A SURVEY ON SENSOR CLASSIFICATION AND THEIR APPLICATIONS

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ABSTRACT

In every field we discover sensors that used to transform real world facts into electrical shape. The sensor can read our environment by measuring physical surroundings. These sensors have the capability to detecting and reading the real-world data and converting those physical data into the digital data. Today many organizations within the world are developing new sensors based totally on the human needs. The lifestyle of Humans can vary according to the various atmospheric conditions in the different part of world, so that the sensor needed can vary from place to place. Also, we make a try to make comparing among the sensors and the overview about the sensor, and the classification may vary according to the surrounding and user conditions. The environmental changes from place-to-place make the need for the different sensors which are capable of working with different environmental conditions from various time to time. People in the world know about the sensors but they don't know the utility of the sensors. The working and functions of sensors lead to the formation of connectivity between machine to machine by various analysis on different types of sensed data, which formed the term of communication called as Internet of Things. The further conceptual and the practical improvements of Internet of Things are utilized for the development of Artificial Intelligence. The automated processing of data from various observations by communication between various systems of Internet of Things and Artificial Intelligence leads to evolution of Internet of Everything. So that, a scheme that works to select the sensor for diverse programs. The scheme focused especially on the home cause.

Keywords: *Outdoor Sensor, Indoor Sensor, Sensor Features, Internet of Things, Artificial Intelligence, Internet of Everything.*

1. INTRODUCTION

In an electronic world there are lot of devices that produces several facts. Human can't capable of manipulate the glide of facts and no longer music each statistic produced by using the gadgets. In previous ranges generally use garage medium like hard disk, pen drives and many others., This occupies more area and decreases the overall performance of the system. To solve this problem, we proposed sensors to document the data and provide records to the consumer in much less computational time with extra performance. A sensor is a bodily tool that used to come across and make moves consistent with the consumer enter statistics. The entry will be any parameter which includes light, pressure, humidity, movement detection, heat, waves and so forth., sensor categorization stages from very simple to complex based on the application. The sensor may be categorized primarily based on various places which include outside, indoor, frame sensors. Technology is used in homes to create digital surroundings including controlling room temperature, sundry gadgets, safety and lighting fixtures. In home we use many devices that comfort our usage which include electrical, mechanical, thermal devices, which can be managed by way of the use of sensors. People inside the global know many sensors but they don't know the utility of these sensors. Thus, our category scheme must be used to choose the sensor to manage the devices.[1]

The primary objective of the proposed system is to find the suitable sensor for user input and various working areas of sensors. After classification the user can select the sensor according to the type of data given by the user to the sensor. In this paper section II provide information on existing works. In section III proposed many sensors that helps to record data and provide results in an effective manner. The classification of sensors that suitable for specific application was given. section IV collaborates the characteristics of various sensors into a single table for user convenience. From section V the conclusion and future work can be discussed. section VI tells about the references for the paper work. This paper provides clear vision about sensors and its classification.

2. RELATED WORK

This related works provides the overview of the sensor and characteristics of the sensor and response time to the user input and the classification of sensor in various environments. Herbert Ernst et al. [2], proposes the use of dynamic thermal measuring principles. Based on this, a micromachined sensor was developed for the measurement of transient thermal signal responses to the user surroundings. R. Narayanaswamy et al. [3], proposes the use of optical analyzing sensor based on fluorescence of light emitted by the object. Aman Tyagi et al. [4], proposes soil moisture sensor that can be placed on suitable locations on field for monitoring of temperature and moisture of soil for agriculture. A blog [5], which proposes the importance of pressure sensor and its measuring variants. The paper [6], provides information about the flow level sensor using Kalman filter with its future benefits. G. Kim, Yang Liu et al. [7],[8], proposes pixel that captured for motion detection and to realize the human motion sequence segmentation and algorithm used for motion sensor. Changlu Ji, Jiayu Zhang [9], Invented A kind of variable reluctive sensor was designed to realize the goal of tilt angle measurement. Its working principle was analyzed for tilt sensor. S. Ryu et al. [10], develop a speech accumulator that finds sound level, ratio of speech and speaking time in 1 day and A. C. Ohlsson et al. [11], develop an algorithm for speech recognition and validation and application of speech recognition in various fields. Jordan G.R et al. [12], proposes a detailed view about the electrical sensor technology and its features currently using technologies for electrical sensor. J. Han et al. [13], develop a sensor that used for integrated home automation system that uses to connect various sensors. Y.T. Park et al. [14], develop a door wave sensor that detects the entry of anonymous persons. C. S. Choy [15], develop a universal system that control all the devices through a single controller. Gudipati Sravanthi et al. [16], develop a people counter detects the person present in the house.

