

# Sixth Sense Technology

Hima Mohan  
Ad-Hoc Faculty  
Carmel College Mala,

**Abstract** — Sixth Sense Technology integrates digital information into the physical world and its objects, making the entire world your computer. It can turn any surface into a touch-screen for computing, controlled by simple hand gestures. It is not a technology which is aimed at changing human habits but causing computers and other machines to adapt to human needs. It also supports multi user and multi touch provisions. Sixth Sense device is a mini-projector coupled with a camera and a cell phone-which acts as the computer and your connection to the Cloud, all the information stored on the web. The current prototype costs around \$350. The Sixth Sense prototype is used to implement several applications that have shown the usefulness, viability and flexibility of the system. The Sixth Sense recognizes the objects around us and displays the information relating to those objects in a real time environment. The Sixth Sense technology allows the user to interact the information through hand gestures. This is a quiet efficient way compared to the text and graphic based user interface. It has the potential to form the transparent user interface for accessing the information around us.

**Index Terms** — Sixth Sense, gesture recognition, working, components, advantages, applications

## I. INTRODUCTION

Sixth Sense is a wearable gestural interface that augments the physical world around us with digital information and lets us use natural hand gestures to interact with that information. 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 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 increasingly all available online. 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 confined traditionally on paper or digitally on a screen. Sixth Sense bridges this gap, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. Sixth Sense frees information from its confines by seamlessly integrating it with reality, and thus making the entire world your computer.

Sixth Sense is a name for extra information supplied by a wearable computer, such as the device called "WuW" (Wear yoUr World) by Pranav Mistry.

## II. WHAT IS SIXTH SENSE?

Sixth Sense is based on the concepts of augmented reality and has well implemented the perceptions of it. Sixth Sense technology has integrated the real world objects with digital world. The fabulous Sixth Sense technology is a blend of many exquisite technologies. The thing which makes it magnificent is the marvelous integration of all those technologies and presents it into a single portable and economical product. It associates technologies like hand gesture recognition, image capturing, processing, and manipulation, etc. It superimposes the digital world on the real world.

Like senses enable us to perceive information about the environment in different ways it also aims at perceiving information. Sixth Sense is in fact, about comprehending information more than our available senses. And today there is not just this physical world from where we get information but also the digital world which has become a part of our life. This digital world is now as important to us as this physical world. And with the internet the digital world can be expanded many times the physical world. God hasn't given us sense to interact with the digital world so we have created them like smart phones, tablets, computers, laptops, net books, PDAs, music players, and others gadgets. These gadgets enable us to communicate with the digital world around us.

But we're humans and our physical body isn't meant for digital world so we can't interact directly to the digital world. For instance we press keys to dial a number; we type text to search it and so on. This means for an individual to communicate with the digital world he/she must learn it. We don't communicate directly and efficiently to the digital world as we do with the real world. The Sixth Sense technology is all about interacting to the digital world in most efficient and direct way. Hence, it wouldn't be wrong to conclude Sixth Sense technology as gateway between digital and real world.

Before Wear Ur World (WuW) came, there were other methods like speechrecognition software, touch recognition etc., which empowered us with direct interfacing. This WuW or Sixth Sense device is a prototype of next level of digital to real world interfacing. This technology enables people to interact in the digital world as if they are interacting in the real world.

## III. GESTURE RECOGNITION

It is a technology which is aimed at interpreting human gestures with the help of mathematical algorithms. Gesture recognition technique basically focuses on the emotion recognition from the face and hand gesture recognition.

Gender recognition technique enables humans to interact with computers in a more direct way without using any external interfacing devices. It can provide a much better alternative to text user interfaces and graphical user interface which requires the need of a keyboard or mouse to interact with the computer. Interfaces which solely depends on the gestures requires precise hand pose tracking. In the early versions of gesture recognition process special type of hand gloves which provide information about hand position orientation and flux of the fingers. In the Sixth Sense devices, colored bands are used for this purpose. Once hand pose has been captured the gestures can be recognized using different techniques. Neural network approaches or statistical templates are the commonly used techniques used for the recognition purposes. This technique has a high accuracy usually showing accuracy of more than 95%. Time dependent neural network will also be used for real time recognition of the gestures.

