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Cursor Movement using Hand Gestures in Python and Arduino Uno

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Abstract: ***As we are moving ahead in time in technology, humans are making various techniques for their comfort. While working with computers, sometimes it is boring to use a mouse or keyboard to give any computer commands and wait for their execution. For this reason, to increase human-computer interaction, we will use our hand gestures to perform cursor movements and some other exciting functions.***
We are using pair of ultrasonic sensors, Arduino Uno, and python as a programming language. Sensors are for the use of measuring distance. Arduino will take the signals in the form of distance, and it will perform cursor movements like Scrolling through Webpages, Changing Tabs, Volume Increase and Decrease, Play/Pause, Forward and Backward, Working on Presentation Slides with operations such as Previous Slide, Next Slide, writing on slide dynamically, Undo the changes written and Playing Games as well, etc.
Keywords: Human-Computer Interaction, Arduino Uno, Python, Ultrasonic sensor.

I. INTRODUCTION

We have chosen this project to gain knowledge about Human-electronic device interaction and implement the idea in an easy and helpful way. Our main motive behind this project was to make a system where even lazy people and children would feel enthusiastic and interesting in working.
The gesture control technology will definitely make an impact in the field of computers and make it easy to interact directly apart from using old devices like mouse or cursors for every action we want to perform.
The objective of this project is that we will apply these cursor movements using hand gestures in working with the webpages, changing tabs, increasing and decreasing volume, video pause, play, gaming, etc.
After applying the above features, we have the secondary objective of using this method while playing games. We have used both hardware and software knowledge in this project. Hardware application was not easy as we had to solder the correct pins of Arduino Uno and ultrasonic sensors; for that purpose, we had to study this component in detail.
We implemented this project by means of providing a virtual system where we will directly connect with computers using simple hand gestures.

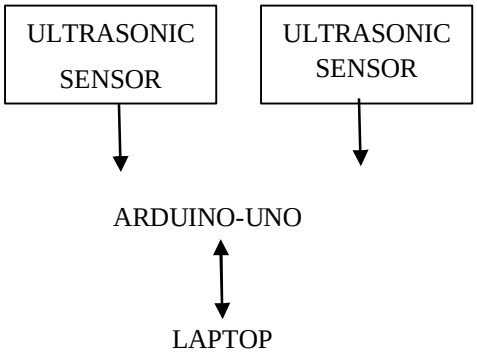
II. LITERATURE SURVEY

Eye gestures have been used as a traditional way of providing virtual keyboards and mouse for some years back technologies. But we are giving all the access by means of our hand gestures for possible work of the cursors, and we are trying to reduce the work of the mouse and other input devices of the computer.
As we have read various research papers related to this topic, we came to the conclusion that in previous years in some technologies, other project teams have implemented the cursor movements using two fingers on which they attached two different color caps, and using that, they tried to perform these actions.
But the drawback of this technique was the uneasiness related to operating actions using only two fingers, and deciding the gestures was a bit complicated.
In the year 2006, Moncton University used ultrasonic sensors to perform the operations which can be done by a mouse. Here we have fitted the ultrasonic sensors which recognize are hand gestures of disabled people, and we got beautiful results. These results can be used in the real-time world instead of the mouse.
In the year 2011, The Institute of Space and Technology published the same project with the help of a camera. Users can interact with the screen using their fingers.

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A. Hardware Components Setup

To implement our project, we require an Arduino Uno Board, Jumper wires, a pair of ultrasonic sensors, and USB cables.



B. Working Of Ultrasonic Sensors

The ultrasonic sensors work on the same principle as the radar system. The basic work of ultrasonic sensors is to detect the distance between sensors and objects. In this project, we have used these sensors for measuring the distance between the sensors and our hand, which we will be using to perform the various actions like up, down, slide, scroll, volume increase and decrease, paint, pause, and play, etc. HC-SR04 is the most popular ultrasonic sensor having four pins. The four pins are Vcc, trigger, echo, and groundpin. The diagram for sensors is shown below. Ground pin. The diagram for sensors is shown below.

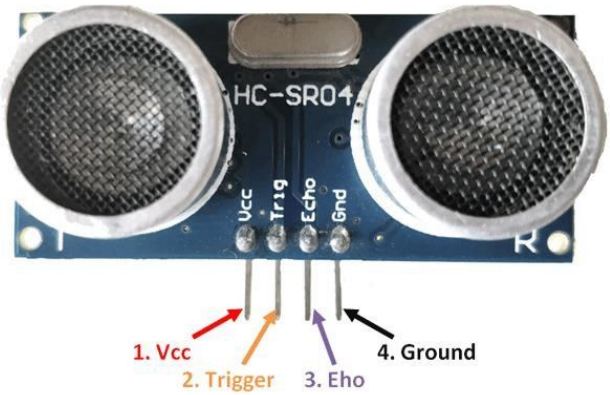


Fig. Pin diagram of ultrasonic sensor

C. Arduino Uno Board

The Arduino Uno Board is an open-source and programmable microcontroller. It consists of 14 digital input/output pins. We can use various programming languages like C/C++, Python, Java, and many more by using the USB cable. The input voltage is between 7-20 volts.



