Gesture Based Virtual Mouse Controlling Home Appliances And Computer

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ABSTRACT: Since the computer technology is growing continuously, Human Computer interaction is gaining its importance enormously. Most of the mobile devices today are using touch screen technology. But, this technology is still not cheap enough to be used on desktop systems. So creating a hand gesture based device such as mouse or keyboard using a sensor(webcam) and computer vision techniques can be an alternative way for the screen touch. Further this technology can be extended to home automation by controlling switch board such as lights on or off with the gesture. The technology is also a boon for handicapped people. Gestures can help a physically challenged person use his/her gestures to control applications in the house like switching on/off television or lights system or door open/close which otherwise would be a difficult task for those people. In this study, hand gesture based a virtual mouse application has been designed and implemented using a regular webcam.

KEYWORDS: Hand Gesture, OpenCV, 892051 Controller, Human Computer Interface

1. INTRODUCTION

Physical strain is the trend going on in the world where each activity demands human interaction physically. Such as operating computer for long hours with the help of mouse and keyboard. Humans have turned too lazy to get up and complete their routine activities which now demands that automation be brought to existence and reduce the tasks. Automation is the new trend of the generation where minimal effort is required from the person's side and related work can be carried out swiftly and within minimum time. This can be achieved using hand gesture recognition where no physical contact will be made with the system and directly using the hand gestures the task of controlling the PC can be carried out.[1]

For example let a presentation be running on a system and the person doesn't feel like touching the mouse or keyboard so he/she can directly give an input in the form of the hand gestures to the PC and the work of moving the slide will be carried out.

This is also applicable in the field of home automation where a person will not be required to touch the switches, he/she can directly through human computer interaction can give command of switch on and off to the system and the task will be carried out swiftly.

We are trying to achieve automation with the help of 892051 Controller and OpenCV library which are the respective basic hardware and software of the system.

OpenCV has been rapidly developing and growing in the field of automation where only with the help of vision tasks are completed within seconds time.[3] This library contains over 500 functions and is used widely in many streams such as medical imaging, security, robotics, stereo vision, camera calibration and lots more.

Our design on this work explores the low cost and high performance virtual mouse. All the functions on computer mouse are considered. We capture the hand gesture by a single web camera for natural and intuitive human-computer interaction. With this common environment, the system can provide high recognition result even in some harsh background environment.

2. LITERATURE REVIEW

There are many approaches to Human Computer Interaction. Few of them are being listed here:-

- In one approach, given by Erdem et al, for controlling the motion of the mouse uses fingertip tracking. The controls of mouse were implemented by defining a screen such that a control of the mouse was initiated when a user's hand passed over the region.

- In another approach developed by Chu- Feng Lien, the concept uses the finger tips to control mouse operations. In this the mouse operations are based on image density, where the person is required to hold the cursor at the desired spot for some period of time.

- In yet another approach developed by Paul et al, the motion of thumb is used to signify a clicking event. Hand gestures are used for mouse control. In his approach a color pointer is used for object tracking and recognition. The left click of the mouse is implemented by calculating the distance between the thumb and index finger while the right click event is implemented by calculating the distance between thumb and middle finger.

- By referring all these techniques we are now designing a system that will recognize gestures through open computer vision. Hand gesture will be sensed by the sensor which will be a 3 MP webcam that will track the image of the gesture and then certain action according to the gesture will be carried out. The same system we are extending to home automation where the sensor will capture the image and will pass to the circuit board which will thus result in the action of ON or OFF of the tube or fan.

2.1 EXISTING SYSTEM

We all are aware of the current scenario of controlling computer through hands which require physical activity. Thus this can be sometimes strainful to people. To operate a simple power point presentation on the PC we use hand movements by being in contact with the optical device. Eg. Clicking the mouse for going to the next slide or using scroll button for zooming in and out. Apart from the PC interaction we also come across the hardships people face while in their homes. For switching on a single tube or fan they have to get up and go to the switch board. Handicapped people face great difficulties for their routine activities. So why not design a system where the person anywhere in the house can easily operate its electrical appliances without stressing himself/herself.

2.1.1 DISADVANTAGES

- Highly strain related work

  Without the help of automation day to day work is becoming highly straining. A user needs to operate a mouse with his/her hand. Continuous clicking on mouse can strain fingers which can result in health problems. While in home, a user when far away from the tube/fan has to go to the particular switch board for switching on/off the controls.

