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IOT BASED SENSORS IN SMART CITY APPLICATIONS

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Abstract:

A sensor technology has benefited people's daily lives in practically every domain where they have been used. Sensors are tiny low computing devices which sense and gather signals from the source and then develop the solution correspondingly. There are a variety of sources that can be employed, comprising light, temperature, motion and pressure among others. Intelligent sensor techniques are used in a broad array of uses in lifestyle, medical, fitness, production, and everyday life. Sensors are an important component of IoT (Internet of Things) growth as these are not the typical kinds that translate physical parameters into electronic signals. To serve a technically and commercially feasible role in the IoT context the sensor devices have to expand into something highly robust. The smart city applications make use of different sensors, such as Level sensors, Position sensors, Gas Sensors. The paper focuses on different types of smart sensors and their uses in smart city applications.

Keywords: Internet of things (IOT), smart city, sensors, applications.

1. INTRODUCTION

The latest advancements in wireless systems and networks have resulted in the progress of revolutionary solutions that would elevate wireless transmission to new heights [1-3]. It's obvious that a significant of time and resources has gone into developing new communications systems that could facilitate huge machine-to-machine interactions and Internet of Things (IoT). Different smart and sensing devices are believed to be installed and interconnected within those systems and allowing extensive volumes of data to being streamed [4-5]. The term "smart sensor" would also relate for a "smart transducer." An analog-to-digital sensor or actuator having a central processor and a transmission link are referred as smart transducer. When sensors and actuators get highly robust, they can support a wider range of operations and connection alternatives. Additional fault tolerance and remote computing are required for particular applications. Integrating an embedded microprocessor to a traditional sensor/actuator can provide such high-level capability increasing the ability to deal with complexity at a reasonable cost. The Figure 1 shows the working of sensor, the sensor senses the physical quantities and converts them into electrical form…

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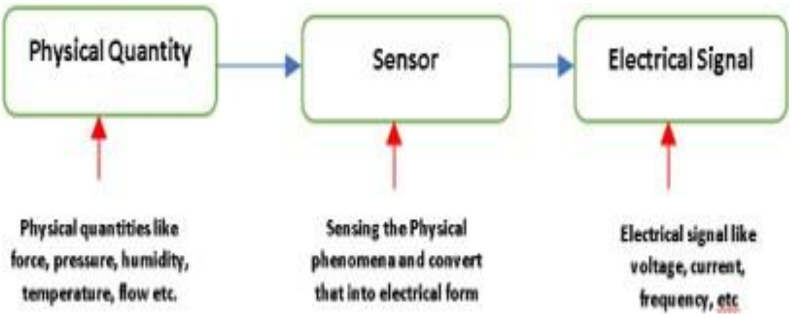

Fig 1: Working of Sensors

The Internet of Things (IoT) is a new field for a million of real processing objects across the universe which are linked together to gather data and sharing for communication. Everything in present era is interconnected to internet [6]. The emergence of transformation and Industrialization 4.0 are terms used to describe this era. The Internet of Things has been a significant contribution in the digital transformation. Sensors are devices that recognize changes in their environment. Sensors perform efficiently when integrated to an automated device and they can be quite useful. Sensors are used to measure a variety of phenomena such as pressure, temperature, and so on [7]. Three characteristics usually seem to be present in a good sensor:

- It is responsive to observable phenomena.
- Other physical phenomena have no effect on it.
- Reports actual sensed values correctly

2. CLASSIFICATION OF SENSORS

1) Direct Sensor

Direct sensors include devices that use several alternate steps to transform non-electrical inputs into electrical outputs. All the passive sensors come under the category of direct sensors such as photodiode.

2) Indirect Sensor

Sensors that have several transition phases to transform sensed signals into electrical signals are known as indirect sensors.

3) Active and Passive Sensor

When monitoring surroundings passive sensors would not require an external power source but active sensors utilize such an external source of power to function.

4) Analog and Digital Sensors

Analog sensors provide constant signals whereas digital sensors produce discrete signals.

The Figure 2 indicates the various applications of sensors in smart city, agriculture, industry

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and environment. However, in this paper we are taking a closer look on smart city applications. The smart health case study is explained.

