Wear Our World Using Sixth Sense Technology (Wow-SST)

Suraj Vishwakarma[1], Siddhivinayak Zaveri[2], Jignesh Yadav[3], Sachin Yadav[4], K. Jayamalini[5]
[1,2,3,4]Dept of Computer Engineering
[5]Asst. Professor, Dept of Computer Engineering
[1,2,3,4,5]Shree L. R. Tiwari College of Engineering, Mumbai, Maharashtra, India

Abstract- *We've evolved over millions of years to sense the world around us. When we encounter something, someone or some place, we use our five natural senses to perceive information about it; that information helps us make decisions and chose the right actions to take. But arguably the data, information and knowledge that mankind has accumulated about everything and which is increasingly all available online and the most useful information that can assist us make the right decision is not naturally perceivable with our five senses. Although the miniaturization of computing devices allows us to carry computers in our pockets, keeping us continually connected to the digital world, there is no link between our digital devices and our interactions with the physical world. Information is restricted traditionally on paper, books or digitally. A few decades ago the invention of computer was able to forge a dent in the universe. Everything was and is becoming automated. Technologies are getting compact with high functionality. Touch screens are becoming an important part of human life. From TV screens to touch screen phones and laptops everything can be swiped with a flick of fingers. The question is what real world objects can be used as a screen.*

Keywords- Sixth Sense Technology, GUI, MATLAB, image processing, hand gestures, colored finger markers, gesture recognition.

I. INTRODUCTION

Sixth Sense Technology, from the name itself, is that which allows people to interact physically with a digital world that has been augmented on their physical world, thus giving them the sense of owning a sixth sense. It is a wearable device that imposes visible digital data onto the physical world for users to interact with the digital world. This is done in such an intelligent manner that even slight gestures by a user can be interpreted by the Sixth Sense device and following actions (like taking a picture) are made. The main idea behind this technology is to change the way people interact with devices and bridge the gap between the physical and digital world [1]. Every one of us is aware of the five basic senses – seeing, feeling, smelling, tasting and hearing. No matter what, information on any object that comes across our way is perceived with the help of these senses before making a relevant decision. But now things have changed, the most useful information about everything is available on internet, making it our sixth sense and a decision on anything needs a consultation with the data, knowledge available online. This information comes to us via smartphones, tablets, laptops etc. thereby providing a round-the-clock link-less connection with the digital world. Information, in normal cases, is available on the paper or digitally on a screen[8].

Now, this is where sixth sense technology makes its introduction taking the digital information from the confined limits of a screen or paper to the outer world making the entire space around us a BIG screen and using our hand gestures to interact with the information. Sixth sense technology takes the digital information from the intangible world to the tangible world. Interaction with the world becomes a 'never before experienced affair' with the sixth sense technology. One of the greatest outcomes of this technology is its ability to scan a human as well as an object and readily project all the available information about it [7].

In order to do mathematical calculations physical devices like calculators or mobile phones are used or to know the time a wrist watch is commonly used. However, this project deals with development of a virtual calculator which we can be used anywhere without any physical devices. In the similar manner, the functionality of a watch, a digital camera and a power point presentation will be developed virtually [3].

In order to do mathematical calculations physical devices like calculators or mobile phones are used or to know the time a wrist watch is commonly used. However, this project deals with development of a virtual calculator which we can be used anywhere without any physical devices. In the similar manner, the functionality of a watch, a digital camera and a power point presentation will be developed virtually [3].

II. LITERATURE REVIEW

Here we will elaborate the aspects like the literature survey of the project and what all projects are existing and been actually used in the market which the makers of this project took the inspiration from and thus decided to go ahead with the project covering with the problem statement

