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AIR QUALITY MONITORING SYSTEM USING LORA

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ABSTRACT:

In our lives air pollution is a big worry all over the world especially air pollution among other. Our Project will use a combination of CO2, CO, PROPANE, and methane (CH4) gas sensors to estimate air quality and show you what the true situation is, including wind and weather. This device may be used to monitor a range of gases at the same time, which addresses the disadvantages of the conventional air quality sensor. The most difficult aspect will be that this system will offer real-time information on ambient air quality based on existing air quality regulations. The system will offer the user with weather information that is forecasted in advance, as well as information on how polluted the ambient weather is. This system will do a lot of things, including determining how safe it is in smart cities, where people have less and less time to spend and the weather is becoming dirtier. The Goal of our Project is to create a low-cost, real-time pollution index (AQI measuring) system using the sensors, Arduino Microcontroller, and LCD. Also our aim is to make it as sensitive as possible to the people in all the communities that use and, if any, research, organization, would like to do follow-up research, a part of the nominal amount of money to be invested, that would be a great solution for a particular station, that is, a quality measuring system of air.

I.INTRODUCTION OF PROJECT

These days, the implementation of IoT applications has been affected in all domains. The IoT applications introduced till now have been implemented in real-time like controlling, managing, and monitoring the day-to-day usual actions of humans, environmental parameters, or animal moments. These IoT applications have made the life of humans easier than before. Many environmental monitoring systems have been proposed to measure and control the parameters. Humans have been trying to analyze the environment for many years. So many things have been invented to measure the various parameters of the environment. For example, humans developed thermometers, barometers, and pyrometers to measure temperature, atmospheric pressure, and solar radiation. However, some legacy tools still need to be used locally. On the other hand, the invention of IoT has made everyday scenarios easier. The procedure to measure the environmental parameters also becomes easier than before.. This system is proposed for smart cities to make the life of city citizens more convenient. Since the industrial revolution, the concentration of CO2 in the atmosphere has increased significantly. Nowadays, the CO2 concentration has increased in the atmosphere at least a 30% than in 1975, leading to increase greenhouse gases that contribute to global warming. The main cause of greenhouse is CO2 contamination, which contributes about 64% to this phenomena [1]. Currently, we are aware about climate change around the world, however we often think that pollution does not affect our daily activities, and we indirectly perceive its effects and therefore we are unable to generate effective changes to prevent pollution. It is estimated that in the global context around 24,000 million tonnes of CO2 are emitted per year, in first place by the countries of the Organization for Economic Cooperation and Development (OECD) with 52%, followed by Russia with 14%, and China with 13%. United States CO2 emissions are about 5,500 million tonnes, representing almost a quarter of the global total. Latin America including Mexico, with 360 million tons represents about 1% of global emissions [2].

global emissions [2]. According to the World Health Organization (WHO), 2.7 million people worldwide die each year due to health problems related with pollution by CO2 emissions [3]. Previous works in the literature are proof of the increasing human concern to try to change the effects caused by CO2 emissions indoor [4-6] or outdoor [7-8]. The gas in larger quantities that has been monitored is CO, for example in [9] a mathematical model for monitoring CO in indoor scenarios is presented. In [10], an evolution in the treatment of the data produced by using a Zigbee network is showed, however the main problem and limitation of such implementation is the equipment used since the modules had a proprietary code. In [6], a study to determine the Vehicle Ad- hoc Networks (VANET) and to inform contaminated routes to vehicles for not running on these routes is showed. As we can see, in the previous cases, monitoring of CO2 related to vehicles emissions has been already previously conducted.

In this sense, we propose to use open source equipment; in this way we can use multiple platforms and development environments for its implementation according to the requirements. The use of Wireless Sensor Networks (WSN) allows an easy deployment of nodes with the Zigbee communication protocol in order to send and receive data. The most common health problems related to CO2 exposure are: asthma, allergy, stress, among others [11]. In such sense, the aim of this work was to determine the level of pollution generated by vehicles circulating around campus, and to report these levels and the times where the CO2 emissions increase. We divided our study in two stages, the former in order to acquire information about the air pollutants, specifically CO2 gas, a real-time wireless air pollution monitoring system was designed and developed, and the latter the analysis of data sensed. In this proposed system, the measurement of the environmental parameters will become easier as we have included the LoRa module along with the IoT system. This helps us to communicate in the long range. In this system, transmitters are placed at different locations to monitor environmental parameters at different locations. The transmitter contains various sensors used to measure environmental parameters such as mq2,gas, dht11.

