Seventh Sense Technology

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***Abstract*—Seventh Sense Technology is a technology used for the human electronic interaction using natural hand gestures. The hand gestures can be used to control any micro controller based devices or robots at distant places using Zigbee or GSM Module or Satellite transceiver. The "Seventh Sense Technology" is easy to implement with reduced implementation cost and it opens a wide area of research for the next generation and a greater development in almost all areas of current interest.**

Seventh Sense Technology uses the Sixth Sense Technology and its advancements to control the autonomous robots or any microcontroller based devices on human will. Currently autonomous robots or any microcontroller based devices are designed for a single purpose, but with this technology robots and those devices can be made to achieve multidimensional purposes. Even the costlier sensors can be replaced with the low cost night vision cameras. It opens a way to control robots or any microcontroller based devices at any distance with natural hand gestures of human beings. It also has the provision of customizable virtual keyboard for giving more actions to distant devices. It is going to be a greater field of research that also paves a lot of attention in this current world of technology.

Key words: Seventh Sense; Sixth Sense/WUW; Computer Vision, Artificial Intelligence; Robotics; Neural Networks; Image processing; Wireless Communication

I. INTRODUCTION

Seventh Sense technology is a human electronic interaction with the incorporation of the sixth sense technology [1] [15] to control the autonomous robots or micro controlled devices with the aid of simple hand gestures [2]. Robots are the main area of interest in the current scenario. Robots do things or moves according to a stored program flashed in its micro controller. It also detects the path or sense the details using varying costly sensors built on its device. For a path or edge detection autonomous robots, we usually use the infrared sensors or color identification sensors. But by using this seventh sense technology we can eliminate the use of sensors and do the same works with more ease and less complexities.

Seventh Sense technology can be used in a system to recognize and percept real world objects and does actions as desired by human beings. Seventh Sense technology connects us to the physical and digital world by giving us a way of interaction with this information through virtual keyboard and natural hand gestures to give instructions to the robots or other microcontroller based devices placed at distant places. Seventh Sense technology is implemented with Sixth Sense/WUW (wear your world) using gesture recognition, computer vision, augmented reality, radio frequency identification, image processing, computer wireless networking and neural networks. Seventh Sense technology could be integrated with voice recognition. Also Bluetooth device and laser projectors could be used to enhance Seventh Sense [3]. The natural language processing overhead can be removed by using projectors in this technology.

Seventh Sense means a state where humans are capable of forecasting the things and making an alteration or an effect somewhere he is not virtually present. Humans make decision from the five senses and that decision making can be made using technology through artificial Intelligence and Neural Networks. Seventh sense technology uses the low rate IEEE 802.15.4 for its short range communication between the transmitter and receiver. Similarly GSM module or Satellite transceivers can be used according to the need of communication range. Therefore seventh sense eventually transmits the sixth sense data to devices at remote places.

Sixth Sense Technology bridges up digital and intangible information out into the tangible world, and allowing human beings to interact with this information through natural hand gestures with markers. 'Sixth Sense' makes the entire world a computer by freeing information from its restricted area by seamlessly integrating it with reality. This capability of sixth sense is capable of controlling the robots or any micro controlled devices at far places using the natural hand gestures or with color markers.

An Autonomous robot is particularly used in fields such as space missions, medical treatments, entertainment, and house hold management. This technology can be applied to any micro controlled devices such as automobiles, washing machine, cars etc. Most of the devices in the world have the micro controller embedded in it.

Some modern car factory robots are "autonomous" and having strict confined movement in their working environment. These robot's workplace can have unpredicted and chaotic variables in their challenging workplace. The precise calibrations of the next step of the work and the object type of next step and the required task have to be analyzed. One important aspect of robots is that it can be used on underwater, on land, in the underground, air, or at space.

A fully autonomous robot has the ability to:

- Gain information from surrounding with the help of sensors.
- Battery life is more and can be even equipped with solar power without human intervention.
- Does things without human assistance.
- Long life and accuracy.

An autonomous robot can acquire knowledge from surrounding for accomplishing its tasks or adapting to changing surroundings. These autonomous robots are used in different areas of technologies in different ways.

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By combining the possibilities of sixth sense through an ad-hoc network between phone or laptop or any device, which is being attached with a projector and a simple camera at the users place (transmitter device) and remotely placed Robot or Nano robot or any micro controlled device (receiver device), we can control the activities of the robot or micro controlled devices along with a help of camera attached to the robot or device. This technology also paves a new way to cure Cancer and other diseases, by injecting nano robots once into human body, it further prevents the reoccurrence of those diseases during the life time.

