Project Documentation

Project Title: Sixth Sense Device
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Basic Aim:
To create a Sixth Sense device which works of the principles of gesture recognition and image processing to capture, zoom(in and out) and toggle pictures with ease just by the help of colored caps worn on the fingertips of the user.

Motivation:
When we were thinking of projects for the summers to execute, we thought of making a hand, which would do exactly what our hand is which could have been something brilliant in robotics. Then we came across a TED talk by Pranav Mistry where he was talking about how we can connect the physical world with the digital world using Sixth Sense. It looked simply amazing

how he was able to just show his fingers in front of his camera (phone) and the camera would click pictures.
This just enthralled us and was just something we had to make considering it's sheer brilliance.

Theory:
'SixthSense' 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.

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/experience 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 technologies 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. The sixth sense technology concept is an effort to connect this data in the digital world in to the real world.

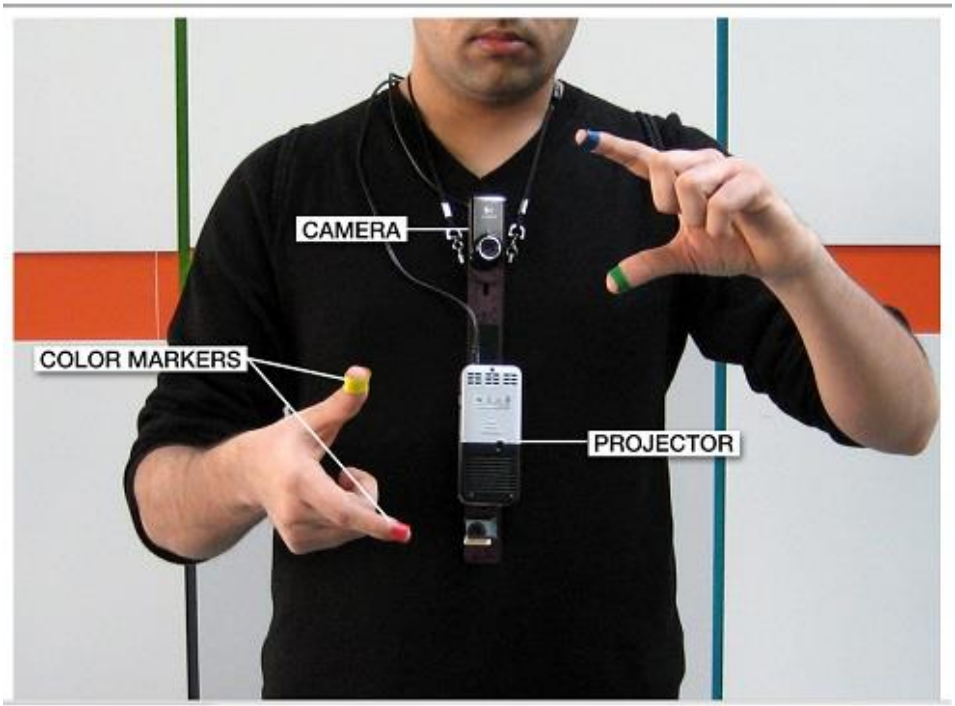
Although miniaturized versions of computers help us to connect to the digital world even while we are travelling there aren't any device as of now which gives a direct link between the digital world and our physical interaction with the real world. Usually the information's are stored traditionally on a paper or a digital storage device. Sixth sense technology helps to bridge this gap between tangible and non-tangible world.

The sixth sense technology was developed by Pranav Mistry, a PhD student in the Fluid Interfaces Group at the MIT Media Lab. According to him the sixth sense technology has a Web 4.0 view of human and machine interactions.

The SixthSense technology contains a pocket projector, a mirror and a camera contained in a pendant-like, wearable device. Both the projector the camera and sensors are connected to a coding device (in our case-a 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. 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. The Sixth Sense prototype is used to implement several applications that have shown the usefulness, viability and flexibility of the system.

The Sixth Sense:

SixthSense 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.



Components of the device:

Camera

It captures the image of the object in view and track the user's hand gesture. The camera recognizes individuals, images, pictures, gestures that user makes with his hand. The camera then sends this data to a smart phone for processing. Basically the camera forms a digital eye, which connects to the world of digital information.

