Real-Time Sensing with IoT and Environmental Monitoring Using Raspberry Pi

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Abstract - Nowadays, development in the embedded system has proved a reliable solution in monitoring and controlling the environment monitoring system. This paper introduces an approach to building a cost-effective standardized environment monitoring device using the Raspberry-Pi single board computer. Raspberry Pi is a small computer with most popular features like low-priced, flexible, fully customizable and programmable tiny PC embedded Linux board and abilities of its usage as a wireless sensor node. The system was designed using Python Programming Language and can be controlled and accessed remotely through an IoT (Internet of Things) platform. It takes data about the surrounding environment through sensors and send the status of the sensors through R-Pi controller to the Android application using inbuilt Wi-Fi and also send to the server where it can be accessed anywhere and anytime through the internet. We will be using Raspberry-Pi as our main board and sensors will collect all the real-time data from the environment and this data will be given to the controller and display it. The user can access this data anywhere through the Internet.

Keywords – Raspberry-Pi, Sensor, IoT, Environment Monitoring.

I. INTRODUCTION

Tracking the environmental parameters' variation is essential in order to find out the quality of our environment. The collected data encompass important details for a variety of organizations and agencies. Outside the governments and other organizations, the information is used by many people, because of the weather's effect on a wide range of human activities. Internet of Things (IoT) is a concept and a paradigm that observe the presence in the environment of a variety of things or objects that through wired and wireless connections and unique addressing schemes are able to interact with each other and combine with other things or objects to create new applications. The IoT can be described as connecting everyday objects like Smartphones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new kinds of communication between individuals and things, 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 communication and information. It's 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 forecasted that by 2021, this ratio will increase to 93% since the cost related with M2M over mobile networks are usually cheaper than fixed networks.[3] Now anyone, from any time 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 energy, healthcare, automation, transportation, financial services to nanotechnology. IoTs technology may also be applied to create a new concept and wide development space for smart homes to provide intelligence, comfort and to enhance the quality of life.

II. RELATED WORK

Gaurav Jadhav, Kunal Jadhav and Kavita Nadlamani [3], in this, 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 like temperature, humidity and many more. In this it will be using raspberry-pi as our main board and sensors will collect all the real-time data from the environment and this data will be fetched by the web server and display it. The user can access this data from anywhere through the Internet. [3]

Kondamudi Siva Sai Ram, A.N.P.S. Guptain [4], gives a solution for monitoring the environmental conditions at some place & makes the information visible anywhere in the world. The technology included in the Internet of Things (IoT), which is an advanced and efficient solution for connecting the things to the internet & to connect the entire world of things in a network. The things in this paper refer to automatic electronic equipment, sensors. The system performs monitoring & controlling the environmental conditions like temperature, humidity, light intensity, CO2 level sensors & send the information to the web page. The data collected from the implemented system is accessible through the internet from anywhere in the world. [4]

Rahman Wagiran and Mohd Nizar Hamidon Hamid Farahani [5], a significant aim of this review is to provide a distinct categorization pursuant to state of the art humidity sensor types, principles of work, sensing substances, transduction mechanisms, and production technologies. Furthermore, performance characteristics of

the different various sensors such as electrical and statistical data will be detailed and provide an additional worth to the report. [5]

Sheikh Ferdous, Xinrong Li [7], they have presented a wireless sensor network system designed with Arduino, Raspberry Pi, XBee, and a number of open-source software packages. The system has a number of features, including low-cost, scalable, compact, easy to customize, easy to deploy, and easy to maintain. One major advantage of the design lies within the integration of the gateway node of a wireless sensor network, database server, and web server into one single compact, low-power, credit-card-sized computer Raspberry Pi, which might be simply configured to run headless (i.e., without a monitor, keyboard, and mouse). Such a design is helpful in many environmental monitoring and data collection applications.[7]

Mihai T. Lazarescu [9] gives information about constructing all phases of Environmental monitoring IoT applications based on WSN. It starts by analyzing the application requirements and defining a set of specifications for the platform. To guide most nodes and platform solution and the implementation decisions, a real-life, implementation is chosen. The purpose of this paper to guide the specification and development of WSN platforms for other IoT application domains.[9]