Here the proposal of upgraded classification scheme for the sensors by taking the above references to provide a good quality sensor for the user. In Fig-1, sensor can be classified as Outdoor, Indoor. This classification can be extended according to the user's requirement.

3. OVERVIEW

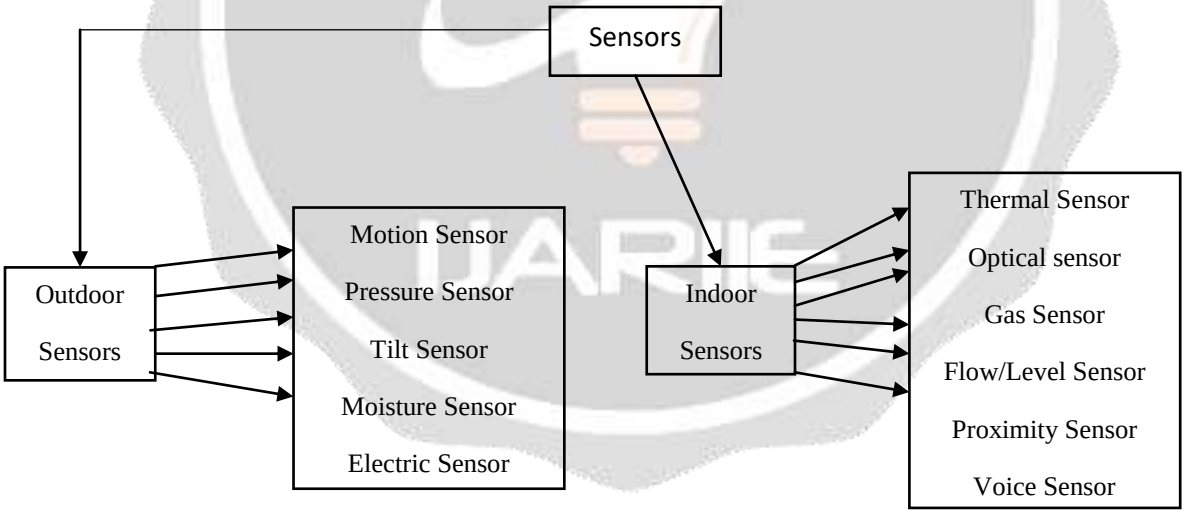

Fig -1: Sensor Classification Based on Surroundings

3.1 THERMAL SENSOR

A thermal sensor reads the *temperature* of the object that attached physically with that object or no contact with the object [2]. The main intention in using the manifold geometries is the search for the optimum achievable thermal insulation from the bulk material, and monitors periodically for any cross-talk occurrence. An insulating system developed to reduce the temperature overflow.

3.2 OPTICAL SENSOR

An optical sensor converts light rays into an electronic signal which increases the transmission speed and is to measure the physical quality of light. The luminescence can be captured by a thin planar surface of each of an array of frustrated cones and for comparison purposes [3]. All spots were approximately circular in diameter 1mm. the CMOS camera captured the image focuses through the lens. The high luminescent object captured with efficiency by over 80 times from radiating molecules.