Colored Marker

There are color markers placed at the tip of users finger. Marking the user's fingers with red, yellow green and blue colored tape helps the webcam to recognize the hand gestures. The movements and arrangement of these markers are interpreted into gestures that act as a interaction instruction for the projected application interfaces.

Microsoft-enabled Laptop

The SixthSense device consists of a laptop which process the data send by the camera. The laptop interprets the hand gestures with help of the colored markers placed at the fingertips.

Dev-C++ was the programmer used for all codes made. MinGW was the compiler used. OpenCV libraries were used which contained all functions sufficient to make our project.

Projector

The information that is interpreted through the smart phone can be projected into any surface. The projector projects the visual information enabling surfaces and physical objects to be used as interfaces. The projector itself consists of a battery which have 3 hours of battery life .A tiny LED projector displays the data sent from the smart phone on any surface in view- object, wall or person.

The Original Device

Technologies that are related to Sixth Sense Devices

Augmented Reality

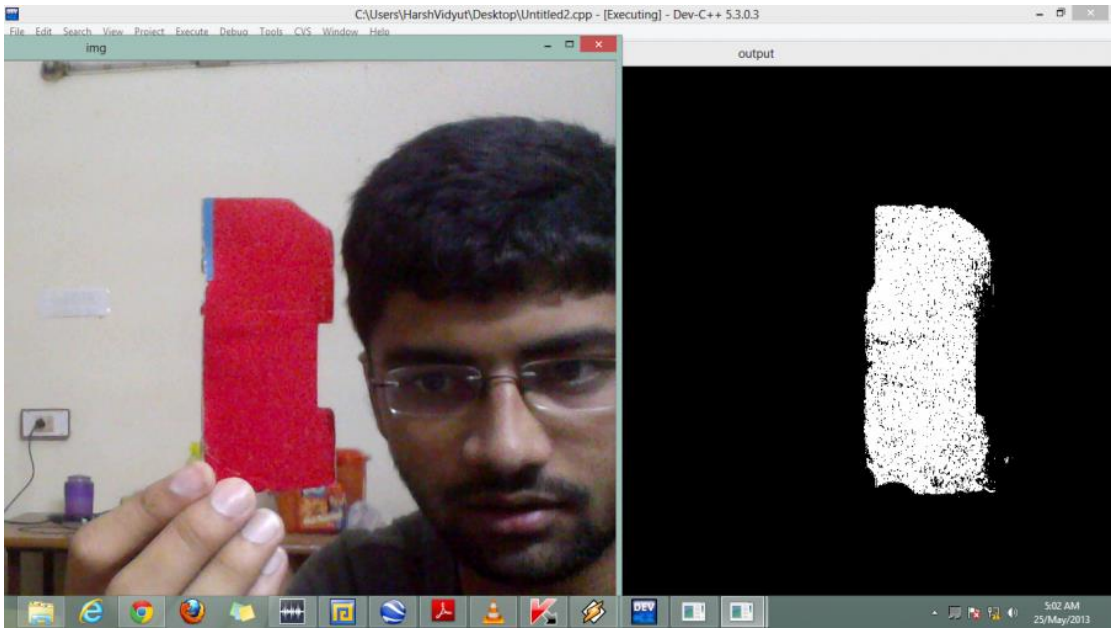
The augmented Reality is a visualization technology that allows the user to experience the virtual experience added over real world in real time. With the help of advanced AR technology the information about the surrounding real world of the user becomes interactive and digitally usable. Artificial information about the environment and the objects in it can be stored and retrieved as an information layer on top of the real world view. When we compare the spectrum between virtual reality, which creates immersive, computer-generated environments, and the

