CHAPTER 1

INTRODUCTION

Sixth Sense is defined as Extra Sensory Perception or in short ESP. It involves the reception of information not gained through any of the five senses. Nor is it taken from any experiences from the past or known. Sixth Sense aims to more seamlessly integrate online information and technology into everyday life. By making available information needed for decision-making beyond what we have access to with our five senses, it effectively gives users a sixth sense.

Sixth sense technology bridges the gap between real world and digital world. Physical object became part of this technology. The information around humans regarding touch, vision, taste, smell, hearing is perceived by using the five senses. But the most important information i.e., data which is available online through internet but it is restricted to interface or screen and is not naturally recognized by human senses, by eradicating the gap between digital world and the physical world such information will be readily available to the users.

The device is comprised of components such as projector, camera, colour markers, mirrors connected wirelessly to the computing device. Camera recognizes individual image, pictures and gestures one make with their hand. Information sent to laptop for processing. The projector can project the information in any direction with the help of mirror.

1.1 Objective

The objective of this project is to create a sixth sense device which works of the principles of gesture recognition and image processing to capture, zoom (in and out), toggle pictures and control a robot with ease just by the help of coloured caps worn on the fingertips of the user and to connect the data in the digital world in to the real world.

1.2 Motivation

We've evolved over millions of years to sense the world around us. We use our five natural senses to perceive information around our surroundings. But the most useful information that can help us make the right decision is not naturally perceivable with our five senses, namely the data, information and knowledge that mankind has accumulated about everything and which is all available online. There is no link between our digital devices and our interactions with the physical world. Information is confined traditionally on paper or digitally on a screen. The key motivation of this project is to build a device which bridges this gap, bringing intangible digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures.

1.3 Problem domain

Every one of us is aware of the five basic senses- seeing, feeling, smelling, tasting and hearing. These senses have evolved through millions of years. Whenever we encounter a new object our natural senses tries to analyse that experience and the information that is obtained is used to modify our interaction with the environment. But in this new age of technology the most important information that helps one to make right decision is something that cannot be perceived and analysed by our natural senses, that information is the data in the digital form, and it is available to everyone through sources like internet.

Although miniaturized versions of computers help us to connect to the digital world even while we are travelling there aren't any device as of now which gives a direct link between the digital world and our physical interaction with the real world.

1.4 Solution to the problem

The sixth sense technology concept is an effort to connect this data in the digital world into the real world. According to Pranav Mistry the sixth sense technology has a view of human and machine interactions.

The sixth sense technology contains a pocket projector, a mirror and a camera in a pendant like wearable device. Both the projector camera and sensors are connected to a coding device (laptop) in the user's pocket. The projector projects visual information enabling surfaces, walls and physical objects around us to be used as interfaces; while the camera

recognizes and tracks users hand gestures and physical objects using computer vision based techniques.

1.5 Methodology

The software program in the sixth sense technology processes the video stream data capture by the camera and tracks the locations of the coloured markers at the tips of the user's fingers. The movements and arrangements of these markers are interpreted into gestures that act as interaction instructions for the projected application interfaces.

CHAPTER 2

LITERATURE SURVEY

In the International journal "**A Study on Sixth Sense Technology (ISSN 2229-5518)"** the paper deals with the sixth sense device, a tool that connects the physical world with the digital world or the world of data. It is a high tech device which can supplement the physical world around us with the digital information. This wearable device has the capability of turning everything to touch screen just by capturing the gestures of a person. But alongside it has led to the invention of another concept having the same point but by using commands instead of gestures. For orders face recognition technique is used algorithms with the sixth sense method.

Here the database is used which will be initially trained for storage. With this model, our goal is to demonstrate, within a neurobiological framework, the ability of network that processes details of any person just by capturing the natural photographs. It implements the similar command which will gain access to the operation from the mobile device associated to it and projector is used for projection over any surface. Because of its cost constraint it is more likely to be implemented in future.

