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SENSOR BASED DATA ACQUISITION SYSTEM USING ARDUINO AND ESP8266

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ABSTRACT:

An enormous expansion of the industrial and infrastructure sectors is causing environmental problems including pollution, malfunctions, and changes in the atmosphere. Since pollution is becoming a major concern, it is necessary to create a robust system that solves issues and keeps an eye on the variables influencing pollution in the environment. The Internet of Things (IOT), a technology that combines electronics and computer science, is one component of the answer. It may provide tools for keeping an eye on the quality of environmental factors including light, temperature, humidity, air, and noise. In order to track the amount of pollution in an industrial setting or specific region of interest, a wireless embedded computer system is suggested. An Arduino Uno board, an ESP8266 wifi module, and sensor devices make up the system's prototype implementation. These sensors detect deviations in parameter values from the standard range by integrating with a wireless embedded computer system. The objective is to develop a robust system to track environmental variables.

I. INTRODUCTION

As the industrial sector grows significantly, environmental pollution-related problems are known to emerge quickly [1]. In our project, we are creating an Internet of Things network that will link sensing devices to wireless embedded computer systems in order to meet the need for a thriving monitoring system. The technology known as the "Internet of Things" connects sensors to embedded systems so that data from those sensors may flow via the Internet. We are putting into practice a growing model that can track the fluctuations in variables including air quality, noise levels, temperature, humidity, and light. The ATMEGA328 microcontroller, which is installed on an Arduino Uno board, is used in the suggested model. Our five sensors include the MQ-7 gas sensor. Our five sensors include the MQ-7 gas sensor. It measures the amount of carbon monoxide in the atmosphere. We employ the high sensitivity microphone sensor module M213 to measure the variations in noise levels. SY-HS220 is utilized as a humidity sensor and LM35 as a temperature sensor. An LDR sensor is used to detect the intensity of light. The flexible wifi sensor, ESP8266, is what we are utilizing to send the data over the Internet. These sensors' data is kept on cloud storage. Following processing, a web browser using hotspot will inquire for IP address; by providing the IP address, a web page will be created that enables system monitoring [4]. In addition to PCs and laptops, cellphones allow us to monitor the settings.

II. LITERATURE REVIEW

Mr. Jamil developed ZigBee-based wireless sensor networks to monitor environmental and physical conditions in "Smart Environment Monitoring System by Employing Wireless Sensor Networks on Vehicles for Pollution Free Smart Cities" [3]. The movement nodes and the sensing nodes have direct communication. It minimized the need for complicated routing algorithms yet required very little local computation.

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1. One of the drawbacks of the current system is that it requires more time and space to run, and its design is complex.
2. Maintenance is challenging

III. DESIGN OF HARDWARE

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

ARDUINO UNO

A microcontroller board based on the ATmega328 is called the Arduino Uno (datasheet). It has a 16 MHz ceramic resonator, 6 analog inputs, 14 digital input/output pins (six of which may be used as PWM outputs), a USB port, a power connector, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; all you need to do is power it with a battery or an AC-to-DC converter or connect it to a computer via a USB connection to get going.The FTDI USB-to-serial driver chip is not used by the Uno, setting it apart from all previous boards. As an alternative, it has the Atmega16U2 (or Atmega8U2 up to version R2) configured as a serial-to-USB converter. The 8U2 HWB line on the Uno board is pulled to ground by a resistor, which facilitates DFU mode entry. The Arduino board now includes the following updates:

• 1.0 pin out: two further new pins, the IOREF, are positioned next to the RESET pin, the SDA and SCL pins that were introduced, and they enable the shields to adjust to the voltage supplied by the board. Shields will eventually work with both the Arduino Due, which runs on 3.3V, and the boards that utilize the AVR, which runs on 5V. The second pin is unconnected and set aside for future uses.

• A more robust RESET circuit.

• The 8U2 is replaced with an ATMega 16U2.

"Uno" is an Italian word for one, and it was chosen to commemorate the impending introduction of Arduino 1.0. Going future, the Arduino reference versions will be the Uno and version 1.0. The Uno is the most recent in a line of USB Arduino boards and the platform's standard model; see the index of Arduino boards for a comparison with earlier iterations.