II. RELATED WORK

There are several related works for the proposed system. Most of the works had been done to reduce the human efforts to make things done digitally. Mainly seventh sense technology uses the sixth sense advancements and robotics. Robotics advancements are of less importance when considered to the sixth sense advancements. Sixth sense is itself supported by the related techniques such as the following:

- Gesture Recognition
- Computer Vision
- Radio Frequency Identification
- Augmented Reality

A. SIXTH SENSE TECHNOLOGY

Sixth Sense or WUW [1] [15] was developed by Dr. Pranav Mistry, when he was doing his Ph. D at Fluid Interfaces Group at the MIT Media Lab. This Sixth Sense prototype provides a way to interact with the applications in a usable and efficient manner, and all the information stored on the web can be obtained through these applications. The main idea is that Sixth Sense system analyses the objects around the person, and displays information automatically and the person can access it in a simple way. The device brings persons closer to reality and assists them with the relevant information to make right decisions, thereby, making the entire world a computer. The technology is mainly based on image capturing, hand gesture recognition, analysing and manipulation, etc. The software of the sixth sense technology tracks the location of the colored markers in the fingers for recognizing different gestures from the video stream that is being captured by the camera. The different computer vision algorithms are used for this process. The author invented 'Sixth Sense / WUW (Wear UR World)' which consists of the wearable markers and user friendly interface which integrates the digital information around human being in the physical world and uses hand gestures made with the colored markers to interact with digital information.

The initial approach incorporated Radio Frequency Identification (RFID), which is an electronic tagging technology that does the detection and tracing of the tags, and consequently Sixth Sense focuses on the fixed objects recognition of RFID to an enterprise setting, such as a university department or corporate office. In short Sixth Sense represents a form of mobile computing which is applied to non-computing entities.

Fig. 2.1 Initial Approaches

The initial approach also incorporated the projector attached to the helmet but there are various drawbacks of this process, e.g. the person had to stay still so that the images could be projected on a suitable surface. And further it was difficult to manage the mobile computing device kept in the user's pocket. This approach definitely needed few changes. Thus the approach changed when a smaller projector has been introduced and created the pendant prototype to be shabby around the neck. The prototype Sixth Sense is composed of a camera, a mirror and pocket projector. The hardware components are grouped in a pendant-like mobile wearable device. Both the camera and the projector are connected to the mobile computing device with the user.

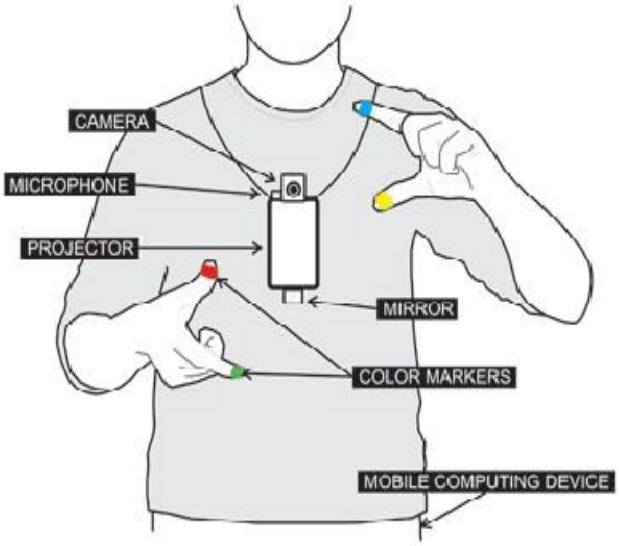

Fig. 2.2 Final approach

The prototype was built from a powered – battery 3M projector and an ordinary web cam, with an attached mirror — all connected to a mobile phone with internet connection. The cost of the setup which is less than $350, allows any user to project information from the phone with the help of projector, onto any surface — user hand, the body of another person or even wall.

The advantage of sixth sense was the ease of use of the technology with limited number of hardware equipment around a person to collect information from his surroundings with four colored markers on the fingers. The camera tracks the markers on the fingers and does the action corresponding to each combination of the colored markers.