Arguably the most useful information that can help us take the right decision and judgement is not naturally perceivable information with the help of our five senses, namely the data, information and knowledge that mankind has amalgated but, rather it's the 'sixth sense technology'. This paper focuses on to make us aware with the sixth sense technology which provides an integration of the digital world with the real world, it helps us to understand how the sixth sense device has overpowered the five natural senses, and it also pours light over its various applications and its security related issues. The recent trend in technology have revolutionised the means interaction between the digital world and real time applications. The primary focus of human computer interaction is to improve the intercommunication between user and computer by making computer more receptive to the user needs. Mouse too has undergone a significant revolution right from its invention, starting from a mechanical mouse to an optical mouse. In this paper they have implemented an invisible computer mouse that enables interaction with computer without attaching a hardware mouse. The methodology used is based on the sixth sense technology where the user will be able to move the cursor by the movement of fingers.

In the International journal "**A Step Towards Smart City Using Sixth Sense Technology (ISSN 2320-7345)**" the paper reviews the evolution of Sixth Sense technology which later on developed into an Augmented Reality. The paper primarily focuses on the existing system and the proposed system. It also describes several participation platforms in which the open data projects include citizen or user competitions to develop app and other digital services to improve the quality and level of participation of public services. This is based on input from citizens obtained by providing ideation platforms to develop a better city, or competitions to take advantage of open public data to develop apps and useful new services.

The paper also reviews about the impact of Sixth Sense Technology in the IT and Electronics industry with the fact that it takes mobile computing to the next level. The paper reviews that the Sixth Sense Technology finds its approach in many ways. ICT (Information and Communication Technology) is a key enabler for cities to address these challenges in a smart manner. A smart city is one with at least one initiative addressing, one or more of the following six characteristics: Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment. According to official reports, Tamil Nadu has given the opportunity to nominate 12 cities to be developed as smart cities. Tamil Nadu comes second with the allocation of 12 smart cities and 33 AMRUT cities. The centre has partnered with Bloombery Philantropies for the smart challenge. They basically look at how a city has found a solution to the most pressing need of its people and turn it into an opportunity to improve lives, an official of the Union Urban Development Ministry says. Although the general and specific objectives are very similar across projects, the technological solutions employed are very different. Some companies like Google are working on technologies to try and integrate parts of Sixth Sense whereas Digital India aims at ensuring that the government services are made available to citizens electronically to reduce paperwork.

The paper also proposes the idea of future work development i.e., the concept of intelligent traffic system. These are ICT enabled systems typically based on road sensors or active Global Positioning System .The objective is to monitor real time traffic information. The system will capture the traffic details via the camera placed at the junction and process it and as a result suitable real time actions will be taken. It might also take the feedback from the nearby camera or junction in order to manage city traffic in most efficient and environmentally friendly way possible.

In the international journal **"Drag & Drop: Data Transfer Between two Digital Devices (ISSN (O):2348-4470)"** the literature review explores various approaches of transferring data between two different digital devices through which we can connect real physical world to digital world. These approaches are described as follows. There are many traditional hardware solutions for transferring data between digital devices such as Floppy Drive, Universal Serial Bus (USB) sticks, Hard disk drives etc. These all devices take long time & limited capacity and speed. So as a solution for this, the wireless methods like Bluetooth and infrared etc., are developed. The Put-that-there concept is a drag and drop controlled by the recognition of hand gestures and joystick operation. This concept was given by Richard Bolt in 1980.With the help of this interaction, any file or virtual object can be copied or moved to another location on the same screen. Pick and drop simulates the interaction of drag and drop to transfer digital information across multiple computer interfaces using a device similar to a pen stylus. In this design each pen has its unique Id which is readable from a computer when a pen is kept closer enough to screen. The Id's are stored in a Cloud named as Pen Manager where the client is initiated for extracting the object.