Fig: ARDUINO UNO

POWER SUPPLY:

The purpose of the power supplies is to convert the high voltage AC mains energy into a low voltage supply that is appropriate for use in electronic circuits and other devices. One may disassemble a power supply into a number of blocks, each of which carries out a specific task. "Regulated D.C. Power Supply" refers to a d.c. power supply that keeps the output voltage constant regardless of differences in the a.c. main or the load.

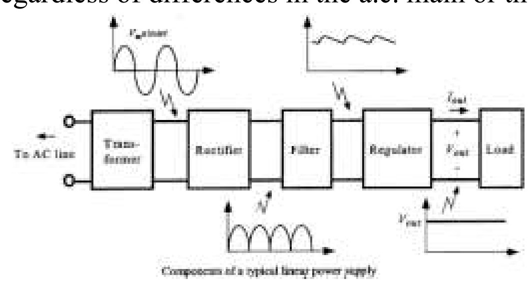

Fig: Block Diagram of Power Supply

LCD DISPLAY

The model shown here is the one that is most often utilized in practice due to its cheap cost and enormous potential. Its HD44780 microcontroller (Hitachi) platform allows it to display messages in two lines of sixteen characters each. All of the alphabets, Greek letters, punctuation, mathematical symbols, etc., are shown. Furthermore, it is possible to show custom symbols created by the user. Some

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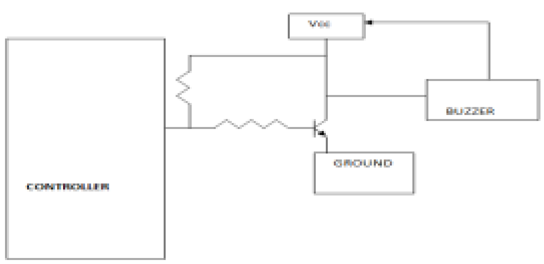
important features are the automatic changing of the message on the display (shift left and right), the presence of the pointer, the lighting, etc.

Fig: LCD

BUZZER

Relays, buzzer circuits, and other circuits cannot be driven by the current available on digital systems and microcontroller pins. The microcontroller pin can provide a maximum of 1-2 milliamps of current, even though these circuits need around 10 milliamps to work. Because of this, a driver—such as a power transistor—is positioned between the buzzer circuit and microcontroller.



WIFI MODULE:

A low-cost Wi-Fi microprocessor with complete TCP/IP stack and microcontroller functionality, the ESP8266 is made by Chinese firm Espressif Systems, located in Shanghai.[1]

In August 2014, a third-party producer named Ai-Thinker's ESP-01 module brought the chip to the attention of western manufacturers for the first time. With the help of this little module, microcontrollers may establish basic TCP/IP connections and connect to Wi-Fi networks by utilizing Hayes-style instructions. But at the time, there wasn't much documentation available in English on the chip or the commands it could execute.[2] Many hackers were drawn to investigate the module, chip, and software on it as well as translate the Chinese documentation because of its very cheap cost and the fact that it had very few external components, suggesting that it may someday be very affordable in production.[3]

With its 1 MiB of integrated memory, the ESP8285 is an ESP8266 that enables single-chip Wi-Fi capable devices.[4]

The ESP32 is these microcontroller chips' replacement.

LED:

A light source made of semiconductors with two leads is called an LED. When turned on, this p-n junction diode generates light.[5] Within the device, electrons may recombine with electron holes when a proper voltage is given to the leads, releasing energy in the form of photons.

This phenomenon is known as electroluminescence, and the energy band gap of the semiconductor controls the hue of the light, which corresponds to the photon's energy. Since LEDs are usually tiny—less than 1 mm2—the radiation pattern may be modified by integrated optical components.

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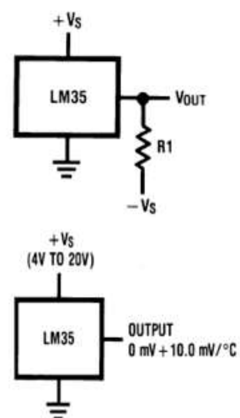
Early LEDs were often utilized to replace tiny incandescent bulbs as indication lighting for electrical equipment. They were quickly bundled into seven-segment displays for use as numeric readouts, and digital clocks became popular with them. Modern advancements have led to the creation of LEDs that are appropriate for task and ambient lighting. New displays and sensors have been made possible by LEDs, and enhanced communications technology has benefited from their rapid switching rates.Compared to incandescent light sources, LEDs are smaller, quicker switching, more physically resilient, need less energy, and have a longer lifespan. Applications for light-emitting diodes are many and include traffic signals, advertising, traffic lights, camera flashes, lit wallpaper, aircraft illumination, and car headlights. Additionally, they are much more energy-efficient, and their disposal may pose less environmental risks.