A. Existing Systems

1. Mouse Movement through Finger by Image Grabbing using Sixth Sense Technology

This project (or more precisely, prototype), built by Prateek Agrawal and Kunal Gupta [4], present a unique way of implementing the Sixth Sense Technology. It is very similar to the one introduced by Mistry in 2012. In this approach, five basic components are used. First, a user with colored markers on his/her finger tips makes a hand gesture. The camera is used to capture live video. This video is sent to the laptop. Inside the laptop is a MATLAB code that does the main processing. This captured video sent to the laptop is divided into images. These images are processed, and the result is sent to the projector. Finally, the mirror reflects the projected image in front of the user. By this method, a user's hand acts as a mouse. Using hand gestures, different tasks can be done like capturing images, browsing the Internet and more. Instead of a laptop, the authors have built a hardware device using a processor and memory. All the working code has been built on MATLAB using the image processing toolbox. The code has been built in such a way that it recognizes red, green and yellow marker colors only (unlike Mistry's approach where more colors are used). Thus, this prototype is basically a system that accepts hand gestures instead of mouse cursor [1].

2. Google Glasses

Google's Glass Project presents a way of implementing the Sixth Sense Technology. The invention of Google Glasses can be considered as a measure for the success of Augmented Reality technology. Google Glasses can be classified as an AR technology, basically belonging to the HUD (head-up displays). As Starner [4] quotes from the Google CEO, "Our goal was to reduce the time between intention and action". In this project, Google has been working in the MIT Media Lab on the Wearable Computing Project for years, where they were aiming to make all activities like taking pictures or browsing files, into a single portable device, just like Sixth Sense. Here, the Google team tried to eradicate the need of taking the device out of the pocket to use it as it is itself time consuming. Google project has come to reduce access time tremendously. It has become very easy to browse the Internet and get instantaneous and accurate search results on the Google Glasses according to the author. The user is made more powerful when the mobile interfaces are made quick and easy to use, according to Starner. It can be noticed that the main goal of Google Glasses was time. As such, even the default screen was made a clock. Just like how Google Glasses received worldwide attraction and acceptance, such is expected of the Sixth Sense Technology when introduced in the market [1].

3. Holographic Projections Using Sixth Sense

This approach involves fusing two technologies together, namely Sixth Sense Technology presented by Pranav Mistry, and Holography invented by British-Hungarian physicist named Dennis Gabo in 1971, to create a new system which will revolutionize the world as predicted [4]. Holographic projectors will enable viewing 3D pictures or videos without the use of 3D glasses. As per this approach by Nadiger and Bhat, the two technologies together will be able to create a virtual presence of a human being. This will simplify communication. The Sixth Sense Technology will map human movements to a computer, and the Holographic projector will take this digital component and convert it into holograms at the other end. Details are given in [4]. This method develops the Sixth Sense Technology further and brings human-computer interaction to an advanced stage [1].

B. Techniques used for the system

1. Gesture Recognition

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via Mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Gesture recognition enables humans to interface with the machine (HMI) and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. Gesture recognition is useful for processing information from humans which is not conveyed through speech or type[2].

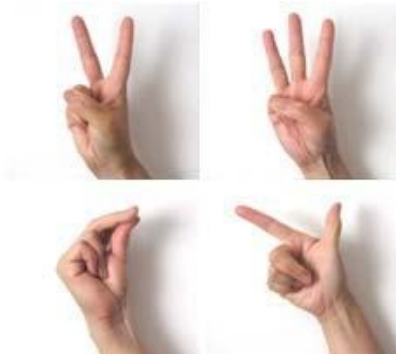

Fig. 1 - Hand gesture [2]

2. Computer Vision & Image Processing

Information extraction from images Computer vision is the science and technology of machines that see. It is concerned with the theory behind artificial systems that extract information from images. An image is a huge array of gray level (brightness) values of individual pixels. Taken individually, these numbers are almost meaningless, because they contain very little information about the scene. A robot needs information like "object ahead", "table to the left", or "person approaching" to perform its tasks. The conversion of this huge amount of low level information into usable high-level information is the subject of computer vision.

Earlier algorithms were too computationally expensive to run in real-time, but also required any type of memory and modeling. We concentrate on two types of images frequently used in computer vision: Intensity images (Photograph like images encoding light intensities), Range images (Encoding shape and distance (sonar and laser) [2].

