A NOVEL METHOD OF IOT BASED WAREHOUSE MONITORING USING RASPBERRY PI

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Abstract : The emerging concept of IoT plays a vital role to help in attaining this mission of Warehouse Monitoring using Raspberry Pi. Policy decisions can be made based on the real time data. And more importantly, their impact can be monitored almost in the real time. The IoT based Warehouse monitoring system using Raspberry Pi has developed in the approach to promote safety and sustainable environment for the storage of goods. The main focus is on sustainable and inclusive development with the help of the Electronics. The system is using low cost low power ARM based minicomputer that is Raspberry Pi. It can communicate through Local Area Network (LAN) or the external Wi-Fi module. The data can be monitored by the Cayenne Server by other terminal devices like Laptop, Smart Phone and Tablet which is endowed with the internet facility. This Cayenne Server is giving access to the real-time information about the parameters like Temperature, Pressure, Smoke, Rain and Motion.

The current monitoring system does not have Remote and Real time monitoring and needs extra Ethernet module to get the internet connectivity, but the Raspberry Pi has on board circuitry for this which helps in monitoring the real time data continuously and ensures the safer environment for the storage of goods in the Warehouse**.**

IndexTerms **– IoT, Cayenne, Sensors, Warehouse.**

I. INTRODUCTION

The IoT concept was put forth in 1999 by a member of the Radio Frequency Identification (RFID) development community. The increasing growth of the mobile devices and development in the area of communication, cloud computing, embedded systems has made the IoT concept more relevant. Internet of Things is the web of physical objects that contain the embedded technology which is helping to develop man to machine or machine to machine communication. It is stated that IoT is a converging technology to create the smart environment and the integrated ecosystem[1-2].

The use of the smart and compact mini-computer kind of device that is Raspberry Pi is very useful in giving good internet connectivity and the use of it is also going to boost the speed of the operation. The system draws very less power compared to the existing systems[4]

II. METHODOLOGY

A Various sensors are used to collect the data from the warehouse where BMP180 pressure sensor uses a piezo-resistive MEMS(Microelectro Mechanical System) and PIR sensors can sense a motion from a warehouse by using a PIR " Passive Infrared", "Pyroelectric" or IR motion sensing techniques and M009 rain drop detection sensor uses the IR(Infrared) transmission methods to detect the rain, Moisture sensor uses a capacitance to measure the moisture of crops and many other sensors can also be incorporated.

IoT Based Warehouse Monitoring Using Raspberry Pi can now serve as a hub to boost efficiency and speed throughout the entire supply chain which is an ARM based credit sized SBC (Single board computer) runs Debian based GNU / Linux Operating system.

IoT Solution for Warehouse Management will have to find the right mix of sensors and information that can bring maximum benefits to the society and Real Time Data Analysis of Warehousing System can be monitored by using Cayenne server which will provides elegant graphical interface and a solid communication protocol[5].

III. DEVELOPMENT OF SYSTEM

3.1 Hardware Architecture:

A comprehensive IoT based Warehouse Monitoring System helps to measure the imbalance in various levels of parameters and harmful air pollutants in the environment which leads to the damage of goods. Both governments and industries can leverage data metrics collected from the system to devise stringent control measure. Our Warehouse Monitoring Systems require less investments and simpler operations[3,5,12].

Fig.1 shows the Block diagram of the system. In this monitoring system, the output of the sensors which are used rain sensor, Temperature & Humidity Sensor (DF robot DHT11), pressure sensor (Bosch BMP 180), motion sensor (PIR) and air quality sensor (MQ2 sensor) are sensed by the GPIO pins and is being processed by the Raspberry Pi and displays in the Cayenne Server. The client uses Cayenne Server dashboard and gets access to the real time data. The Cayenne Server also helps to control the parameters. USB ports are the means to connect accessories such as mouse, keyboard and printers to the Raspberry Pi. Ethernet port is available on board. It can be connected to internet using a standard LAN cable on the Ethernet port otherwise we can use WIFI. A DSI compatible LCD screen can be connected through the DSI connector, although it may require additional drivers to drive the display. CSI – Camera Serial Interface is a serial interface designed by MIPI (Mobile Industry Processor Interface) alliance aimed at interfacing digital cameras with a mobile processor. HDMI is provided on the Raspberry Pi to connect with HDMI screens. The HDMI port provides digital video and audio output[9-12].