#### IV. ORIGIN OF THE NAME

Sixth Sense technology (a camera combined with a light source) was developed in 1997 as a head worn device and in 1998 as a neck worn object, but the Sixth Sense name for this work was not coined and published until 2001.

Steve Mann is considered as the father of Sixth Sense technology who made wearable computer in 1990. He implemented the Sixth Sense technology as the neck worn projector with a camera system which Mann referred to as "Synthetic Synesthesia of the Sixth Sense", believing that wearable computing and digital information could act in addition to the five traditional senses. Ten years later, Pattie Maes, also with MIT Media Lab, used the term "Sixth Sense" in this same context, in a TED talk.

Mann's work carried forward by Pranav Mistry (PhD student in the fluid interfaces group at the MIT Media Lab. Similarly, other inventors have used the term Sixth Sense technology to describe new capabilities that augment the traditional five human senses. For example, in their 2012-13 patent applications, timoplatt, refer to their new communications invention as creating a new social and personal sense, i.e., a "metaphorical Sixth Sense", enabling users (while retaining their privacy and anonymity) to sense and share the "stories" and other attributes and information of those around them.

#### V. CONSTRUCTION AND WORKING

The Sixth Sense technology contains a pocket projector, a mirror and a camera contained in a head-mounted, handheld or pendant-like, wearable device. Both the projector and the camera are connected to a mobile computing device 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. The software program processes the video stream data captured by the camera and tracks the locations of the colored markers (visual tracking fiducials) at the tips of the user's fingers. The movements and arrangements of these

fiducials are interpreted into gestures that act as interaction instructions for the projected application interfaces. Sixth Sense supports multi-touch and multi-user interaction. The software that is used in Sixth Sense device is open source type.

Mann has described how the Sixth Sense apparatus can allow a body-worn computer to recognise gestures. If the user attaches colored tape to his or her fingertips, of a color distinct from the background, the software can track the position of those fingers.

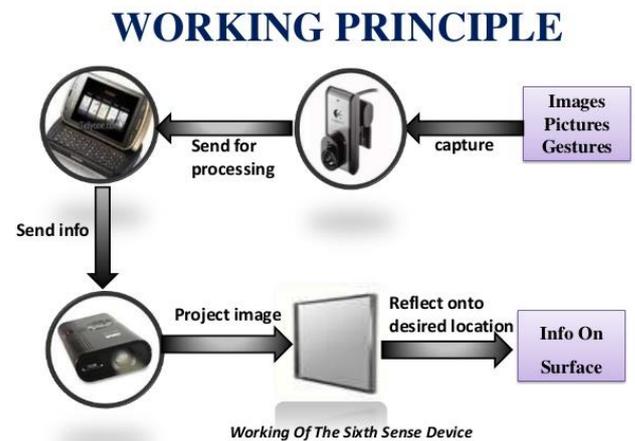


Figure 1. Block Diagram of Sixth Sense Technology

#### VI. HARDWARE COMPONENTS

##### A. Camera

The camera is the key input device of the Sixth Sense system. The camera acts as a digital eye of the system. It basically captures the scene the user is looking at. The video stream captured by the camera is passed to mobile computing device which does the appropriate computer vision computation. The major functions of the camera can be listed as:

- Captures user's hand movements and gestures (used in reorganization of user gestures)
- Captures the scene in front and objects the user is interacting with (used in object reorganization and tracking)
- Takes a photo of the scene in front when the user performs a 'framing' gesture
- Captures the scene of projected interface (used to correct the alignment, placement and look and feel of the projected interface components)

Suggested Product: Logitech QuickCam Pro for notebooks

##### B. Projector

The projector is the key output device of the Sixth Sense system. The projector visually augments surfaces, walls and physical objects the user is interacting with by projecting digital information and graphical user interfaces. The mobile computing device provides the projector with the content to be projected. The projector unit used in prototype runs on a rechargeable battery. The major functions of the projector can be listed as:

- Projects graphical user interface of the selected application onto surfaces or walls in front

- Augments the physical objects the user interacting with by projecting just-in-time and related information from the Internet

Suggested Products: You can buy either laser (AAXA, Microvision) or L.E.D (3M MPro110) projectors.