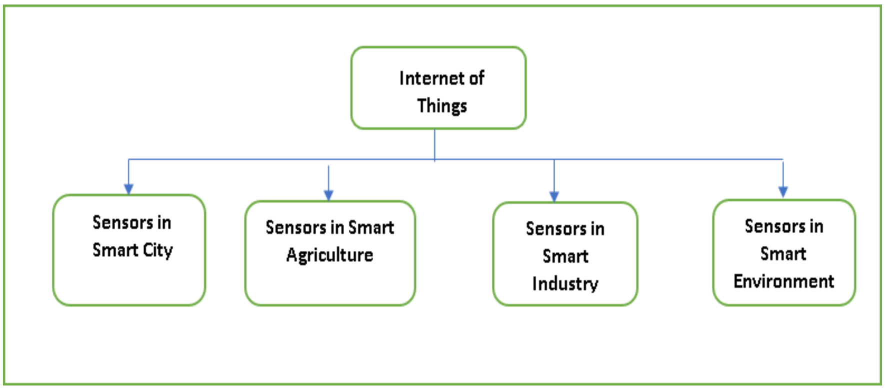

Fig 2: Applications of Sensors

a) Level Sensor

A level sensor [8] is a device that determines the threshold or volume of fluids, liquids or other solutes running in either an open or sealed system. Such sensors can be found in a wide range of industries. They are primarily known for measuring gasoline level but also used in water - based businesses. Such sensors are used by the reusing industry as well as the juice and liquor sectors to monitor various liquid inventories. The water level sensors work with supply voltage range between voltages

3.3 to 5 VDC and sensor dimension is usually ranging from 60X 20 mm and produces the output in the range of 0.5 to 2.5 VDC, when the water level is low then the digital output goes high.

b) Smoke Sensor

A smoke sensor [9] measures both the existence and quantity of smoke. Smoke sensors have been here over a while now. Smoke sensors are even more successful today thanks to the Internet of Things because of inter connected to a system which alerts the person toward any hazards which develop in different organizations. To detect danger threats smoke detectors are frequently used in the industry sector, multistoried buildings and hotel facilities. It protects personnel who operate in dangerous environments since the system as a whole is significantly greater powerful over earlier ones. The minimum operating voltage is 8.5V in case of smoke sensors and maximum voltage is 35V. The physical specification includes

5.3 inches (127 mm) diameter; 2.0 inches (51 mm) height

c) proximity Sensor

Since proximity detectors [10] can sense movements, they are extensively used in the commercial industry. Other major and hard usage application is automobiles. During reverse

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the proximity sensor warns car driver to any obstacle or GPS instruction. These sensors are also used to calculate the amount of available parking space at malls, arenas, and air terminals. The proximity sensor works with a supply voltage between 12 to 24 VDC, and current is 0.3mA

d) Temperature Sensor

Sensors are largely utilized in air conditioning, refrigerators and other climate monitoring systems [11]. These are now being used in the production, farming and healthcare industries. Since majority of the devices in the production process requires a predetermined atmospheric temperature and instrument warmth such kind of monitoring may potentially be utilized to optimize the operation. In farming on the other hand soil temperature is critical for crop yields. It aids in the proper development of plants allowing for maximum output. The resolution in temperature sensor ranges from 2 m°C @ 30°C and 25 m°C@100°C

e) image Sensor

Image sensors [12] consist of electrical circuits which transform image data to electrical impulses which can then be viewed or retained. Digital cameras and projectors, diagnostic scanning and night motion equipment, radar, infrared cameras devices, acoustic, fingerprinting and IRIS mechanisms are all examples of image sensor uses. The supply range of image sensor ranges from 2.5 V to 5V.

f) Pressure Sensor

A range of systems use liquid or different kind of pressure [13]. These sensors allow IoT devices to manage pressure-driven equipment to be created. Any deviation beyond the normal pressure limit notifies the computer administrator to any problems that must be resolved. Because it is simple to detect any pressure variations or drops the use of these sensors is advantageous not only in manufacturing but also in the monitoring of full water and thermal systems. The sensor, pressure range is 0 to 0.4 bars with the offset value + 25mV or -25 mV.

g) Position Sensor

By sensing the motion position sensor [14] determines the activity of humans or objects in a specific region. It could be deployed to home safety to control the doors and windows of rooms and equipment from any location. It keeps them informed about the open or closed state at all times and allows them to follow thieves while they are away. It could be used in health management to keep track of where patients, nurses, and doctors are in the hospital. The position sensors are usually including 12ft shielded cable and having supply voltage ranges from 8 to 28 VDC.

h) Water Quality Sensor

Water is used in practically every aspect of life. Water sensors [15] are essential for a range of applications since it can monitor water purity. These water sensors serve in a broad scope of industries. For a variety of purposes water quality systems are required in

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water supply infrastructure. Non-potable water cross-connections, contaminated water attempting to enter the supply system through pipe leaks in a low-pressure site and bacterial development in distribution system pipes are all concerns that must be handled. Water quality sensors having the resolution of 0.1% / 0.01mg/L and having the accuracy rate of 0 – 200%: ± 1% of reading.