TEMPERATURE SENSOR (LM35):

This temperature measurement must first be read and sent to the microcontroller in order for it to be continually monitored and compared to the preprogrammed fixed temperature. It is necessary to perceive this temperature. As a result, a sensor must be employed, and the LM35 sensor is the one used in this project. Temperature values are transformed into electrical impulses by it.

The output voltage of the precision integrated-circuit temperature sensors of the LM35 series is directly proportional to the temperature in Celsius. Since the LM35 is internally calibrated, no external calibration is necessary. The LM35 can achieve typical accuracy levels of ±1⁄4°C at ambient temperature and ±3⁄4°C across the whole temperature range of −55 to +150°C without the need for external calibration or trimming.

The LM35's ability to interface with readout or control circuitry is facilitated by its low output impedance, linear output, and perfect intrinsic calibration. It may be used with plus and minus supplies or a single power supply. It has extremely low self-heating, less than 0.1°C in still air, since it consumes just 60 µA from its supply.



The characteristic of this LM35 sensor is:
For each degree of centigrade temperature it outputs 10milli volts.

ROLE OF LM35:

This project involves constant temperature monitoring. If the temperature rises beyond the preprogrammed limit, a buzzer signal is included into the circuit to notify industry personnel to halt the operation right away. As a result, the microcontroller must compare the temperature value obtained from the temperature sensor LM35's constant readings with the preprogrammed temperature. The buzzer makes a loud noise and receives an indicator from the

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microcontroller when the temperature rises over the predetermined level.

MQ2- SENSOR

The MQ2 flammable gas and smoke sensor measures the amount of combustible gas present in the atmosphere and provides an analog voltage as a result. The sensor has a 300–10,000 ppm range for measuring combustible gas concentrations. The sensor uses less than 150 mA at 5 V and can function in temperatures ranging from -20 to 50°C.

The heating (H) pins of the sensor may be connected to five volts to maintain a temperature that allows proper operation. The sensor emits an analog voltage on the other pins when five volts are connected to either the A or B pins. The sensitivity of the detector is adjusted by a resistive load placed between the output pins and ground. Please take notice that the datasheet's image of the top arrangement is incorrect. The pin layouts in both variants are identical and align with the bottom configuration. The resistive load should be calibrated using the datasheet's calculations for your specific application; nonetheless, 20 kΩ is a decent place to start when choosing a resistor.

HUMIDITY

The quantity of water vapor in the air is referred to as humidity, and there are several ways to detect humidity. Officially speaking, humid air is not the same as "moist air"; rather, it is a combination of water vapor and other air components. Humidity is determined by the mixture's water content, or absolute humidity. It is usually used to refer to relative humidity, which is measured as the present absolute humidity in relation to the maximum and is expressed as a percentage on home humidistats and weather forecasts. The ratio of the mixture's water vapor content to its total air content (on a mass basis) is known as specific humidity. Depending on the application, the mixture's water vapor concentration may be expressed as a partial pressure or as mass per volume.

Humidity in meteorology is a measure of the probability of precipitation, dew, or fog. Elevated relative humidity hinders sweating's ability to cool the body by slowing down the skin's moisture evaporation rate. During the summer, a heat index table is used to determine this impact.

IV. PROJECT DESCRIPTION

4.1. BLOCK DIAGRAM:

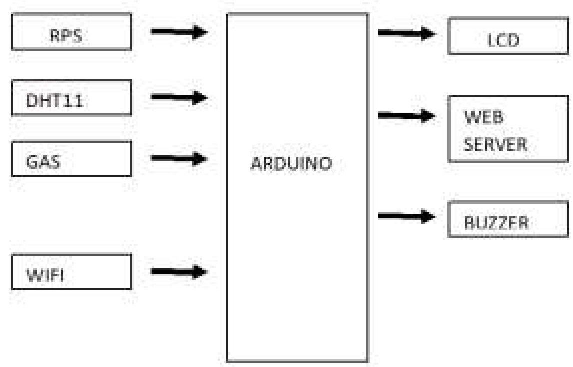

Fig 6.1 block diagram

4.2. SOFTWARE REQUIREMENTS:

- Arduino IDE
- Proteus

4.3. HARDWARE REQUIREMENTS:

- RPS
- Lcd
- Gas sensor
- Air sensor
- Arduino

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The data collecting system uses an Arduino and ESP8266 combination with an LM35 temperature sensor, a gas sensor (like the MQ-series), and a humidity sensor (such the DHT11 or DHT22) to monitor and transmit environmental data in real-time to cloud platforms for remote access. Here is a thorough, step-by-step explanation of how this system works:

