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APPLIANCES CONTROL USING LEAP MOTION DEVICE FOR PHYSICALLY DISABLED PERSONS

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Abstract

Controlling the home appliances and electronics gadgets through an Infrared remote control is now in general. But the same controlling tasks can be done more easily. Primary motive of proposing the new system of hand gesture remote control is to remove the need to look in to the hand held remote and to search for a specific key for specific function. This paper presents a novel system to control home appliances through hand gesture as a remote control device. It uses real time image processing for hand gesture recognition in infrared vision and microcontroller development board , Arduino. This paper proposes a possible solution to control the gadgets for physically challenged people.

Keywords: leap motion controller, gesture recognition, Hand gesture, Infrared vision , Arduino, Personal computer interaction.

1. INTRODUCTION

Among the rising age of technology in the field of gesture recognition for hand gesture or human computer interaction many research are done. Here the Handmote is referred to as use of hand gesture recognition to control the home or office gadgets that are operated through an infrared remote control in general. Simple remote controlled gadgets can be operated to change a TV channel or to tune radio by finding the key on hand held remote control and pressing it. But in this paper author puts effort to control the same but using hand gesture. Simply a hand gesture or showing number of fingers TV can be On/Off . By showing a cross fingered gesture to the camera, light can be on/off, rotating the hand in clockwise or counter clockwise can change to regulate the speed of fan.

2. PROPOSED CONCEPT

There is a computer application designed in Java Processing to have real time image processing. An infrared camera is giving images in infrared vision to the computer application. After processing the images and recognizing the hand gesture, decision data is send to a microcontroller hardware based on Arduino environment . This hardware sends the data to the gadgets in same way as a remote control does for general use. Gesture recognition solutions can be divided regard to the type of gesture used for controlling a computer. Gesture can be considered as a change of the hand position (hand movement) in a particular time interval with a given velocity or as a change of the hand shape (forming ellipse with thumb and the index finger). Gesture that belong to the first group are typically called dynamic gestures while there from the second group are often referred to as static gesture.

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BLOCK DIAGRAM

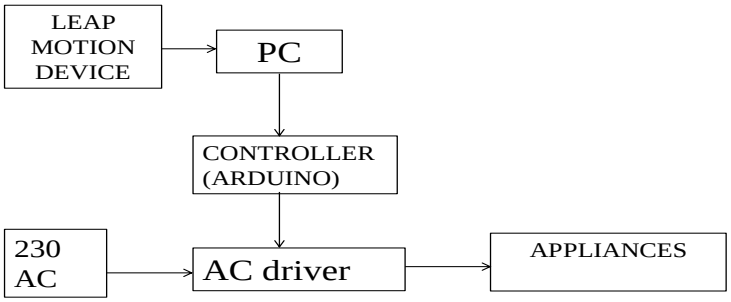

Fig.1. Block Diagram

Leap motion controller

From a hardware perspective, the Leap Motion Controller is actually quite simple. Its an iPod sized gesture recognition human computer interface

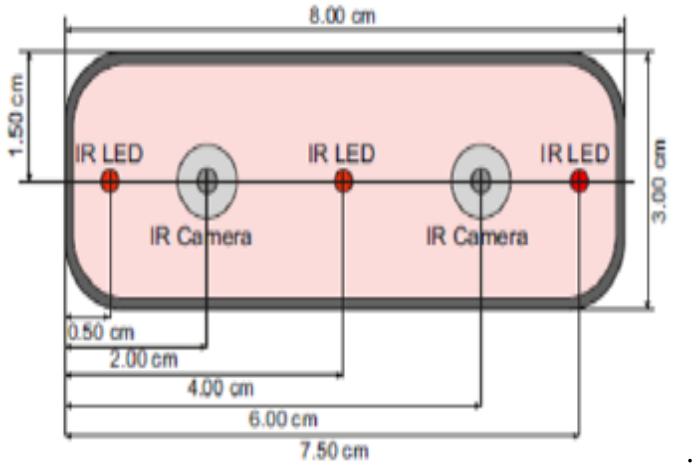

Figure.2. Schematic view of leap motion

It connects to a computer via USB .It is 200 times more sensitive than existing touch free technologies. It tracks movement down to a $1/100^{th}$ of a millimeter. The heart of the device consists of two cameras and three infrared LEDs. These track infrared light with a wavelength of 850 nanometers, which is outside the visible light spectrumLeap Motion's technology is designed to allow users to control their pc or rasperry with hand gestures alone