- Trouble for physically challenged

  Handicapped face the major problem in day to day life and we all are aware of their scenario. Day to day routine without automation gives rise to many problems for them where they are unsuccessful in achieving the controls of home/computer in time. This can be highly frustrating for them.

- Time consuming

  Normal execution of our routine activities can be time consuming as compared to same activities performed by gestures.

- Health problems

  Constantly working on PC can lead to spine related health issues which are chronic problems and take time to heal. Similarly constant operation of mouse by hand can strain finger muscles.

3. OBJECTIVE AND SCOPE

The main objective behind this project is to reduce the workload and strain in daily life. If things are made automated operating computers and home appliances can become easy. The aim to make things easy for a human being and help him/her in his/her routine life. Apart from the ease the project also focuses on the time consumption which is very high in the existing system. Using automation can reduce time to a great extent. Since the computer technology is growing continuously, Human Computer interaction is gaining its importance enormously. Most of the mobile devices today are using touch screen technology. But, this technology is still not cheap enough to be used on desktop systems. So creating a hand gesture based device such as mouse or keyboard using a sensor(webcam) and computer vision techniques can be an alternative way for the screen touch. Further this technology can be extended to home automation by controlling switch board such as lights on or off with the gesture. In this study, hand gesture based a virtual mouse application has been designed and implemented using a regular webcam.

4. PROPOSED SYSTEM

The system that we are proposing in this project is for two purposes:

- Automate computer activities.
- Automate routine home activities.

For the Mouse click events, and controlling mouse for computer based activities like left click or right click, zoom in, zoom out, snapshot we need certain hardware requirements like a PC, some color bands, and a sensor(webcam). For the particular application the user generates a hand gesture which is then detected by the sensor. The sensor conveys this message to the PC and then a certain action according to the gesture is taken. For home automation or reducing routine activities performed by one in their homes like switching on/off a tubelight, switching on/off a fan and opening and closing a door we need a PC, an arduino,[4] sensor(webcam) and a circuit board. First we connect the arduino to the PC through USB. Then a gesture is recorded in the PC. The signal corresponding to the gesture is passed to the arduino and from there to the circuit board and the desirable action is performed.

4.1 BLOCK DIAGRAM

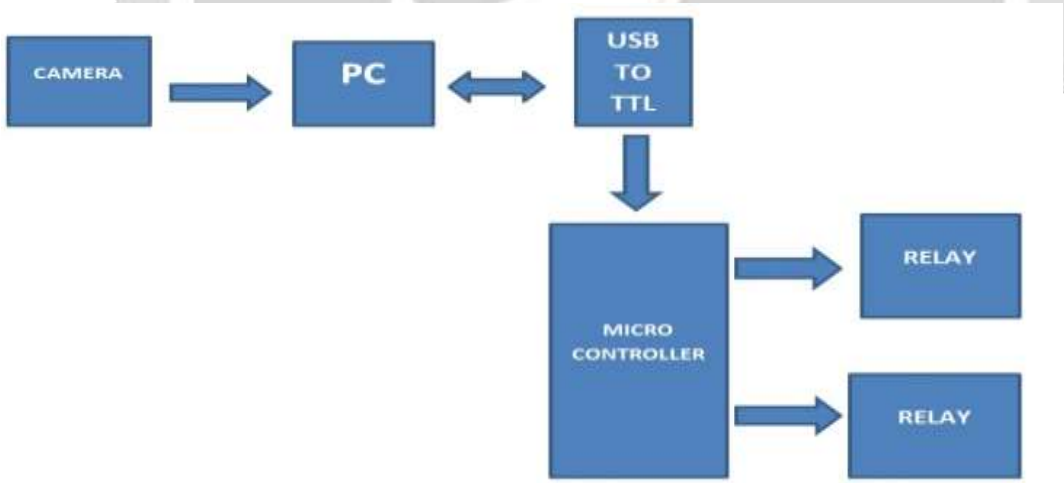


Figure 1:- Block diagram of system

4.1.1 MICROCONTROLLER

The AT89C2051 is a low-voltage, high-performance CMOS 8-bit microcontroller with 2K bytes of Flash PEROM. The AT89C2051 provides the following standard features: 2K bytes of Flash memory, 128 bytes of RAM, 15 I/O lines, 2 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, a precision analog comparator, on-chip oscillator and clock circuitry.