III. SEVENTH SENSE TECHNOLOGY WITH AUTONOMOUS ROBOT

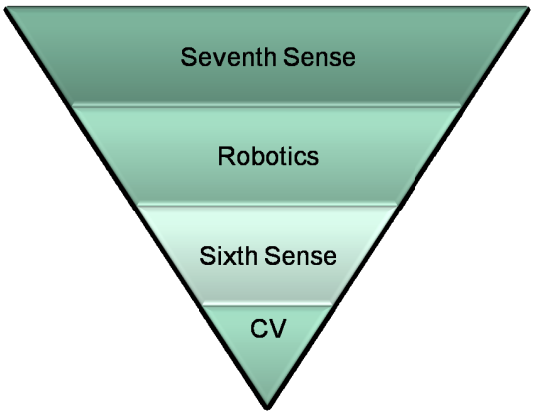

Fig. 3.1 Seventh Sense Flow Diagram

From the Fig. 3.1 we can describe Seventh Sense technology as a technology built upon Robotics and Advanced Sixth Sense Technology on the basis of Computer Vision [4]. We will find more details of the advancements of sixth sense and the details of an autonomous robot.

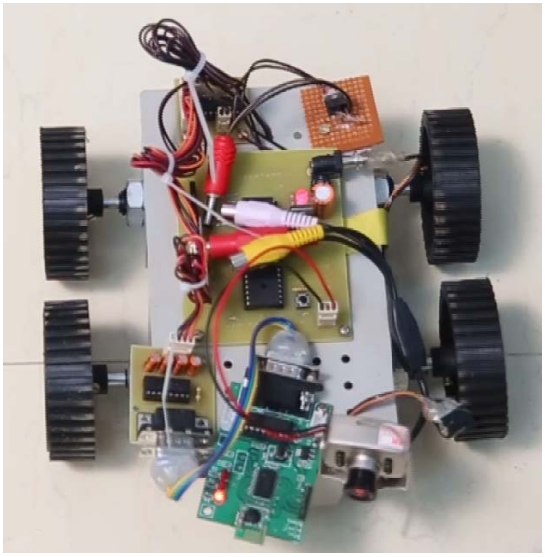

Fig. 3.2 Seventh Sense Demo Robot

A. WORKING OF NORMAL AUTONOMOUS ROBOTS

Autonomous Robot is built using the IR based Line Detecting Module or any other sensor modules. The modules are connected to robots so as to detect the needed parameter early and take proper action in time. The distance between the sensors is maintained greater than the width of the autonomous robot considering the turning radius of the wheels.

The main features are the following:

- When the surface is detected, the IR module gives a high pulse to the controller.
- When the edge is detected, the IR module does not reflect light thus giving a low pulse to the controller.

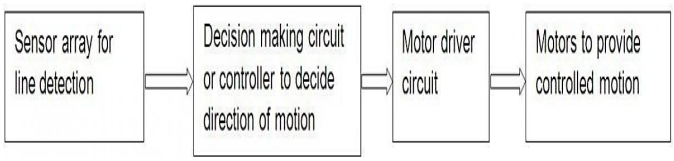

Fig. 3.3 Block Diagram of working of autonomous robot

An array of sensor may be used to detect the needed parameter. Based on the status of sensors, special circuit or controller decides the criteria and also the required direction or action is carried out. Motor driver circuit is used to ON/OFF the LEFT/RIGHT motors of the robot to provide desired motion. See the values and decision making of movement from Table 3.1 for an autonomous line follower robot

LEFT SENSOR	RIGHT SENSOR	MOVEMENT
ON	ON	FORWARD
OFF	ON	BACKWARD; DELAY; RIGHT TURN; DELAY;
ON	OFF	BACKWARD; DELAY; LEFT TURN; DELAY;
OFF	OFF	BACKWARD; DELAY; RIGHT TURN; DELAY;

Table 3.1 Sensor value and corresponding movement of line follower autonomous robot

IV. DESIGN OF SEVENTH SENSE TECHNOLOGY

Design of the seventh sense can be broadly classified into three components. First component is the seventh sense technology based hardware, and the second component is related to computer vision and artificial neural networks and the third related to robotics. The following are brief descriptions of each component**:**

A. HARDWARE COMPONENTS OF SEVENTH SENSE TECHNOLOGY

1) CAMERA

Camera is basically used to capture the scene where the user is looking at. The stream of video captured by the camera is passed to mobile computing device or laptops, which does the

appropriate compute vision computation. The functions of the camera are:

- Obtain user's different gestures and movements of hands
- Obtain the scene in front and objects the user is interacting with, for performing various actions

2) PROJECTOR

The one of the key output device of the Seventh Sense is projector. The projector visually augments physical objects, on walls and on surfaces, where the user is interacting. It also projects graphical user interfaces and digital information. Projector provided by the mobile computing device can be used to project the content. The important functions of the projector have been listed below:

- Augments related information from the system
- Projects graphical user interface and virtual keyboard of the selected application onto walls or surfaces in front.

