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Distributed Environmental Monitoring using Wireless Sensor Network

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Abstract: ***Today environment monitoring becomes important for humans to ensure a safe and wealthy life. Monitoring requirements are extremely different depending on the environment, leading to specially appointed usage that needs adaptability. The proposed system describes an implementation of Wireless Sensor Network that can be adjusted to various applications. And it also inserts the adaptability required to be conveyed and updated without necessity of arranging complex infrastructures. The solution is based on small autonomous wireless sensor nodes, small wireless receivers connected to the Internet, and a cloud architecture which provides data storage and delivery to remote clients. The solution permits supervisors on-site not only to monitor the current situation by using their smart-phones but also to monitor remote sites through the Internet.***

Keywords: Wireless sensor network; environmental monitoring; android application ; cloud server

I. INTRODUCTION

The environmental care has become one of the biggest concerns for almost every country in the last few years. Even though the industrialization level has been increasing without any control in the last decades, the current situation is clearly changing towards more environmentally friendly solutions. Water and air quality are essential to maintain the equilibrium between human development and a healthy environment. It is also important to notice that by means of looking for a more efficient production in factories both pollution and consumption of natural resources can be decreased. Processes, such as boiling, drying, binding, and so forth, are being carried out by almost every kind of the current factories. Those processes are responsible of a great amount of gas emissions and polluted water discharges. Although the majority of the factories have their own sewage plants, it is crucial to measure the quality of the waste water that is being poured into the public sewer. The main intention of environmental monitoring is not only to gather data from a number of locations, but also to provide the information required by scientists, planners, and policy-makers, to enable those making decisions on managing and improving the environment, in addition to presenting helpful information to end-users. There are huge efforts are carried out to improve the air quality in both environments: indoors and outdoors. Habitat and environmental monitoring represent an important class of sensor network applications. Recent advances in low-power wireless network technology have created the technical conditions to build multi- functional tiny sensor devices, which can be used to sense and observe physical phenomena. Wireless Sensor Networks (WSNs) are currently an active research area due to their wide range applications including military, medical, environmental monitoring, safety, and civilian. Many environmental monitoring examples of WSNs are already presented in the literature and developed for different purposes.

II. PROBLEM STATEMENT

Existing ad hoc network implementations are complex, costlier and lack flexibility due to requirement of monitoring equipment that are different depending on the surrounding environment. Therefore, a system is proposed to design a low cost wireless sensor network to measure temperature and relative humidity, to detect rain and the presence of CO gas.

III. OBJECTIVE

A. To design 3 wireless sensor node.
B. To monitor temperature, humidity.
C. To detect rain.
D. To alert authorized people about increasing level of carbon monoxide gas.
E. To develop android application.

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IV. PROPOSED SYSTEM

For determining temperature and humidity of atmosphere we are using DHT11 sensor which will help in predicting weather condition. MQ-7 sensor is used for detecting Carbon Monoxide in environment, whereas FC37 sensor is used for detection of rain. The system is placed in 3 different locations and data from each location is collected by the server as shown in figure. The server stores and displays the current values of all 4 parameters. A look up table is generated which contains the values of temperature and humidity and is used for predicting the current environmental conditions like if humidity is more and temperature is less then there is a chance of rain. Data from all 3 nodes is updated on servers as well as in Android App.

V. SYSTEM HARDWARE AND SOFTWARE

A. DHT11

The DHT11 humidity and temperature sensor makes it really easy to add humidity and temperature data to your DIY electronics projects. It's perfect for remote weather stations, home environmental control systems, and farm or garden monitoring systems. DHT11 Temperature and Humidity Sensor features a temperature and humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature and humidity sensing technology, it ensures high reliability and excellent long-term stability.

B. MQ-7

The MQ-7 is a simple-to-use Carbon monoxide (CO) sensor suitable for sensing CO concentrations in the air. It can detect CO gas concentrations anywhere upto 2000ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The sensor's conductivity gets higher along with the CO gas concentration rising. At high temperature of the sensor, it cleans the other gases adsorbed at low temperature. The change of conductivity is converted to the corresponding output signal of gas concentration through a simple circuit.

C. FC-37

The rain sensor module (FC-37) 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 through a potentiometer.

