the command to micro controller. As per the pre-recorded message speaker give the sound at the output. Eleven different kind of sound output i.e. command given to the android application.

Many kind of voice base applications are available in android smart phone. These all application can work on the base of human-voice. Many application like Voice command, Google translate, speak to find on map and GPS available in android application based phone. Such application can be useful for the command base application.

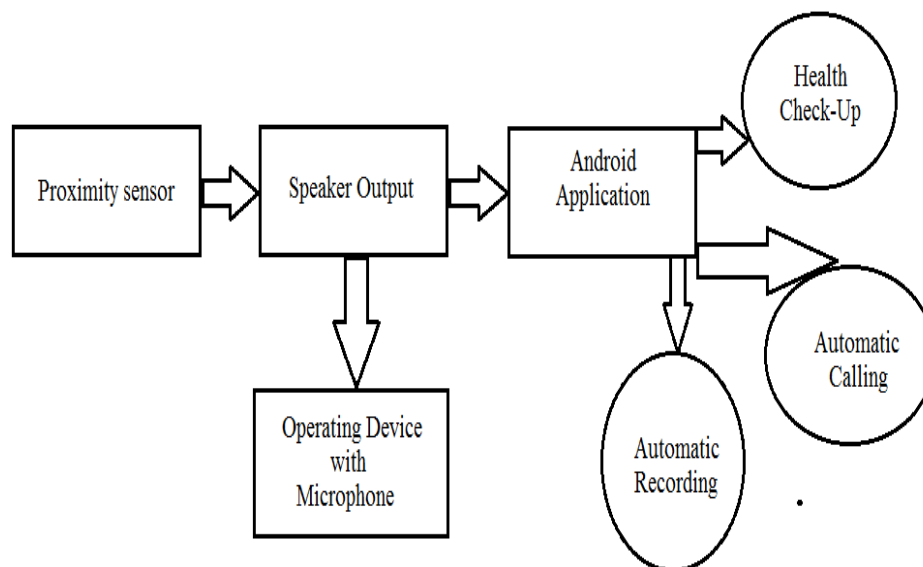


Fig 2. Block diagram of Internet of Things application

This android application run on the base of human pre-recorded voice and it can check health like sugar, Blood pressure and calorie burn during a day and many more. This can work on the base of their function. Output of this application is like it will suggest you to check your blood pressure, calorie and sugar as per your requirement.

Another application can useful for voice base call dialing in that you call your car also. Come out from parking or go to the parking.

2. Distance sense or touch base kiosk system:

Another good application can possible from this project is Kiosk system without requirement in software and hardware. Just by changing the track of memory card output sound is change. So depend up on the application output sound can change in the whole system.

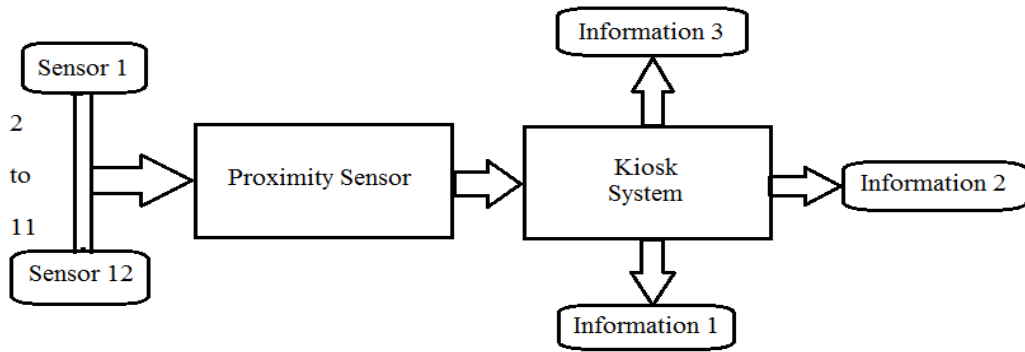


Fig 3. Block diagram of distance base kiosk system

Fig 3. shows the basic block diagram of simple Kiosk system which is based on proximity sensor. Here in this system concept is very simple proximity sensor will sense 12 different sense. As per the requirement information is stored in .MP3 format in memory card with particular sense. Particular .MP3 file will run the depending up on the sense. For example information about heating section is stored in sensor 1 so it will play that. As per our requirement we can put different picture of section above the sensing element.