3) MOBILE COMPUTING DEVICE

The Seventh Sense system uses a mobile computing device in user's pocket as the processing device or a laptop at user's desktop.

4) MICRO CONTROLLED DEVICE OR ROBOTS WITH WIRELESS CAMERA

Any micro controlled device which can accept the serial communication data which is being transmitted from mobile computing device. According to the serial requests, the device does the functions by a program which is being embedded in the microcontroller. Additionally the micro controlled device is enhanced with wireless camera for getting information from surrounding and sends the information to the transmitter. According to that information the user can decide which action to be performed next.

5) ZIGBEE, GSM AND SATELLITE TRANSCIEVER MODULE

IEEE 802.15.4 is basis for low rate transmission and that is the basis for Zigbee and it can be used for communications under 100 meter range or for extended versions of a range of 1000 meters. For more coverage of communication GSM module can be used. For very large range the use of satellite transceivers can be used. For the prototype implementation Zigbee has being used.

The Functioning of the seventh sense pendant is given below. The operator side is equipped with a mobile device or laptop with a camera for tracking the hand gestures and a projector for projecting the details to a surface. The transmitter side connects with remotely placed robots or micro controlled devices like cars, washing machine, etc. with the help of the Zigbee, GSM or Satellite transceivers for communication. The receiver side is equipped with software embedded in the micro controller and the other Zigbee, GSM or satellite transceivers foe effective communication.

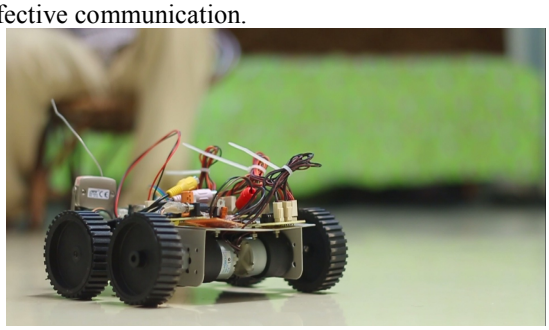

Fig. 4.1 Seventh Sense Demo Robot

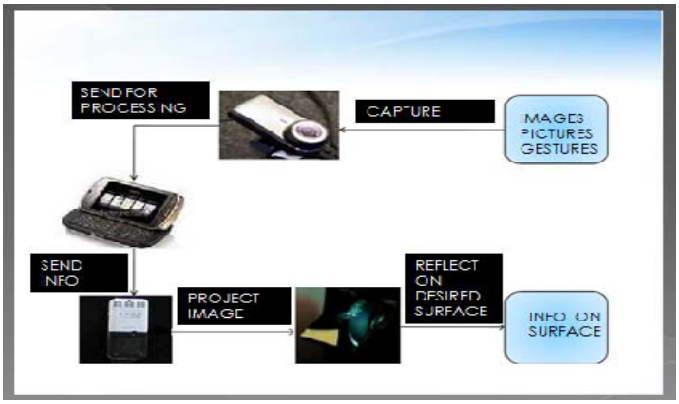

Fig. 4.2 Functioning of the pendant

B. SOFTWARE IMPLENENTATION OF SEVENTH SENSE TECHNOLOGY

To develop an application based on seventh sense technology one can use:

- Languages used are Java, OpenCV, JavaCV.
- Image processing Software used is Matlab
- Embedded programming in Embedded C

C. SYSTEM IMPLEMENTATION

Seventh Sense Technology is based upon mainly two types of gesture recognition and through virtual keyboard technique for doing the desired actions.

The two types of gestural recognition are:

- Gesture recognition with markers
- Gesture recognition with bare hand (without markers)

The system design flow for the gesture recognition in the seventh sense technology is given below in the Fig. 4.3. The image from the web camera or a night vision camera is processed frame by frame. Markers are identified used corresponding background subtraction. For bare hand, in the seventh sense technology, we use back ground subtraction followed by canny edge detection and Scale Invariant Feature Transform (SIFT) process to store each gestural actions [5]. Pattern matching is implemented in both cases. In the testing phase, the inputs are captured and saved in the datasets. For

virtual keyboard technique, the seventh sense technology uses the neural networking concept on background extraction of the initial frame. The main algorithmic change in seventh sense technology is that it brings novel changes in each algorithm and merged the algorithms to speed up the computational process.