The Drag and drop operation using Sixth Sense Technology is described in which the information on the paper is copied to PC using coloured marked hand gestures. In this Technology Pranav Mistry has used five components Camera, Smart phone, Projector, Mirror and Coloured Markers. The paper reviews about two different prototypes Slurp and Sparsh.

Sparsh takes and interactive approach to transfer data through the idea conceptually. Slurp provides a Tangible User Interface (TUI) for extracting digital information from the physical objects and transfer them to the digital domain.

These two prototypes work over the concept which allows a user to copy data from an Information Container in which the information is stored in the cloud under the camera device Id once another two devices are linked via the smart finger and drop/put it at the desired location in the computer. Thus this concept overlays the idea that with the help of this interaction, any file or virtual object can be copied or moved to another location on the same screen.

CHAPTER 3

SYSTEM DESIGN

Sixth sense is a wearable gestural interface that augments the physical world around us with digital information and lets us use our natural hand gestures to interact with that information.

Our main aim is to capture the image enclosed in the frame formed by the colour caps at the fingers of the users. Swiping, zoom in, zoom out, rotating and other additional features are implemented based on the position of colour caps in the input video Stream. For doing that we need some components such as PC camera/webcam, colour markers, laptop/PC.

3.1 Components:

- **Camera:** Camera is used to capture the object which is in the range and follow the users hand gestures. It grabs the motion of the coloured markers worn on the fingertips and tracks the users hand gestures. The camera recognizes individuals, images, gestures that user makes with his hand and then sends this data to the laptop or PC for processing. The camera performs a basic interface device between laptop and the physical world. It acts as a digital eye connecting the user to the digital world.

- **Coloured Marker:** These coloured markers placed at the fingertips of the users. Making the user's fingers with red, yellow, green and blue coloured tape helps the webcam to recognize the hand gestures. The movements and arrangements of these markers are grasped as gestures that act as an interaction or projected application interfaces.

- **Laptop or Personal Computer:** A laptop with web enabled services is used as the processing device that processes the input video data send by the camera. It is also used for running or implementing the code written on the MATLAB tools for executing the concept of image processing. The various gestures done by the colour marker are tracked by the camera and hence given to the laptop for further processing of the various applications involved.

- **Projector:** the information through the laptop or phone can be projected into any surface. The projector projects the visual information enabling surfaces and physical objects to be used as interfaces.

3.2 Construction and working

The methodology shown below in the algorithm used is based on the Sixth Sense Technology where user has to make several gestures using the finger worn colour markers and perform real time actions whose images are preloaded in the program.

Our aim is to move mouse cursor as the user moves his/her fingers, zooming of images, capturing of photos, etc.