4.1.2 USB TO TTL

This cable is the easiest way to connect to your micro-controller. Inside the USB plug is a USB to Serial conversion chip and at the end of the 36 inch cable are four wires viz. red for power, black for ground, white RX into USB port and green TX out of USB port.

4.1.3 RELAY

The relay is a kind of an electrical switch used to automatically move the switch position from off state to on state. Relay for this operation basically uses an electromagnet which automatically changes the state of a switch.

5. METHODOLOGY

This section illustrates the detailed working of the proposed system.

In this a webcam is used to capture and track the hand movements made by the user with the help of computer vision interface.

5.1 SYSTEM ARCHITECTURE

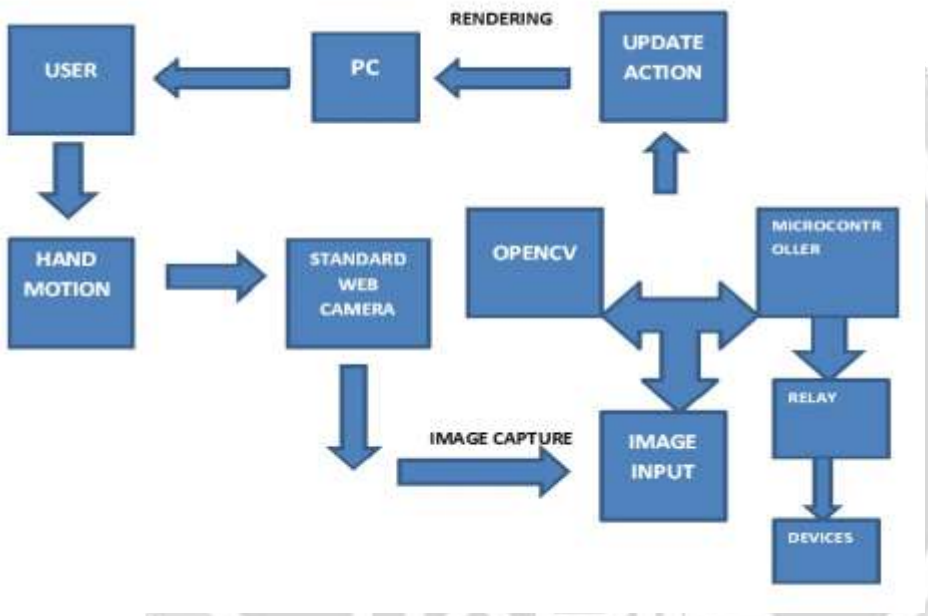


Figure 2:- System Architecture

5.2 IMPORTANT TERMS AND METHODS

5.2.1 COLOR MARKERS

These are kind of sticky bands that are used at the tip of fingers of the user's hand. These are red, blue, green and yellow coloured bands which helps the camera to recognise user's hand gestures.

5.2.2 COLOR RECOGNITION

Initially when an image is captured by the camera then the RGB colour space is turned into HSV colour space. HSV is more intuitive and perceptually relevant as compared to the Cartesian representation.

5.2.3 COLOR THRESHOLDING

Thresholding process is used to represent only specific colours of an image. It helps convert a grayscale/colour image into binary image. In this process certain threshold is decided and individual pixels of the image are compared with this threshold. If pixels have value greater than threshold then they are termed as object pixels otherwise as background pixels. Now the threshold values for some operations are:

Left= colour 1, Right= colour 2, Move= colour 3, Drag= colour 1 + colour 3.

5.2.4 BLOB DETECTION

This technique is used to find points and or regions in the image which are brighter or darker than the surrounding. A blob is a group of pixels which are casted into some structure.

5.2.5 CENTROID DETECTION

Coordinates of the centre of blob are found out.

5.2.6 SMOOTHING

Also referred as "opening". It basically smoothes the contour objects by eliminating thin protrusions.