i) Chemical Sensor

Chemical sensors [16] are utilized in a range of different fields. It is their task to monitor liquid or chemical abnormalities in the air. They play an important function in metropolitan areas in which it is necessary to keep an eye on changes and protect the inhabitants. Chemical sensors could be used in a variety of application fields, which include industrial pollution controlling and control systems, identifying toxic chemicals injected maliciously or unintentionally, combustible and radioactive sensing, and reusing systems on the International Space Station and laboratory facilities. Electro chemical sensor includes the gas species (NO and HC) having accuracy 25ppm.

j) Gas Sensor

Gas sensors [17] are identical like chemical sensors except that gas sensors measure air purity and distinguish numerous gases. These are employed in coal-fields, oil and gas industries, chemical research laboratories, and manufacturing –acrylics, polymers, rubber, pharmaceuticals and petroleum, and related goods – for air purity measurement, hazardous or flammable gas leakage, and dangerous gas monitoring. Carbon monoxide (CO) gas sensor ranges from 0to 300 ppm, whereas Hydrogen Sulphide (H2S) ranges from 0 to 100 ppm.

k) Infrared Sensor

To sense certain aspects of environment an infrared sensor [18] transmits or captures infrared radiation. It can sense and analyze the amount of temperature emitted by the objects. These sensors are being used in a variety of IOT development today especially in healthcare, since it allows blood flow and blood pressure monitoring simple. They're also found in smart watches and cell phones, among other smart devices. In case of infrared sensor, the detection distance ranges from 1mm to 8mm.

l) Humidity Sensor

Humidity [19] refers to the amount of moisture present in an atmosphere of air or similar gases. The term "relative humidity" (RH) is the more commonly used? Its applications and usefulness for managing heating, ventilation, and air-cooling equipment can be seen in both the industrial and housing sectors. Automotive, galleries, industrial locations, gardens, weather stations, paints and varnishes firms, hospitals, and the pharmacy sector all utilize them to preserve medications. The operating voltage in case of humidity sensor is from 3.3 to 5 VDC and resolution is 8bit required for humidity.

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3. SMART CITY APPLICATIONS

The paper Deployment of an Open Sensorised Platform in a Smart City context [20]. It depicts in the university premises; how smart city applications are incorporated. The author is trying to project, how smart sensors are deployed to perform smart things and entire environment can be monitored and having total control by using sensor platforms.

The paper, Citizen-Centric Data Services for Smart Cities [21] projects how the sensors are deployed in various cities, so that it can help all the citizens to access the infrastructure in a smart way. The main intention was to explore and incorporate all the citizen centric apps to ease the usage.

The paper, IOF Clime, used the Fuzzy logic and Internet of Things to control indoor temperature regarding outdoor ambient conditions [22]. It proposed new methodology to control temperature and humidity both indoor and outdoor, using Fuzzy logic and also optimize the savings on energy.

The Figure 3 shows different smart city applications such as healthcare, smart services, innovative infrastructures, and weather forecasting and transportation services. Various sensors are deployed such as temperature sensor, pressure sensor, level sensors, water quality and position sensors, which are mentioned in the types of sensors.

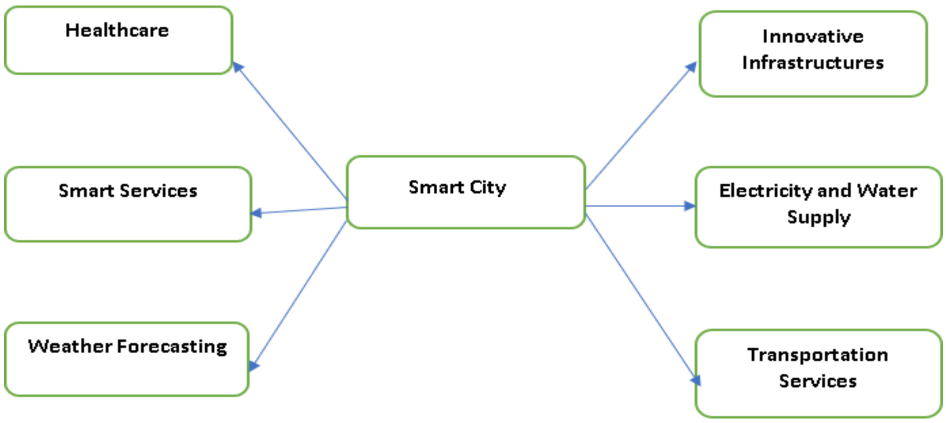

Fig 3: Smart City Applications

There are many Smart City applications widely used by deployed various sensors needed for each of the application. Out of which, Smart healthcare services incorporates new generation advanced technologies such IOT, Cloud Computing. Smart healthcare services involve all the emerging services which can be easily accessible to the patients. Doctor can also easily log into the mobile app or connect through the web to monitor and access various details about the patients, the sensors are deployed to monitor patients pulse rate and other vital organs information, if the patient is in intensive care unit. The below diagram shows smart health care services in a smart city. The Figure 4 shows the architecture of smart health services using IOT based sensors.