Fig. Arduino Uno Board

D. The Connections of the Board pins are as Follows

For the left sensor, we have to connect the echo pin to pin3 of the Arduino board then we need to connect the trigger pin to pin2. We have to connect Vcc to a 5-volt power pin, and then we have to connect the ground pin first GND pin of the Arduino Uno board.

For the Right sensor, we have to connect the Vcc pin to the 3.3-volt power pin of the Arduino board, and then we will connect the ground pin to the second GND pin. Lastly, we will connect the trigger pin to pin four and the echo pin to pin 5 of the Arduino board.

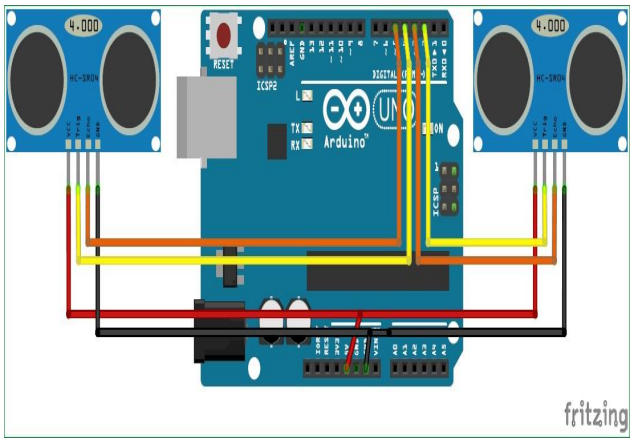


Fig. Connections of Arduino uno board with ultrasonic sensors.

III. SOFTWARE AND PACKAGE INSTALLATIONS

A. Installation of Arduino IDE

Arduino IDE is open-source software that is created to program circuit boards efficiently. We can perform simple operations on this board, like turning on and off LEDs to complex operations like functions related to robots. We can use this software for performing coding operations related to IoT projects, 3D printing, etc.

We have to simply download and install the software and start implementing it.

B. Installation of Python IDE

The main purpose of using python IDE is that we can use various packages for simplifying our work and performing various operations effectively.

C. Installation of PyAutoGUI Library

PyAutoGUI library in python is used to control keyboard and mouse actions on a computer without the help of a mouse.
So, to install this library, we have to use the command "pip install pyautogui."

D. PySerial Library

PySerial library provides backend support to python running on our computer. The main role of this library is that it enables communication with the serial port. To install this library again, we have to use the command "pip install pyserial."

IV. RESULT

Following are some hand gestures we used for cursor movement:

A. Video Player and Web Page Results

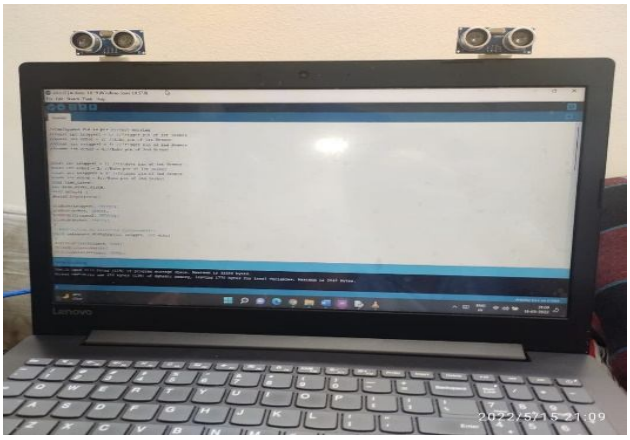
1) Volume up and Webpage Scroll up – Place Left hand near
2) Volume down and Webpage Scroll down – Place Left hand far
3) Tab Change next – Place right hand near
4) Previous Tab – Place right hand far.
5) Moving both hands from right to left in front of Ultrasonic sensors: Play the next video in the VLC player
6) Placing both hands in front of an ultrasonic sensor means playing/pausing of video.

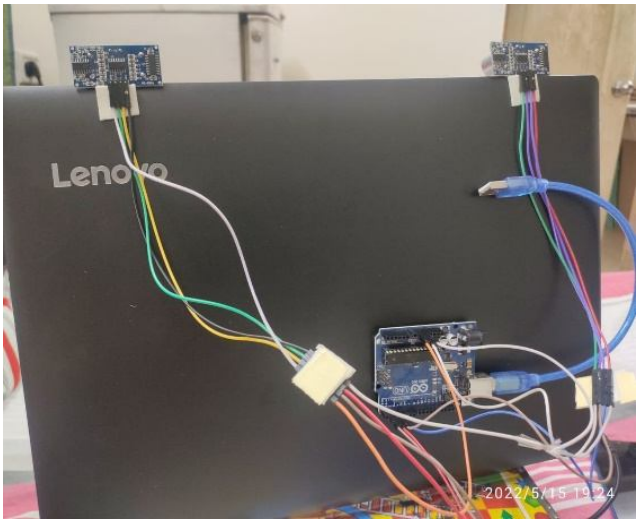
B. Result for Presentation Slide Changes

1) Next Slide – Showing right-hand little finger.
2) Previous Slide – Showing right-hand thumb finger.
3) Freehand drawing – Use index finger to draw/write on a slide
4) Stop writing – Show index and middle finger to stop writing.
5) Undo written changes – Show index, middle, and ring finger to undo changes.