3.2 Hardware Architecture:

The Raspberry Pi primarily uses Linux kernel-based operating systems. The OS used for Raspberry Pi is Raspbian. Cayenne is an app for smart phones and computers that allow us to control the Raspberry Pi and also the Arduino through the use of an elegant graphical interface and a solid nice communication protocol. The Pi 3 has 40 pin GPIO pins arranged in 2x20 strip. It is having on board LCD, USB & Ethernet ports. Cayenne was designed for the purpose of Internet of Things. Cayenne is a simple and open source app, in provides a good connectivity and provides a easy way to triggers.

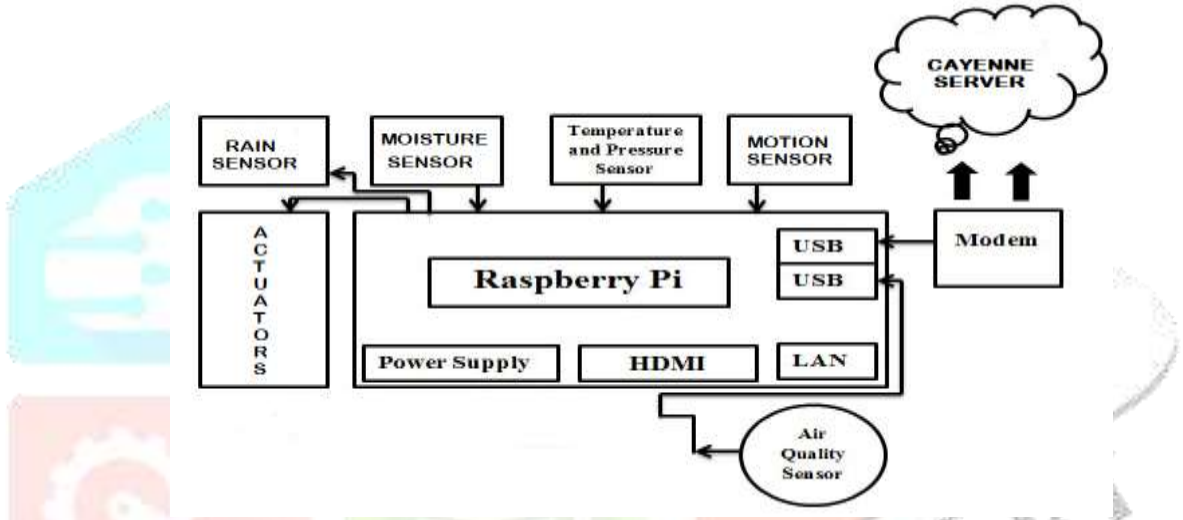

Figure 1 Block diagram of our system

IV. WORKING PRINCIPLE

Fig. 2 shows the experimental setup of our work, we aimed at reducing the cost of display controllers in a mobile device. It is commonly targeted at LCD and similar display technologies. It defines a serial bus and a communication protocol between the host (source of the image data) and the device (destination of the image data). We connected all the sensors are connected to the board and working of the each sensors are explained below[8].

