

## Hand Gesture Controlled Laptop Using Arduino

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### ABSTRACT

*The purpose of gesture recognition in Computers has always been the minimization of the distance between the physical world and the digital world. The way humans interact among themselves could be implemented in communication with the digital world by interpreting gestures via mathematical algorithm. Numerous ways and algorithms have been proposed and implemented to achieve the goal of gesture recognition and its use in communicating with the digital world. Gestures can be tracked using hand movements, accelerometers and more. This paper deals with the design and implementation of a gesture controlled computer using Arduino Uno with ATMEGA32 processor and a laptop loaded with Windows 10 operating system along with low cost hardware requirements. The system can be broadly classified into two components: The Hardware part consisting of Arduino Microcontroller, the ultrasonic sensors HC-SR04 and a computer, preferably a laptop, and the software part consists of Arduino IDE and Python 2.714 IDLE with PyAutoGUI module installed.*

**Keywords :** Arduino, Gesture, Laptop, PyAutoGUI, Python, Ultrasonic

### I. INTRODUCTION

Humans interact in the physical world by the means of the five senses. However, gestures have been an important means of communication in the physical world from ancient times, even before the invention of any language. In this era of machines taking control of every complex works, interactions with machines have become more important than ever. Since this paper deals with gesture controlled laptop, the primary focus will be on the use of hand gestures for specific applications only.

There are several ways to capture a human gesture that a computer would be able to recognize. The gesture can be captured using distance measurement, camera, or a data glove. Gestures can also be captured via Bluetooth or infrared waves, Acoustic, Tactile, optical or motion technological means. The embedded systems designed for specific control functions can be optimized to reduce the size and cost of the device and increase the reliability and performance.

This project consists of mainly three components – Arduino Uno, Ultrasonic sensors, and a laptop. The ultrasonic sensors hooked to the Arduino are used to determine the gestures and the distance of the hand from the ultrasonic sensors. The code loaded in Arduino finds the respective keyword for the distance found and sends it to Windows OS. Python code that runs in the background recognizes the keywords and generates the

corresponding virtual keystrokes for Windows. The hotkeys then control particular function of the application of intend to run, that is VLC Media Player.

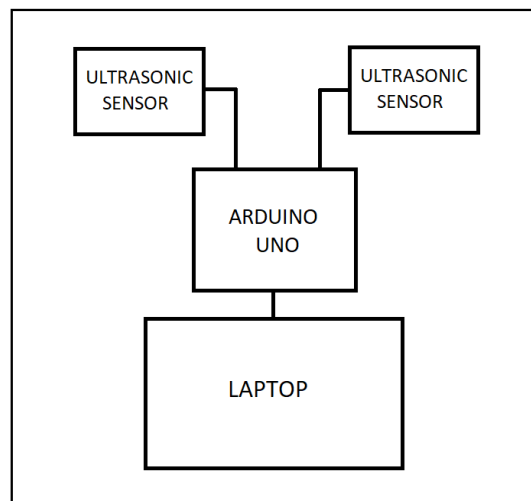
The Arduino coding is done in “Arduino IDE” and uploaded to Arduino Uno. To run the required python code, we need to complete a few more steps.

- (1) Python 2.7.14 is downloaded and installed.
- (2) “pip” function is upgraded, a tool to easily update python modules.
- (3) PyAutoGUI module is downloaded using the pip function and downloaded through internet in the Python command screen itself.
- (4) Then we open “IDLE (Python GUI)”.
- (5) We create a new file and type in the code.
- (6) The file is then saved and run

With the above steps done, python will be able to receive feedback from the Arduino board and hence generate virtual keystrokes in Windows OS. The keystrokes then control the hotkeys of the VLC media player.