D. Node MCU

The NodeMCU is a micro controller comprising of ESP8266 wi-fi chipset. Given that the ESP8266 is a more recent release than the Arduino, it's not surprising that it has stronger specs. There's a 32-bit RISC processor clocked at 80MHz, along with a generous RAM complement and support for up to 16mb of external flash storage. The device is especially useful for IoT applications, thanks to its tiny footprint and built-in WiFi support. In all other aspects, however, the ESP is pretty much similar to the Arduino. There's an on-board voltage regulator that ensures the cleanest possible power to the MCU itself, as well as a push-button reset and a USB connection for easy interface with your computer.

E. Firebase and ubidots

Firebase is a technology that allows you to make web applications with no server-side programming so that development turns out to be quicker and easier. It supports the web, iOS, OS X, and Android clients. Applications using Firebase can just utilize and control information, without thinking about how information would be put away, and synchronized crosswise over different examples of the application in real time.

Ubidots offers a platform for developers that enables them to easily capture sensor data and turn it into useful information. Use the Ubidots platform to send data to the cloud from any Internet-enabled device. You can then Configure actions and alerts based on your real-time data and unlock the value of your data through visual tools.

F. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

G. MIT App Inventor 2

MIT App Inventor 2 for Android is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT), which allows newcomers to computer programming to create software applications for the Android operating system

H. Battery

The nine-volt battery, or 9-volt battery, is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top.

VI. RESULTS

A. Designed WSN nodes

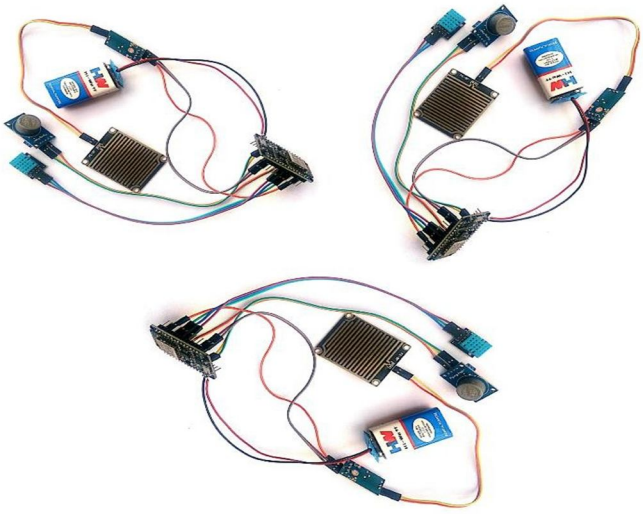

Fig. 1 Successfully designed 3 WSN nodes

B. Developed Android Application

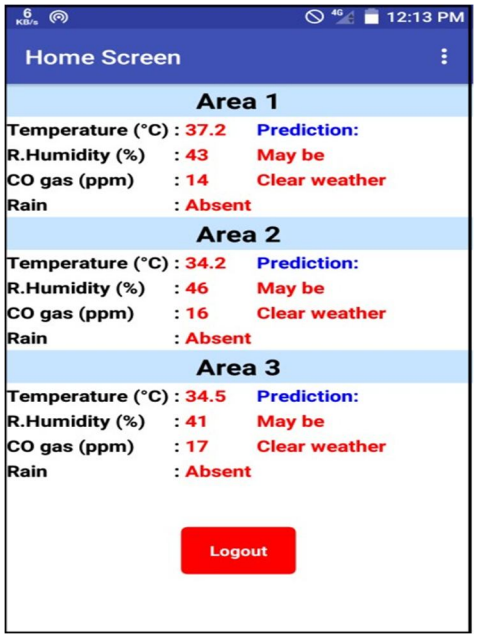

Fig. 2 Developed android app

C. Sending SMS to Mobile Number

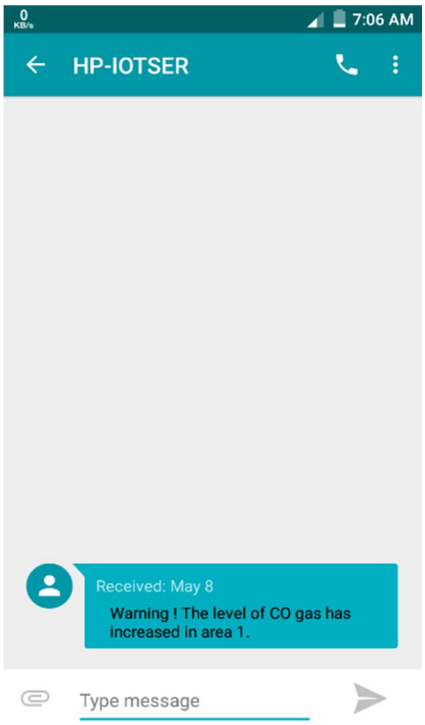

Fig. 3 Sent SMS to user's mobile number

VII. CONCLUSION

The components developed within the framework described in this work is designed flexible enough to adapt to the change in different environmental parameters. It is a simpler system with minimal cost which uses battery-operated sensors equipped with a wireless transmission protocol, which ensures real time monitoring.

