Gesture Controlled User Interface Technology and Ubiquitous Applications

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ABSTRACT   *Sixth sense is a power of perception seemingly independent of the five natural sense organ which basically include eyes, ears, nose, tongue, mind and body to perceive different things from environment. Six sense has been a revolutionary technology that is being used in different gesture approaches to enhance the physical world with digital. It is extensively used in many "gesture interface" devices which refers to the interaction with something greater than physical senses which can perceive by human. Being a new & interesting development toward the digital world for which the first step was taken by the researcher Steve Mann, known for making wearable computer in 1990 and his work was carried forward by young master minds Pranav Mistry (Ph.D student in the Fluid Interfaces Group at the MIT Media Lab). According to the young minds the sixth sense technology has a Web 4.0 view of human machine interaction (HMI). Six sense technology (SST) is a wearable gesture interface device, which is capable of recognizing user's hand gestures as well as icons/symbols drawn in the air with fingers which may led to easier user interface between human and machine. In this paper, we will be discussing technical aspects behind gesture technology, sixth sense technology "which provides freedom of interacting with the digital world" its necessity and applications of Sixth Sense Technology.*

INTRODUCTION

Sixth sense is a gestural wearable interface that augments corresponding environment with digital information and user can use color marker approach to interact with obtained information. Sixth Sense technology (SST) is a technology with which a system could be trained to recognize and percept real world objects and react as desired. SST bridges the gap between the physical world and the digital world, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. Known to all there are five basic senses: seeing, feeling, smelling, taste and hearing which is shown visibly in fig 1. Whenever we encounter a new object/experience our natural senses tries to analyze that experience and the information that is obtained is used to modify our interaction with the environment. But in this new age of technologies the most important information that helps one to make right decision is something that cannot be perceived and analyzed by our natural senses. That information is the data in the digital form, and it is available to everyone through sources like internet. The concept behind SST is to connect information data in the digital world to the real world. Sixth Sense is a revolutionary technology that can be used to access digital information in the world with wearable gestures. Now, we are moving toward the era of SST. The main focus of this paper introduces about the SST with human interface its basic use is to make computers by adapting to human needs.

Fig 1: The basic senses

The aim of Sixth Sense is to let the computer assist human in making correct decisions by molding information into various forms. We have been used this to a clear gap between the virtual world and the real world and Sixth sense aims to fill this void successfully. It associates technologies like hand gesture recognition, image capturing, processing, manipulation etc, which

makes it magnificent and present it in single portable and economical form.

Emergence of Sixth Sense Technology

Sixth Sense in scientific (or nonscientific) terms is defined as extra sensory perception [1]. With the help of SST we can access or manipulate the information using fingers or hand gestures such as:

➢ If want to make a call just extend hand in front of projector and automatically dial up number will appear.
➢ Draw a circle on wrist watch will appear showing the current time.
➢ Just make a square with fingers to take a photo, highlighting the frame and the system will make the photo accordingly [2, 3].

Steve Mann known as father of this significant technology give a shape to this technology in form of a neck worn projector with a camera system [4]. Later on his work was advanced by an Indian researcher who came up with ambitious new applications. Birth of SST took place at media labs in MIT and coined as Wear Ur World which was developed by a Ph. D student Pranav Mistry, at Fluid Interfaces Group at the MIT Media Lab, according to him this technology has a Web 4.0 view of human and machine interactions. Prototype of The Sixth Sense implements several applications that demonstrate the usefulness, viability and flexibility of the system acts as the computer when connection to the Cloud with all the information stored on the web. Maes-A group of MIT graduate had thought about how one can access information around the world without taking out a gadget and neither browsing through the internet. The key to this was Sixth Sense which recognizes the objects around you while displaying information automatically and letting you to have access it in any way you want, in the simplest possible way. These device brings us closer to reality and virtually assisting us in making right decisions by providing the relevant information, thereby making the entire world as a computer. The technology here we talk is mainly based on hand gesture recognition, image capturing, processing, and manipulation, etc. which may also uses video stream, captured by the camera, and also tracks the location of the tips of the fingers to recognize the gestures as shown in fig:2 . This process is done using some techniques of computer vision.
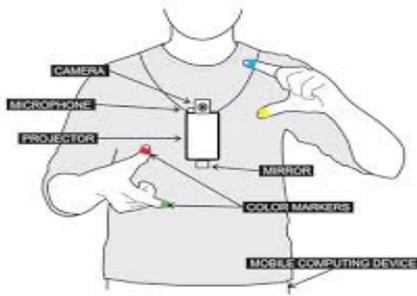
Fig: 2 Sixth Sense Prototype Design Page Layout
Componenets Used in SST