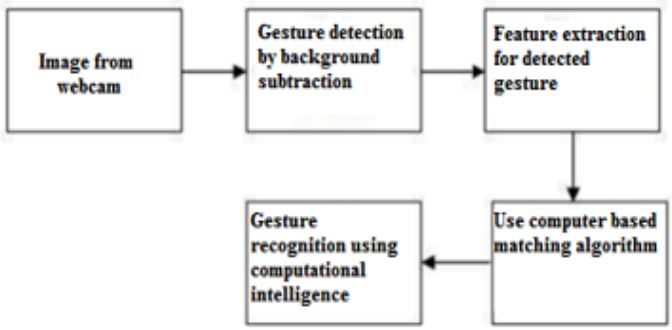

Fig. 4.3 Hand gesture recognition process execution

D. METHODS OF IMPLEMENTATION

The novel changes in algorithms and the merging of each algorithm phases is given below:

1) GESTURE RECOGNITION WITH MARKERS

The below two algorithms are based on color markers and the changes bring on the current algorithms are explained below:

a) Enhancing background extraction of red and blue markers with height and distance parameters

It is basically a static approach with markers in the hand fingers and for the prototype, red and blue markers are used. The main flaw of this algorithm is the movement of objects with same color of the marker in the background. This has being reduced by introducing the checking of marker size and a specific distance and rotation angles. In the prototype, the frame gestures with finger rotations are used to capture selfie and groupfie images and remote pictures from robots.

The process can be as follows:

- Capture every single frame from the video.
- Process each frame obtained.
- Get the two red/blue 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.

The Fig. 4.4 shows the detection of specified size red marker.

Fig. 4.4: Background subtraction of a square red marker

b) Combination of background subtraction algorithm and centroid algorithm for mouse control and paint drawing

For moving mouse pointer and do mouse actions, the user can do it by red and blue markers. Even the paint drawing can be done with these two markers. This is made possible by the background subtraction of these two colors and compares consecutive frames to find the movement of the marker by the centroid algorithm [6] [7]. Centroid algorithm finds the area of the marker and the center of the region and by which it determines the movement of the marker in the x-y direction. This can be used as an alternative for NLP algorithm as it draws the letters on the user interface and it can be used for hearing disabled persons

The step-by-step process is:

- Capture every single frame from the video.
- Process each frame obtained.
- Get the red channel from the frame.
- Subtract the gray scale image from the channel.
- Convert the subtracted image to binary image.
- From the bounding of specified size, find the centroid and use it to move mouse pointers.

2) GESTURE RECOGNITION WITH BARE HAND (WITHOUT MARKERS)

The below section is all about the gesture recognition of bare hand [8][5]. The novel changes in the algorithms are explained as follows:

a) Embedding pattern matching and artificial intelligence with background subtraction

The different stages of the background subtraction are given below in the Fig. 4.5. The frame obtained from the video is first captured and converted to YCC and applied threshold for skin color and converted the image back to RGB and finally to the binary image.

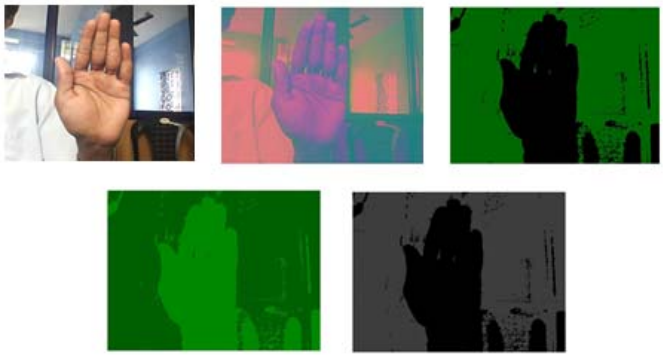

Fig. 4.5: Different stages of background subtraction

This method of implementation needs a set of process:

Initialization

It is a real time approach where frames are captured using webcam or from a video input file.

Acquisition

Different gestures without markers (bare hand) are captured, enhanced, features are extracted and finally a gesture template or cluster model is created using Background subtraction algorithm of artificial intelligence like MLP with Feed Forward Network [14] [16] [17].

Segmentation

In this technique each of the frames is processed continuously and separately. Before analysis the image is smoothed first. Then skin pixels are labeled by giving thresholding values for skin color for the various chrominance and luminance parameters, then noise is removed and small gaps are filled. Image edges are found, and then a region detection algorithm is used to segment the target gesture from other background information.