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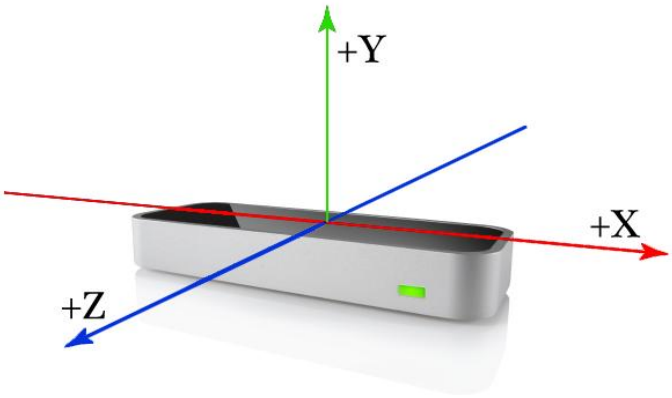


Figure.3. Block representation of leap motion

Project is based on using the leap motion device to control home appliances. This is the concept which is going to control without any physical contact with the appliances by using leap motion (hand gestures).

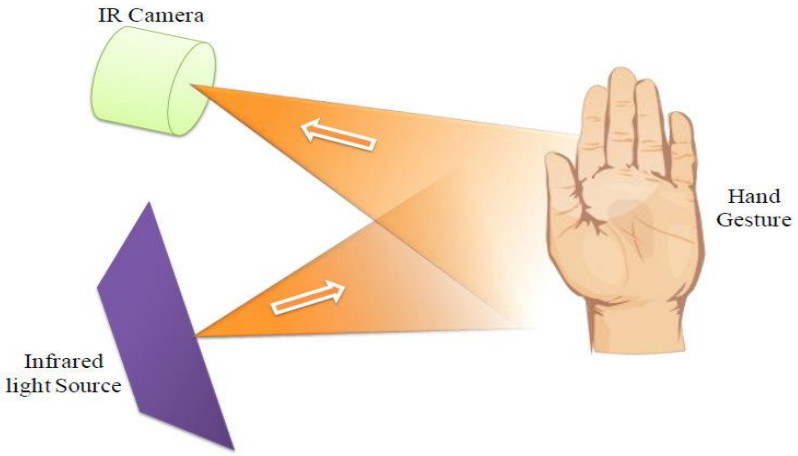


Figure.4. Camera and IR Setup

Using leap motion device, the appliances can be switch on or off from any place.

Software

To implement the algorithm and its logic for run time image processing, a JAVA Processing environment [7] is used. Processing is a Java based programming structure. To process the images, an open source image processing library is used. Once the data or frame is taken from an infrared web camera. After having the image in software, code will find the hand based on skin detection algorithm. If nothing is available then system will be ideal but if hand part is detected then system will start implementing the gesture recognition algorithm on the image to recognize the gesture. There will be always a question of removing background noise to increase the probability of occurrence of

correct recognition . But here Authors wants to propose a novel method for recognition environment. In the practice authors used an infrared camera and an infrared

LED source to create bright beam of infrared light. This IR source is put just near to the camera in the direction of user's hand. Now whenever user will make a gesture , his hand comes near to camera. Hand will look more bright then other region of image just because camera is infrared visible. Once interested area is more brighter then background noise or unwanted part, it is easy to convert the image in

Camera Hardware

Camera used in Handmote prototype is a simple Webcamera. Light spectrum contains visible light and infrared light as well.Aim is to use infrared spectrum, thus the IR stop filter is replaced with IR pass filter, that is why camera will not see the visible spectrum but only the IR light reflected back from hand. Now this camera will give infrared region images of environment to the software application.

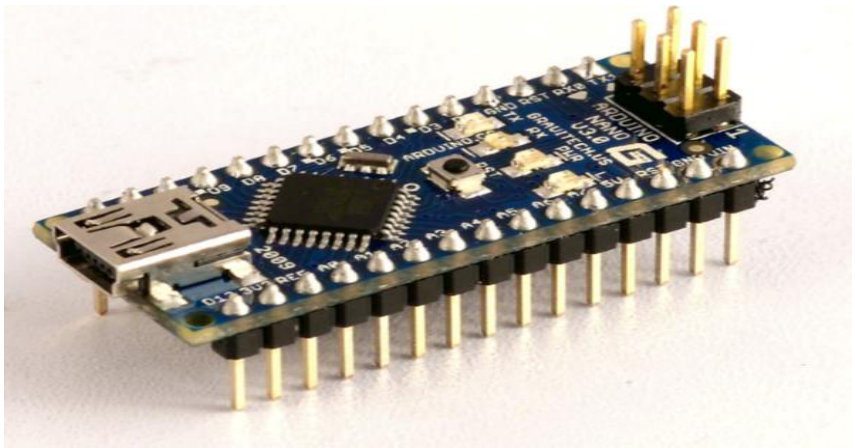
Processing

First step after taking a frame from camera is to track the hand based on skin detection algorithm using standard leap motion library. Next step is converting the image into binary form and then edge tracing. Once this much part is ready or hand is present in image than application search for gesture behavior by counting the number of fingers and its orientation. Angle between two successive finger gives useful flow to recognize the hand gesture. Software application reference background frame stored in variable, and every time it compare with upcoming frames. This gives reliable recognition

Giving Data to microcontroller Hardware

Microcontroller Hardware To decode the data coming from software application and send it to the electronic gadget , we used Arduino[4] development board based on microcontroller Atmega328 from ATMEL. Processor of hardware is running at the speed of 16MHz. The communication between software application and Arduino is based Serial port. Software code uses IBM COM port to send the data over serial port. The data rate for communication is 115,200 bauds/second.