C. Results for Playing the Game

1) Use left-hand index finger as a left player and right-hand index finger as a right player and move up-down to play the game.
2) Press R to restart the game again.





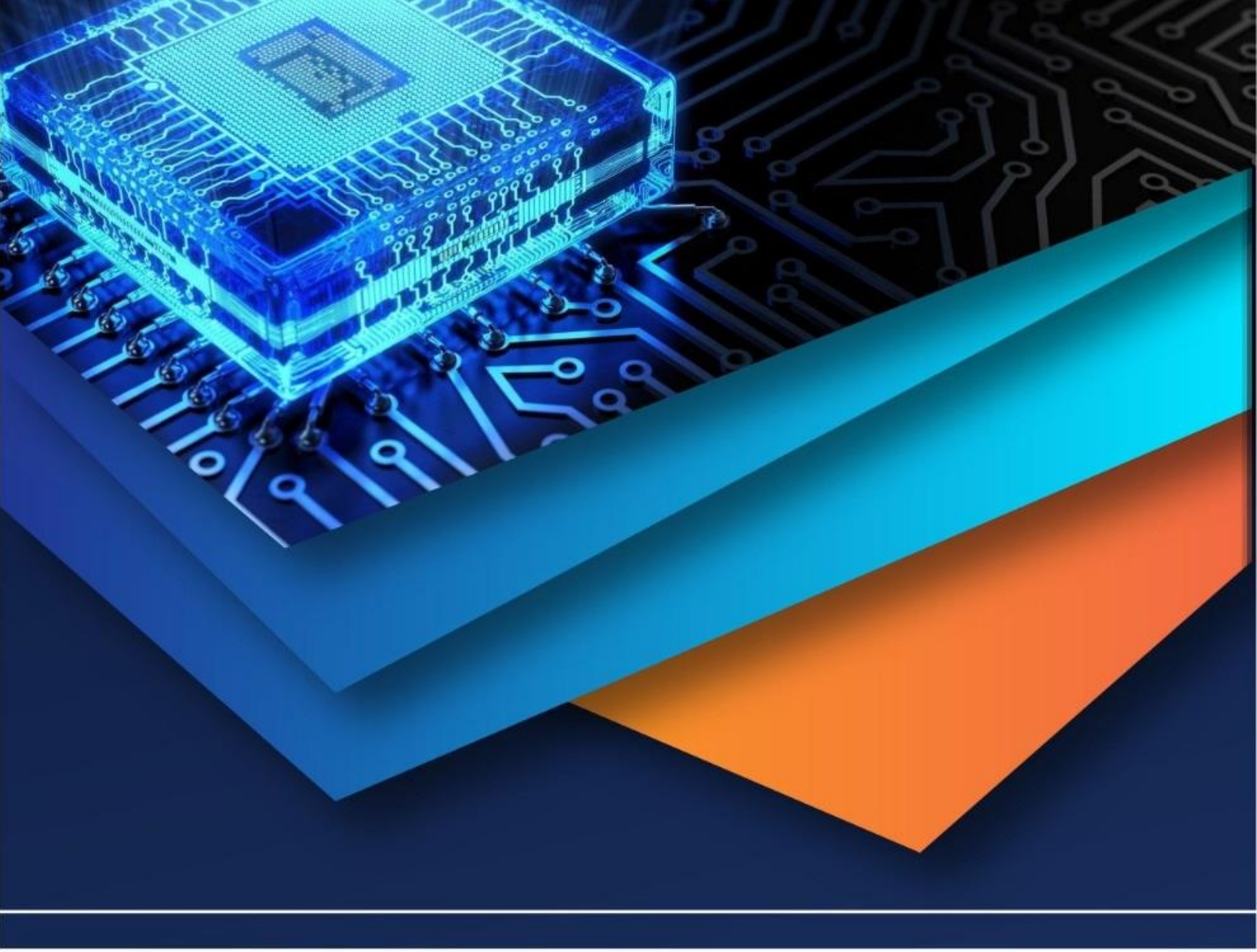
This is the setup we did for our project using hardware components like Arduino Uno, Ultrasonic Sensors, jumper wires, and a USB cable.

V. CONCLUSION

We have created a model that controls mouse actions and implements operations using the camera. The main motive of our project is to create a model which will acknowledge the gestures that will control the laptop/PC in line with those gestures. Our project will make a really great difference were using a mouse will be going tough. The actions like painting, starting the applications, right-click, left-click, notepad, etc., are going to happen with our hand gestures. Before actual implementation, it will detect our skin and then will start implementing. We have designed our model so that any new user can simply handle the system just by installing the setup in very little time.

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