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Sensors and Their Working in Ambient Intelligence

Rashmi I Chamakeri[1], T Roja[2], Roshnee Krishnamurthy[3], Vaishnavi M[4]

B.E. Student, Dept., of ISE, New Horizon College of Engineering, Bangalore, Karnataka, India.

B.E. Student, Dept., of ISE, New Horizon College of Engineering, Bangalore, Karnataka, India.

B.E. Student, Dept., of ISE, New Horizon College of Engineering, Bangalore, Karnataka, India.

B.E. Student, Dept., of ISE, New Horizon College of Engineering, Bangalore, Karnataka, India.

ABSTRACT: Due to the rapid advances in networking and sensing technology, we are witnessing a rapid growth in sensors and sensor networks where a number of sensors are connected to each other and to other computational devices such as a processor that is capable of analysing and processing the data. Sensors are increasingly playing an important role in the emergence of ambient intelligence and the technologies associated with ambient intelligence. In this paper, we discuss about ambient intelligence and the sensors required for ambient intelligent environments.

KEYWORDS: Network, sensors, ambient intelligence, radiations, transmission.

I. INTRODUCTION

Ambient Intelligence refers to our immediate surroundings i.e. electronic environments which are sensitive and responsive to the presence of people or any other occupants. The term AMI is defined by the Advisory group to the European community's ISTAG (Information Society Technology Program) and was originally developed by Eli Zelkha in the late 1990s along with his team at Palo Alto Ventures.
Sensors are the basic component that supports the ambient networks. It provides us the support to implement this technology into the real world. Sensor is a device or an electronic element whose basic functionality is to detect and measure the physical properties, responds to its environmental changes and stores the information. The common physical phenomena that occur in environmental changes are motion, light, heat and so on. After detecting, the sensor sends the data to other electronic devices, usually a computer processor. The sensor then generates an output in the form of signals and is conveyed sensor's location display, which are human-readable.

II. RELATED WORK

A. Passive Infrared Sensors:
Definition: It is an electronic sensor that measures infrared light that radiates from objects in its surroundings.
Working: The objects with a temperature above 0 K (absolute zero) emits heat energy and these radiations aren't visible to the human eye as they are infrared. Therefore, we use PIR sensors where the front view of the sensor (sensor face) has materials that are naturally electrically polarized which detect these radiations when exposed to heat.
Applications: Passive infrared sensor detects the movement of people, animals or any other objects.
These sensors are commonly used in burglar alarm and in automatically activated lighting system.
Cost: Starting cost is from Rs.130.

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B. Carbon Mono Oxide (CO) Sensors:
Definition: It is a device that detects the presence of the carbon mono oxide gas in order to prevent CO poisoning. It is a colourless, tasteless and odourless compound. These sensors are also known as CO alarms.
Working: When CO alarm comes in contact with the oxygen in the air, it produces an electric current. When the current goes beyond threshold, the alarm starts beeping to make us aware of the danger. The specific gravity of CO alarms is 0.9657 and it is advised to place CO alarms on the walls at a height of 2 ft below the ceiling.
Applications: CO alarms help in detecting the leakage of this gas in homes, hospitals, etc.
Cost: It ranges approximately from $26 to over $100 USD.

C. Glass Break Sensors:
Definition: These sensors are used in electronic burglar alarms that detects if a pane of glass is shattered or broken.
Working: The sensor consists of a low frequency band pass, threshold comparators, high frequency filter; trigger comparator, frequency to voltage converter, alarm logic, etc. A low frequency band pass filter is designed to a value of the vibration when the glass is not broken. A microphone monitors the noise or vibrations in the environment. When the vibrations are sensed and if the frequency is low, it is allowed to pass through the circuit as the threshold comparator compares received frequencies and the designed frequencies. If they are nearly the same, there is no change. When the glass is broken and the frequency is above the specified frequency, it doesn't pass through the low pass filter. It causes the trigger comparator to compare the sensed frequency and the trigger frequency. If these two frequencies are nearly equal, it causes the alarm to go off.
Applications: These sensors are used in electronic burglar alarms, stores that have glass front windows or glass doors
Cost: It approximately cost $25 USD.

D. Fire Detection Sensors:
Definition: It will alert the people through visual and audio appliances during smoke, fire, CO or other emergencies.
Working: There are two types of alarms which are generally used i.e. ionization detectors and photoelectric detectors. The ionization detectors contain ionization chamber with two plates and an ionizing radiation source. The voltage is sent by battery of an alarm to the plates. Now, one of the plates is charged to positive and one to negative. The radiation source emits alpha particles at a constant rate. The particles will now travel through the chamber and remove an electron from the oxygen and nitrogen atoms in the air that moves through the chamber. Now, the new free electrons with negative charge are attracted towards positive charge and vice versa. This leads to a constant current between plates. If smoke enters the chamber, current flow stops triggers the alarm.
Application: It can be used in sports, stadiums, hospitals, car parks, shopping complexes, etc.
Cost: Standard cost is around $1 to $2 USD per square foot. For expensive buildings, it is ranges from $2 to $7 USD.