II.LITERATURE SURVEY

The Internet of Things (IoT) is a collection of interrelated computing systems, mechanical and digital appliances, objects, animals or individuals that have specific UID identifiers and the ability to transmit data over a network without the need for contact between humans and humans or between humans and computers (Margaret Rouse,2020). The Internet of Things (IOT) is a network of objects that are physical. The internet is not only a computer network, but it has grown into a network of devices of all sorts and sizes, cars, smartphones, home appliances, toys, cameras, medical devices and industrial networks, livestock, humans, houses, all linked, all communicating and exchanging information based on stipulated protocols to achieve smart reorganizations, positioning, mapping, safe (Keyur Patel,2016). Dams has a huge significance, largely due to their use for hydroelectricity production and irrigation purposes. This has resulted in a variety of dams being constructed over the years in possible locations. As there are many risk factors involved with the life of these dams, it has become important to establish a proper control and management mechanism for ensuring a safe water level in dams with respect to the opening of the shutters. Dam mismanagement can contribute to manmade disasters. Dams in our state are currently being manually supervised and controlled. The risk of error can be raised by this manual interference which also results in time lag in decision making. The goal of this research is to develop and incorporate a Disaster Monitoring and Management Framework for Dams based on IoT.The model diagram of the system proposed is shown in Fig. The sensors obtain information from the surroundings and the dam. A smart controller provides all the details. To automatically control the overall system, a microcontroller is used, which helps minimize system design and control complexity. It takes parameter data from the relevant sensors at the back end of the system and dumps it into the database. Dumped data is processed for the hosting and further decision-making of the web portal (KAVITHA, 2021).

III.DESIGN OF HARDWARE

This chapter briefly explains about the Hardware. It discuss the circuit diagram of each module in detail.

ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. 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.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Arduino board has the following new features:

- 1.0 pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

- Stronger RESET circuit.

- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Fig: ARDUINO UNO

POWER SUPPLY:

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as "Regulated D.C Power Supply".

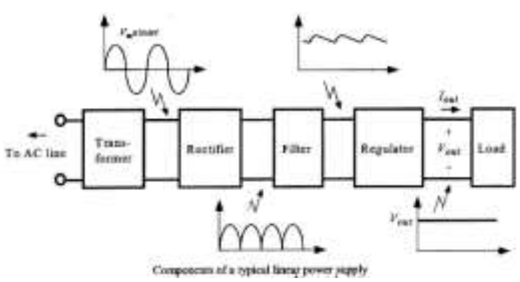

Fig: Block Diagram of Power Supply

LCD DISPLAY

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

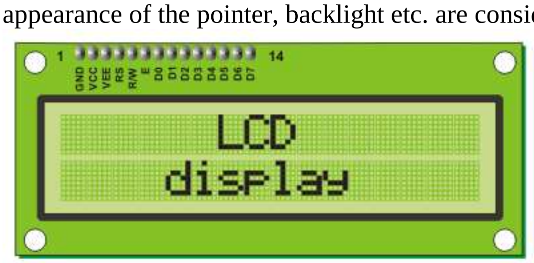

Fig: LCD

BUZZER

Digital systems and microcontroller pins lack sufficient current to drive the circuits like relays, buzzer circuits etc. While these circuits require around 10milli amps to be operated, the microcontroller's pin can provide a

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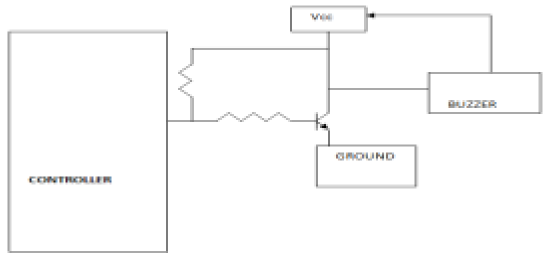
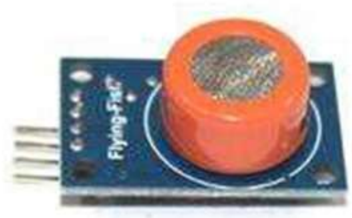
maximum of 1-2milli amps current. For this reason, a driver such as a power transistor is placed in between the microcontroller and the buzzer circuit.



