Environment Monitoring System using Raspberry-Pi

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Abstract -_The development in embedded system has proved to a reliable solution in monitoring and controlling the environment monitoring system. The project aims at building a system which can be used on universally at any scale to monitor the parameters in a given environment. With the evolution of miniaturized sensor devices coupled with wireless technologies it is possible to remotely monitor the parameters such as temperature, humidity, amount ofco2 in air and many more .We will be using raspberry-pi as our main board and sensors will collect all the real time data from environment and this real time data will be fetched by the web server and display it. User can access this data from anywhere through Internet. Due to unnatural and unpredictable weather farmers now a day face large financial losses due to wrong prediction of weather and incorrect irrigation methods and the amount of pesticides and insecticides used for crops. This system will prove to bean important part in development in agricultural field._

**Key Words:** Raspberry-Pi, Sensors, Web server, Weather.

1. INTRODUCTION

The development in wireless sensor networks can be used in monitoring and con- trolling various parameters in the agriculture field, weather station field. Due to uneven and natural distribution of rain water it is very difficult for farmers to monitor and control the distribution of water to agriculture field in the whole farm or as per the requirement of the crop. There is no ideal and advanced irrigation method for all weather conditions, soil structure and variety of crops cultures. Farmers suffer large financial losses because of wrong prediction of weather and incorrect irrigation methods and the amount of pesticides and insecticides used for crops. In this context, with the evolution of miniaturized sensor devices coupled with wireless technologies, it is possible remotely monitor parameters such as temperature and humidity and sun light intensity. Weather monitoring plays an important role in human life, so the collection of information about the temporal dynamics of weather.

1.1 Internet of Things (IOT)

Internet of Things (IoTs): The Internet of Things (IoTs) can be described as connecting everyday objects like smart-phones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. Building IoTs has advanced significantly in the last couple of years since it has added a new dimension to the world of information and communication technologies. It is expected that the number of devices connected to the Internet will accumulate from 100.4 million in 2011 to 2.1 billion by the year 2021, growing at a rate of 36% per year. In the year 2011, 80% machine to machine (M2M) connections were made over mobile networks such as 2G and 3G and it is predicted that by 2021, this ratio will increase to 93% since the cost related with M2M over mobile networks are generally cheaper than fixed networks. Now anyone, from anytime and anywhere can have connectivity for anything and it is expected that these connections will extend and create an entirely advanced dynamic network of IoTs. The development of the Internet of Things will revolutionize a number of sectors, from automation, transportation, energy, healthcare, financial services to nanotechnology. IoTs technology can also be applied to create a new concept and wide development space for smart homes to provide intelligence, comfort and to improve the quality of life.

1.2 Motivation

The Motivation of Project is in recent developments in wireless and micro sensor technologies have provided foundation platforms for considering the development of effective modular systems. They offer the prospect of flexibility in use, and network scalability. The Raspberry Pi has proved to be ideal as the core of such a system. There are many other practical uses for the environment monitor including monitoring of temperature and humidity in a home, outbuilding, greenhouse, or even a museum Although this has been designed for passive monitoring it would be possible to have this used for actively notifying someone of a temperature change, turning on heating.

2. Literature Survey

Ruchi Mittal and Bhatia propose a system in which they detect irregular patterns of sensory data with respect to time and space. They design a system which continuously queries and monitors sensor data to detect any deviations from the norm. This is essential in detecting a faulty sensor node and ensuring it can be quickly replaced. This system is especially helpful when detecting environmental activity like forest re. In or- der to achieve desired results, Data preprocessing and sensor data clustering is used. In data preprocessing, the sensor data is cleaned by putting in missing values and removing any unwanted data. Mittal and Bhatia analyzed this data cluster by plotting data, comparing them against expected/predicted patterns and detect anomalies. Ye and Wang in have a WSN system which is based on IRIS mote hardware platform which consists of ATmega 128 microprocessor, a RF230 radio chip and external ash memory for over the air programming. The sensors are programmed to collect and deliver sensor data periodically. Sensor data is sent on an event basis, which means that whenever there is a sudden change in the environment, the sensor data is sent. However, the sensors are always listening, i.e. they wait for changes in environment and report only once a drastic change is detected. These sensors are user-denied and act based on requirement.

The Sensors used are barometric pressure, ambient temperature, humidity, wind direction, wind speed, and rainfall sensors. Once data from all the nodes are collected, this information is transmitted to a local base station (ATmega 128) through multi-hop transmission. This data is stored in an embedded database SQLite3 and displayed on a web-page using TCP/IP.

