INVISIBLE SENSORS IN ATMOSPHERE

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Abstract- Sensors and Sensor Networks play an important role in extending the capability "Standard Surveillance Systems". But how far does it extend? Can the present age sensors sense something or someone without any infrastructure? Without any equipment? Or can someone who is in India, track a person who is in Canada without any pre-exiting base station present in Canada? The answer is obviously no. In this paper, proposed solutions range from providing all time surveillance wherever whenever in this earth without any pre-existing infrastructure not even satellite. We have looked beyond the shell, and came up with an idea of using "INVISIBLE SENSORS IN ATMOSPHERE". A sensor which is basically not a sensor of this generation, a sensor which can reform image, position, motion of a foreign body with only basic minute hardware required (irrespective of distance) .We have created theoretically a device called "RECETRAN" which will fulfill our idea practically. However for better understanding purpose concepts like 'An Automated self-localization mechanism (which is the key to modern sensor networks) and Blob Extraction techniques are explained and also the standard surveillance systems that are able to detect and track people moving in the observed scene to advanced surveillance systems based on Multiple Sensor Networks (optical, infrared, thermal, radar etc) that are able to understand complex human behavior automatically detect and recognize their faces to discover their identity by means of specific biometric features are explained in this paper. This paper also describes about Radiation Sensors (infrared and visible light sensors which are used in cameras and night vision systems) which transforms incident radiant signals into standard electrical signals to be used for data collection, processing and storage and many others like infrared detectors, actuators are explained as they are prime elements in our device Recetran. Security issues are very important in proper control of surveillance systems (which are commonly ignored by the designer) and hence the basic security measures are viewed.

Keywords-Sensor networks, multisurveillance systems, Radiation sensors, Invisible sensors in Atmosphere, object detection.

I. INTRODUCTION

A sensor being a device that can convert a physical phenomenon into an electrical signal. As such, sensors represent part of the interface between the physical world and the world of electrical devices, such as computers. The other part of the interface is represented by actuators, which can convert electrical signals into physical phenomena. Along with the availability of inexpensive microprocessors has grown an opportunity for the use of sensors in a wide variety of products. In addition, since the output of the sensor is an electrical signal, sensors tend to be characterized in the same way as the electronic devices .Multiple sensors are increasingly being used in visual surveillance systems. The use of multiple sensors enables us to augment the capabilities of single sensors in many aspects. The system can monitor a larger area, it can detect and reason about a larger set of events, and via the choice of appropriate sensors it can operate under a variety of difficult situations such as poor illumination and adverse weather conditions . In order to build a sensor which can determine position and motion of a foreign body, we can use acceleration sensors. These sensors experiences acceleration whenever a structure moves. Measurement of this acceleration helps us gain a better understanding of the dynamic characteristics that govern the behavior of the object. In order to build an efficient sensor for surveillance, few factors have to be kept in mind. These concepts are discussed briefly.

II. INVISIBLE SENSORS IN ATMOSPHERE FOR SURVEILLANCE

1) Overview: We are hugged by the atmosphere. The atmospheric layers has a lot of physical properties, we can steal those properties to spy any corner in the earth. The ionosphere layer has different radiations present in natural form. By redirecting those naturally present radiations (preferably Infrared) in those layers back to earth. We can form an invisible cover of Infrared like an umbrella around the earth, hence we can interpret that these radiations fall on every object on earth, and whenever the radiations fall on any object, it either gets absorbed or reflected. By detecting those reflected rays or level of absorbed rays we can detect anybody anything anywhere by simply having a sensor device to capture the reflected signals using accelerator sensors, bio metric sensors etc and a new sensor which has a database of information depending on the levels of penetration and reflection of the reflected rays. Hence with a capability of forming the image of the object by calculating all the features like position, location etc combining these features we can determine the original feature of the object**.**

2) Natural Presence of Infrared rays in Atmosphere: There are different layers in Atmosphere. The upper

part of the atmosphere where the ionization is appreciable is ionosphere. F_2-layer is the uppermost region in ionosphere layer situated at a height range of about 250km to 400km in day having highest electron density of all ionospheric layers. The electron density of F2 layer is ranging from $3 * 10^5$ to $2 * 10^6$. F_2 layer is formed by ionization of UV, X-rays and probably corpuscular radiations. In ionospheric region, Infrared rays can be found near the frequency of 10^{11}Hz where UV rays in the frequency of 10^{15} Hz and visible light at 10^{14}Hz. Since frequency is indirectly proportional to wavelength, Infrared rays have a long wavelength.