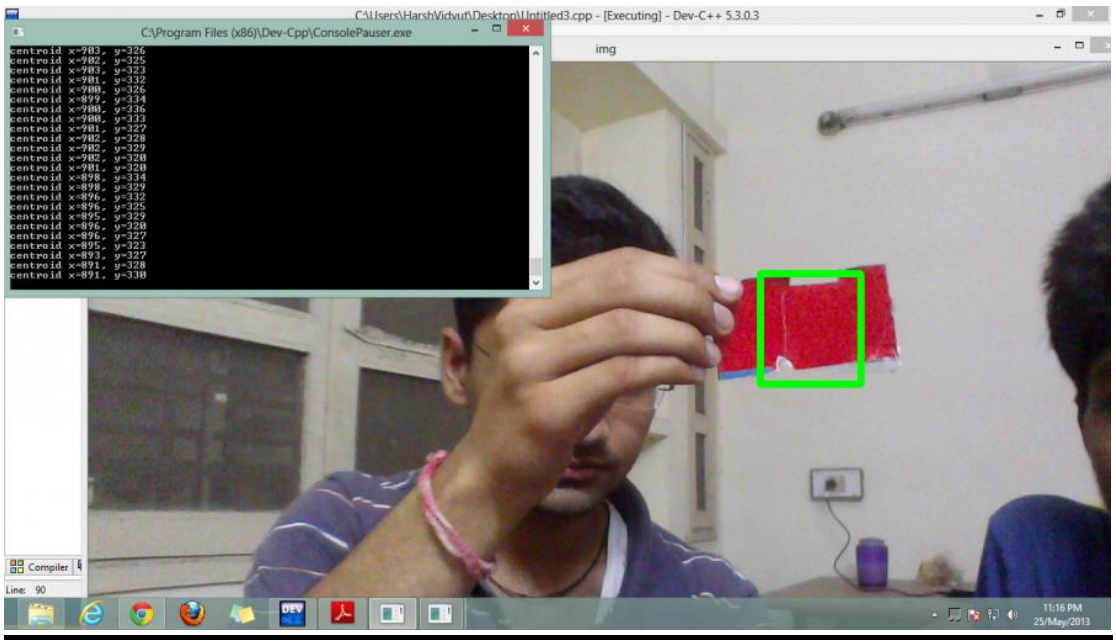
real world, augmented reality is closer to the real world. Augmented reality adds graphics, sounds, haptic feedback and smell to the natural world as it exists. Both video games and cell phones are driving the development of augmented reality. The augmented systems will also superimpose graphics for every perspective available and try adjusting to every movement of the user's head and eyes. The three basic components of an augmented reality system are the head-mounted display, tracking system and mobile computer for the hardware. The main goal of this new technology is to merge these three components into a highly portable unit much like a combination of a high tech Walkman and an ordinary pair or eyeglasses. The head-mounted display used in augmented reality systems will enable the user to view superimposed graphics and text created by the system. Another component of an augmented reality system is its tracking and orientation system. This system pinpoints the user's location in reference to his surroundings and additionally tracks the user's eye and head movements. Augmented reality systems will need highly mobile computers. As of now many computers aren’t there to satisfy to provide this option.

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 SixthSense devices colored bands are used for this purpose. Once hand pose has been captured the gestures can be recognised 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.





Computer Vision

Computer vision is the technology in which machines are able to interpret/extract necessary information from an image. Computer vision technology includes various fields like image processing, image analysis and machine vision. It includes certain aspect of artificial intelligence techniques like pattern recognition. The machines which implement computer vision techniques require image sensors which detect electromagnetic radiation which are usually in the form of ultraviolet rays or light rays. The computer vision find itself applicable in varies field of interest. One such field is bio medical image processing. It's also used in autonomous vehicle like SUV's. The computer vision technique basically includes four processes.

1. Recognition: One of the main task of computer vision technique is to determine whether the particular object contain the useful data or not.
2. Motion Analysis: Motion analysis includes several tasks related to estimation of motion where an image sequence is processed continuously to detect the velocity at each point of the image or in the 3D scene.
3. Scene Reconstruction: Computer vision technique employs several methods to recreate a 3D image from the available images of a scene.
4. Image Restoration: The main of aim of this step is to remove noise from an given image. The simplest method involves using simple filters like low pass or median filters. In order to get better quality images more complex methods like Inpainting are used.

ADVANTAGES OF SIXTH SENSE DEVICES

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 deigned in such a way that it gives more importance to the portability factor. All the devices are light in weight and the smart phone can easily fit into the users pocket.

Cost effective

The cost incurred for the construction of the sixth sense proto type is quiet low. It was made from parts collected together from common devices. And a typical sixth sense device cost 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.

Connectedness between real world and digital world

Forming a connection between the real world and the digital world was the main aim of the sixth sense technology.

Data access directly from the machines in real time

With 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 made open source. This enables other developers to contribute to the development of the system.