Ye and Wang extend the WSN to include ZigBee technology as the wireless medium. ZigBee is a wireless standard based on IEEE802.15.4 which is low cost, low power, low data rate and more importantly, highly reliable and secure medium of networking. The WSN is built using a coordinator node and several sensor nodes, a workstation and a database. Raw sensor data is collected from multiple nodes.

2.1 WSN Using Raspberry-Pi

Although the systems mentioned above are active in achieving the purpose of collecting sensor data and storing them, they do have a few limitations that are addressed in this project. For detecting anomalies in sensor networks, creating clusters of data and inserting expected data values and comparing them against received values is a good way of detecting faulty sensor nodes and replacing them, however, this project uses the in-built features of MySQL servers, namely Triggers Delimiters, using these features of MySQL, expected data ranges can be specified in the database table and any deviation from this value will send a trigger to alert the user that either an event has occurred or a node is malfunctioning. This can be checked via the phone app or by logging into the server to check the latest values updated in the database and compare them with past values.

2.2 Problem Statement

Design and Implementation of Environment monitoring system using Raspberry-Pi which is interfaced with various sensors (temperature, Humidity, CO2, Vibration). Real time data will be collected by all the sensors and will be fetched by the Webserver. This data can be accessed by the user through web browser.
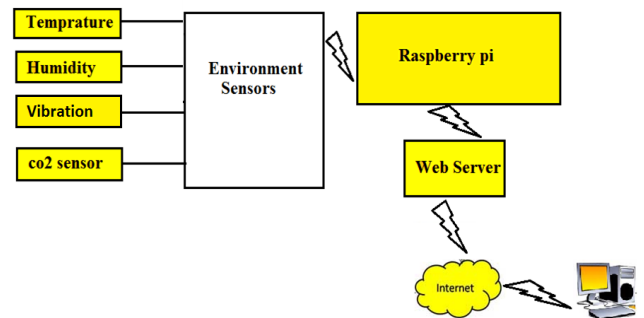
3. System Design

Fig-1:System Architecture

3.1 Hardware

3.1.1 Raspberry-Pi

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

3.1.2 Sensors:

3.1.2.1 DHT11 Digital Humidity and Temperature Sensor:

The **DHT11** is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed).It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are usedby the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package.

3.1.2.2ADIS16220 Digital Vibration Sensor:

The ADIS16220 is a digital vibration sensor that combines industry-leading sensing technology with signal processing, data captures, and a convenient serial peripheral interface (SPI). The SPI and data buffer structure provide convenient access to wide-bandwidth sensor data. The 22 kHz sensor resonance and 100.2 kSPS samplerate provide adequate response for most machine health applications. The averaging/ decimating filter provides optimization controls for lower bandwidth applications. An internal clock drives the data sampling system, which fills the buffer memory for user access. The data capture function has three different trigger modes. The automatic data collection allows for periodic wake-up and capture, based on a programmable duty cycle. The manual data capture mode allows the user to initiate a data capture, providing power and read-rate optimization. The event capture mode continuously updates the buffers and monitors them for a preset trigger condition. This mode captures pre-event data and post-event data and produces an alarm indicator for driving an interrupt.

3.1.2.3 LPG Gas Sensor - MQ-6

This is a simple-to-use liquefied petroleum gas (LPG) sensor, suitable for sensing LPG (composed of mostly propane and butane) concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. This sensor module utilizes an MQ-6 as the sensitive component and has a protection resistor and an adjustable resistor on board. The MQ-6 gas sensor is highly sensitive to LPG, iso-butane, propane and less sensitive to alcohol, cooking fume and cigarette smoke. It could be used in gas leakage detecting equipment's in family and industry. The resistance of the sensitive component changes as the concentration of the target gas changes.

3.2.1 Technologies

Python: Python is a widely used general-purpose, high-level programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. The language provides constructs intended to enable clear programs on both a small and large scale. Python supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles .It features a dynamic type system and automatic memory management and has a large and comprehensive standard library.