5.3 MATHEMATICAL CALCULATIONS

For our system we use morphological algorithm which performs image erosion and image dilation to eliminate noise from the image. Image erosion crops that part of the image where hand is not present and process only that part where hand is present. Mathematically, erosion is given by

$$A \ominus B = \{x \mid (B)\, x \cap A\, c = \varphi\} \ldots (I)$$

where A denotes the input image and B denotes the structure element. Dilation is used to expand the area of the image pixel which is

$$A \oplus B = \{x \mid (B\hat{}) \cap A \neq \varphi\} = \{x \mid (B\hat{}) x \cap A] \subseteq A\} \ldots (II)$$

where A denotes the input image and B denotes the structure element. The structure element above is used for operating on the image where it is matched with the center pixel(centroid). If the pixel matches then the area around that pixel is marked. The opening of set A by structuring element B, denoted $A \circ B$, is defined as, $A \circ B = (A \ominus B) \oplus B \ldots$ (III) Thus, the opening A by B is the erosion of A by B, followed by a dilation of the result by B. Similarly, the closing of set A by structuring element B, denoted A B, is defined as $A \bullet B = (A \oplus B) \ominus B \ldots$ (IV) Which, in words, says that the closing of A by B is simply the dilation of A by B, followed by the erosion of the result by B.

5.4 FLOW OF THE SYSTEM

- The basic requirement of any system are its sensors. So in this system too a sensor (webcam) is used to interact with the environment. Its functionality is to record the live video which is taken as input through hand gesture by the user.
- It processes this input and then sends it to openCV . here in CV a code is generated which is used to convert the live video into frames of images. This activity is technically termed as "slicing of video".
- Then this frame of images are processed for colour recognition process, where only images with colours mentioned in the code are kept. Rest images are discarded by the system.
- The speed at which output images are displayed is equal to the speed at which slicing of the video is done. This output display seems like a movie running where input is the physical world while output are only those colours which are present on the fingertips of the user.
- These colours signify mouse cursor on the screen. As these colours move similarly mouse cursor on the screen moves.
- And in this way output is produced and the mouse click is replaced by finger clicks, gesture recognition and image processing.

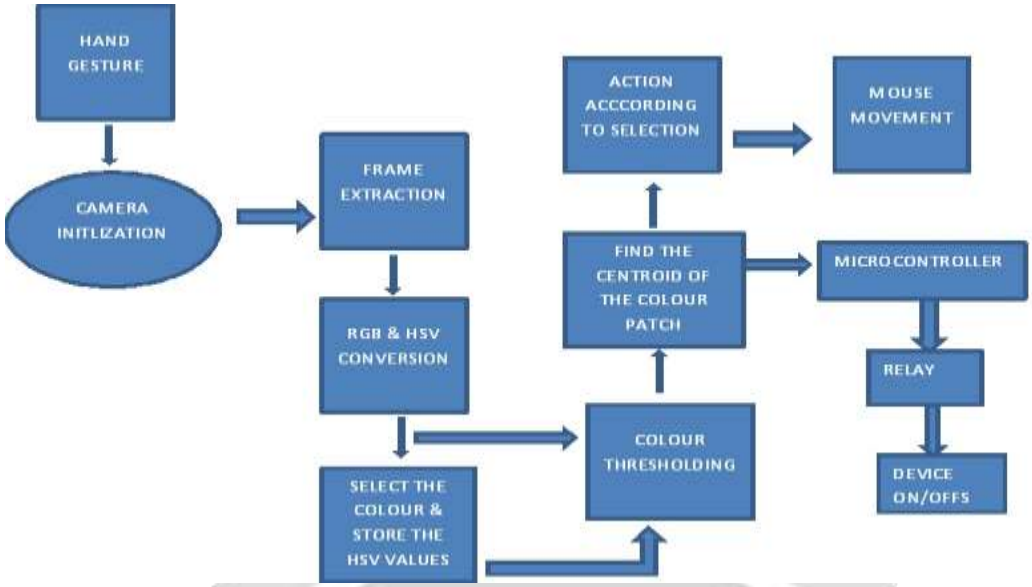


Figure 3:- System Flow

5.5 HARDWARE AND SOFTWARE REQUIREMENTS

5.5.1 HARDWARE

- 89S2051
- USB TO TTL
- Relay
- 2 GB RAM
- I GB free Hard disk

5.5.2 SOFTWARE

- OpenCV
- Windows 7 or latest OS

5.6 ADVANTAGES

1. Less reliability on the physical devices like mouse or keyboard.

2. Highly efficient.

3. Time savvy.

4. System can be extended to eye recognition based system where with eye movements control of system can be done. This will be efficient for handicapped people.