3.3 MOISTURE SENSOR

Moisture forms up in air and turns to humidity hence it is known as *humidity sensor*. It measures both moisture and air temperature and works according to the user comfort. The soil moisture sensor has been developed using the basic property that the resistance of the soil between two points decreases with the increase of water content in it. The developed sensor has two probes that are inserted into the soil [4]. A resistance is connected in series with the probe and current is passed through it.

3.4 PRESSURE SENSOR

The working of pressure sensor is to convert *pressure into an electrical signal* and it display in one of the physical units ("pascal", "bar", "PSI"). These sensors are worked based on piezoelectric effect [5]. Pressure transducer have a sensing area that constantly responds to the force will deflect the diaphragm inside the pressure transducer and produces an electronic output through internal transducers.

3.5 FLOW/LEVEL SENSOR

It is a physical sensor used to measure the quantity of moving air and liquid. Kalman filter is a flow sensor used to measure the varying liquid capacity and rotation angle of liquid tank. Fusion algorithm is used to measure the gas flow in the cylinder [6]. The filter cyclically overrides the mean and variance of the result and the predicted value is produced as output.

3.6 MOTION DETECTION SENSOR

These sensors are fixed in exterior doorways or windows of a building for monitoring the area around the building. It generates *electrical signals based on motion*, vibration, IR detection and even sound. In real-world applications, sensor network is always adopted to record the human motions [7]. However, different kinds of sensors may adopt by a sensor network to fully describe the poses of human motions which causes the problem of representing human motions with features of different scales [8].

3.7 TILT SENSOR

This sensor detects the *orientation or inclination of object*. They are small, affordable, easy to use. It is cylindrical in shape and electricity pass throughout the sensor. When a conductor moves the electric signal cuts-off. Tilt sensors are used to measure the gradient of the carrier, and acquire the input signals of the automatic follow and adjusting of the platform [9]. A kind of novel low-cost tilt sensor was presented based on bionics. This kind of tilt sensor is realized based on variable relative transducer theory.

3.8 VOICE SENSOR

This sensor is used to receive input through voice and convert into electrical signal. The mechanism is conversion of *analog to digital* signal. Voice recognition is commonly used to operate a device, perform commands, or write without having to use a keyboard, mouse, or press any buttons. The data recorded by the voice accumulator were transferred to a personal computer for analysis. Phonation time was expressed as percentage of a selected time interval from 6 s up to a whole day [10]. The sensor also focuses on the condition of the speaker and the surroundings.

3.9 GAS SENSOR

These are the sensors used to detect gases like *oxygen, nitrogen, carbon-di-oxide*. It is connected with the device used to detect the leakage of harmful gases, monitor the air quality of the environment. This sensor also used to find the mixing of gases in the environment by detecting using the molecular ratio of each gases that surround us. This sensor records the limitation of each gases and prevent the gases that reach above the limit [11].

3.10 ELECTRICAL SENSOR

These are the sensor used to check the electric field of the appliances. The sensitivity of the power sensor is 1 W, and the power for the Micro Controller Unit (MCU) can be generated from an appliance power of 23 W. The sensor itself consumes 3.75 mW [12]. This sensor can be used to measure the power consumption of the existing electrical appliances. Monitoring the power consumption of each electrical appliance in a house is a key technology for High Level Entity Management System (HEMS). However, methods of monitoring the power consumption of existing electrical appliances are not sensitive enough.

3.11 EMBEDDED SENSOR

Two or more sensors integrated to form a single unit to reduce the size of the sensor and made the sensing function more accurately [13]. In Table-1, The combination of various sensors are tabulated.