## **II. WORKING OF THE LAPTOP**

### **2.1 Basic Layout**



**Fig 2.1 : Block Diagram**

From the above figure 2.1, we see that two ultrasonic sensors are connected to Arduino Uno board and the board is connected to Laptop through USB. The ultrasonic sensors have a transmitter and a receiver where the transmitter emits ultrasonic waves. The waves hit a surface in front of the sensor and any reflected waves are picked up by the transmitter and based on the intensity the distance of the object is determined. This data is received by the Arduino and looks for specific keywords within the code according to the distance that is to be sent to the Python code running in the background of Windows. Python picks up the keywords and generates virtual keystrokes of hot keys for the VLC media player. This process is kept on a continuous loop to control media playback, either video or audio files.

The ultrasonic sensors are the components that read the hand gesture and the distance of the hand from the sensor. For the left sensor, bringing our hand closer to it will rewind the video and moving away from it will fast forward the video. In the right sensor, the same actions would result in controlling the volume of the player.

## 2.2 Circuit Layout

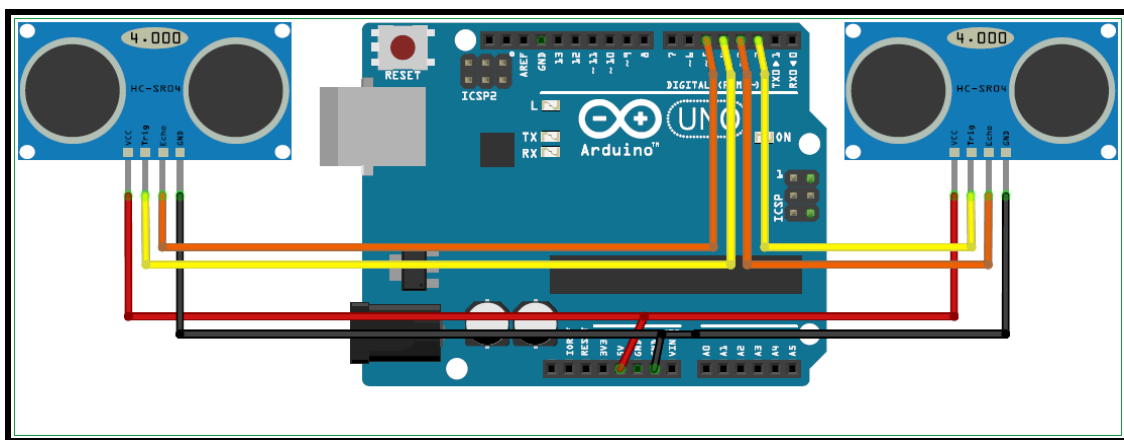


Fig 2.2: Circuit Diagram

As we see in Fig 2.2 here, two ultrasonic sensors are connected to Arduino Uno board and the board is connected to Laptop through USB. The Vcc pin of each sensor is provided by Arduino using the 5V output port. Grounding of both sensors is attached to GND0. The Trigger and Echo pins are connected as per the code written.

The ultrasonic sensors are equipped with a transmitter and a receiver where the transmitter emits ultrasonic waves. The waves hit a surface in front of the sensor and any reflected waves are picked up by the transmitter and based on the intensity the distance of the object is determined. This data is received by the Arduino and looks for specific keywords within the code according to the distance that is to be sent to the Python code