Pattern Recognition

Once the user's gestures has been segmented and its features are extracted, it is compared with stored gesture templates using different matching algorithm [18] [19] such as Hausdorff matching, Euclidean distance, Hamming Distance, correlation based approach etc. Finally, the system carries out the corresponding action according to the recognized gesture.

b) Combination of SIFT and background subtraction algorithm for hand gesture tracking

The introduction of SIFT [9][10]is to get rid of the numerous training process, as SIFT is invariant to scaling and rotation of the images. Here the approach is the same as above method but adding SIFT features after the background subtraction and again neural networking is used at the end to find accurate results for high precision works. Here the SIFT parameters of the palm, first, index and litter fingers are taken separately as the part of training the system. The main advantage of this system is that it reduces neural networking overhead as the rotation and any size scalability feature of SIFT helped to identify the correct gestures without much training upfront. The general hand gesture training process using SIFT [9] [10] is given below in the Fig. 4.6.Hand first, index, litter and palm training images are fed into SIFT feature key point extraction after the initial background subtraction. Then the region of interest points are clustered using K-means clustering and build the multi-class SVM model as the output of the SIFT process. The initial step of SIFT process is to scale down the image to different scales. Then apply the Gaussian filter on different scales and then find the difference of Gaussian on each pixel. The Fig. 4.7 below shows the scale invariance and different frequencies features.

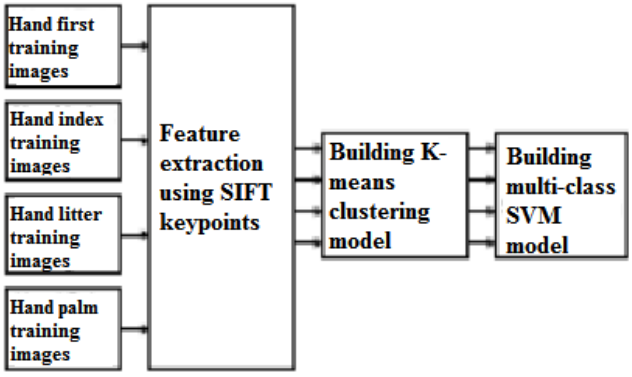

Fig. 4.6: Hand gesture training process using SIFT

The Gaussian filter is calculated and convoluted with the image and the formulas used are as follows:

$$G(x,y,\sigma) = \frac{1}{2\pi\sigma^2} e^{\frac{-(x^2+y^2)}{2\sigma^2}}$$
$$L(x,y,\sigma) = G(x,y,\sigma) * I(x,y)$$

Then the 26 neighborhood pixels of a corresponding pixel, i.e. taking its surrounding eight pixels and top and bottom nine pixels in different scales are compared to find the best key points. The 26 point neighborhood is depicted in the Fig. 4.8

The gradient magnitude and angle are calculated to find the strength of the pixel and its direction, so as to find the edge and regions of interest.
The gradient magnitude is calculated in SIFT is as follows:

$$m(x,y) = \sqrt{(L(x+1,y) - L(x-1,y))^2 + (L(x,y+1) - L(x,y-1))^2}$$

The gradient angle is obtained by the formula:

$$\theta(x,y) = \tan^{-1}\left[\frac{(L(x,y+1) - L(x,y-1))}{(L(x+1,y) - L(x-1,y))}\right]$$

The step by step process for SIFT key point detection is as follows:

- Input is the background subtraction output.
- Octave pyramid generation (different scaling of the image).
- Obtains the key points from the image.

- Form the key point neighborhoods.
- Form the key point Descriptors.
- Dividing into 4x4 blocks and gets the output through threshold bins.

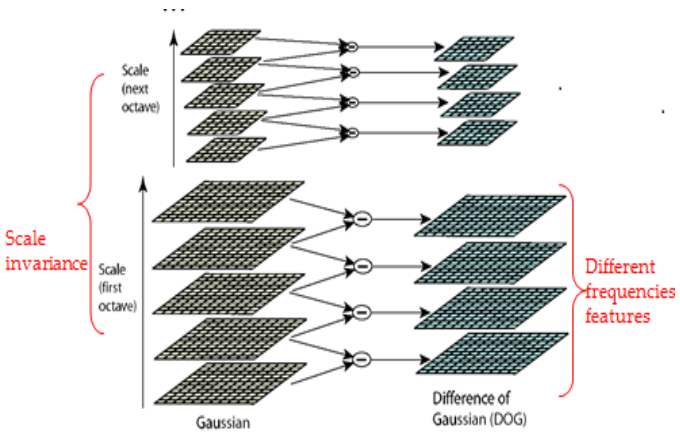

Fig. 4.7: Scale invariance and different frequencies features

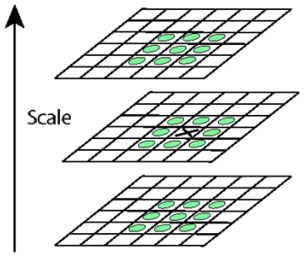

Fig. 4.8: The 26 point neighborhood matching

The background subtraction output and the output obtained after SIFT [9] [10] applied on background subtraction output are shown on the Fig. 4.9. Here in this method we need to train each gestures and the output of SIFT is saved in the dataset for matching it with the gestures obtained from the testing phase.