Sensor name	Individual sensors
Weather Shield	Humidity, Pressure, Temperature
Flutter Sensor	Gyroscope and Accelerometer
3D Sensor	Detects UV, Invisible, IR rays
Strain Sensor	Image, Temperature, Air Pressure

Table -1: Embedded Sensors

4. SENSOR PARTITIONING ACCORDING TO USER APPLICATION

In Table-2, The sensor classification based on functionalities are described

TITLE	ROLE	TYPE	NAME	FEATURES	APPLICATION
THERMAL SENSOR	To detect temperature of surrounding	Thermocouples, Thermistor, infrared sensor	LM35	It has an output voltage that is proportional to the temperature being measured. The scale factor is 0.01 V/oC.	human body, computers, mobiles, laboratories, factories
OPTICAL SENSOR	To detect light intensity according to user constraint	Through beam sensors, Retro-reflective sensor, Diffuse reflection sensor	LM393	It is a photo sensitive resistor sensor used to detect brightness and light intensity. It is digitally connected with the microcontroller. The working voltage is 3.3 – 5v	xerox machines, light that turn on automatically in the dark, alarm systems
MOISTURE SENSOR	To detect moisture in agricultural land	capacitive(meas -ures relative humidity), resistive(measur -es electrical impedance of atom) and thermal sensors	DHT11	It is a humidity sensor integrated with thermal sensor which measures humidity varying 20-90% and measuring temperature range 0-50 degree temperature	Home Heating, Ventilating and Air Conditioning (HVAC)systems, offices, cars, meteorology stations to predict weather

PRESSURE SENSOR	To detect pressure hold by the object or around surrounding	absolute, gauge, and differential pressures	BMP280	It is a sensor which can withstand *300 to1100* hpa and temperature 0-65 degree centigrade.	Automotive industry, Bio-medical instrumentation, aviation and marine industry
FLOW SENSOR	To detect the level and rate of air and liquid	NIL	YF S201	Humidity:35to90%RH pressure: 1.75Mpa, temperature: -25~+80 degree centigrade	To find the position of the vehicle by knowing the current & previous speed corresponds to x distance and to find noise between two signals
MOTION SENSOR	To monitor the action of a human or animal or any moving objects	active(emit radio waves), passive(not emit any waves), combined(hybrid) detectors, ultrasonic detector	BT31F6	Detecting distance: *0~7*m, detecting angle: *360* degree, motion speed: *0.6~1*m place within 1.6m	It is implemented in intruder alarm, automatic doors, hand dryers
TILT SENSOR	To find the position of the object based on its angle	Inductance type Potentiometric type Liquid pendulum Gas pendulum MEMS based tilt sensor	WT931	Acceleration: x, y, z angle: x, y range: acceleration:±16g angular velocity: ±2000/s, angle:±180º	self-tuning, self-adapting and self-testing devices uses tilt sensors
VOICE SENSOR	To receive voice and convert into electronic form	NIL	RC-A-4051	It supports up to 80 voice commands. Each voice sustained for(1500 ms). One or two words processed at a time.	Google assistant, alexa, cortana, echo dot
GAS SENSOR	To detect the level of gases in the surrounding	NIL	MQ2	Detects methane, LPG, butane gas embedded with Arduino board.	It is used in industries to monitor the concentration of toxic gases. It is used for domestic gas leakage, used in detecting fire.
ELECTRIC SENSOR	To detect the electric field of the material	NIL	MB9AF131KB	Operating voltage: 1.8-5.5 v Operating ampere: 4-5 mA	Attached with electric socket to find the voltage fluctuations and control household devices

Table -2: Sensor Classification based on functionalities

5. HOME SENSOR OVERVIEW

5.1 KINECT SENSOR

The sensor which is developed by *Microsoft for x-box game*. Later it acts as a interface to computer and the Arduino. This sensor converts voice signals from analog into digital signals. The microphone which records human voices and convert into digital form. The Kinect V2 as voice receiver is used for voice control and it is trained as a computer system to identify set of voice commands [14]. In Table-3 The Kinect Sensor Characteristics are discussed.