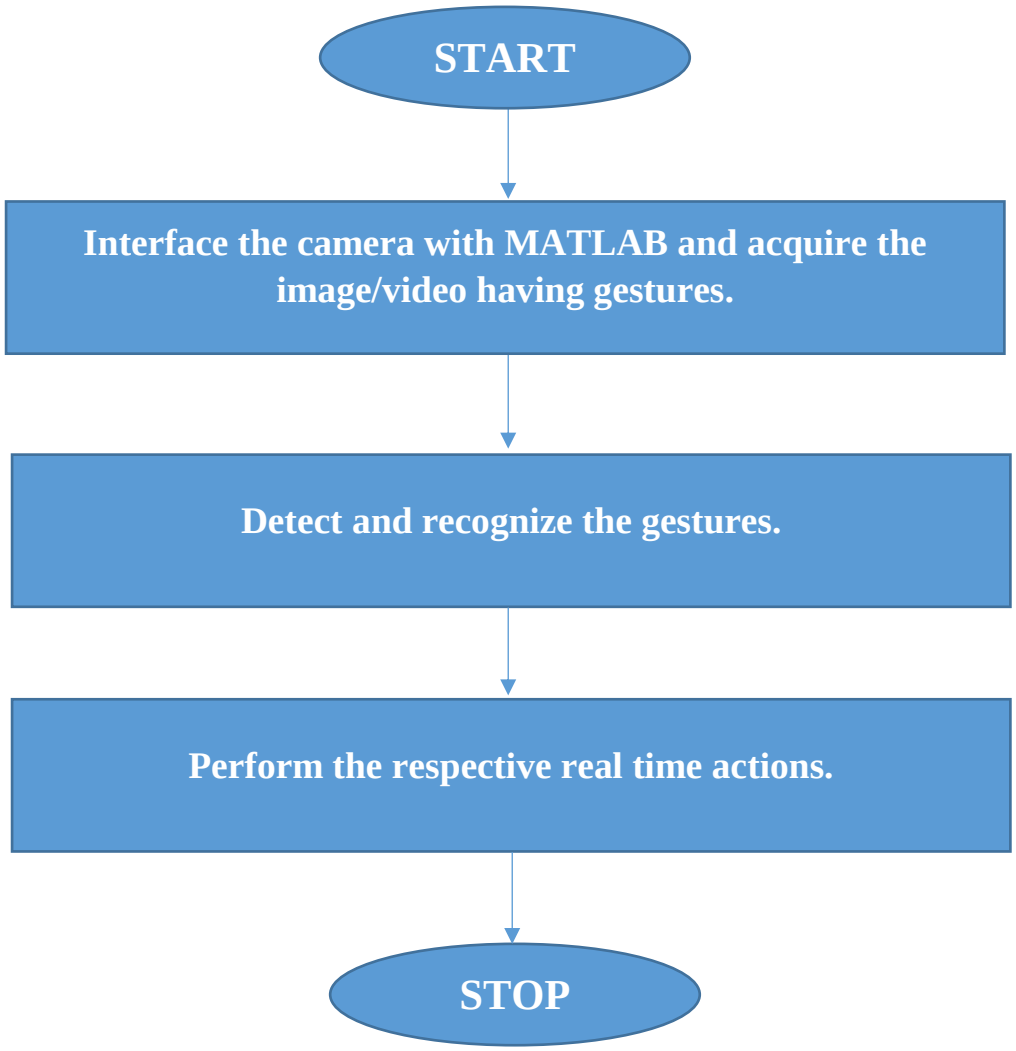


Figure 3.1. Algorithm of Working

The approach works in a continuous manner where camera takes the live video, sending to the laptop and MATLAB installed in laptop processes the input and recognizes the colours at the fingertips of the users.

Camera takes the video and starts recording the live video and in continuation of recording it sends the live video to MATLAB which is installed in the laptop which is further connected with the camera. In MATLAB, code is prepared which convert the incoming live video from camera into frames of images or slicing of video is done in the form of images. These images that are obtained from the slicing of video are the processed for **colour recognition process**. The output of the colour recognition process are the images that contains those colours of which colour caps are present at the fingertips of the user.

RGB values of the colour caps are set to prior in the code so that no other colour will be detected in the image after colour recognition except the caps colours. The output images are displayed in continuation and at the same speed as the speed at which slicing of video is done, so that it looks like a continuous move in which the input is physical world and the output is only those colours which are present at the fingertips of user. The colour is then associated with the mouse cursor in code so that whenever the colour moves in the output image from one position to another, the mouse cursor gets attached at the same position where the colour is now displayed. In the same manner the combination of yellow, green and blue, red is detected and hence by the action performed we can click the images. Neither fingers of the user are not shown in the output images nor are any background colours are there in the output images from the colour recognition process. Each time a feature is implemented, its result is shown in a separate figure in MATLAB environment to clearly differentiate between the features.

The process can be as follows:

- Capture every single frame from the video.
- Process each frame obtained.
- Get the green channels from the frame by setting threshold.
- Subtract the gray scale image from the channel.
- Convert the subtracted image to binary image.
- Find bounding box of definite height and definite distance from each other.