Sis sense can be named as an innovative computing method that uses user gestures with gesture techniques to perform day to day activities. This technology gradually changes the way one interact with computers and can be used for a variety of stimulating applications such as checking of flight delay just by showing the ticket, getting the reviews of books just by showing it cover etc.
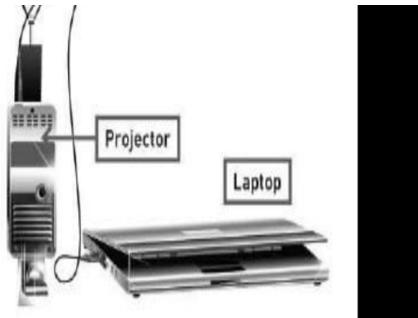
(i)Software: The six sense technology software will be open sources and secured coding inside the device for security of the software. The prototype system runs on windows platform & majority of the code is written in C++ & C#. The software for the sixth sense prototype is also developed on WPF open CV.[5] The software program processes the video stream data captured by the camera and tracks the locations of the colored markers (visual tracking fiducial) . The maximum number of tracked fingers is only constrained by the number of unique fiducials, thus Sixth Sense also supports multi-touch and multi-user interaction.

Hardware Used
The hardware components are coupled in a pendant like mobile wearable device. The components are camera, projector, mirror, mobile component and coloured markers.

Camera
Camera is used to captures an object in view and to tracks the user's hand gestures. Sixth Sense system implements a gestural camera that takes photos of the scene the user is looking at by detecting the 'framing' gesture. It acts as a digital eye, connecting you to the world of digital information. It should have Gesture tracking engine, Gesture enabled application.

Projector
A tiny LED based Pocket projector Pk101 from Optima is used. It displays data sent from the smart phone on any surface in view- object, wall, or person. The projector projects visual information enabling surfaces, walls and physical objects around us to be used as interfaces. The projector itself contains a battery inside, with 3 hours of battery life.

Mirror
The usage of the mirror is significant as the projector dangles pointing downwards from the neck. Mirror reflects image on to the desired surface. Thus the digital image is freed from its restriction and placed in the physical world.

Smart Phone
A Web-enabled smart phone in the user's pocket processes the

Figure. 3 Camera used, Visualize device, Mirror, Web Enabled Device, Gesture Recognititon Approach
Functionality

The working principle of Sixth Sense Device totally based on Feedback mechanism. The Sixth sense prototype implements several applications that demonstrate the usefulness, viability and flexibility of system.
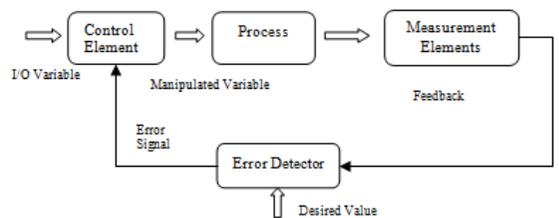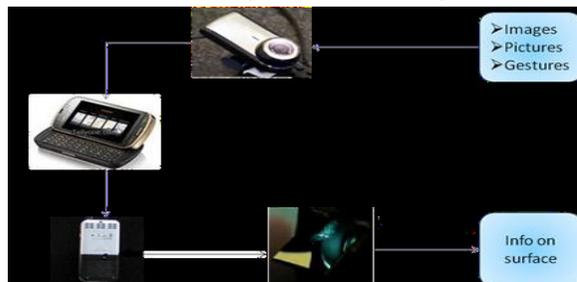

Figure. 4 Block diagram of Sixth Sense Technology
The SST uses different technologies like gesture recognition, image processing, etc. The Sixth sense prototype uses a mini –projector, a camera along with a mirror and a cell phone. Camera and cell phone together act as a computer and connect us to the 'cloud' which is all the information stored on the web. The Camera recognizes objects using computer vision based technique. Hand gestures and images captured by the camera are processed using software programs. It also tracks the locations of the colored markers also known as 'visual tracking fiducials' at the tips of the user's fingers. The motion and arrangements of these fiducials are interpreted into gestures that act as interaction instructions for the projected application interfaces. The

mirror reflects the projection and thus helps in projecting onto the desired locations on walls or surfaces. The user can manually change the tilt of the mirror for location of the projection [6]. The microphone is an optional component of the Sixth Sense. It is required when using a paper as a computing interface. This data is passed to computing device for processing.