Components	Functions
Kinect Sensor Version 2.0	Microsoft used this technology for playing games in the beginning. But at present the technology has been applied to real world applications
Kinect Microphone Array	The Kinect sensor has an array of four linear microphones and has 24-bit audio data resolution. This microphone array uses Analogue to Digital Converter
Speech Module	In the Speech module section, we have used Microsoft Speech Recognition Engine (Speech recognizer) and Microsoft Speech Recognition Grammar
Arduino Uno	The Arduino Uno is a microcontroller board based on the ATmega328p. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

Table -3: Kinect Sensor Characteristics

5.2 DOOR WAVE DETECTION

The sensor which goes based totally at the vibration of the environment. In Fig-2, the architecture of door wave automation is designed. IR sensor is placed on the doors. If any boundaries come across at the door, the vibration motor integrated with human node and indicators humans. It is designed particularly for deaf people. The door lock machine has a Radio Frequency Identification (RFID) reader to authenticate customers and a motor module for establishing doorways and last. It has a Liquid Crystal Display (LCD), a manipulate module used to adjust different modules and sensor modules to come across the house surroundings [15]. The gadget automatically opens the door for disabled humans when they enter the residence.

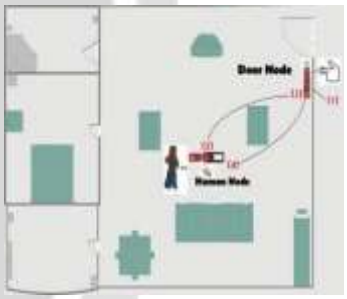

Fig -2: Door Wave Automation

5.3 UNIVERSAL REMOTE CONTROLLER

It is an embedded device which consists of *numerous sensors* controlled by the common device called Universal Remote Controller (URC). It is used in home automation to integrate all the home appliances in a single node. In Fig-3, The URC has been designed and implemented by means of various receivers to connect all appliances. For example, it is possible to control audio and video devices with Infra-Red (IR) signal control, lighting devices and Audio video (AV) switches with RS232/RS485, electric motorized screens and elevation with relay contact control. Receivers are very closely placed between a URC and their appliances for efficient wired or wireless communications. In addition, the URC-based system can be also controlled by a cellular phone with a TCP/IP route [16].

Section	URC - Touch Panel
CPU	32 bit RISC processor(206MHz)
LCD	3.5" TFT LCD (320 X 240 pixel)
Memory	64M NAND Flash 64M SDRAM
O.S	WinCE .NET 5.0
RF Range	120M (Max)
IR Range	45M (Max)
RF Freq.	2.4Ghz (Zigbee)
Size	160 X 99 X 17.0 240g
WiFi	Available
Channel	16
ID	16

Fig -3: Universal Remote Controller specifications

5.4 PEOPLE COUNTER (PC) SENSOR

The range of persons present in domestic is detected by using the use of this sensor. In Fig-4, the people counter can be constructed. The infrared sensor placed in each door will allow for the detection of humans and will boom the rely inside the machine [17]. Automatic switching of the lights could be done the use of the Foot Step Counter; while there's no time to begin the application, or to attach via Blue-teeth, the character when passes through the door and lighting fixtures within the room can be switched.

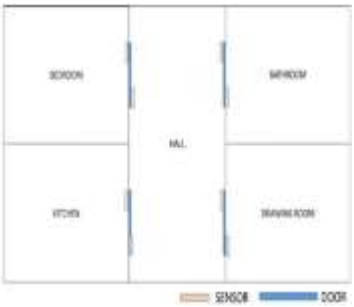

Fig -4: People Counter Sensor

6. CONCLUSION & FUTURE WORK

This proposed work gives clear idea about the sensor and classification. This work helps people to choose sensor for their application. The sensor classification can take according to various surroundings. This sensor Classification also discussed about the application according to various surroundings. This work avoids the confusion about the sensors which is used for various application. This proposed paper also deals with home automation sensor classification scheme. It gives better result by comparing with previous work and giving a complete classification scheme. This classification is not ended, this can be varying according to the various human inputs. In future the classification develops along with the development of new sensors responds to the user command.

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