E. Contact sensors:
Definition: Contact sensors are those devices that detect if there is any physical contact of the objects with the door or windows. We use contact sensors to increase the security of our houses.
Working: A Contact sensor (on doors) usually consists of a "reed switch" which is used to indicate that the area has been breached. Reed switch was invented in Bell laboratories in 1936. They consist of set of electrical connectors that are placed apart. When the magnetic field is parallel to these connectors, it pulls them closer by closing the circuit. The reed switch of the door sensor and a magnet create a closed circuit. So, whenever someone tries to pull the locked doors, the magnet is pulled away from the switch resulting in breaking of circuit that will in turn trigger an event. Depending upon the system set up and its mode the event can be a discrete text or full blown alarm.
Applications: It is used to catch an intruder while opening a door or window, used to trigger smart phone alerts, turn your lights on or off when someone enters or leaves the house.
Cost: the price of this sensor stars from $59.9.

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F. Audio Visual Sensors:
Definition: It possesses both, sound as well as a visual component and consists of all signals that humans make use of in interpersonal communication.
Working: The devices first receive signals such as sounds and pictures. These information signals are converted to electrical signals using a transducer. This electrical signal is then sent to the processor that is already loaded with a voice or picture. It then compares two voices or pictures and if there is a match, it then carries out the task it is programmed to do.
Applications: Used in mobile phones as safety measure that unlocks the phone, ShotSpotter system which uses all roof mounted microphones to detect gunshots and it can direct the camera to try to record the scene. Cost: Starting range is from $46 USD.

G. Proximity Sensors:
Definition: A proximity sensor is a sensor which is able to detect the presence of nearby objects without any physical contact.
Working: They emit an electromagnetic field or a beam of electromagnetic radiation and look for changes in the environment. The object on being sensed is called a “target”. Different targets need different sensors for example, photoelectric sensors for detecting plastic objects or inductive sensors for metal detectors. The minimum distance between the target and sensors is called nominal range. The sensor consists of an oscillator, ferrite core with coil, a detector circuit, output circuit and cables. The oscillator generates a sine wave of a fixed frequency used to drive a coil along with the core to induce the electromagnetic field. When the sensor detects the reflected magnetic field lines, i.e. when interrupted by the object, the oscillator voltage is reduced, proportional to size and distance of the object. The reduction is calculated and sent to the output circuit.
Application: These sensors can be used in metal detectors, traffic lights, car washes, etc.
Cost: it costs about $10 USD.

H. Energy Monitors:
Definitions: Energy monitors are basically a management technique that uses the energy information to calculate the energy used, eliminate waste, and control the level of energy in use and to improvise the procedures of operation. It establishes a pattern of energy being used, targeting the energy consumption level with mail goal towards the conservation of energy.
Working: They have sensors, transmitters and a display. The sensors are placed in a main power cable and are connected to the electricity meter that monitors the magnetic field which measures the amount of current used. The sensors are plugged into the transmitters which send the current readings to the display. It will calculate and tell us the amount of current used in kWatt/hour and estimate greenhouse gas emissions.
It is the way of collecting the real time data for its efficient management it can be done in real time by sending the data to cloud-based energy management software which can be accessed outside the building
Applications: Electricity use may be measured with an inductive clamp placed around the electric main, via the electric meter (either through an optical port, or by sensing the meters actions), by communicating with a smart meter, or by direct connection to the electrical system. The display portion may be remote from the measurement, communicating with the sensor using a cable, network, power line communications, or using radio. Online displays are also available which allow the user to use an internet connected display to show near
Real-time consumption. The essential elements are recording for monitoring and recording energy consumption, analysing for comparing energy used to measured output (production quantity), Setting targets, monitoring, controlling and reporting. Cost: Starting from $90.00 USD.

I. Communication of two sensors:
Any two sensors can communicate with each other only if one sensor is within the communication range of the other. Consider two sensors, Si and Sj which can communicate with each other if and only if d(Si, Sj)<= rj and d(Si,Sj)<=rj, where r is the range. By using sensor web, a wireless sensor architecture initially used by Kevin Delin of NASA in 1997, the network platforms known as pods are used for individual pieces that co-ordinate and communicates as a

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whole. The wireless communication of the sensors with each other is synchronous as well as router-free. These pods can be fixed or mobile and can also have real time accessibility via internet. They are bi-directional where they send data to each other i.e. pod-to-pod communication in the network.

III. CONCLUSION

Sensors are the most important module for the implementation of automation in the ambient environment such as homes, hospitals, transportation, factories, automobiles and countless other applications. Without sensors there would be no automation. About 30-40% of smart phones are made of sensors. Application of sensors lies where there is a prefix 'smart' like smart lighting, smart home, smart parking and so on. They play a very important role in making our environment smart such as homes, hospitals and many more places through emerging technologies like AMI.

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