C. Mirror

The mirror reflects the projection coming out from the projector and thus helps in projecting onto the desired locations on walls or surfaces. The user manually can change the tilt of the mirror to change the location of the projection. For example in application where the user wants the projection to go on the ground instead of the surface in front, he can change the tilt of the mirror to change the projection. Thus, the mirror in the Sixth Sense helps in overcoming the limitation of the limited projection space of the projector.

Suggested Product: Any 1”X1” first surface mirror

D. Microphone

The microphone is an optional component of the Sixth Sense. It is required when using a paper as a computing interface. When the user wants to use a sheet of paper as an interactive surface, he or she clips the microphone to the paper. The microphone attached this way captures the sound signals of user’s touching the paper. This data is passed to computing device for processing. Later, combined with the tracking information about user’s finger, the system is able to identify precise touch events on the paper. Here, the sound signal captured by the microphone provides time information whereas the camera performs tracking. The applications enabled by this technique are explained earlier.

Suggested Product: Microphone of Logitech QuickCam pro for notebooks

E. Mobile computing device

The Sixth Sense system uses a mobile computing device in user’s pocket as the processing device. The software program enabling all the features of the system runs on this computing device. This device can be a mobile phone or a small laptop computer. The camera, the projector and the microphone are connected to this device using wired or wireless connection. The detail of the software program that runs on this device is provided in next section. The mobile computing device is also connected to the Internet via 3G network or wireless connection.

Suggested Product: Any Windows computer

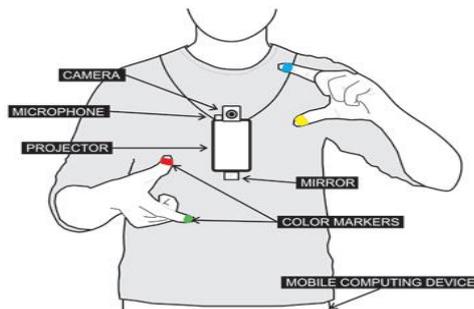


Figure 2. Components of Sixth Sense Technology

Now that you have all these pieces, you need a way to combine them. We recommend using Lego strips to form the base. The projector, camera, and mirror assembly can be directly put onto this base. You can also use Velcro to combine the products.

VII. ADVANTAGES

- *Portable*  
One of the main advantages of the Sixth Sense devices is its small size and portability. It can be easily carried around without any difficulty. The prototype of the Sixth Sense is designed in such a way that it gives more importance to the portability factor. All the devices are light in weight and the Smartphone can easily fit in to the user’s pocket. Support Multi touch and Multi user interaction. Multi touch and Multi user interaction is another added feature of the Sixth Sense devices. Multi sensing technique allows the user to interact with system with more than one finger at a time. Sixth Sense devices also in-corporate Multi user functionality. This is typically useful for large interaction scenarios such as interactive table tops and walls.
- *Cost Effective*  
The cost incurred for the construction of the Sixth Sense prototype is quite low. It was made from parts collected together from common devices. And a typical Sixth Sense device costs up to \$300. The Sixth Sense devices have not been made in large scale for commercial purpose. Once that happens it’s almost certain that the device will cost much lower than the current price.
- *Data access directly from the machines in real time*  
With the help of a Sixth Sense device the user can easily access data from any machine at real time speed. The user doesn’t require any machine human interface to access the data. The data access through recognition of hand gestures is much easier and user friendlier compared to the text user interface or graphical user interface which requires keyboard or mouse.
- *Open Source Software*  
The software that is used to interpret and analysis the data collected by the device is going to be made open source as said by its inventor. This will enable other developers to contribute to the development of the system.