VIII. ACKNOWLEDGMENT

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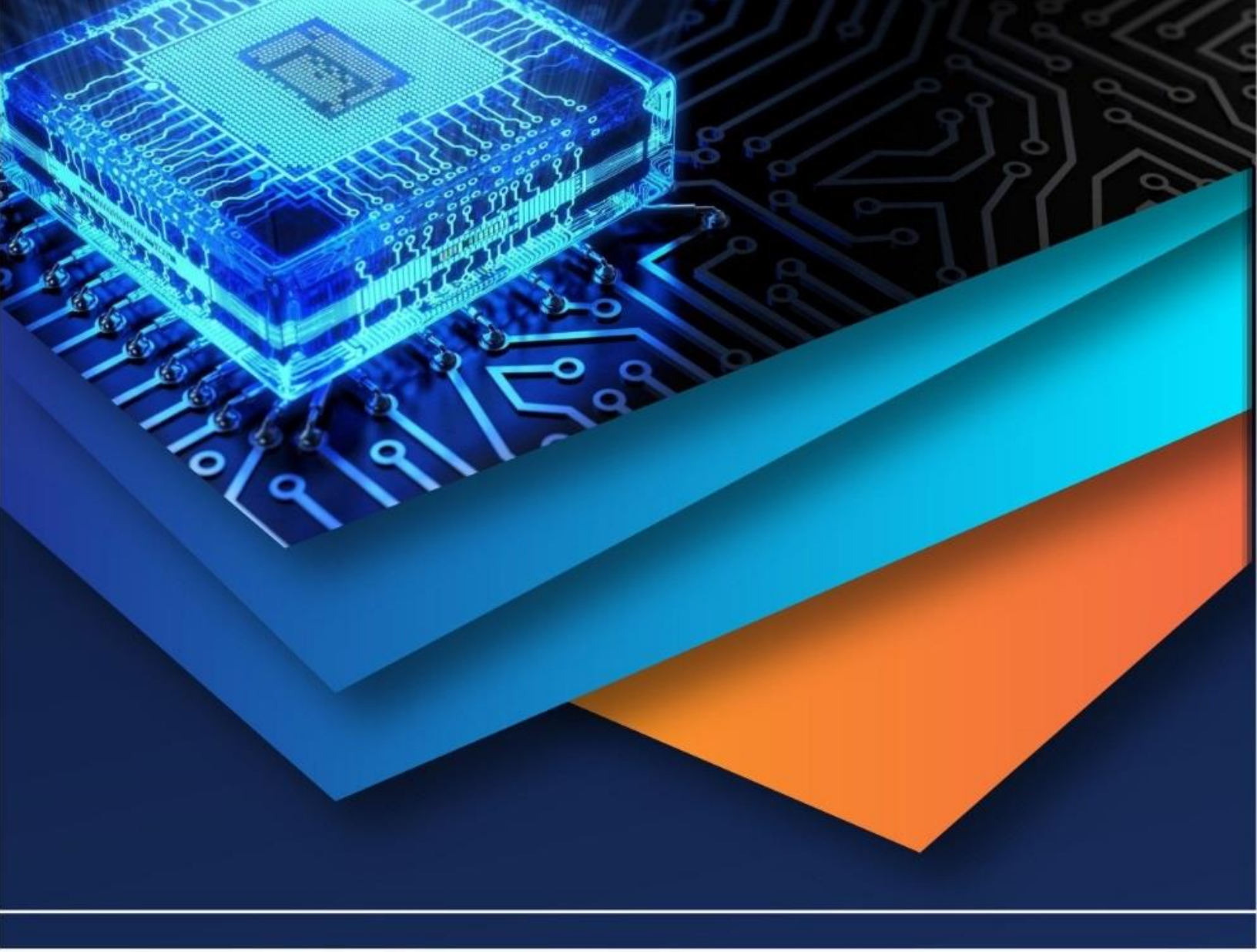

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