MQ3 Alcohol Gas Sensor Module



This module is made using Alcohol Gas Sensor MQ3. It is a low cost semiconductor sensor which can detect the presence of alcohol gases at concentrations from 0.05 mg/L to 10 mg/L. The sensitive material used for this sensor is SnO2, whose conductivity is lower in clean air. It's conductivity increases as the concentration of alcohol gases increases. It has high sensitivity to alcohol and has a good resistance to disturbances due to smoke, vapor and gasoline. This module provides both digital and analog outputs. MQ3 alcohol sensor module can be easily interfaced with Microcontrollers, Arduino Boards, Raspberry Pi etc.

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple, all it needs is one resistor. A simple interface could be a 0-3.3V ADC.

MQ135

A device that is used to detect or measure or monitor the gases like ammonia, benzene, sulfur, carbon dioxide, smoke, and other harmful gases are called as an air quality gas sensor. The MQ135 air quality sensor, which belongs to the series of MQ gas sensors, is widely used to detect harmful gases, and smoke in the fresh air. This article gives a brief description of how to measure and detect gases by using an MQ135 air quality sensor.

The alternatives for the MQ135 air quality sensor/detector are MQ-2 (methane, LPG, butane, and smoke), MQ-3 (alcohol, smoke, and ethanol), MQ-4 (CNG gas and methane), MQ-5 (natural gas, and LPG), MQ-

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6 (butane and LPG), MQ-7 (CO), MQ-8 (Hydrogen), MQ-9 (CO, and flammable gases), MQ131 (ozone), MQ136 (Hydrogen sulfide gas), MQ137 (ammonia), MQ138 (benzene, alcohol, propane, toluene, formaldehyde gas, and hydrogen), MQ214 (methane, and natural gas), MQ303A (alcohol, smoke, Ethanol), MQ306A (LPG and butane), MQ307A(CO), MQ309A(CO and flammable gas).

An MQ135 air quality sensor is one type of MQ gas sensor used to detect, measure, and monitor a wide range of gases present in air like ammonia, alcohol, benzene, smoke, carbon dioxide, etc. It operates at a 5V supply with 150mA consumption. Preheating of 20 seconds is required before the operation, to obtain the accurate output.

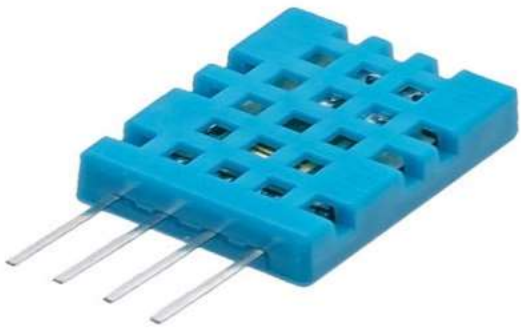
MQ135 Air Quality Sensor

DHT11 Sensor

Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc… Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.



DHT11 Sensor

DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller.

LoRa TX & RX

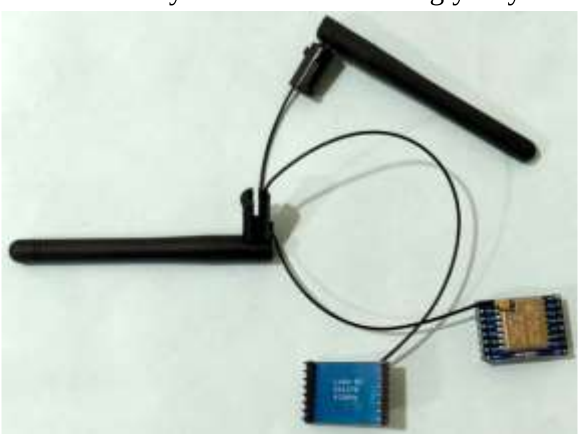
It is expected that by 2020 we will have 25 Billion devices connected to the internet. To give you an idea that is more than three times the population of earth today. With the concepts of **IoT** and **Industry 4.0**, Connected Vehicles and Smart Cities spreading rapidly, this is most likely to happen. We already have a handful of wireless protocols like **BLE**, Wi-Fi, Cellular etc, but these technologies were not ideal for IoT sensor nodes since they needed to transmit information to long distance without using much power. This lead to the rise of **LoRa Technology**, which can perform very-long range transmission with low power consumption.