III. DESIGN SPECIFICATIONS OF " RECETRAN"

1) IR Recetran: Generally devices transmit and receive, but in order to redirect the IR Radiation from Ionospheric layer we need to detect the Infrared Radiations first and then a receiver to receive those detected signals. After receiving the radiation in the form of electrical signals using Radiation Sensors we need to transmit it to the earth using a transmitter and an Actuator. We are using an Actuator to convert the IR signal which is present in the form of electrical signal back to radiation. Combining all these components we can form a satellite like device called "Recetran". Now one will understand why we have named this device as Recetran which Receives – Transmits.

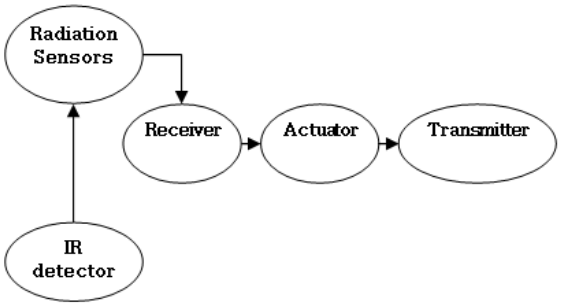


Fig 2: Structure of Recetran

2) IR Detectors: IR detectors can be divided into two types, they are those which dependent upon the heating effects produced by the absorbed radiation (thermal detectors) and those which makes use of photoconductive effects. The IR spectrum covers the range of wavelengths which are longer than the visible wavelengths but shorter than microwave wavelengths. All important IR detectors except pneumatic detector are solid state devices. One disadvantage of thermal detectors is that response time is long. This can be overcome by photoconductive detector. Here the absorbed radiation causes changes in the electronic distribution and hence a change in the conductivity. The most important technology for low cost uncooled infrared detectors has emerged in the form of pyroelectric plastic material. Pyroelectricity is change in temperature causes thermal expansion, which causes appearance of charge. What is needed is an array of detector elements and some sort of focused optics. Remember pyroelectric detectors detect only changes in heat not heat and hence focused optics is needed. These IR detectors can be used to detect the IR radiations in the Ionospheric layers and hence making it ready to transmit back to earth .At infrared frequencies heterodyne detector also acts, in effect as both an antenna and a receiver and requires careful alignment between the LO and signal beams. Most useful for detecting weak signals.. But for our concept we are using a type of IR detector which detects only the infrared radiations in space. As there are a lot of radiations present in space it is necessary to extract only the IR radiations and eliminate others. The photosensitivity of the IR detector must be really high. Detectivity of the detector, if higher the better.

3) Radiation Sensors: Radiation Sensors transform incident radiant signals into standard electrical signals to be used for data collection, processing and storage. Electromagnetic energy is carried by photons. These are the quantum particles involved in the exchange of radiant energy. These are also used in the Recetran.

4) Transmitter: Since the transmitting range is high, high efficiency modulation techniques are used. The carrier frequency is 15 times greater or more than the modulating frequency. QPSK modulation is most favorable for this transmitter.

IV. GROUND SIGNAL RECEIVEING SYSTEMS

Once Recetran starts operating, the next process is interpreting the reflected signals, by tuning the receiver to a frequency of 10^{11}.Then a sensor is used to reform the image, using some techniques like blob extraction, biometric and self localization techniques.

1) Blob Extraction: Sensors may be either physical (to generate information by translating observed physical quantities into electrical signals) or virtual (i.e., to produce new information from the existing one). Video signals of each physical sensor is first processed to extract the moving image regions called blobs, Generally the processing elements (PEs) track each detected blob on the image plane and transform 2D blob positions (in the sensor coordinates) into 3D object positions (in the coordinates of the monitored environment's map). The trajectory of each blob, extracted by a given sensor, is first approximated with cubic splines. Information about object blob features can be used to learn neural network to recognize suspicious events in the observed scene. Blob Extraction occurs at sensor level, Motion Detection and blob extraction is exploited following a layered background subtraction approach. Change detection is performed using an algorithm for

automatic threshold computation based on Euler's numbers. The background I updated using a kalman filter. Frame by frame subtraction is also applied in conjunction to improve detection results. Morphological filters are also applied to improve the quality of the extracted blobs by removing spurious pixels due to noise and by enhancing the regions connectivity. Following the scheme in fig.1 at time t, images VI(t) and IR(t) are produced respectively by the optical and infrared sensor. Each sensor applies the blob extraction procedure thus obtaining the blobs $B^{i}_{vi}(t)$ and $B^{k}_{ir}(t)$.With $1\leq j\leq n_{vi}$ and $1\leq k\leq n_{ir}$ are the number of blobs extracted on the current frame respectively by the optical and infrared sensor. we are using blob extraction techniques so that it will be easy to reform the image by individual blobs. Though its an old method, it's the most effective method to develop images from scrapes.