II. PROXIMITY CAPACITIVE DETECTION PRINCIPLE.

The measurement circuit uses the Atmel patented charge-transfer (QT) technology to measure changes to a sensor as an object approaches. There are three sensing technologies available from Atmel:

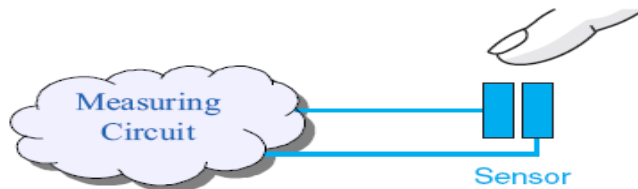


Fig 3. Mutual Capacitance: Q Matrix

1. Q Touch: - Self capacitance, measured using V_{ih} of the sensor input/output (IO) pin.
2. Q Touch ADC: - Self capacitance, measured using an internal Successive Approximation Register (SAR) analog-to-digital converter (ADC).
3. Q Matrix: - Mutual capacitance, measured using an internal counter and comparator.

Q Matrix: it uses the mutual capacitance of a sensor. The E-field associated with mutual Capacitance is coupled closely to the X and Y portions of the sensors. The E-field couples to an object in close proximity to the sensor's E-field.

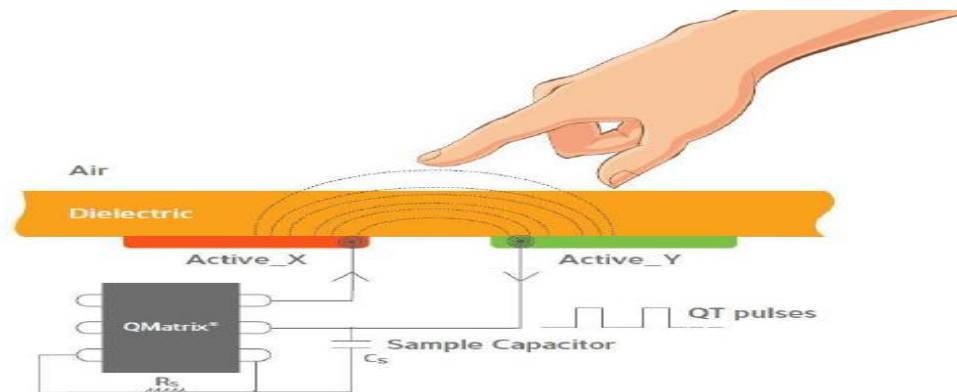


Fig 4.Q Matrix E-field

Sample Capacitor Q Matrix uses a pair of sensing electrodes for each channel. One is an emitting electrode into which a charge consisting of logic pulses is driven in burst mode. The other is a receive electrode that couples to the emitter via the overlying panel dielectric. When a finger touches the panel the field coupling is reduced, and touch is detected. Here in this work Q Matrix Concept is used.

III. EXPERIMENTAL SET UP.

Arduino board is the board in which I can download the code with .ino file. This file is Arduino board compatible file. This board includes the proximity capacitive touch sensor controllers MPR121 cheap which can sense any object with the principle of Q Matrix and plays .mp3 file using this audio codec Ic VS1053b through SD card & 3.5 mm jack Speaker.

The proposed capacitive proximity sensor has been design and its range of detection is shown in table has been tested with a Arduino board.

Arduino board is a part of this work. Here I have connected board with the sensor as per fig 5.

For configuration and set up Arduino board is connected with the windows 7 and above system. Following step must be followed with the system for configuration.

1. Get an Arduino board and USB cable
2. Download the Arduino 1.5.8.
3. Connect the board.
4. Install the drivers.
5. Install library files.
6. Launch the Arduino 1.5.8.