Pre-processing means to extract the meaning from raw data. The web-cam captures the input and using an image differencing technique, the sequence of (x, y) coordinates representing the gesture is determined. This raw set of (x, y) coordinates will have to be pre-processed before it can be fed into the trained neural network for classification. Segmentation is done to convert grey scale image into binary image, so that we can have only two objects in image one is hand and other is background. Segmentation is done to segment the hand area & isolate it from the background, based technique deals with the color pigment of the human skin[5].

3. Object Recognition Classification

When the image segmentation process has isolated the object and the objects features have been measured properly it is possible to determine the objects type. Properties of the feature measurement are then used to identify and classify an object. Classifier design consists of establishing the logical structure of the classifier and the mathematical basis of the classification rule [2].

4. Color Detection and Tracking

In this system we have used different pre-processing techniques, feature extraction a tool for recognizing the pixel values or coordinates of RBG color by tracking the change in pixel position of color stickers attached at fingers of user in real time. So accordingly, the new updated values will be sent to PC to track motion of mouse.

Getting user input virtually is the main aim for this module where user will move his finger in front of camera capture area. This motion will capture and detected by the camera and processed by the system frame by frame. After processing system will try to get the finger coordinates and once co-ordinates get calculated it will operate the cursor position. Now for detecting the coordinates of moving finger i.e. fiducial as mouse cursor we are using red marker. Each pixel has two properties

i) X, Y position
ii) Color property i.e. RGB value

When the main loop starts executing, camera starts to analyses the video frame getting to it by using two loops. One loop will start for finding the appropriate color vertically and another loop at same time in horizontal direction so that complete camera frame analyzes and wherever we get our desire pixel then another counter starts which start to count the pixel of similar property which should be greater than five then only it will be treated as pointer and then based upon the aspect ratio of the screen mouse pointer moves. [5]

5. System requirements

This section contains all of the functional and quality requirements of the system. It gives a detailed description of the system and all its features.

a. Hardware requirements

i) Camera: The camera is capable of capturing the images that falls within its vision and also it provides information about the objects present in front of it. The hand gestures performed by the user can be tracked with this component.
ii) Color Markers: The user can wear these markers at the tip of their fingers which helps the camera to track hand gestures. These gestures can perform

various tasks such as painting, taking a picture and many more.

iii) Laptop: It is a processing engine that processes the data obtained from camera and sends the output to projector.

iv) Projector: The projector is basically an output gadget which is used to display any information provided by the mobile component.

v) Mirror: Mirror is placed just below the projector. The projector can project the information in any direction with the help of a mirror which can be tilted in any direction as per the user's requirement.

b. Software requirements

- MATLAB
- OpenCV
- Python
- Java

III. SYSTEM ARCHITECTURE

Figure 3 shown below depicts the system which consists of a camera which captures the gestures/images/pictures with the help of colored finger markers. Two cases can be implemented:

- If desired GUI is to be projected (in case of calculator and watch) the space will be allocated within the detected markers.
- If some interaction is to be made with the projected image it will detect the movements of markers and data will be collected.

The data is send for pre-processing to the computing device. After the pre-processing is completed, computing device sends information(result) to the projector. The projection is not directly achieved from the projector, but a mirror is used for reflection of the projected images which comprises the main technique of 'Sixth Sense Technology'. The problem of gesture tracking which is very important and complex procedure which is achieved by image acquisition & image processing.

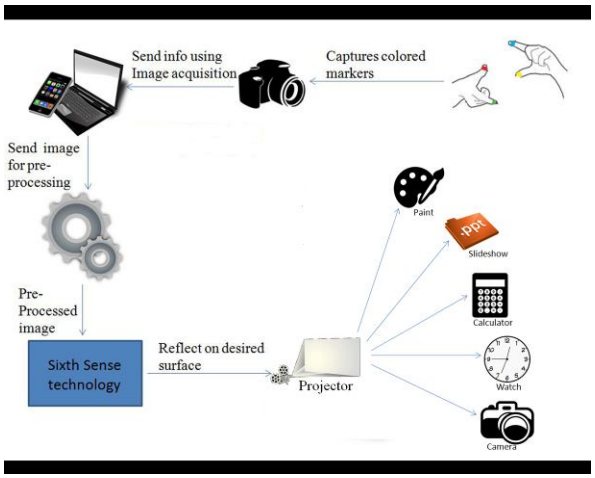

Fig. 2 - Block Diagram of implementation of Sixth Sense Technology

IV. IMPLEMENTATION

A. Calculator

Algorithm:

