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IOT Based Smart Environmental Monitoring Using Arduino

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Abstract- This paper proposes an approach to build a cost effective standardized environmental monitoring device using the Arduino Board. The system was designed using Embedded C Programming language and can be controlled and accessed remotely through an Internet of Things platform. It takes information about the surrounding environment through sensors and uploads it directly to the internet, where it can be accessed anytime and anywhere through internet. Experimental results demonstrated that the system is able to accurately measure: temperature, humidity, light level and air quality in surrounding condition. It's also designed to detect earthquakes through an assembled vibration sensor.
Keywords – Arduino, IoT, Sensors, Node MCU, Adafruit Server.

I. INTRODUCTION

The current advances in the fields of technology and economy are having a significant impact over the Environment, and have led to serious concerns regarding pollution and climate change. Internet of Things (IoT) is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications, services and reach common goals. Environmental monitoring applications of the IoT normally exploit sensors to aid in environmental protection by monitoring parameters like temperature, humidity, light level, air quality and atmospheric conditions. This paper designs a prototype of wireless environmental monitoring system to upload information from array of sensors to the database. This application allows us to observe or measuring the environmental conditions from remote location from anywhere in real time. This system consist of main three modules namely sensor nodes, the wireless communication and the web server. The sensor nodes in remote location collect the information from surrounding environmental conditions and send data wirelessly using ESP8266 to the server. Adafruit (Input/Output) IO is a system that makes data useful. Our concentration is to allowing simple data connections with little programming required and moreover easy of use.

II. OBJECTIVE

The use of modern technologies such as low power controller can facilitate and provide even more functionalities to IoT. Air is essential to life, poor air quality threatens the health of all living things from humans to plants. There are many types of air pollution and each have a different effect on human health. The air quality measurements are more important in applications where pollution caused by gases, odours(distinctive smell) and particulates have to be monitored, perhaps for compliance, for warning systems or for data modeling of dispersion or air quality. Temperature and humidity is also plays an important role in environmental so we have to monitor these parameters and even though some vibrations on ground level helps us to take some action.

III. LITERATURE SURVEY

This paper presents a large number of research efforts that make use of wireless sensors for achieving environment monitoring applications. Internet of Things, there is connectivity between computers and other physical devices such as vehicles and buildings, embedded with sensors and network connectivity that enable the reading from sensors and actuators to be monitored from the internet [1]. In this paper we are using Arduino is an easy-to-use hardware and software based on open-source prototyping platform. Originally Arduino was created as tool for fast prototyping, aimed for students without any background in electronics and programming. Later, the Arduino board started to change to adapt to new needs and challenges [2]. The Air quality sensor detects the samples absorbed by the electro-catalytic sensing electrode contain gas molecules. Next, they pass through a diffusion medium and electrochemically react to an appropriate sensing electrode potential. The electric current generated by the reaction is directly proportional to the gas concentration. This current is converted to voltage for a meter or recorder readout [3]. Most of the currently available humidity sensors are constructed based on a porous sintered body structure ceramics and utilize the ionic type humidity-

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sensing principle. By water adsorption on the ceramic surfaces, their electrical properties would change and this change encompasses the resistance, capacitance or electrolytic conduction depending upon the sensor type [4]. The modified inverted-pendulum design used in this project is very responsive to low-frequency seismic vibrations and is fairly inexpensive to construct. It's an extremely simple design, yet highly capable of detecting low-frequency seismic waves. The sensor produces an analog voltage representation of the seismic wave in lieu of a mechanical tracing, as is the case in the classical design. Tracking the environmental parameters' variation is essential in order to determine the quality of our environment. The collected data encompass important details for a variety of organizations and agencies [5]. An LDR (Light dependent resistor), as its name suggests, offers resistance in response to the ambient light. The resistance decreases as the intensity of incident light increases, and vice versa. In the absence of light, LDR exhibits a resistance of the order of mega-ohms which decreases to few hundred ohms in the presence of light. It can act as a sensor, since a varying voltage drop can be obtained in accordance with the varying light. It is made up of cadmium sulphide (CdS) [6].

IV. PROPOSED DESIGN METHODOLOGY

The system is comprised of several subsystems. The design process included designing the basic units for sensing the: air quality, weather and earthquake parameters. The proposed system is involved with sensors networks like, Humidity, temperature, light level, vibration, air quality etc. which are connected to the Arduino microcontroller. The controller prepossess the data and convert it into the desirable format then data is send to the web portal(Adafruit) using local Wi-Fi network/internet service, this can be employed by the NoodeMcU (ESP8266) module.

A. Block Diagram

Figure 1 presents an overview of our proposed IoT Based Smart Environmental Monitoring Using ARDUINO. The block diagram shows the different sensors, which briefly described.