VIII. APPLICATIONS

The Sixth Sense technology finds a lot of application in the modern world. The Sixth Sense devices bridge the gap by bringing the digital world into the real world and in that process allowing the users to interact with the information without the help of any machine interfaces. Prototypes of the Sixth Sense device have demonstrated viability, usefulness and flexibility of this new technology. According to the words of its developers the extend use of this new device is only limited by the imagination of human beings.

During a 2009 TED talk given by Pranav Mistry and his advisor Professor Pattie Maes, she showed a video demonstrating a number of applications of the Sixth Sense system. In 2010, the inventor Pranav also showed live demos. Those applications include:

- Four colored cursors are controlled by four fingers wearing different colored markers in real time. The projector displays video feedback to the user on a vertical wall.
- The projector displaying a map on the wall, and the user controlling it using zoom and pan gestures.



Figure 3. A map on the wall

- The user can make a frame gesture to instruct the camera take a picture. It is hinted that the photo will be automatically cropped to remove the user's hands.



Figure 4. Sixth Sense could use a gestural camera, taking a picture within the framed corners marked by the user's hands

- The system could project multiple photos on a wall, and the user could sort, re-size and organize them with gestures. This application was called Reality Window Manager (RWM) in Mann's headworn implementation of Sixth Sense.
- A number pad is projected onto the user's palm, and the user can dial a phone number by touching his palm with a finger. It was hinted that the system is able to pin point the location of the palm, and that the camera and projector are able to adjust themselves for surfaces that are not horizontal.



Figure 5. Number pad on user's palm

- The user can pick up a product in supermarket (e.g. a package of paper towels), and the system could display related information (e.g. the amount of bleach used) back on the product itself.
- The system can recognize any book picked up by the user and display Amazon rating on the book cover.

- As the user opens a book, the system can display additional information such as reader's comments.
- The system is able to recognize newspaper articles and project the most recent video on the news event on a blank region of the newspaper.



Figure 6. Video on newspaper

- The system is able to recognize people by their appearances and project a word cloud of related information retrieved from the internet on the person's body.



Figure 7. Recognize people by appearance

- The system is able to recognize a boarding pass and display related information such as flight delay and gate change.



Figure 8. Recognize boarding pass

- The user can draw a circle on his or her wrist, and the system will project a clock illustrating the concept.



Figure 9. Watch on wrist

- Sixth Sense also lets the user draw icons or symbols in the air using the movement of the index finger and recognizes those symbols as interaction instructions. For example, drawing a magnifying glass symbol takes the user to the map application or drawing '@' symbol lets the user check his mail.

All the applications were developed and demoed by their prime inventor Pranav, who went on to be Global head of Samsung research team.

#### IX. WHY CHOOSE SIXTH SENSE TECHNOLOGY?

Humans take decisions after acquiring inputs from the senses. But the information we collect aren't enough to result in the right decisions. But the information which could help making a good decision is largely available on internet. Although the information can be gathered by connecting devices like computers and mobiles but they are restricted to the screen and there is no direct interaction between the tangible physical world and intangible digital world. This Sixth Sense technology provides us with the freedom of interacting with the digital world with hand gestures. This technology has a wide application in the field of artificial intelligence. The current prototype system costs approximate \$350 to build. Instructions on how to make your own prototype device will come soon.

#### X. FUTURE ENHANCEMENTS

- To get rid of color markers.
- To incorporate camera and projector inside mobile computing device.
- To have 3D gesture tracking.
- To make Sixth Sense work as Fifth Sense for disabled person.

#### XI. CONCLUSION

It's the beginning of a new era of technology where engineering will reach new milestones. Just like in the science fiction movies where display of computer screen appears on walls, commands are given by gestures, the smart digital environment which talks to us to do our work and so on, these all will be possible very soon. You imagine it and Sixth Sense technology will make it possible. Now it's time for sci-fi movie directors to think ahead because the technology shown in there fiction movies soon will become household stuff. Before few years back it was considered to be supernatural or tantalizing imagination. But now it has been made possible. Thanks to Pranav Mistry, a genius who introduced mankind to this futuristic technology.

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