1. Start the calculator application
2. Color/Gesture Detection
    1. Take one frame at a time and convert it from RGB color space to HSV color space for better yellow color segmentation.
    2. Use a mask for yellow color.
    3. Blurring and thresholding.
    4. If a yellow color is found and it crosses a reasonable threshold, we start to create a gesture.
    5. The direction of movement of the yellow cap is calculated by taking the difference between the old center and the new center of the yellow color after every 5th iteration.
    6. The directions are taken and stored in a list until the yellow cap disappears from the frame.
    7. The direction list is processed and the processed direction list is used to take a certain action.
3. Control mouse to perform operations.

This module builds the GUI of Virtual Calculator. The values are calculated on the basis of the values pressed by the color markers.

B. Paint Application

Algorithm:

1. Set Threshold value for Blue, Red, Green, Yellow
2. Initialize plotting variables
3. Acquire video input
4. Set blob analysis handling for Blue and Green colors
5. Set box handling for each color
6. Start loop

7. Extract Single Frame
8. Get red, blue, green and yellow component and filter out noise by using median filter
9. Conversion of image into binary with red, blue, green and yellow object as white
10. Output video stream
11. Plot different colors using plotting variables
12. Save the file

This program detects user's finger's position by color recognition and paint in a white space. Different colors can be plotted using different color markers. A basic GUI is made to save the picture in JPG, PNG and BMP format.

C. Virtual Watch

Algorithm:
1. Set Threshold value for red
2. Acquire video input
3. Set blob analysis handling
4. Set box handling
5. Start loop
6. Acquire single frame
7. Get red component & filter out noise by using median filter
8. Conversion of image into binary with red object as white
9. Count number of red blobs
10. Output video stream
11. If number of red blobs > 0
    1. Then read saved image
    2. Get real time from working computer and store it in individual array for hours, minute and seconds
    3. Set simple text for each individual hand
    4. Start loop
    5. Rotate each hand by using set function by multiplying by negative 6 for each clockwise 6-degree rotation
    6. Accordingly rotate each hand with respect to each other
12. Else

1. Increment the frame

The above sample code generates the GUI of watch. Calculations are done so as to ensure proper functioning of the hour, minute and second hand.

D. Game

Algorithm:
1. Set Threshold value for Blue and Green
2. Acquire video input
3. Set blob analysis handling for Blue and Green colors
4. Set box handling for each color
5. Start loop
6. Acquire single frame
7. Get Blue and Green component individually and filter out noise by using median filter
8. Conversion of image into binary with blue & green object as white
9. Count number of blue and red blobs
10. Output video stream
11. If number of blue blobs > 0.
12. Press key E using java robot and awt event which will be input for game to move game cursor up to hit pong ball
13. If number of green blobs > 0.
14. Press key C using java robot and awt event which will be input for game to move game cursor down to hit pong ball

E. Camera

Algorithm:
1. Set Threshold value for red
2. Acquire video input
3. Set blob analysis handling
4. Set box handling
5. Start loop
6. Acquire single frame
7. Get red component & filter out noise by using median filter
8. Conversion of image into binary with red object as white
9. Count number of red blobs
10. Output video stream

V. RESULTS

A. GUI Prototype

Figure 3 – GUI Prototype

Figure 3 is the initial prototype design for the GUI.

B. Color Marker Detection

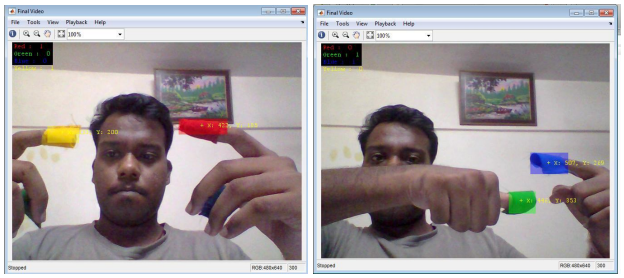

Figure 4 & 5 - Result of color marker detection

The position of color marker will be shown. The number of objects for individual colors will be displayed on top left corner of Video Player.