The main key features of compenets which help in working of Sixth sense based Devices.

- ➢ It captive the image of the object, tracks the movements and arrangement made by user are interpreted into hand gestures. (camera)
- ➢ The color markers approach with multi-colored tape implied on user's fingers preferred.
- ➢ The smart phone searches the web and interprets the hand gestures with the help of the colored markers placed at the finger tips.
- ➢ The information that is retrieved through the smart phone can be projected into any surface.
- ➢ The Mirror in Sixth Sense helps in overcoming the limitation of the limited projection space of the projector mirror reflects the image on to a desired surface.

Pros and Cons of 6ᵗʰ Sense Technology

S.No.	Advantages	Disadvantages
1.	It will be easier for us to be technologically awake all the time and to connect to the world via this newest invention.	Excessive use of technology had already been affecting our social lives. With this, there is going to be a reduction in the social nature of the world and the humanness is bound to diminish.
2.	No need to carry devices like laptops, tablets as one can easily browse or store data at any time using sixth sense.	Technologies like computer vision and RFID are used in sixth sense which leads to projection of rays on surface. The most feasible surfaces to be used are human body parts for instance arms hands; which may lead to some health problems due to exposure to rays.
3.	Peripheral devices like keyboard, mouse, and external speakers are not used in sixth sense prototype as used in computers and laptops which make it light and portable.	Sixth sense Technology is wiping out the use of peripheral devices which may lead to a huge crash in hardware market and will deteriorate revenue generated.
4.	Any data can be accessed any time with the help of its Projections.	Projection is better in night time and dark areas rather than mornings and bright areas. This is an issue because the vision of the user can be damaged when using this instrument.

Technology Associated to Sixth Sense

5.1 Image Processing

Image Processing belongs to computer vision technology. The computer vision technique basically includes four processes like- Recognition, Motion Analysis, Scene Reconstruction, Image Restoration. Image Processing is the science and technology, concerned with the theory behind artificial systems that extract information from images. An image is an array of gray level (brightness) values of individual pixels. 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). These numbers are almost meaningless, as they contain minute information about the scene. A robot needs information like "Object ahead", "table to the left", or "person approaching" to perform its tasks. To convert this low level information into high tech information is the goal of computer vision.

Augmented Reality

Augmented reality is a term for a live direct or indirect view of a physical real world environment whose elements are augmented by virtual computer generated imagery. Augmented reality blurs the line between what's real and what's computer-generated by enhancing what we see, hear, feel and smell. Augmented reality is one of the newest innovations in the electronics industry. It superimposes graphics, audio and other sense enhancements from computer screens onto real time environments. Augmented reality goes far beyond the static graphics technology of television where the graphics imposed do not change with the perspective. Augmented reality systems superimpose graphics for every perspective and adjust to every movement of the user's head and eyes.

Voice Recognititon

The term "voice recognition" is referred to recognition systems that must be trained to a particular speaker—as the case for most desktop recognition software. Recognizing the speaker can simplify the task of translating speech. Speech recognition is a broader solution which refers to technology that can recognize speech without being targeted at single speaker—such as a call center system that can recognize arbitrary voices. Speech recognition is widely exploited applications of 6ᵗʰ sense technology. From mobile phones to navigation systems in cars, the presence of speech recognition has become a necessity. Speech recognition is also used in biometric security in many areas. Many people use speech recognition as a locking system in their laptops and mobile phones.

Gesture Recognititon

Gesture recognition is a language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion 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 can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), which limit the majority of input to keyboard and mouse. Smart phones now have gesture technology that allows the user to attend calls or unlock the applications using gestures instead of actual touch. Many gaming platforms such as Nintendo Wii, PlayStations and Xbox have launched many lucrative gesture following games. Hand-swiping doors and smart sanitation facilities have become a common sight in malls and other public places.