B. MQ135 Air quality Sensor

The quality of air can be measured by using MQ135 sensor. MQ-135 gas sensor applies SnO2 which has a lower conductivity in the clear air as a gas-sensing material. In an atmosphere where there may be polluting gas, the conductivity of the gas sensor raises along with the concentration of the polluting gas increases, which is feed to the Arduino microcontroller for further processing the data

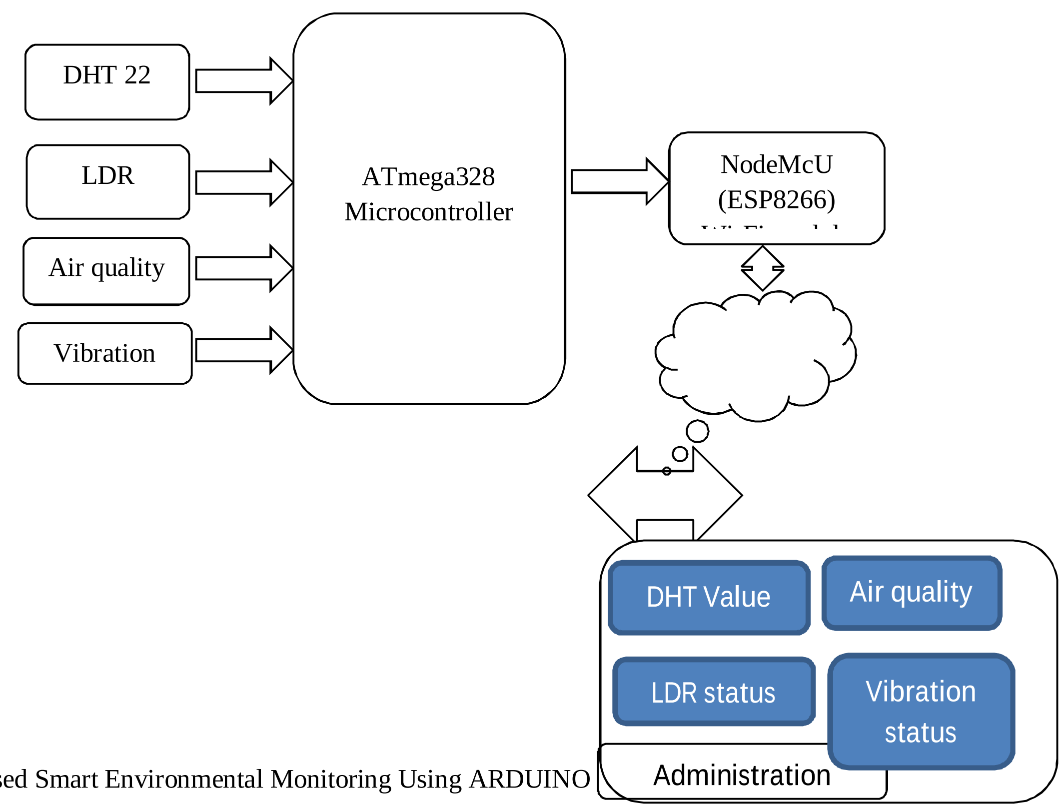

Figure-1. IoT Based Smart Environmental Monitoring Using ARDUINO

C. Dht22 Humidity Sensor

To check the humidity and the temperature of the atmosphere the DHT22 sensor has been used. The DHT22 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor complex. Its technology ensures the high reliability and excellent long-term stability. This sensor includes a resistive element and a sense of wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high cost performance advantages.

D. Vibration Sensor

Measuring of earthquake plays an important role in the environmental monitoring. Seismic sensors are devices used to measure seismic vibrations by converting ground motion into a measurable electronic signal. As the signal is analogue in nature, sensors must be linked to a data acquisition unit to convert its output into a digital format that can be read by microcontroller.

E. LDR Sensor

The measurement of light intensity is achieved by the Light Dependent Resistor (LDR) sensor. An LDR (Light dependent resistor), as its name suggests, offers resistance in response to the ambient light. The resistance decreases as the intensity of incident light increases, and vice versa. In the absence of light, LDR exhibits a resistance of the order of mega-ohms which decreases to few hundred ohms in the presence of light. It can act as a sensor, since a varying voltage drop can be obtained in accordance with the varying light. It is made up of cadmium sulphide (CdS). A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices.

F. Arduino-Uno Microcontroller

Arduino Uno is a microcontroller board based on the ATmega328P. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The Arduino/Genuino Uno can be programmed with the (Arduino Software (IDE). The ATmega328 on the Arduino/Genuino Uno comes preprogrammed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. Here all the sensors are connected to the analog pins of Arduino. The Arduino is prepossessing the data and calibrate the sensor data into the slandered measurable units of all different environmental parameters. Later that data is feed into the NodeMcU through a serial communication.

G. NodeMcU (ESP8266) Sensor

Node MCU is a microcontroller which is connected to IOT server through internet. MCU will receive the ON OFF packets from server and switches appliances respect to server signal. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface). Here this plays a role in connecting the local Wi-Fi network and the server. Then it updates the data to server which is received from the microcontroller unit.