As ESP modules become synonyms for Wi-Fi applications, this LoRa technology also has caliber to build a vast network like Internet. We previously build many IoT Based projects using ESP8266 and Arduino, here in this article we will **learn about LoRa and how to use it with Arduino Development Platform.**

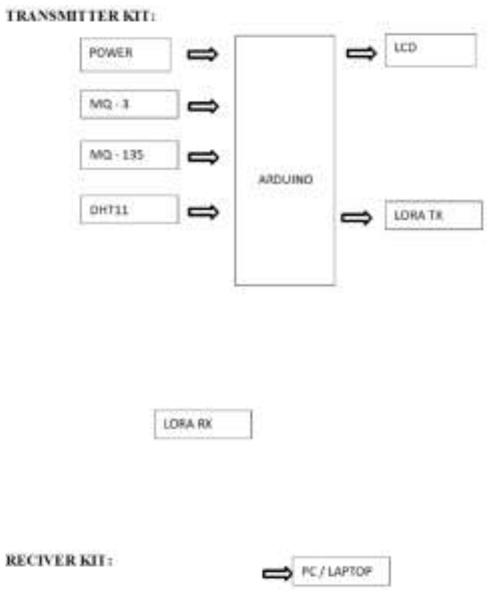
The term **LoRa stands for Long Range**. It is a wireless Radio frequency technology introduced by a company called **Semtech**. This LoRa technology can be used to transmit bi-directional information to long distance without consuming much power. This property can be used by remote sensors which have to transmit its data by just operating on a small battery.

Typically **Lora can achieve a distance of 15-20km** (will talk more on this later) and can work on battery for years. Remember that LoRa, LoRaWAN and LPWAN are three different terminologies and should not be confused with one another. We will discuss them briefly later in this article.

Next important thing to have with your LoRa module is your Antenna. Remember that it is mandatory to operate the LoRa module only with an antenna, else the output transmitting power will damage the Module. I am using a 433Mhz Lora module so my antennas are also rated for 433MHz, you have to select your antenna accordingly. My LoRa module along with antenna is shown below.



IV.BLOCK DIAGRAM:



Working: This proposed paper is designing and implementing a LoRa-based smart city air quality monitoring system. The system consists of several sensor nodes used to measure environmental parameters such as temperature, humidity, and airborne contaminants. A transmitter is created by connecting all the sensors, a arduino, and a LoRa module. These sensor nodes read pollutants in the environment. These sensor nodes are placed in various locations. Data from each sensor node is sent through the LoRa module to the LoRa gateway to the receiver, transferred to the cloud, sent to laptop.

V.CONCLUSION

The use of WSN in this research allows no cables and electrical connections near the nodes, thus CO2 A LoRa-based low cost air quality monitoring system in this study has been able to work well to detect the change of exposure to CO, CO2 and PM. It also works well to detect the change of air temperature and humidity. Data from sensor nodes can be sent to the gateway and forwarded to the Thing speak server. The communication system between sensor node and gateway has been tested with an outdoor-indoor scenario. In testing processes, the sensor node was placed outdoors, and the gateway was indoors. Both devices could communicate up to 32 meters away with 100% packet received without error. At a distance of 50 meters, 1 out of 120 packets was lost (99.17% packets received without error). While at a distance of 70 meters, 78.3% of packets could be received without error.

FUTURE SCOPE: Proposed pollution monitoring system. Overcame many of the shortcomings of the conventional Pollutant measurement system that also relies on radio transmission technology within 100 meters of Coverage such as Zigbee and Wi-Fi. The proposed system is a low-cost system, with no phone/data charges, etc. The cellular system, small in size, and long-range is sent in real-time. Based on the practical examination. This system has been proven both indoors and outdoors ability to detect contamination and classify the degree of contamination. Compared to other wireless transmission technology, the technology is very suitable for air pollution systems, especially for long-distance transmission. Future studies may focus on improving the coverage. LoRa technology by adding a gateway to data traffic-crowded areas. Also, new types of sensors can be added to detect other related types of gases.

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