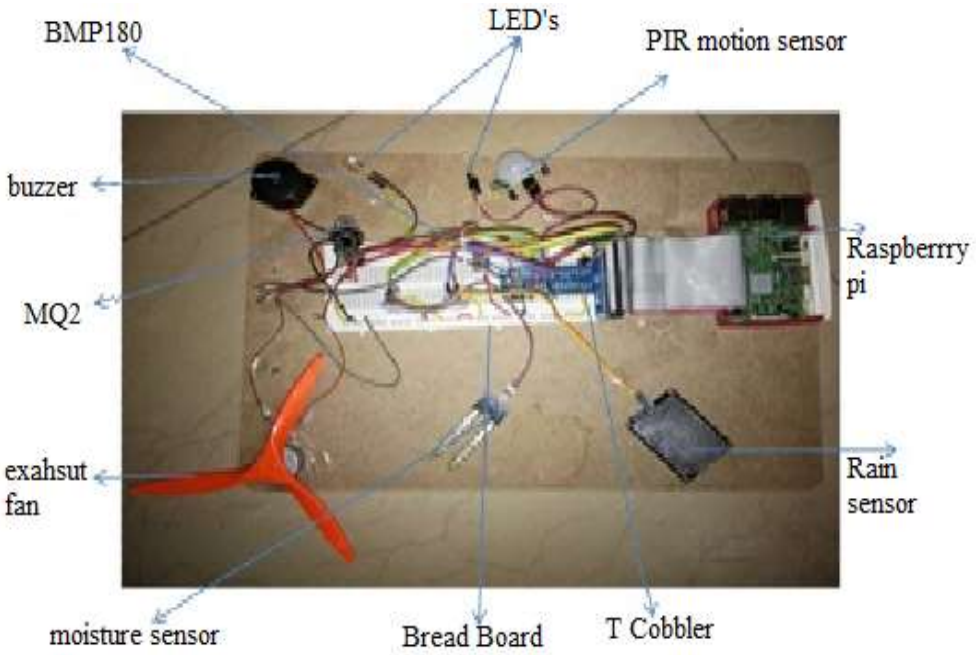

Figure 2 Experimental setup

4.1 Pressure sensor BMP 180:

The BMP180 is the new digital barometric pressure sensor of Bosch Sensor tech. It is a smaller size and the expansion of digital interfaces. The ultra-low power consumption down to 3 μA makes the BMP180 the leader in power saving. The BMP180 comes as a fully calibrated, ready-to-use sensor module without the need for additional external circuitry. Pressure and temperature data are provided as 16 bit values, which, together with the stored calibration data, are used for temperature compensation on the external microcontroller. Data transfer can be performed via I2C or SPI interfaces[6].

4.2 MQ2 sensor

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target smoke exist, the sensor's conductivity is more higher along with the smoke concentration rising. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application. MQ2 sensor Exhaust Fan is used so that when there is smoke the fan will ON and when no smoke is present then fan will be OFF[7]. In order to make the sensor with better performance, suitable RL value is needed:

Power of Sensitivity body(Ps):

$Ps=Vc^2\times Rs/(Rs+RL)^2$

4.3 PIR motion sensor

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. For PIR Motion sensor Buzzer is used so that when there is motion of human or animal detected the Buzzer will ON automatically and when no such motion is detected the Buzzer will be OFF[8].

4.4 Rain sensor

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer.

The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level. Rain sensor LED is used so that when the rain drops will be detected LED will be ON automatically and when no drops are detected LED will be OFF[9].

4.5 Moisture Sensor

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor. Another sensor, the neutron moisture gauge, utilize the moderator properties of water for neutrons. The Raspberry Pi board reads the values of all sensors and send to cayenne server which is Tab or Laptop or system[10].

V. ADVANTAGES & DISADVANTAGES

- **Advantages**
  - ✓ System provides open access to particular set of data
  - ✓ Low cost
  - ✓ Less power Consumption
  - ✓ Compact Module
  - ✓ Real Time Monitoring
  - ✓ Reduces the use of manual labor

- **Disadvantages**
  - ✓ Internet connectivity is Compulsory
  - ✓ Specific Operating System is required

VI. RESULTS

The figure 3 shows the result of all sensors in the Cayenne Server. The Sensors included are BMP180 sensor, MQ2 (smoke sensor), Moisture sensor, Rain sensor and Motion sensor. Along with the sensors actuators are also included to take control measures when needed.

Figure 3 Results of all sensors in Server

VII. FUTURE SCOPE

The communication methodologies can be upgraded from wire to wireless communication from the independent sensors to Raspberry pi and along with the sensing technique other monitoring of resources techniques can be embedded and information sharing methodologys can be customised. Interactive type of communication between citizens and system, enhanced level of speed and security and the protocols for communication which will be compatible to all kind of servers and clients are the few more challenges.

CONCLUSION

Improved Climate quality level ensures a safe, healthy environment for storage of goods in the Warehouse. The IoT Based Warehouse Monitoring System using Raspberry Pi supports energy-efficient solutions for storage of goods. The ubiquitous availability

of dynamic datasheets on the dashboard and the time to time graphical representation provided by the Cayenne Server helps in planning the control measures against increasing the parametric levels to create awareness among the people.

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