Figure 3.2. Background subtraction of a square green marker

3.3 An example application

All though there are numerous applications of sixth sense technology which are discussed briefly in the application section of this report but one application is discussed in detail in this section as **Controlling movement of a Robot using Sixth Sense Technology**.

3.3.1 Additional hardware used

- Microcontroller
- DC motor
- Motor Driver IC
- Wi-Fi module

3.3.2 Working

A Microcontroller which has enabled serial communication is used to program the robot as per the requirement. The overall movement of a robot is controlled by the motors used. These motors are attached to the wheels of the robot and are programmed for moving forward, backward, turning left and turning right by giving a certain command.

These commands are send to the microcontroller by serial data communication which is fed to the motor driver IC L293D which further drives the motor as per the requirements.

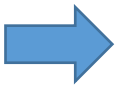
Now the above working is interfaced using Sixth sense technology. The marker in figure 3.2 act as a command to drive the robot in the forward, backward, turning left and turning right. Initially a command from the keyboard is send by serial data communication to drive the motor but now these colour markers act as a virtual keyboard and are used to send the command to the robot.

If there are two markers the fingers, that will behave as two object in the output screen of MATLAB. So using multiple colour we can make multiple object in the output screen. So now with the help of these multiple markers we can control the movement of our robot because now these markers will act as different commands which are sent by serial communication to drive the motor.

The logic for driving a motor and controlling it by the marker is as shown:

RB0	RB1	MOTOR STATUS
Low	Low	Stops
Low	High	Anti-Clockwise
High	Low	Clockwise
High	High	Stops

Table 3.1. Logic for driving a motor



OBJECT USED	MOTOR STATUS
No Object	Stops
One Object	Anti-Clockwise
Two Object	Clockwise

Table 3.2. Controlling the motor by marker

CHAPTER 4

APPLICATIONS

The Sixth Sense prototype implements several applications that demonstrate the usefulness, viability and flexibility of the system.

Some of the applications of Sixth Sense Technology are mentioned below:

- **Taking Pictures:** The implementation of gestural camera is done by forming gesture of yellow, green and blue, red when these colours are positioned on the output image the action of gestural camera is done.

Figure 4.1. Capture of object

- **Moving mouse pointer using fingers:** With the help of colour markers the image processed on the camera implements the mouse. The yellow colour marker helps in moving pointer while blue marker acts as right click and red marker act as left click.

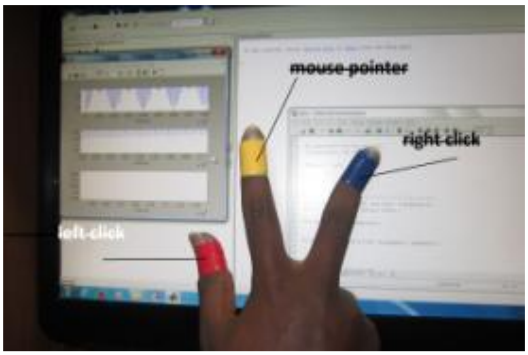


Figure 4.2. Mouse Pointer Description

- **Resizing of Images:** The gesture helps us to zoom in and out, rotate the given image using the concept of hand gesture and image processing. The distance and angle between the markers is calculate. Depending on the distance between markers zoom in and zoom out is done. The maximum distance performs zoom in and minimum performs zoom out. The change of angle between colour markers performs the function of rotating the image.