APPLICATION

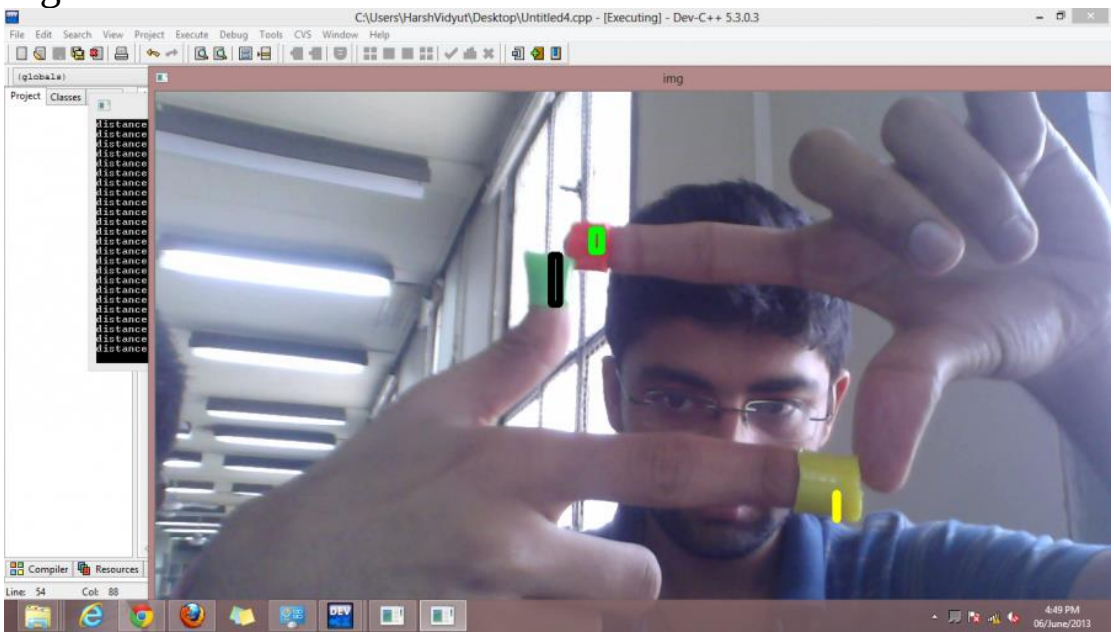
The sixth sense technology finds a lot of application in the modern world. The sixth sense devices bridge the gap by bringing the digital world into the real world and in that process allowing the users to interact with the information without the help of any machine interfaces. Prototypes of the sixth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

Map Application

With the help of a map application the user can call upon any map of his/her choice and navigate through them by projecting the map on to any surface .By using the thumb and index fingers movements the user can zoom in, zoom out or pan the selected map.

Taking Pictures

Another application of sixth sense devices is the implementation of a gestural camera. This camera takes the photo of the location user is looking at by detecting the framing gesture. After taking the desired number of photos we can project them onto any surfaces and then use gestures to sort through those photos and organize and resize them.



The user taking making a pose gesture. The camera takes the photo of the location

Drawing Application

The drawing application allows the user you to draw on any surface by tracking the fingertip movements of the user's index finger. The pictures that are drawn by the user can be stored and replaced on any other surface. The user can also shuffle through various pictures and drawing by using the hand gesture movements

Making Calls

We can make calls with help of sixth sense device .The sixth sense device is used to project the keypad into your palm and the using that virtual keypad we can make calls to anyone.

Interacting with physical objects

The SixthSense system also helps to interact with physical objects we use in a better way. It augments physical objects by projecting more information about these objects projected on them. For example, a gesture of drawing a circle on the user's wrist projects an analog 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

Newspaper showing live feeds

an analog watch projected into the wrist

Getting Information

Sixth sense devices can be used for getting various information relating to our everyday life by getting in contact with objects

Product Information:

Sixth sense technology uses marker technology or image recognition techniques to recognize the objects we pick in our hand and then provide information relating to that product.

Book Information:

By holding and shuffling through the book pages, the sixth sense provides Amazon ratings on that book, other reviews and other relevant things related to the book.

Flight Updates:

With the help of the sixth sense technology it is no longer required to log into any sites for checking the status of the flights. The system will recognize your boarding pass and let you know whether the flight is on time or not.

Information About People:

With help of face recognition techniques the sixth sense devices are able to provide information about the people when we meet them. The sensor detects the face and checks the data base for the relevant information. The system will then project the relevant information about a person like what they do, where they work,

Boarding pass showing current status. The information about a person being projected

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