C. Calculator

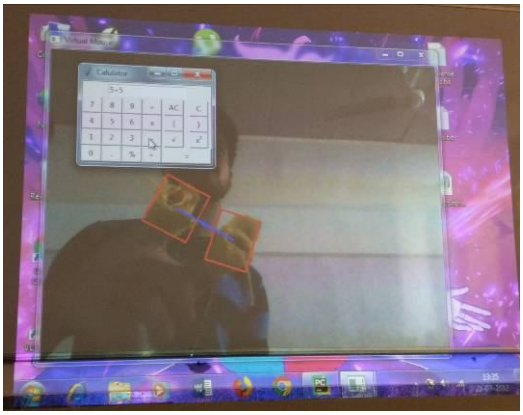

Figure 6 - Calculator GUI

Figure 6, depicts the working of calculator. The mouse is controlled using a virtual mouse. The keys will be then pressed and the operations will be performed accordingly.

D. Paint Application

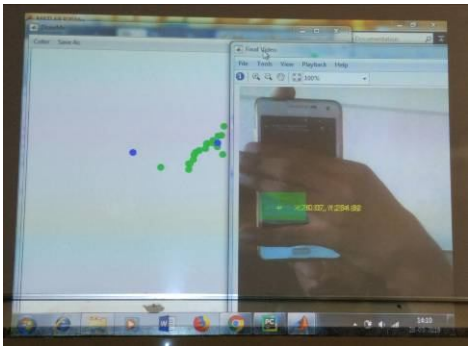

Figure 7 - Result of Paint Application

Figure 7 is the result of drawing application. The red color maker will be detected by the Web Cam and its movement will be simultaneously traced on the paint sheet. Different colors can be switched by the menu on the top left corner.

E. Virtual Watch

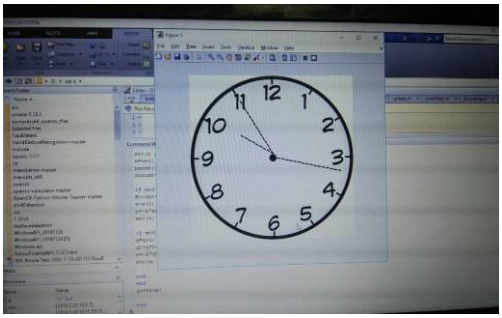

Figure 8 - GUI of Virtual Watch

Figure 8 is the GUI of watch which will be displayed on the wrist on the user. Since it is a real time application, the system time will be taken as input and passed on to the code, ultimately showing the correct time.

F. Game

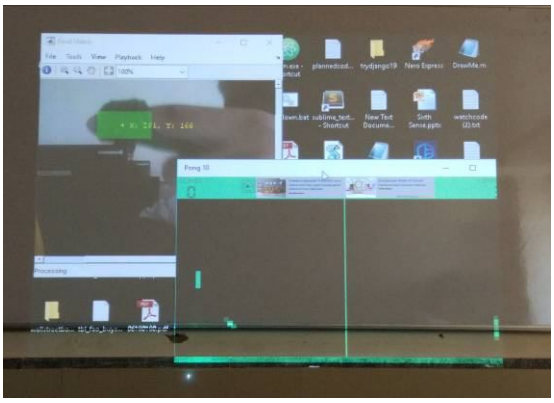

Figure 9 – Pong Game

Figure 9 shows a pong game running. Using color markers, the user is able to control the bat of the pong game. Detection of green color makes the bat move upwards, and blue color moves the bat downwards.