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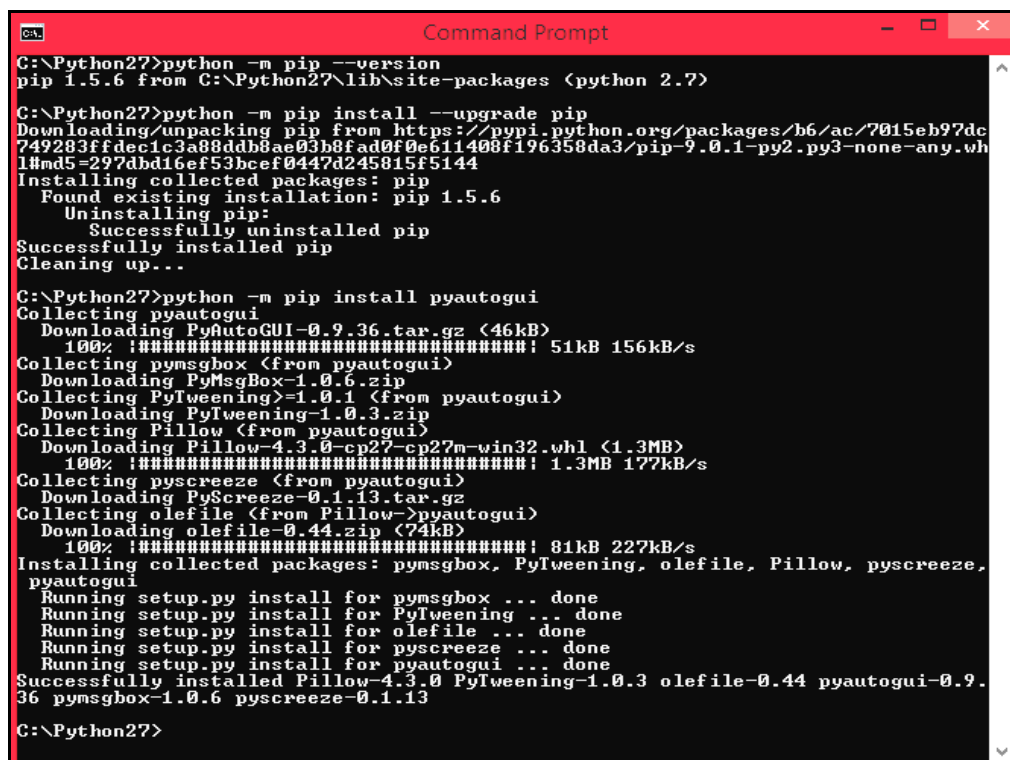
The ultrasonic sensors are the components that read the hand gesture and the distance of the hand from the sensor. For the left sensor, bringing our hand closer to it will rewind the video and moving away from it will fast forward the video. In the right sensor, the same actions would result in controlling the volume of the player.

## 2.3 Software Used

To read hand gestures, will need to program an Arduino and design a Python code. As mentioned earlier that Windows does not recognize commands given by Arduino, hence we use Python to establish serial connection and turn the data received into virtual keystrokes. These virtual keystrokes control the Hotkeys of VLC media player which in turn will control playback of video or audio being played.

The Arduino IDE software works well for programming the Arduino but for Python we need to perform a few more steps after installing Python 2.7 as shown in Fig 2.3. The steps are

- (1) Upgrade pip function of Python
- (2) Install the PyAutoGUI module using pip function.



```
C:\Python27>python -m pip --version
pip 1.5.6 from C:\Python27\lib\site-packages (python 2.7)

C:\Python27>python -m pip install --upgrade pip
Downloading/unpacking pip from https://pypi.python.org/packages/b6/ac/7015eb97dc749283ffdec1c3a88adb8ae03b8fad0f0e611408f196358da3/pip-9.0.1-py2.py3-none-any.whl#md5=297dbd16ef53bcef0447d245815f5144
Installing collected packages: pip
  Found existing installation: pip 1.5.6
    Uninstalling pip:
      Successfully uninstalled pip
Successfully installed pip
Cleaning up...

C:\Python27>python -m pip install pyautogui
Collecting pyautogui
  Downloading PyAutoGUI-0.9.36.tar.gz (46kB)
    100% |#####| 51kB 156kB/s
Collecting pynmsgbox (from pyautogui)
  Downloading PyMsgBox-1.0.6.zip
Collecting PyTweening=1.0.1 (from pyautogui)
  Downloading PyTweening-1.0.3.zip
Collecting Pillow (from pyautogui)
  Downloading Pillow-4.3.0-cp27-cp27m-win32.whl (1.3MB)
    100% |#####| 1.3MB 177kB/s
Collecting pycreeze (from pyautogui)
  Downloading PyScreeze-0.1.13.tar.gz
Collecting olefile (from Pillow->pyautogui)
  Downloading olefile-0.44.zip (74kB)
    100% |#####| 81kB 227kB/s
Installing collected packages: pynmsgbox, PyTweening, olefile, Pillow, pycreeze, pyautogui
  Running setup.py install for pynmsgbox ... done
  Running setup.py install for PyTweening ... done
  Running setup.py install for olefile ... done
  Running setup.py install for pycreeze ... done
  Running setup.py install for pyautogui ... done
Successfully installed Pillow-4.3.0 olefile-0.44 pyautogui-0.9.36 pynmsgbox-1.0.6 pycreeze-0.1.13

C:\Python27>
```