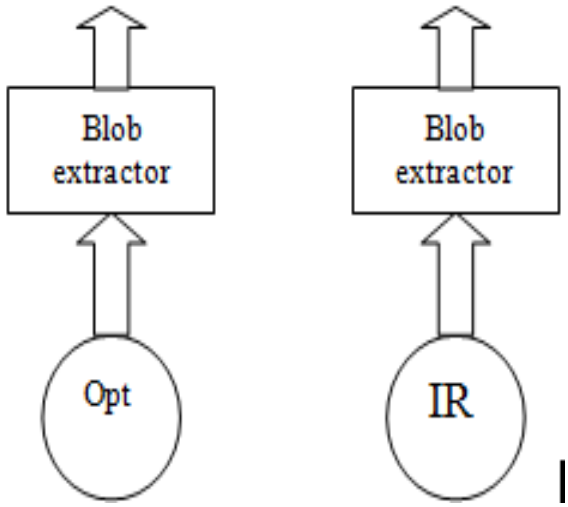


Fig 1: Blob Extractor

2) Biometric in surveillance systems: Biometric authentication or simply biometrics refers to automatic identification of an individual based on his distinguishing physiological and/or behavioral characteristics (biometric identifiers).Because they are distinctive to each person, they are more reliable than the knowledge based or the token based . Face recognition is a very active research field with any application. Face recognition is subdivided into two types, application in controlled and uncontrolled environments. One of the main applications of the first type is the so called "identity authentication". Applications of the second type refer to the problem of recognition of an identity in a scene. The recognition system first detects the face in the image and normalizes it with respect to the pose, lighting and scale conditions. Then, it tries to associate the face to one or more faces stored in its database, and provides as outputs the set of faces that are considered as "nearest" to the detected face. Each of the above problems is so complex that it must be addressed separately. We shall focus on the last stage of the face recognition process. The most used approach is the face representation by Principal Component Analysis (PCA), or 'eigenface' approach, proposed by Turk and Pentland.The face image is projected to a space where the correlation among the features is zero. Only the components with highest variance are used for characterizing the face. A transformation that satisfies this condition is the so called Karhunen-Loeve transform. Another appearance- based approach is the face representation by Linear Discriminant Analysis (LDA), or "fisherface" approach, proposed by Kriegmann et al. The face image is projected to the so called fisher space, in which the variability among the face vectors of the same class is minimized, and the variability among the face vectors of different classes is maximized. In this case, the face is represented by a number of components smaller than the one of the PCA. The major biometric technologies involves finger-scan , voice scan, facial scan, iris scan, and signature scan, as well as integrated authentication technologies. But we shall concentrate on facial scan. Facial scan- there are various methods , all the methods share certain commonalities, such as emphasizing those sections of the face which are less susceptible to alteration, including the upper outlines of the eye sockets, the areas surrounding the cheekbones, and the sides of the mouth. Most technologies are resistant to the moderate changes in the hair style, as they do not utilize the area of the face located near the hairline.

3) Self Localization techniques: Sensor network self localization typically utilizes a set of internode measurements based on distance, time of arrival(TOA), time difference of arrival(TDOA), received signal strength(RSS) or angle of arrival (AOA) observations of transmitted calibration signals. One common application of sensor networks is source localization (also called target localization), where the position of a foreign target is to be estimated. It may be used to perform most rudimentary form of sensor network localization. In this setting, a set of known-location sensors, referred to as anchor nodes (or beacon nodes), make direct measurements of each unknown-location node. Each unknown-location node is individually localized using a source localization algorithm. These methods are typically called one-hop localization techniques because in a measurement graph, where vertices denote sensors and edges denote measurements, the sensors are one-hop separated from the known-location anchors. Some of the localization algorithms are Distributed, Absolute, statistical Basis Algorithms.

4) Security of Recetran: Recetran which is to be placed in the ionosphere must be controlled by safe hands. The control of this device is well efficient and secure if it lays in hands of the national authorities for surveillance. Various techniques have been already

proposed using those security techniques we can keep the device out of hackers.

CONCLUSION

The current trend in sensor networks in the field of surveillance is limited to only certain regions at a time and the detection of objects at places with absolutely no idea is still a challenge. This paper has highlighted on detecting objects which are far and unreachable and also to detect any object or anybody or anything anywhere by simply having a sensor device to capture the reflected signals using accelerator sensors, bio metric sensors. The growth in embedded systems have found application in reducing the size of any processing device. Hence handheld sensors can be carried. In this paper, a device called Recetran is envisaged, which can act as a detector-receiver-transmitter-actuator device which is to be placed in the ionosphere layer. This paper concludes that Recetran can redirect the radiation from the ionosphere layer to the earth surface, thus fulfilling our idea.

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