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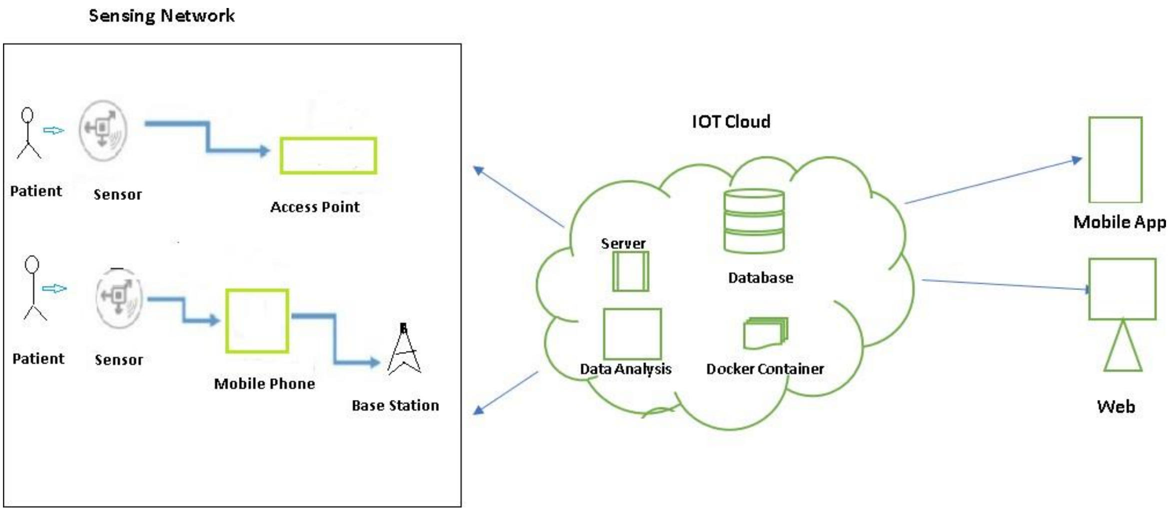

Fig 4: Architecture of smart health services using IOT based sensors

In a smart city environment, number of locality or a population staying together, where in there is a need of smart health infrastructure, to get to know patients details quickly and act accordingly. This can be achieved effectively by using IOT based smart sensors.

1) Day-to-Day activities

Smart objects have a wide range of uses in everyday tasks. In the chemical, oil, gas, and nuclear energy industries, it is used to monitor critical procedures. Sensors are also necessary in the renewable energy industry to control geographically broad power and distribution networks. Intelligent sensor standards for communication, interoperability, reliability, calibration, safety, and accuracy have been developed for such critical infrastructure.

2) Safety

Devices also can be interconnected with the Internet and utilized in collaboration with home automation technologies to improve comfort and security. Data collecting networks, cloud computing, and machine-to-machine interaction are all part of these systems.

3) Cleaning

Sensors ensure that the building is thoroughly cleaned in all areas, and vacuum machines can navigate around structural obstacles. Water sensors may be employed in the real world to avoid harm to the home induced by washing machines or dishwashers.

4) Emergency

Through camera systems, infrared, ultrasonic sensors, and radar sensors driving assist systems such as automated emergency braking equipment and parking devices make daily life easier and improve road safety.

5) Food quality control

Sensors in the food industry have been used to measure carbs, alcohol, and acidity as part of

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standard monitoring activities. These gadgets are often used to keep track of fermentation. The detection of infections in fresh meat, poultry, or fish is critical. Sensors are successfully used to control air and water quality.

4. CONCLUSION

Sensors are ubiquitous in industry and also in our daily lives. Processing parameters like as temperature, humidity, volume, rate of flow, and granularity are precisely analyzed in industrial facilities. The Internet of Things (IoT) is fundamentally changing the era by automating traditional procedures. It is the future of smart computing, sensors, actuators, and other supporting technologies aid in the building of a smart world through the Internet of Things. This paper discusses the several types of sensors used in smart city applications. When sensors are interconnected to a network, they gather critical data and communicate it with other network objects and administrative systems. As a result, sensors remain important to the smooth operation of smart city applications which includes smart services, Health care, Infrastructure and Transportation. However, these sensors can be deployed in various other applications such as agriculture, smart home.

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