Fig 2.3: Installing pip function and PyAutoGUI module

## 2.4 Hardware Used

For this, we use an Arduino Uno connected to an Asus laptop using the USB port as shown in Fig 2.4.

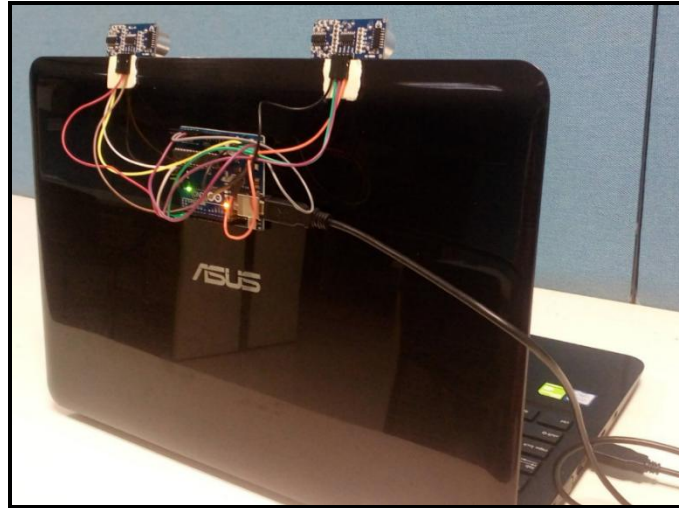
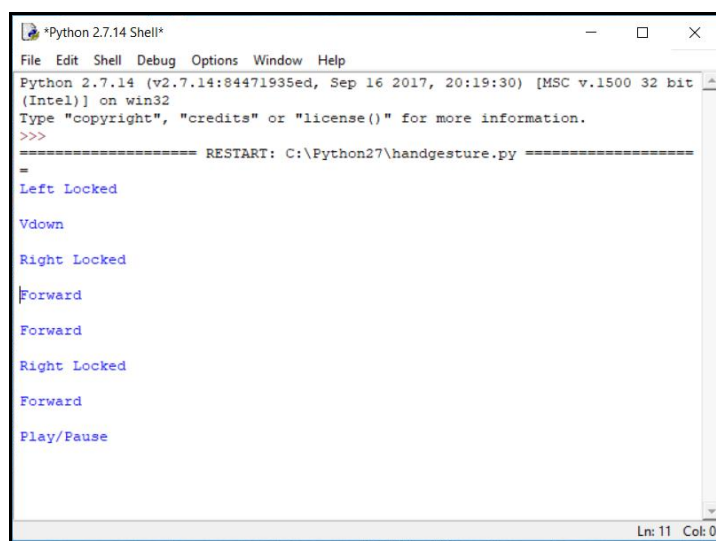


Fig 2.4: Arduino Uno and Ultrasonic Sensors are connected and serial communication is established through USB