G. Camera

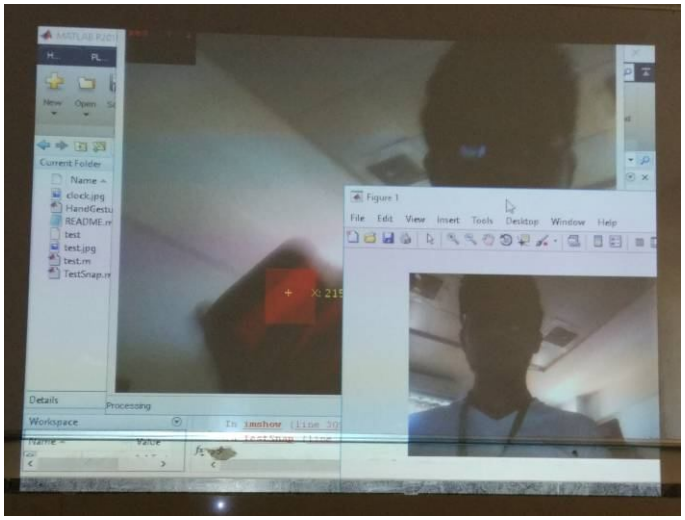

Figure 10 – Capturing an Image

Upon the detection of the color marker, after a pause of couple of seconds, the image will be captured and saved from the webcam.

H. Slideshow Control

Figure 11 - Snapshot of controlling PPT Slides

With the help of color markers, the user is able to control the flow of the presentation. Upon color detection the slides are changed.

VI. CONCLUSION

With the help of computer vision and image processing augmented reality applications became a reality. Calculator, Virtual Watch, Camera, Power Point Presentation, Paint Application are a few of the ones which are implemented. The system's future scope may range from Game Control Application to different domains in Artificial Intelligence.

VII. ACKNOWLEDGMENT

This paper was made possible by the thoughts, ideas, experiments and work done by people around the world contributing for the advancement of computer technology. We would like to thank them for making resources available on the Internet for us to get inspired from and conduct research for making this paper. All images and texts used are have been given their proper links in the References section to give them credit. Some statements made in the paper are subjective and opinionative as there are no proper definitions or scale for words like performance, slow, etc.

REFERENCES

[1] Zeenat AlKassim and Nader Mohamed College of Engineering, College of Information technology, "Sixth Sense Technology: Comparisons and Future Predictions" IEEE paper, UAE University, Al Ain, UAE.
[2] Pradeep Kumar and O. Pandithurai "Sixth Sense Technology" Anna university of technology Coimbatore.
[3] Dr. Ashwani Kush "Sixth Sense Technology, A new Paradigm", University College, Kurukshetra University, Kurukshetra, Harayana, India.
[4] Allan Shivji and Neeta Patil, "Sixth Sense Technology: Applications and Comparisons", St.John college of engineering of technology. 2nd International Conference on Contemporary Computing and Infomatics (ic3i 2016).
[5] Mr. A.A. Kadu and Prof. A.S. Nagdive, "Real-Time 3D Game Using Sixth Sense and Haptic Technology", International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC), 2014.
[6] http://www.pranavmistry.com/projects/sixthsense/ (Accessed on September 2017)
[7] http://www.pranavmistry.com/projects/sixthsense/ (Accessed on September 2017)
[8] https://www.mepits.com/tutorial/174/DSP/Sixth-Sense (Accessed on September 2017)
[9] http://www.123seminarsonly.com/Seminar-Reports/025/50779808-sixth-sense-technology.pdf
[10] http://sallu-sixthsense.blogspot.in/2011/10/sixth-sense-advantages-and.html (Accessed on August 2017)
[11] http://www.pranavmistry.com/ (Accessed on August 2017)

[12] http://students.iitk.ac.in/eclub/assets/documentations/summer13/Sixth%20Sense.pdf
[13] https://www.slideshare.net/atinav242/the-sixth-sense-technology-complete-ppt
[14] https://en.wikipedia.org/wiki/SixthSense (Accessed on August 2017)
[15] http://ieeexplore.ieee.org/document/SixthSense/ (Accessed on August 2017)
[16] https://www.engineersgarage.com/articles/sixth-sense-technology (Accessed on August 2017)
[17] https://www.ted.com/talks/pranav_mistry_the_thrilling_potential_of_sixthsense_technology. (Accessed on July 2017)