ENVIRONMENTAL MONITORING SYSTEM USING IOT

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Abstract

Air pollution is a growing issue these days. It is necessary to monitor environment and keep it under control for a better future and healthy living for all. Here we propose an environment monitoring system that allows us to monitor and check live environment in particular areas through IOT. System uses air sensors to sense presence of harmful gases/compounds in the air and constantly transmit this data to microcontroller and reports it to the online server over IOT. The sensors interact with microcontroller which processes this data and transmits it over internet.

Keywords: dust detection; temperature monitoring ; humidity monitoring

I. INTRODUCTION

Recently, with the increasing interest in the Internet of Things (IoT), the interest in cellular IoT is growing such that the LTE-Advanced Release-13 standard of 3GPP (the 3rd Generation Partnership Project) introduced a Narrowband IoT technology to provide services over wide [1, 2].Meanwhile, as the damage from air pollution due to fine dust and ozone increases continuously, interest in the atmospheric environment is increasing rapidly around the world. According to the recent study [3], fine dust is mainly caused by combustion of fossil fuel, and it is known to act as a main factor causing or exacerbating various lung diseases in the human body [3]. Ozone is caused by the photochemical reaction of NO2 and volatile organic compounds (VOCs) emitted from automobile exhaust gas and the like due to strong sunlight, which causes respiratory system diseases [4].

Hence, there is a growing need for an atmospheric environment monitoring system capable of effectively measuring and analyzing contaminants in the air as the hazard of air pollution becomes serious. For this purpose, a government-led air monitoring system in most countries is installed to provide information on air pollution to users by observing the atmospheric environment [5], and air pollution information observed through the National Ambient air quality Monitoring Information System (NAMIS) of Korea Environment Corporation is also provided to the public [6]. However, the NAMIS consists of high-cost atmospheric environment measurement equipment, and thus, it is very expensive to build a new atmospheric environment measurement station. Therefore, there is a desperate need for an atmospheric environment monitoring system that can effectively provide atmospheric environmental observation results to public facilities such as kindergartens and schools, or homes and commercial facilities in the area where the NAMIS' atmospheric environment measurement station is not operated.

In this paper, we propose an IoT-based atmospheric monitoring system using LTE mobile communication network (Long Term Evolution) in order to solve the problems such as cost and the restrictions in the installation place and space of existing atmospheric environment measuring equipment. The proposed system has been developed as a prototype that measures various air environment information including fine dusts and ozone in the atmospheric environment measuring device and transmits the packet including the measured information as well as the location and operation status of the measuring device to the LTE network and analyzes them on the server.

II. SYSTEM DESIGN AND IMPLEMENTATION

The following requirements are considered for the proposed IoT-based atmospheric monitoring

system. 1) It is necessary to be able to access the mobile communication network that provides wide coverage in order to measure the atmospheric environment information without restriction on the place or location and to transmit it to the server. 2) In addition, it is capable of measuring various types of air environment information including fine dusts, and also provides a visualized result form so that users can conveniently use the results through web or smart phone application.

III. EXISTING SYSTEM

There are many existing works on evaluating and comparing physical activity monitors. Some of them evaluated a set of monitors on their accuracy of step counts, and the others on their accuracy of energy expenditure. Most of the existing works evaluated accuracy by testing the monitor's performance during pollution, and there were also a small part of these works can be improved by using IOT technology in proposed system.