Arduino Mega 2560



The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by.

Technical Specifications:

- Microcontroller : Atmel ATmega168 or
- Operating Voltage (logic level): 5 V
- Input Voltage (recommended): 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins :14 (of which 6 provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA

Flash Memory :16 KB (ATmega168) or 32 KB (ATmega328) of which 2 KB used by bootloader SRAM

- 1 KB (ATmega168) or 2 KB (ATmega328) EEPROM 512 bytes (ATmega168) or 1 KB (ATmega328)
- Clock Speed: 16 MHz Dimensions 0.73" x 1.70"

Operation

Based on the decision taken by software flow that which gesture is made, it will send a unique code related to a gesture. Now at hardware side, a program written

on microcontroller will first receive the unique code, decode it and then transmit the related data to gadget by means of Infrared LED same as a remote control do.

3. HANDMOTE - PROPOSED SYSTEM

Handmote is a prototype model to control the electronics gadgets through hand gesture. It is a wearable device suggest as Hand + Remote, Handmote . It consist of a computer to run software application,and andvinfrared camera to take images, Arduino development board to send commands to the gadgets, IR torch made up of number of IR LEDs to create bright infrared beam front of hand. At this development stage user need to wear the device and carry a laptop bag beside back. We integrated all modules on a wearable device, so that user can wear it and interact with gadgets just by making a hand gesture. IR camera and Arduino board are powered up through USB port its self , rest the IR torch is using 12V battery supply to have very bright illumination. Question is, We always need to carry a laptop computer with it. Solution is briefed in section V

4. TESTING AND EXPERIMENTAL RESULTS

We tested this Handmote device in both the conditions, 1. IR illumination off and 2. IR illumination on. Use of Handmote device is not limited to Television On/Off. The device is tested on TV to change channels through up/down thumb gesture. Showing 5 fingers opened to power on/off

TV. Even, Air conditioner temperature can be changed through gesture. Here sin practice we are replacing the traditional remote control with Handmote device so that, blind people or physically challenged people can operate the electronics appliances through simply a hand gesture, and no worry about which key press should do what ?.

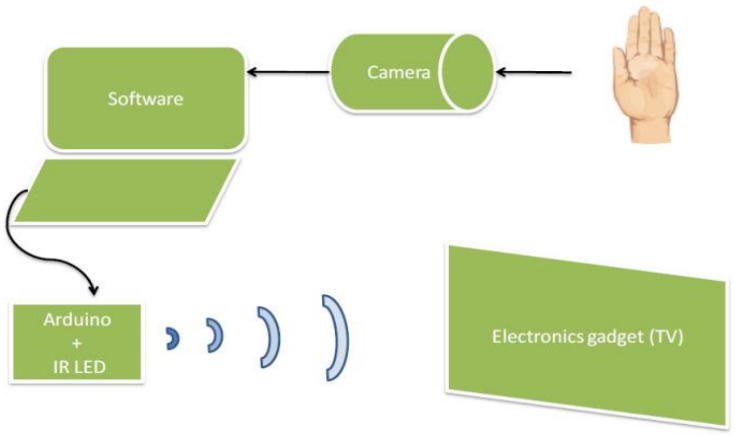


Figure.5. Processing flow

Advantages

It is used for elderly and physically challenged people who can't move from one place to another and who finds difficult in operating the home appliances.

It is used to avoid electrical shocks while operating the electrical devices.

It reduces the physical contact between the user and the appliances.

FUTURE WORK AND AKNOWLEDGEMENT

One disadvantage to this prototype is that, user should always keep a Laptop computer to run software application , however the application is written in JAVA processing environment, same software application can be made for Mobile phone device so that , processing power of software will be given by Mobile phone. Authors are working to develop same application in Android environment and making application open source, and available to all user that Interaction between home gadgets and human become cost effective.

CONCLUSION

A new technique has been proposed to increase the adaptability of a gesture recognition system. We have implemented a real-time version, using an ordinary workstation with no special hardware beyond a video camera input. The technique works well under different degrees of scene background complexity and illumination conditions with more than 94% success rate.

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