1. System Components

- LM35 Temperature Sensor: Provides an analog signal proportionate to the temperature measured by the sensor.
- Gas Sensor (MQ series): Measures the amount of gases in the air, such as carbon monoxide, propane, and methane. It has outputs that are either digital or analog.
- Humidity Sensor (DHT11/DHT22): Uses a digital signal to measure temperature and humidity.
- Arduino: Serves as the primary microcontroller, interpreting and processing data from sensors.
- ESP8266 (Wi-Fi Module): Enables wireless transmission of the gathered data to a mobile device or cloud server for remote monitoring.
- Power Source: The system is powered by batteries or USB**.**

2. System Initialization

- The Arduino initializes every sensor and creates a communication connection with the ESP8266 Wi-Fi module as soon as the system is switched on.
- For data recording and remote monitoring, the ESP8266 joins a pre-configured Wi-Fi network and creates a connection to a cloud platform (like ThingSpeak, Blynk, or Firebase).

3. Data Acquisition from Sensors

- LM35 Temperature Sensor: This sensor detects the outside temperature constantly and generates an analog signal proportionate to the temperature (in degrees Celsius). Arduino reads the output voltage using one of its analog pins.
- Using the following formula, Arduino transforms this analog signal into a temperature measurement: Temperature (°C) = Analog Value × 51024 × 100The temperature (degree Celsius) is equal to \frac{\text{Analog Value} \times 5}{1024} \times 100.Temperature (°C) = 1024 Analog Value × 5×100
- Gas Sensor (such as MQ-2, MQ-7): o The gas sensor gauges the amount of certain gases (such as CO, propane, and methane) in the atmosphere. Either an analog signal proportionate to the gas concentration or a digital output (HIGH/LOW depending on a threshold) are used to show this data.
- The Arduino receives a signal from the gas sensor, which it may analyze to find out the concentration of the gas or if any hazardous gas levels are present.
- Humidity and Temperature Sensor (DHT11/DHT22):
- Digital measurements for temperature and humidity are provided by the DHT11/DHT22 sensors. A single digital pin on the Arduino connects the sensor to the board.
- To analyze the raw data and extract temperature and humidity percentage measurements, Arduino needs a library (such as DHT.h)**.**

4. Data Processing in Arduino

- Arduino processes the collected data from all sensors and formats it into a

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human-readable format (e.g., °C for temperature, % for humidity, and ppm for gas concentration).

- It also checks for abnormal readings, such as high gas levels or extreme temperatures, which may trigger alerts or alarms.

5. Transmission to Cloud (ESP8266)

- After collecting and processing the sensor data, Arduino sends this data to the **ESP8266** module via serial communication (UART or SoftwareSerial).
- The **ESP8266** Wi-Fi module, connected to a cloud platform or IoT dashboard, transmits the sensor data to the remote server or cloud in real-time.
- Data is displayed on a **web interface** or **mobile app**, enabling users to monitor temperature, humidity, and gas levels from anywhere.

V. CONCLUSION:

Using cloud platforms for data transmission and storage makes it possible for users to access historical records and real-time data from any location, which improves trend analysis and decision-making. Real-time warning generation from the system enables quick reactions to hazardous environmental situations, especially when it comes to spotting gas leaks or very high temperatures, which may improve operational effectiveness and safety.

Scalability, versatility, and simplicity of implementation are among the features of the system, although some constraints like the need for a steady Wi-Fi connection and cautious power management. Incorporating further sensors or features to meet particular requirements makes this system a strong basis for the development of IoT-based monitoring solutions in the future.

In conclusion, an effective, dependable, and reasonably priced platform for data collection and remote monitoring is provided by the combination of Arduino, ESP8266, and several sensors. This platform gives insightful information for businesses, homes, and research settings.

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