3.2.2 THINGSPEAK:

Open source data platform and API for the Internet of Things The Internet of Things provides access to a broad range of embedded devices and web services. ThingSpeak

is an open data platform and API for the Internet of Things that enables you to collect, store, analyze, visualize, and act on data from sensors or actuators, such as Arduino®, Raspberry Pi™, Beagle Bone Black, and other hardware. For example, with ThingSpeak you can create sensor-logging applications, location-tracking applications, and a social network of things with status updates, so that you could have your home thermostat control itself based on your current location.
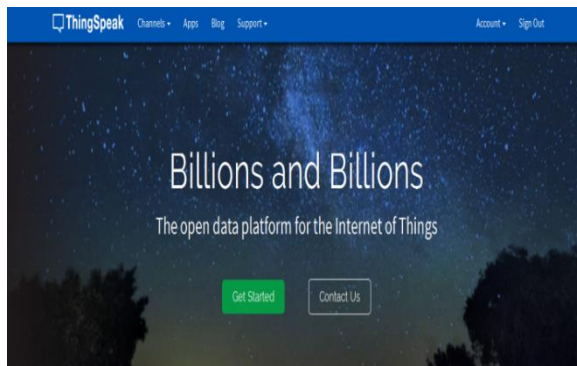

Fig-1: ThingSpeak

CHANNEL CREATION: ThingSpeak channels store data sent to them from apps or devices.

We have created our channel as Environment Monitoring system.
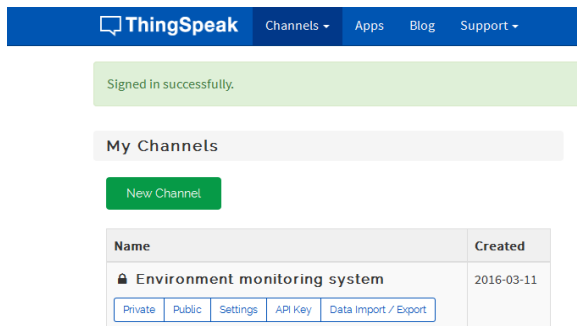
Fig-2: Channel Creation

API KEYS:

API keys enable you to write data to a channel or read data from a private channel. API keys are auto-generated when you create a new channel.
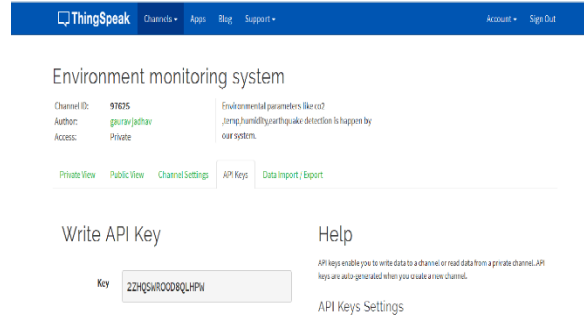
Fig-3:API Keys

4. Hardware and Software Specification
FOR COMPUTER:
Computer with Internet.

For Raspberry-pi

1) SD card of 8GB or 4GB.
2) HDMI/DVI monitor for display.
3) Ethernet cable for internet access or WIFI.
4) Keyboard and Mouse.
5) 5 volt power supply.
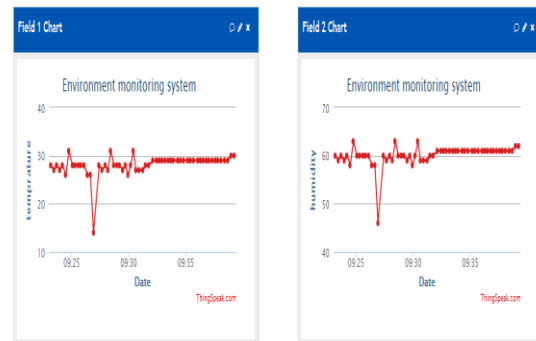6) Sensors.

Software Specification:
Languages: Python
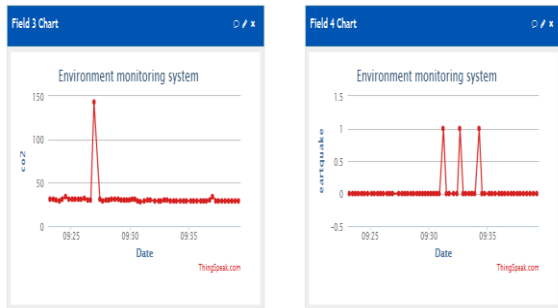**For Raspberry pi Board***:*
Operating system:
NOOBS

5. USER INTERFACE:

5.1:For Temperature and Humidity

5.2: For CO_2 and Vibration Sensor:

International Conference on Computational Intelligence and Computing Research, 2010, pp. 15.

6.ACKNOWLEDGEMENT

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