H. Adafruit Server (IoT Server)

Adafruit IO is a system that makes data useful. Our focus is on ease of use, and allowing simple data connections with little programming required. IO includes client libraries that wrap our REST and MQTT APIs. IO is built on Ruby on Rails, and Node.js. To use Adafruit IO with the MQTT protocol on an Arduino you can use the Adafruit MQTT Arduino library. This is a general-purpose MQTT library for Arduino that's built to use as few resources as possible so that it can work with platforms like the Arduino Uno. The server is created on the domain www.adafruit.com, where user can create different dashboards, Graphical User Interfaces (GUI's) which can be integrated with the embedded systems by sharing the IP address (KEY value) of the server. The sensors values, graphs are shown in the results are from Adafruit server.

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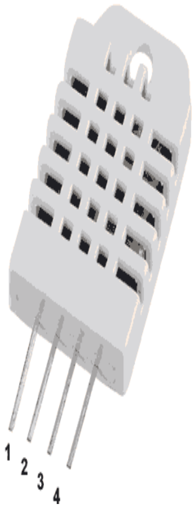

Figure-2(a) DHT22 Humidity Sensor

Figure-2(b) MQ135 Air Quality Sensor

Figure-2(c) SW420 Vibration Sensor

Figure-2(d) LDR Sensor

V. RESULTS

The experimental setup has done with different locations like crowd areas, Gardens, Traffic zones etc. The sensors values of these are listed shown below.

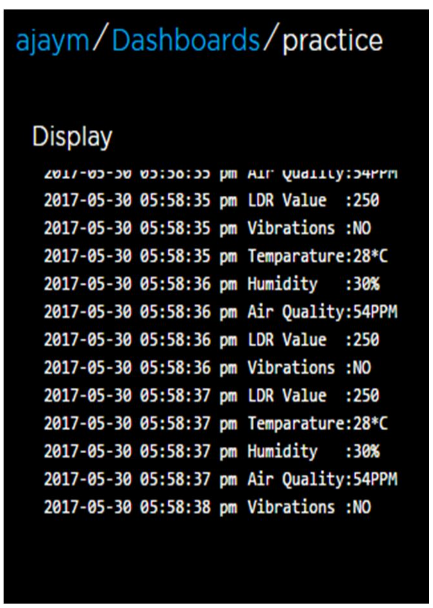

Figure-5(a) Sensor Values in Garden Area

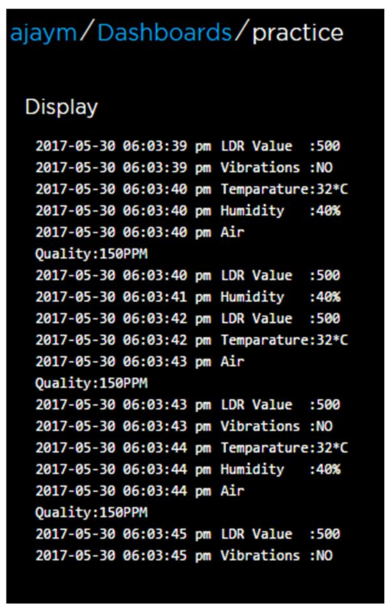

Figure-5(b) Sensor Values in Crowd Area

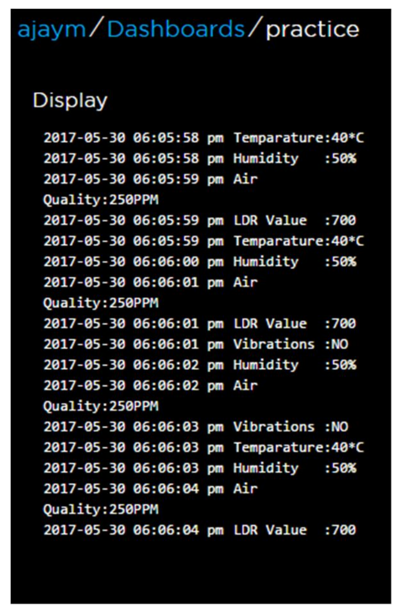

Figure-5(c) Sensor Values in Traffic Area

VI. CONCLUSION

The environmental monitoring system might offer several potential benefits; it provides monitoring services for remote areas. Three different wireless sensors for implementing IoT-based solutions for environmental monitoring were designed, developed, and analyzed. The analysis of the three implementations revealed the fact that Wi-Fi technologies is suited for monitoring applications that can successfully compete with the MQTT protocol. As expected, Wi-Fi consumes more energy but enables the development of solutions with reduced total cost of ownership through the use of the existing infrastructure. Its' earthquake detection capability can help saving millions of lives. The total life-cycle cost of the system is minimized and could theoretically run for months on end entirely without the need for human intervention. Due to its ability to automatically upload to the internet, one correctly placed system can provide easily accessible weather data for the whole community. It can be used to predict the onset of bad weather using signs such as changing temperature and humidity. Raising the awareness of how society is affected the region's environmental policies and have the knowledge basis to push for the change. The analysis presented in this paper represents a starting point for the selection of a direction in the implementation of IoT-based environmental monitoring applications, providing an overview of the potential and challenges of each one of the three developed wireless sensors.

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