## 2.5 Execution of the Program.

When the setup is completely done, we run the python code. Fig 2.5 is how the screen would appear once we click on Run Module. Now we can use our hand gestures near the ultrasonic sensors where necessary actions will be executed.



```
*Python 2.7.14 Shell*
File Edit Shell Debug Options Window Help
Python 2.7.14 (v2.7.14:84471935ed, Sep 16 2017, 20:19:30) [MSC v.1500 32 bit
(Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: C:\Python27\handgesture.py =====
=
Left Locked
Vdown
Right Locked
Forward
Forward
Right Locked
Forward
Play/Pause
Ln: 11 Col: 0
```

Fig. 2.5: Python code being executed according to inputs from Arduino



The left ultrasonic sensor is coded such that bringing our hand closer to the sensor will Rewind and farther from it will Fast Forward the movie or video we play in VLC. Similarly, the right ultrasonic sensor is used to decrease the volume when we bring our hand closer to the sensor and increase the volume when we bring our hand away from it. The same is read by the python code and displayed in blue font.

When we place our hand in front of the left sensor, the input gets activated for the left sensor only and the screen displays “Left Locked” and reads the input as Vdown or Vup, in short for Volume up and Volume down. The same process happens for the right hand. Only when we want to pause, we bring both our hands in front of each of the sensors. Now we can use hand gestures to control VLC Media Player as in Fig 2.6.

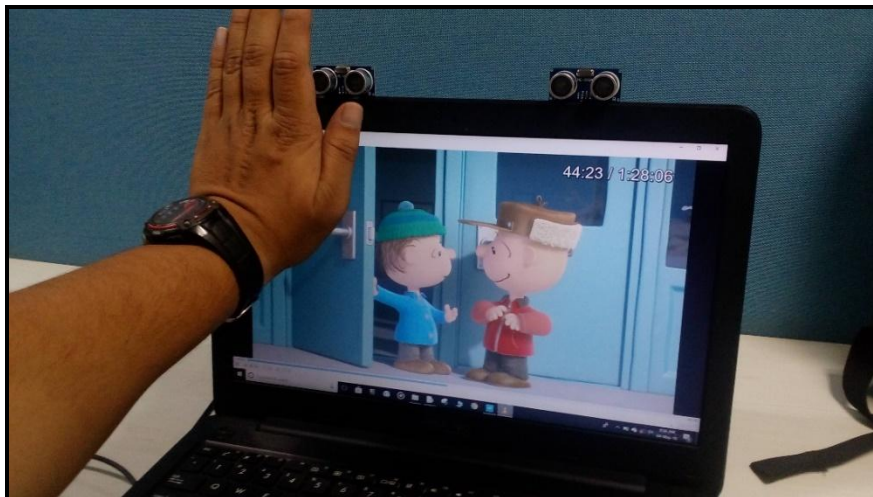


Fig 2.6: Hand Gesture Controlled Laptop in action

### III. HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENT	SOFTWARE REQUIREMENT
<ol style="list-style-type: none"><li>1. HC-SR04 Ultrasonic Sensor</li><li>2. Arduino Uno</li><li>3. Laptop (Windows 7/8/10 OS)</li></ol>	<ol style="list-style-type: none"><li>1. Arduino IDE</li><li>2. Python 2.7.14</li><li>3. VLC Media Player</li></ol>

Table 3.1 Hardware and Software requirements

#### **IV. CONCLUSION**

Hand gesture laptop uses an Arduino Uno, Ultrasonic sensors and a laptop to carry out the operation of controlling media playback and volume. It is mainly aimed at reducing the effort of interaction with computers through input devices using simple gestures. It is also done to increase the interactivity with computers. This type of technology can be used in classroom for easier and interactive learning, immersive gaming, interacting with virtual objects on screen. It will become more effective if merged with completely developed hologram technology. We will be able to interact with virtual 3D objects in the physical world in real time.

#### **REFERENCES**

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- [3] John M.Zelle, Watburg College.,(2016). “Python Programming: An Introduction to Computer Science”
- [4] <https://automatetheboringstuff.com/chapter18/> , “Chapter 18 : Controlling Keyboard and mouse with GUI Automation”