Disadvantages

- Low communication
- Not efficient

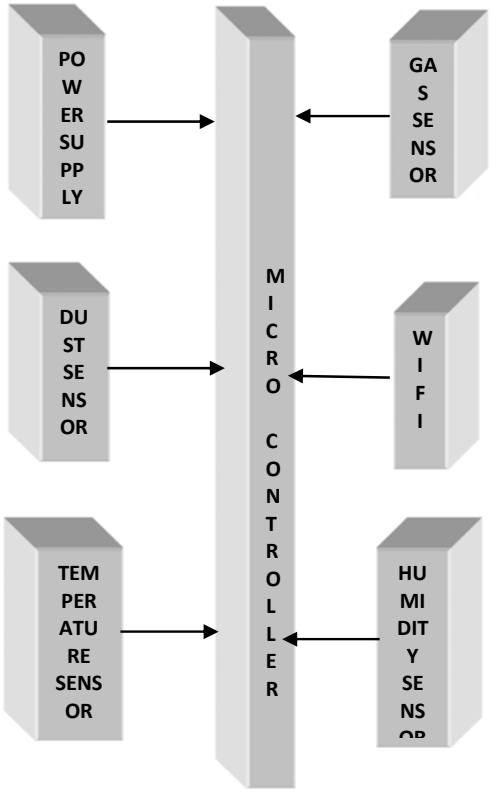
IV. PROPOSED SYSTEM

The goal of building a smart city is to Improve quality of life by using technology to improve the efficiency of services and meet residents needs. Information and Communication Technology allows city officials to interact directly with the public to tell what is happening in the city, how the city is evolving, and how to enable a better quality of life. We are going to monitor the environment by using IOT technology. Consider an area that is being surveyed for estimating how much the area is affected by pollution. The constituents of air along with its proportion are calculated and if it is higher than normal then the officials are intimated about it.

Advantages

- User friendly
- High reliability
- Low power consumption

BLOCK DIAGRAM



V. SYSTEM CONFIGURATION

Hardware used:

- Microcontroller
- Temperature Sensor
- Power supply
- WIFI

Software used:

- Embedded C
- Arduino compiler
- Proteus

VI. MODULES

Dust Sensor:

Characteristics and principle this module is a dust sensing system based on the sensor GP2Y1010AU0F. It integrates an internal infrared emitting diode (IRED) to detect the reflected light of dust in air and generate an output voltage proportional to dust density so as to measure dust and smoke concentration.

1) Definition:

This Dust Sensor measures the Particulate Matter level in air by counting the Lo Pulse Occupancy time (LPO time) in given time unit. LPO time is in proportion to PM concentration.

This sensor can provide you pretty reliable data for air purifier system because it's still responsive to particulates whose diameter is 1um. Note: This sensor use counting method to test dust concentration but not weight method, and the unit is pcs/L or pcs/0.01cf.

2) Features:

- Highly responsiveλ
- Reliableλ
- ROHS/PEACH compliantλ

3) Application Ideas:

- Dust emission monitorλ
- Air Quality Monitoringλ

4) Usage:

Here is a demo to show you how to obtain PM concentration data from this Grove - Dust Sensor. 1. Plug the dust sensor into digital port D8 on the Grove - Base Shield. It can only be D8, because the operation of this sensor involves sampling, a function only can be achieved by D8, the capture input pin of Atmage328P, on Arduino/Seeding. Also you can connect Grove - Dust sensor to Arduino UNO without Base Shield: Arduino UNO Dust Sensor 5V Red wire GND Black wire Digit 8 Yellow wire Characteristics and principle This module is a dust sensing system based on the sensorGP2Y1010AU0F. It integrates an internal infrared emitting diode (IRED) to detect the reflected light of dust in air and generate an output voltage proportional to dust density so as to measure dust and smoke concentration.

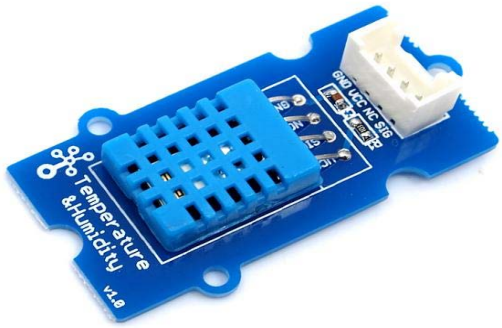
A. DHT SENSOR

Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. 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 programmes in the OTP memory, which are used by 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. It is convenient to connect and special packages can be provided according to users' request.