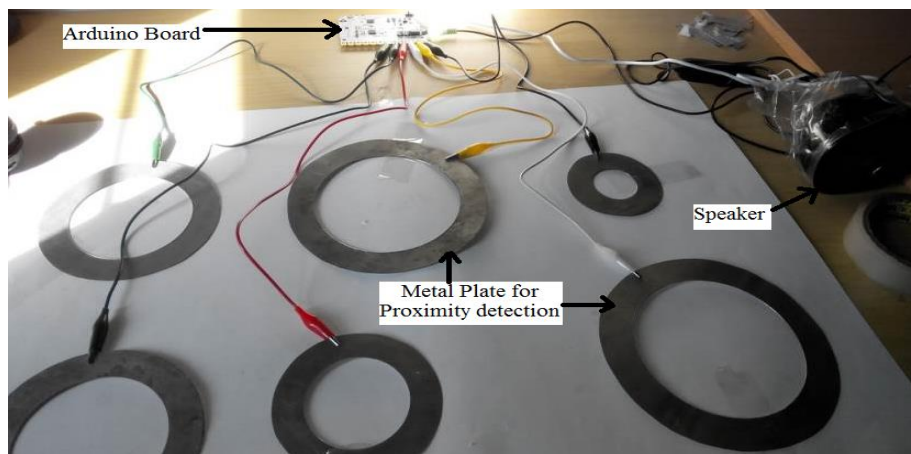


Fig 5. Image of working model of board with proximity sensor

7. Open file: In this project work Open proximity_MP3 sketch: **File >Proximity _MP3 folder>Proximity _MP3>**
9. Here I have to select the entry in the **Tools > Board>bare conductive board.**
- 10 .Select your serial port: Serial Port menu: COM 3
11. Verify & Upload the program.
12. Connect bare conductive board with power supply.
13. Switch on the board with small switch.
14. Store the track with name TRACK000, TRACK001, TRACK002 UP TO TRACK011.
15. Install SD card on its place.
16. Connect the speaker with the bare conductive Board.

17. Do the Master reset before going to sense the proximity sensor.
18. Connect cable with any conductive material to board sensor point to make it work as distance sensor.
19. Put your hand on proximity sensor and see how it detect your movement with the distance of 5 to 20 cm.
20. These same sensor can also work as a touch sensor.

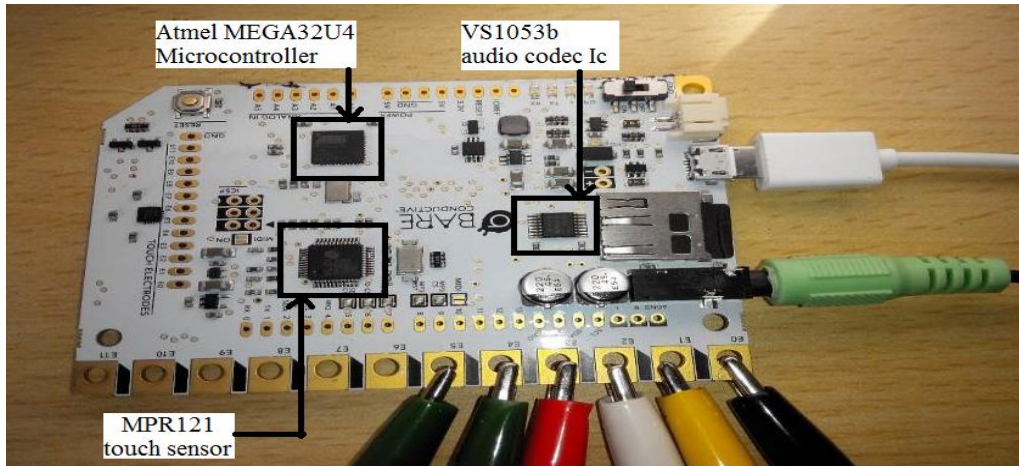


Fig 6. Image of working model of Arduino board without sensor.

Figure 6 shows the Arduino board with the sensor pin connected.

IV. RESULTS

Maximum range of proximity detection is shown in below table. Here in this table two kind of readings are taken. One is with filter and one is without filter.

Table 1. Proximity detection range without C filter

Measurement	Without C in filter	
	PCB	Copper Plate
Noise standard deviation	0.9	1.2
Range(inch)	7.5	8
Range (cm)	19.05	20.32

Table 1. Shows the reading of measurement of Proximity sensor range without C filter.

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Table 2. Proximity detection range with C filter

Measurement	With C in filter	
	PCB	Copper Plate
Noise standard deviation	0.8	1.0
Range(inch)	4.5	8
Range (cm)	11.43	20.32

Table 2. Shows the reading of measurement of proximity sensor range with C filter. Above measurement was checked in laboratory condition and after 20.32 cm in copper plate and 11.43 in PCB detection is not possible.

V. CONCLUSION

Here, we have prepared the project that can be used for the proximity sensing using microcontroller ATmega32U4 and this project can sense any live object from distance of 20 centimetres. In this hardware Proximity distance sensing threshold can be set as per our requirement up to 10 centimetres. We have prepared a novel algorithm and coding for implementation of the proximity detection from distance and as per the detection of 12 different sensor 12 different MP3 track file can played. Interruption of any sensor can stop the running track and play new one which can be sense latest from sensor and store history of last played in microcontroller. This hardware can work as distance sensor and plays the sound.

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