5. Less strain on fingers.

5.7 DISADVANTAGES

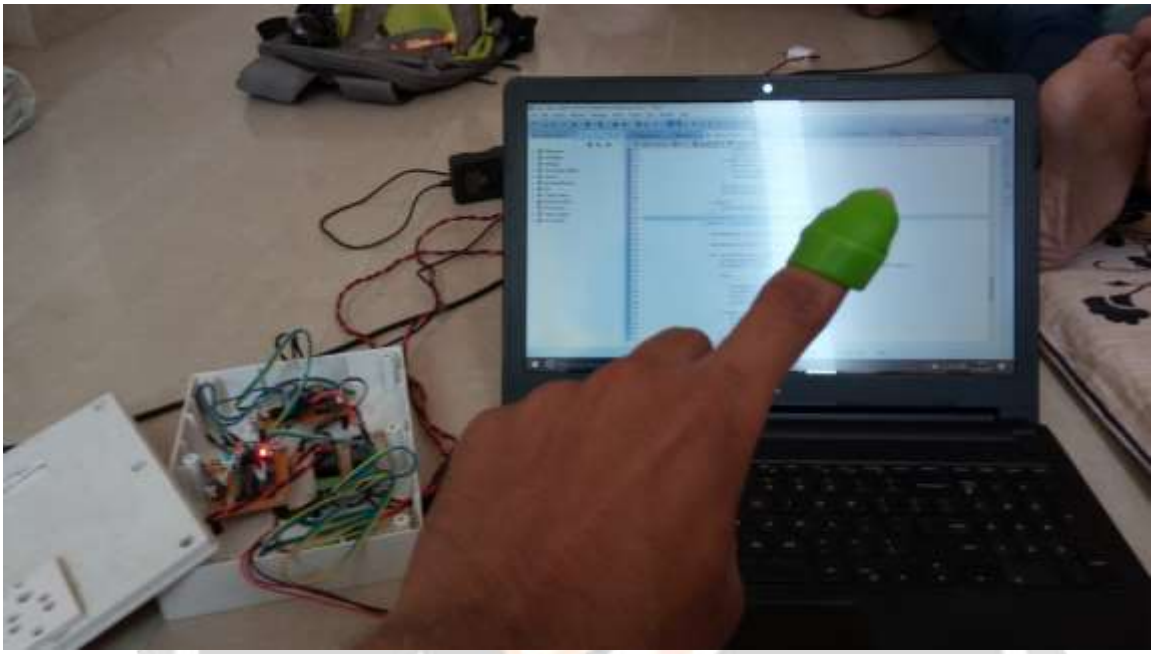
1. Initial cost of system may be high

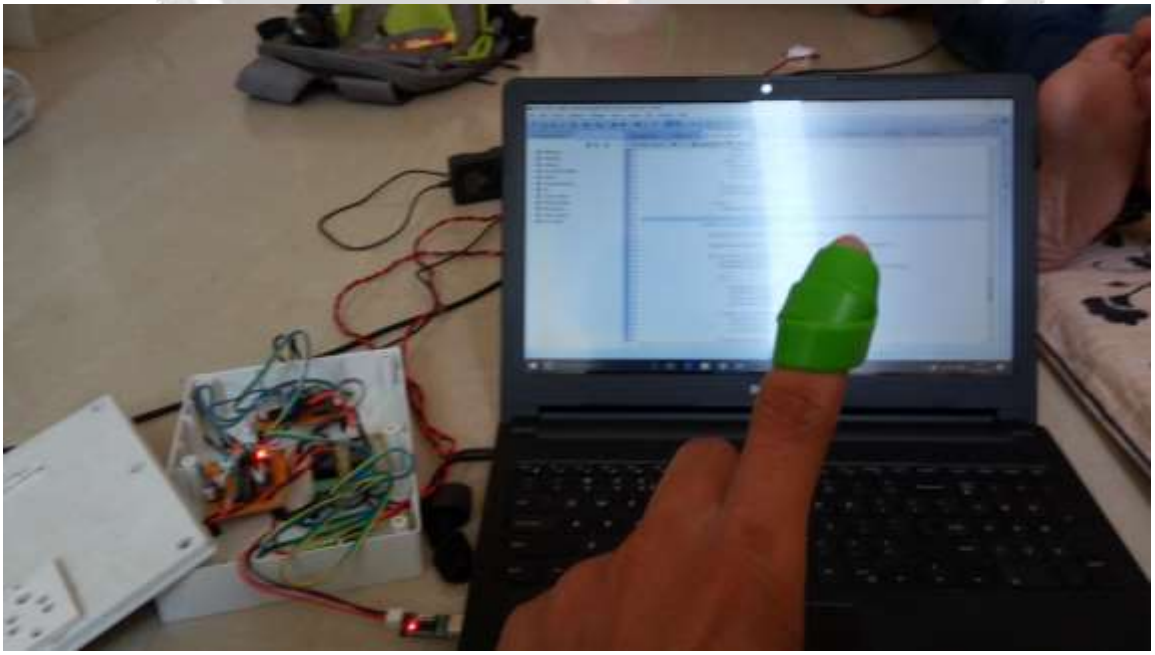
2. High level of coding.