5.5. Radio Frequency Identification

In radio frequency identification two devices are tagged to communicate with each other by radio waves. The RFID tags can

be read by magnetic fields at short ranges (meters). It is used to transfer information from sensors and enterprise systems to make inferences about people, their interactions, objects and their workstations. Fig shows the implementation of RFID technology in library.
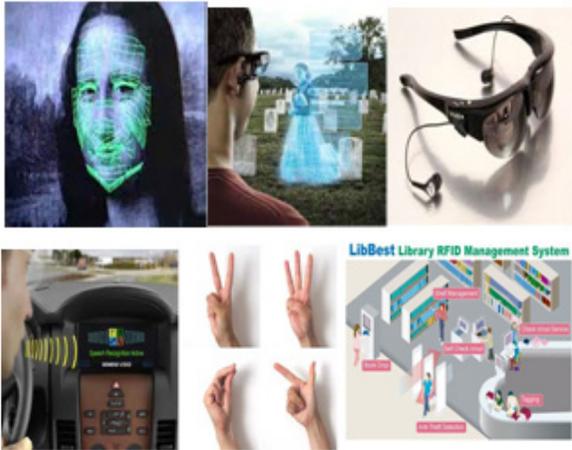

Fig.. 6 Image processing, VR Glasses and its Application, Speech recognition system in cars, General hand gestures, Library management system using RFID technology
 Application of 6th Sense Technology

Six Sense is an open source, could be work as jewelry and can perform various task like create multimedia reading experience, interacting with objects, object information, to browse the web. The greatest benefit of the device is the availability of wide variety of application in it they are:

A) Drawing Applications: The drawing applications allow the user to draw on any surface by simply tracking the finger tip movements of the user's index finger.

B) Multimedia Reading Experience: The Sixth Sense system also helps to interact with physical objects so we can use them in a better way. For example, a gesture of drawing a circle on the users wrist projects a watch on the users hand. Similarly a newspaper can show live video news or dynamic information can be provided on a regular piece of paper.

Fig. 7. Image using Gesture Technology, Video Newspapers
C) Get product Information: Sixth Sense uses image /marker recognition technology to sense products we pick up, and feeds us information on these products. We can get Book information, get flight updates, and feed information on people.

D) Palm is the New Dialer: The technology enables the user to call without using the dialer. We can use Sixth Sense to display a virtual Keypad on your hand, and then use that virtual keypad to make a call. As there is no need of mobile device, simply user have to just type the number with the help of other hand.

E)Call Up a Map: The map application allow the user to navigate a map that displayed on a nearby surface by using our hand gestures, which is similar to gesture supported by Multi-Touch based systems, which permits the user to zoom in, zoom out us-

ing intuitive hand movements.

Future of 6th Sense Technology
The Sixth Sense technology will remove the tedious task of carrying our laptops or any other devices which are very heavy. It's light and easy to carry and easy access to any information. The main uses are in the field of Interactive advertisements, True 3D print media, 3D Visualization. This gives access to interactions between the real world and the world of data. Although the reduced sized computing devices permits us to carry computers in our pockets, it enables one to account, browse and compute data on anything. First thing for the sixth sense applications is to provide the security. The benefits of this technology is that it is portable, its medium between the world and the information as speech and gestures. In future (MCT) mind control technology will take place over Gesture Recognition Technology and Speech Recognition where sensors will detect the changes in brain activity will be placed on a head and computer will decode the information collected by sensors and transmit to the device. It's economical efficient and connect with real world.

Fig. 9. Fututre of Sixth Sense Technology

Conclusion
The Sixth Sense technology is the latest technology which is user interactive and provide the facility to interface with the environment. The Sixth Sense technology will remove the tedious task of carrying our laptops or any other devices which are very heavy. All we have to do is just wear the device which is a pendant shaped. It's light and easy to carry and easy access to any information. This gives access to the information about the things in the environment and enables the new kind of interactions between the real world and the world of data. Although the reduced sized computing devices permits us to carry computers in our pockets, the thing to notice that there is no link between the digital devices that we carry with us and our communications with the physical world, and our speech in an efficient level. The key here is that Sixth Sense recognizes the objects around you, displaying information automatically and letting you access it in any way you want, in the simplest way possible. This will enable individuals to make their own application depending on imagination and requirement.

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