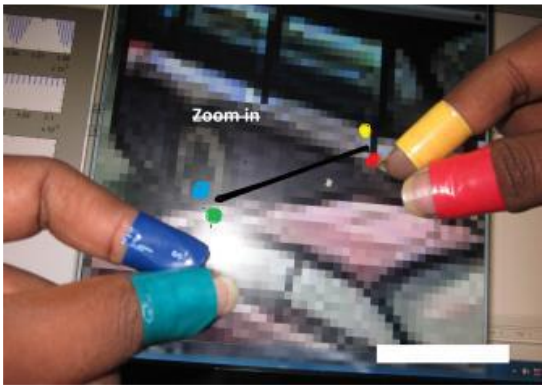


Figure 4.3. Zooming of image

- **Gestures based Robot Control:** Sixth sense Technology can also be used to control the movement of a robot as discussed in earlier section. This technology can be interfaced with any microcontroller device and sends the command with the help of its gestures to make the microcontroller perform its job.

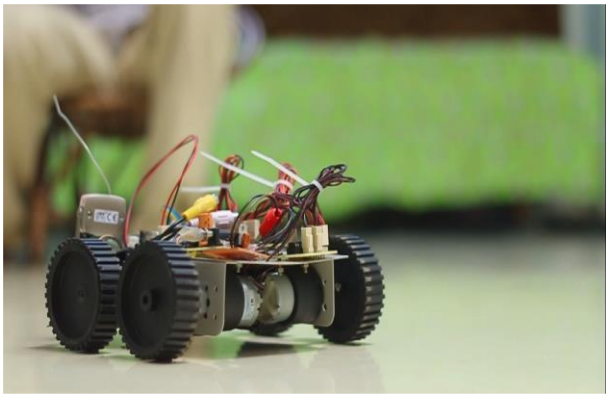


Figure 4.4. Sixth sense demo robot.

- **Home Automation:** Using microcontroller we can implement a home automation circuit which performs variety of jobs by giving commands like turning ON and OFF of lights and fans, switching ON TV, Radio and many more. Now this commands can be sent to the microcontroller via a camera using normal hand gestures as we used in sixth sense technology. So an additional hardware will be required in home automation that is camera and everything can be controlled by the hand gestures only.

Figure 4.5. Home Automation using Sixth Sense.

CHAPTER 5

ADVANTAGES AND DISADVANTAGES

5.1 Advantages:

- One of the main advantage of the sixth sense device is its small size and portability. It can be easily carried around without any difficulty.
- The cost incurred for the construction of the sixth sense prototype is quite low. It was made from parts collected together from common devices.
- Forming a connection between the real world and the digital world was the main aim of the sixth sense technology.
- The data access through recognition of hand gestures is much easier and user friendly to the text user interface or graphical user interface which requires keyboard or mouse.

5.2 Disadvantages:

- It will undoubtedly lead to a technology addiction. Excessive use of technology had already been affecting social lives. With this there is going to be a reduction in social nature of the world.
- Night vision mode camera has to be used in darker regions, this might make this technology quite expensive.
- Coloured finger caps has to be used for creating an object.

CHAPTER 6

CONCLUSION

The key here is that Sixth Sense recognizes the objects around us, displaying information automatically and letting us access it in any way we want, in the simplest way possible. Clearly, this has the potential of becoming the ultimate "transparent" user interface for accessing information about everything around us. The approach has huge potential once it gets further optimized, as its time complexity is higher, with the help of hardware having better specifications.

This is the science of tomorrow with the goal of bringing together the digital world with the physical world seamlessly, eliminating hardware devices. Although the general and specific objectives are very similar across projects, the technological solutions employed are very different. Sixth sense technology analyses the gestures or virtual keyboard commands, and it displays information automatically and allowing us to do actions at distant places at our own will. It allows us to interact with the information via natural hand gestures. In simple, it is almost like installing a digital system (computer) into our body and further making it as sixth sense of our body. It allows us to interact with the information via natural hand gestures and move robots or small devices at our will.

So from the discussions so far it is not hard to insinuate the remarkable scope of sixth sense technology. it has the potential to completely change man's perspective about real objects and there will be a thin line and narrow line between our real world and the virtual world. It will make our world easily accessible by introducing the digital world into it.

CHAPTER 7

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