c) Combination of SIFT and Canny edge detection algorithm for hand gesture tracking

The computational time of Canny and SIFT is a concern so merging the two gives a great real time performance and invariant to scaling and rotation of

Fig. 4.9: (a) Background subtraction output (b) Output obtained after SIFT applied on background subtraction output images.

Firstly we do the Canny edge detection [13] [20] of the background subtracted image, for that we first calculate the first derivate between the Gaussian applied pixels. Then we will calculate the strength and direction of each pixel to get the correct edges.

The formulas used for the same are shown below:

The first derivatives of image on both axes:

$$\frac{\partial S}{\partial x} = S[i,j] * G_x$$

$$\frac{\partial S}{\partial y} = S[i,j] * G_y$$

The gradient magnitude and direction is calculated as below:

$$M[i,j] = \sqrt{\frac{\partial S^2}{\partial x} + \frac{\partial S^2}{\partial y}}$$

$$\theta[i,j] = \arctan\left(\frac{\frac{\partial S}{\partial y}}{\frac{\partial S}{\partial x}}\right)$$

The background subtraction output and output obtained after canny edge detection applied on background subtraction output is given in the Fig. 4.10

The step by step process for canny edge detection is as follows:

- Input is the background subtraction output.
- Smooth the image with Gaussian filter.
- Compute the gradient and orientation of the image.
- Apply Non maximum suppression to the gradient magnitude.
- Double thresholding to detect and link edges.
- Output will be an outline figure of our hand gesture.

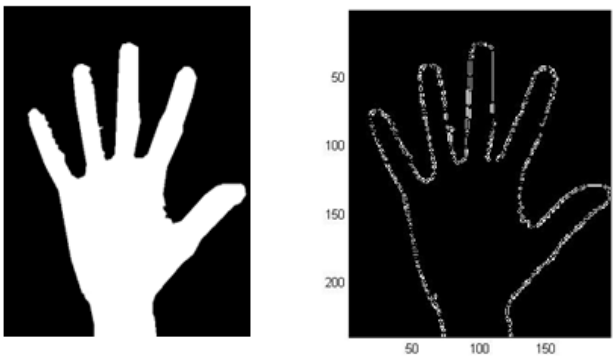

Fig. 4.10: (a) Background subtraction output (b) Output obtained after Canny edge detection applied on background subtraction output

After the Canny edge detection, we apply the SIFT key point detection and we can remove the steps of edge removal and Gaussian filtering from SIFT [9] [10] as it is being already applied through Canny edge detection. So this combination of Canny and SIFT gives a real time performance and with great accuracy. Canny edge detection output and output obtained after SIFT key point detection applied on Canny edge detection output is shown in the Fig. 4.11

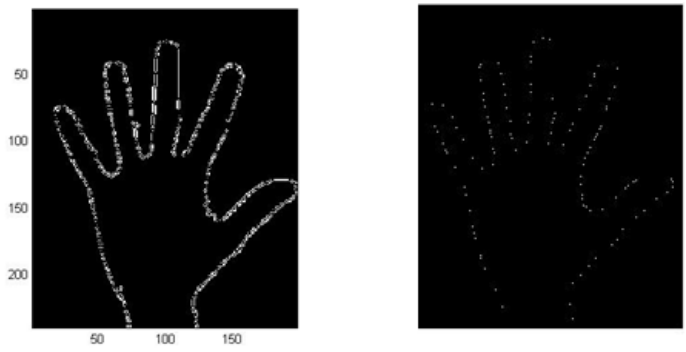

Fig. 4.11: (a) Canny edge detection output (b) Output obtained after SIFT key point detection applied on Canny edge detection output

3) *VIRTUAL KEYBOARD TECHNIQUE*

Virtual keyboard technique is implemented with the help of color marker and it overcomes the disadvantages of marker based and bare hand gesture recognitions. Mainly it has no limit like the number of gestures made my fingers. Combination of background subtraction algorithm and artificial intelligence for virtual keyboard technique
Another important feature of seventh sense technology is the use of virtual keyboard technology for doing actions at remote places. The prototype here used the combination of Artificial Intelligence [11] and Background subtraction for reading the characters from the projected keyboard. Only one red marker used in a finger used to track the letters or digits pressed and its being alerted to the user by spelling it to the user. The projected keyboard is monitored by a camera, which will monitor the movement of the finger with marker. That camera will take an initial snap of the projected keyboard and save it in its dataset for future comparison. Here there is no flaws of background subtraction comes into play as it is being projected into a wall or hand in front and no background movement happens so. The neural networking [12] basis is used for this virtual keyboard technique. The seventh sense prototype virtual keyboard is shown below in the Fig. 4.12. In this we can customize our keyboard to our needs. The symbols used in this prototype are used as backspace, caps lock, spacebar and enter key respectively.