3. Any fault in software can lead to system inefficiency.

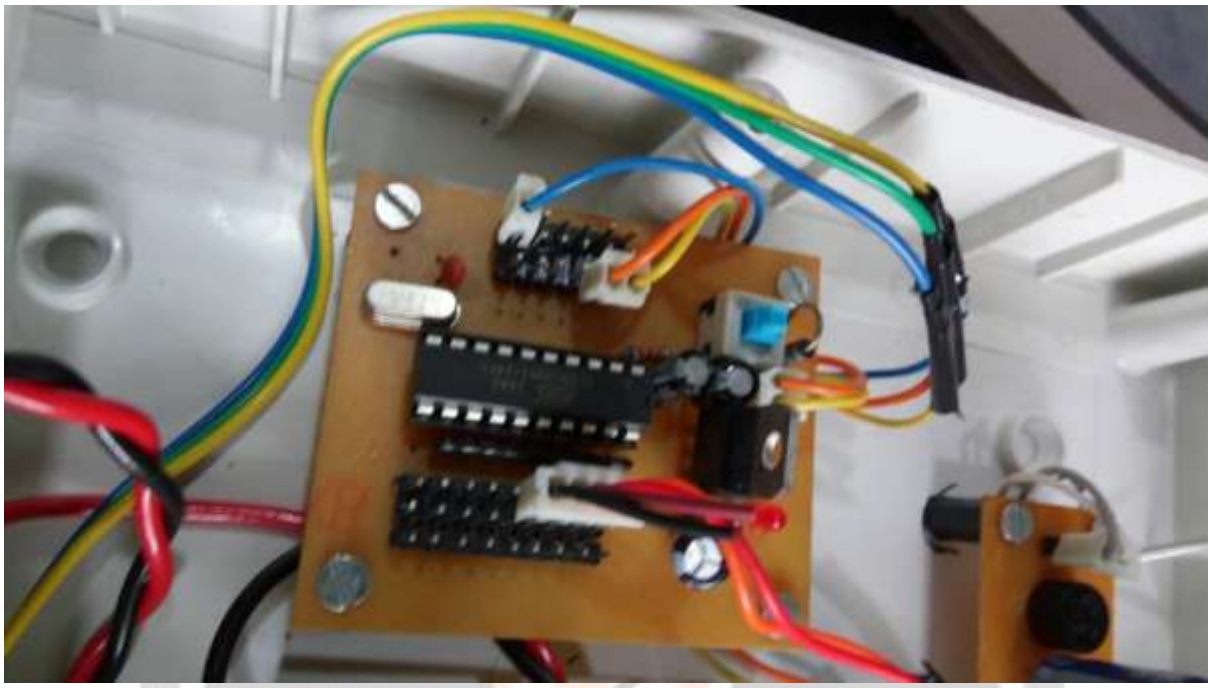
6. RESULTS

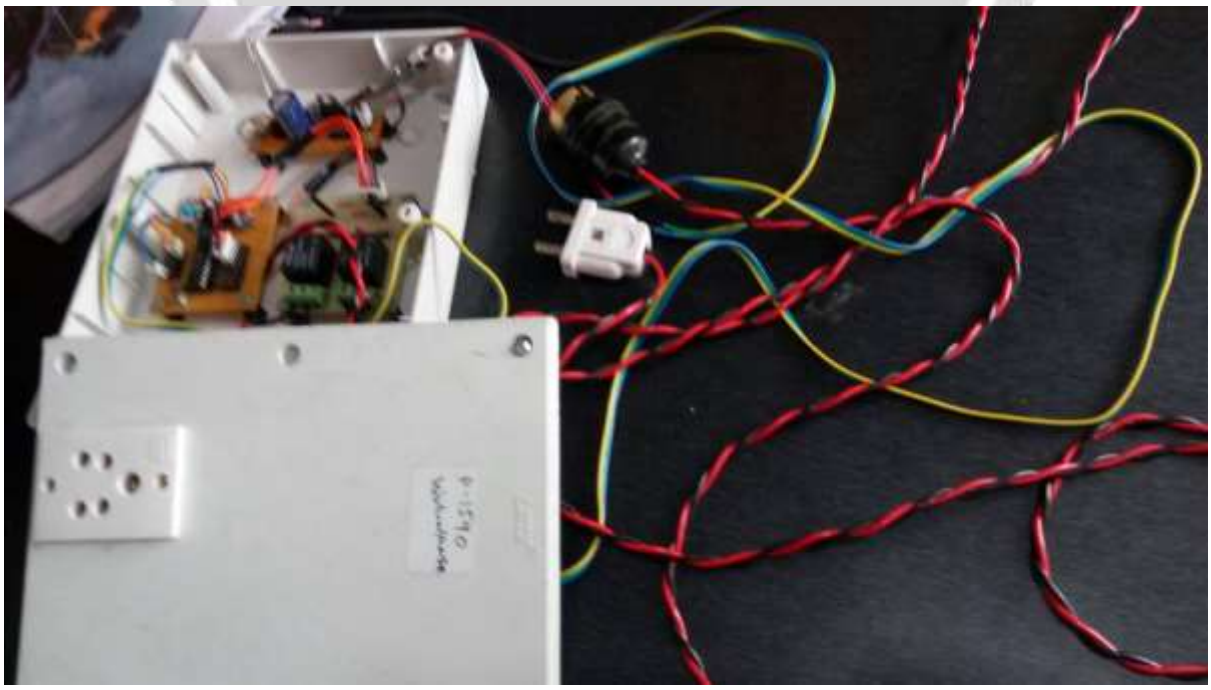
6.1 SOFTWARE

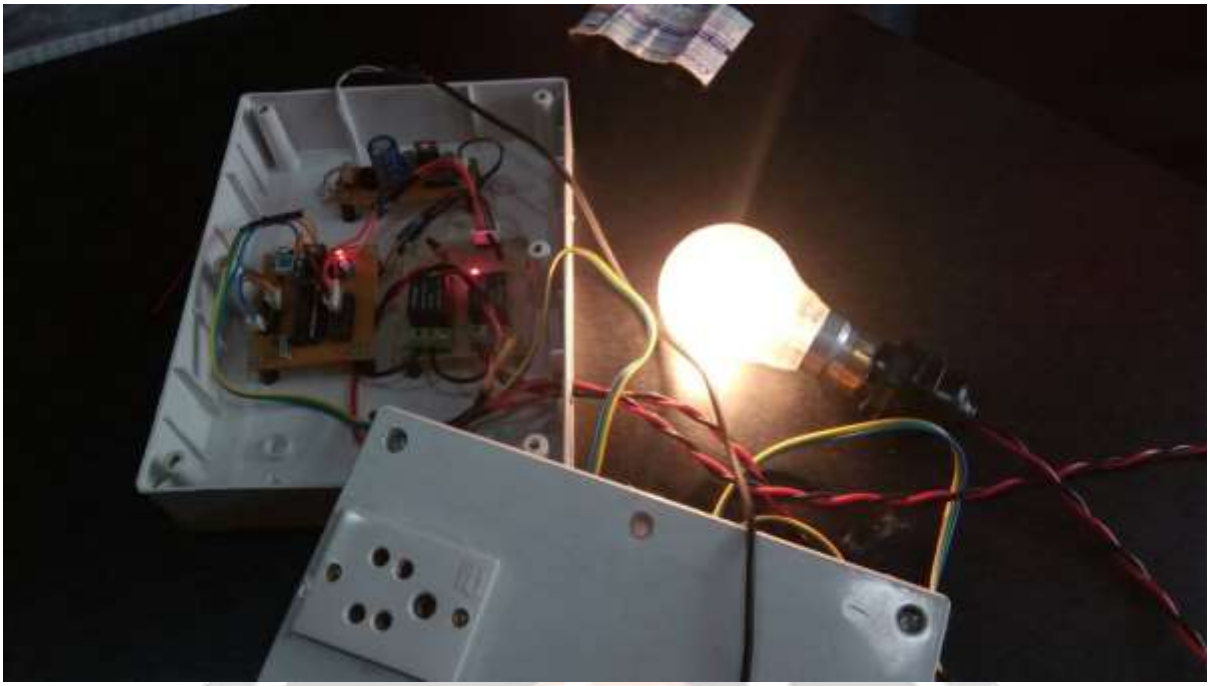




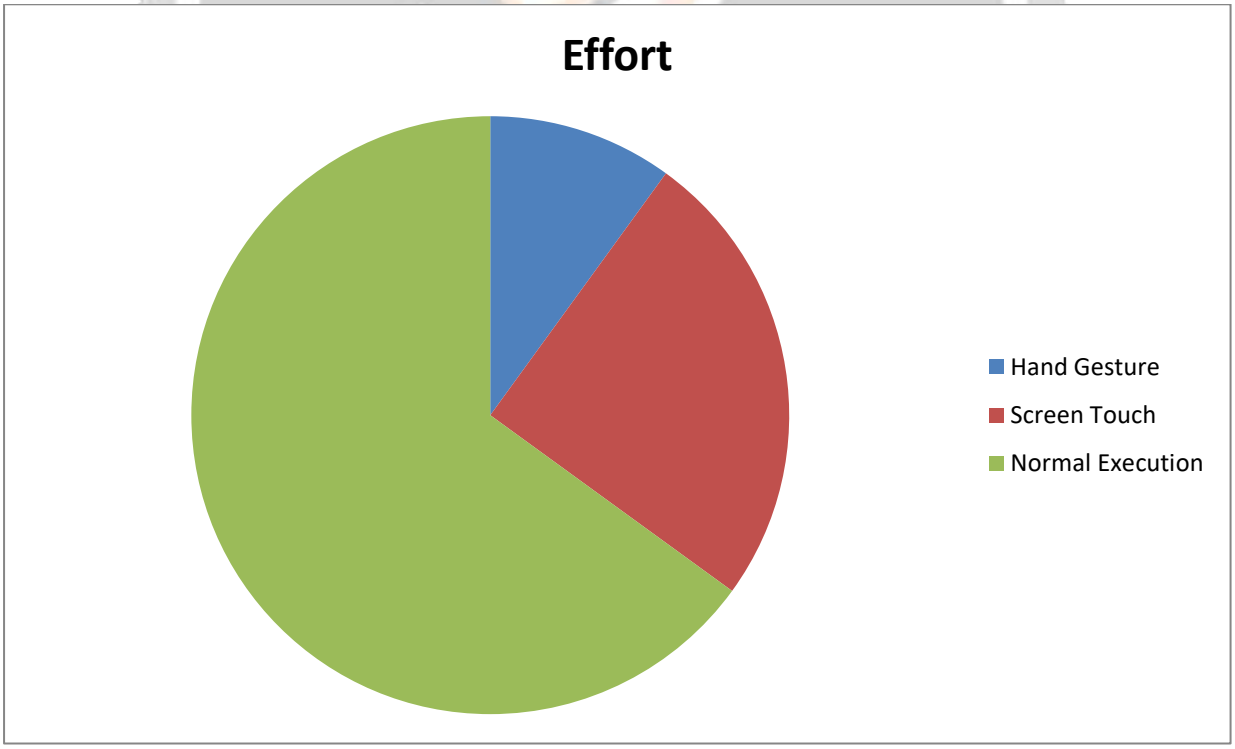
6.2 HARDWARE







6.3 EFFORT ANALYSIS



7. CONCLUSION

We have tried proposing a system which requires minimal efforts from the user's side. Use of image processing and CV gives maximum benefit in the field of automation. The system is also proposed for home automation where with the help of gestures tubes or fans can be controlled. As compared to normal execution, screen touch and recognition based system, hand gestures recognition proves to be the best and most effective system. Further this system can be expanded to keyboard controls and thus can be highly used in games [2] where both mouse and keyboard controls are required.

8. REFERENCES

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