1) Definition:

This DHT11 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 sensorincludes a resistive element and a sense of wet NTC temperature measuring devices



2) Working:

They consist of a humidity sensing component, a NTC temperature sensor (or thermistor) and an IC on the back side of the sensor. For measuring humidity they use the humidity sensing component which has two electrodes with moisture holding substrate between them. So as the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes. This change in resistance is

measured and processed by the IC which makes it ready to be read by a microcontroller.

On the other hand, for measuring temperature these sensors use a NTC temperature sensor or a thermistor. A thermistor is actually a variable resistor that changes its resistance with change of the temperature. These sensors are made by sintering of semi conductive materials such as ceramics or polymers in order to provide larger changes in the resistance with just small changes in temperature. The term "NTC" means "Negative Temperature Coefficient", which means that the resistance decreases with increase of the temperature. The DHTXX sensors have their own single wire protocol used for transferring the data. This protocol requires precise timing and the timing diagrams for getting the data from the sensors can be found from the datasheets of the sensors. However, we don't have to worry much about these timing diagrams because we will use the DHT library which takes care of everything.

3) APPLICATION:

Food industries and food transportation are the businesses which are directly affected by unwanted temperature and humidity levels. To maintain the quality of food while producing or transporting it from one place to another, they have to ensure required level of temperature and humidity.So Food industries can find useful this IoT application to avoid losses due to environmental factors.

B. Light-emitting diode

A light-emitting diode (LED) is a two-leadsemiconductorlight source. It is a p–n junctiondiode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

C. Resistor

A resistor is a passivetwo-terminalelectrical component that implements electrical resistance as a circuit element.

In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage.

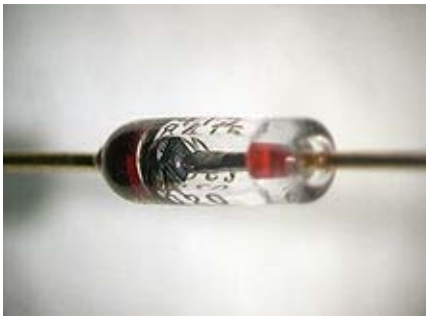
Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

D. Capacitor

A capacitor is a passivetwo-terminalelectrical component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape, and positioning of closely spaced conductors, and the intervening dielectric material. A capacitor was therefore historically first known as an electric condenser.

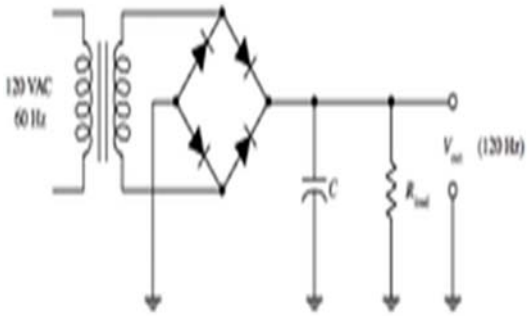
E. Diode

In electronics, a diode is a two-terminalelectronic component that conducts primarily in one direction (asymmetric conductance); it has low (ideally zero) resistance to the flow of current in one direction, and high (ideally infinite) resistance in the other. A semiconductor diode, the most common type today, is a crystalline piece of semiconductor material with a p–n junction connected to two electrical terminals. A vacuum tube diode has two electrodes, a plate (anode) and a heated cathode. Semiconductor diodes were the first semiconductor electronic devices.



F. Power supply

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters. Some power supplies are discrete, stand-alone devices, whereas others are built into larger devices along with their loads.



VII. CONCLUSION

In this paper, we have proposed an IoT-based atmospheric dust monitoring system, which is developed by a prototype with a small size,low cost and eco-friendly air environment measurement device connected by the LTE network, and the atmospheric environment analyzer.The development system has no restriction on installation location or installation space. The development system observes the atmospheric environment elements similarly, even though it is difficult to directly compare the observation results of the two systems due to the different locations in the measurement sites of the two systems. The development system can easily change measuring sensors, and compatible with various communication systems such as the WIFI communication network for the transmission of the measurement results. It is expected that the development system will be effectively utilized in atmospheric environment based services by installing the developed measurement devices at public facilities such as schools and homes.

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