Fig. 4.12: Seventh sense virtual keyboard prototype

The step by step process for virtual keyboard technique is as follows:

- Initially take a snap of the projected keyboard as a reference
- Then train the system with a red marker
- Video continuously evaluating each frame
- Background extraction of the red channel and its co-ordinates position is taken
- The co-ordinate position is looked up in the reference
- Output the desired alphabet or number

E. COMPONENTS OF ROBOTICS

Any robots are made of basic elements such as:

- Sensors
- Controller
- Actuator

The sensor part senses the path and detects the objects or colors depending on the sensor type, which then sends the signals to the controller part to determine which activity should robot take and it sends that corresponding signals to the actuators to rotate the wheels or move the arms.

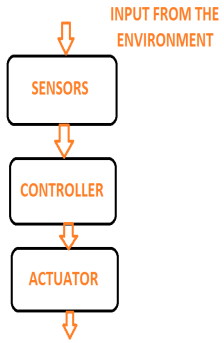

Fig. 4.13 Block diagram of robotic components

The Fig. 4.13 describes the flow of signals through the different components of a robot. It is the basic component parts of a robot in current scenario.

F. ANATOMY OF SEVENTH SENSE CONTROLLED ROBOT

The robots working with seventh sense can work without costlier sensors and only a normal night vision camera attached to the robot instead. The seventh sense robot also has an attached transceiver for receiving and transmitting the signals with the mobile computing device. The computing device is also aided with a camera. It has also got a transceiver for transmitting and receiving the signals from the remote microcontroller based device.

V. APPLICATIONS

Some of the applications of the seventh sense prototype are the following:

- Virtual Keyboard for email, notepad writing
- Virtual Keyboard for robotic actions
- Virtual Keyboard for song selection
- Gesture based robotic control
- Gesture based selfie pictures and groupfie pictures
- Gesture based for taking scene pic of remote places through robot
- Gesture based Presentation Slide control
- Gesture based mouse control
- Finger marker used for paint drawing and for expressing ideas for dumb persons
- Car controlling and house monitoring by washing machine through gestural control
- Virtual keyboard technique and DSP based technology for hearing disabled persons
- Gestural control for writing the words on user interface without NLP for vision disabled persons

With sophisticated machines and developments this technology can lead to the following future applications:

- Nano robotic technology for cancer treatment
- Medicine for all normal diseases
- Security and prevent trespassing
- Control over satellites for getting into correct orbit tracks
- Doctoral assistance for operations

VI. ANALYSIS

A. BACKGROUND EXTRACTION OF RED AND BLUE MARKERS WITH HEIGHT AND DISTANCE PARAMETERS

- More better accurate tracking than normal background subtraction
- Computationally easier

B. BACKGROUND EXTRACTION OF RED AND BLUE MARKERS WITH CENTROID ALGORITHM

- Accurate tracking of the markers and plotting of their co-ordinates
- Computationally faster and easier

C. SIFT AFTER BACKGROUND SUBTRACTION

- Time taken for Pyramid level generation is: 9.901082 milliseconds
- Time taken for finding the key points is: 5.217522 milliseconds
- Time taken for magnitude and orientation assignment is: 5.739967 milliseconds
- Time taken for finding key point descriptors is: 5.886831 milliseconds

D. SIFT AFTER CANNY(BLENDED TOGETHER)

- Time taken for Pyramid level generation is: 2.679540 milliseconds
- Time taken for finding the key points is: 1.219979 milliseconds
- Time taken for magnitude and orientation assignment is: 1.484858 milliseconds
- Time taken for finding key point descriptors is: 1.571920 milliseconds

VII. CONCLUSION

Seventh sense technology analyzes 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 seventh 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.

This Seventh sense can be extended to Nano robotics and can find different diseases and cure at will. It can be used as like polio injection to inject the Nano robots to the body and can be in the body of humans till the death. Humans won't be suffered from diseases or pains anymore.

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