Ruchi Mittal and Bhatia [11] 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 find any deviations from the norm. This is essential in detecting a faulty sensor node and guaranteeing it can be quickly replaced. This system is especially useful when detecting environmental activity. In order to achieve desired results, Data preprocessing and sensor data clustering is used. In data preprocessing, the sensor data is clean by fitting missing value and removing any unwanted data. Mittal and Bhatia analyzed this data cluster by plotting data, comparing them against expected/predicted patterns and detect anomalies. [11]

III. HARDWARE

a) Raspberry Pi

Fig 3.1. Raspberry Pi

The Raspberry Pi is a small but full-featured computer on a single board. It plugs into a monitor and you attach a keyboard, mouse, and speakers. It supports a number of operating systems including a Raspbian OS which is recommended by the raspberry pi foundation, which is used in our design. Raspberry Pi can be connected to the internet through Wi-Fi which is inbuilt in Raspberry-Pi 3. It also comes with 4 USB ports and one Ethernet port. The raspberry pi is booted by an external SD or micro SD card.

b) Sensor for Monitoring Harmful Gas

MQ – 7

Fig 3.2. MQ – 7 Sensor

It is a semiconductor sensor for detecting Carbon Monoxide (CO). The MQ-7 i.e. Carbon Monoxide (CO) gas sensor detects the concentrations of CO in the air and gives output reading in the form of an analog voltage. The sensor can measure concentrations of 10 ppm to 10,000 ppm. The sensor consumes less than 150 mA at 5V. The sensor has a long life and low cost.

IV. PROPOSED WORK

In this system, the sensor will be used to measure the gases in the air to check the quality. There will be using sensors i.e. MQ-7. A power supply will be given to Raspberry-Pi. The sensor will check the presence of gas in the

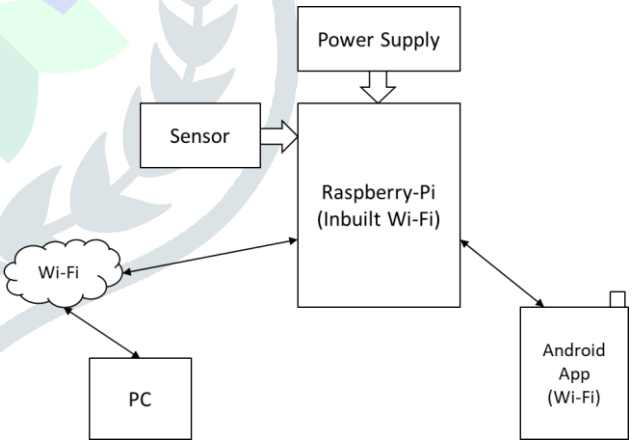

Fig 4.1. Block Diagram

environment and the values or data received from the sensor will be pass to the Raspberry controller. Then the controller will send the data i.e. whether CO gas is present or not to Android Application. If the gas is detected then the notification will be sent to the user to take necessary action. Simultaneously the controller will send this data to the PC through inbuilt Wi-Fi.

V. CONCLUSION

The environmental monitoring system may provide several potential benefits. It provides monitoring services for remote areas. Wireless sensors for implementing IoT - based solutions for environmental monitoring were designed, developed, and analyzed. As expected, Wi-Fi

consumes more energy but enables the development of solutions with a reduced total cost of ownership through the use of the existing infrastructure. It is a system which can monitor the leakage of harmful gases and hence the level of pollution using Raspberry-Pi and IoT is proposed. By the use of MQ 7 gas sensor, the poisonous gas can be sensed and alert can be given to save the life of people. Raspberry-Pi serves as the heart of this module which controls the entire process. Wi-Fi module connects the whole process to the internet. The air monitoring system can help in the innovation of new practices to overcome the problems of the highly-polluted areas, which is a major issue. It supports new technology and effectively supports healthy life ideas. This system has also features which enable people to monitor the amount of pollution on their mobile phones using the application.

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