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TOWARDS THE IMPLEMENTATION OF IOT FOR ENVIRONMENTAL CONDITION MONITORING IN HOMES

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Abstract
This project focuses on the implementation of IoT for environmental condition monitoring in homes and explores its implications. By deploying a network of sensors throughout the home, homeowners can gather data on key environmental factors such as temperature, humidity, air quality, and energy consumption. This data is collected, processed, and made available through a central system or a smartphone application, allowing homeowners to monitor and control the indoor environment remotely. The objective of this project is to investigate the benefits that IoT-based environmental condition monitoring brings to homeowners. Firstly, it provides a higher level of comfort and convenience by allowing users to adjust and optimize the indoor environment based on their preferences and needs. For example, the system can automatically adjust the thermostat based on the detected temperature and occupancy patterns, ensuring an ideal living environment while minimizing energy waste. Secondly, IoT-based monitoring enables homeowners to identify and address potential health hazards related to indoor air quality. By continuously monitoring parameters like CO2 levels, particulate matter, and humidity, users can take preventive measures to improve air quality and reduce the risk of respiratory problems. Lastly, the data collected from IoT sensors provides valuable insights into energy consumption patterns, enabling homeowners to identify opportunities for energy efficiency and make informed decisions regarding their energy usage.

Keywords: Internet of things, LCD display, WSN, Zigbee, home automation, energy management.

Introduction

The concept of the Internet of Things (IoT) has gained significant attention in recent years, revolutionizing various industries and aspects of our lives. IoT refers to the network of interconnected devices embedded with sensors, software, and connectivity that enable them to collect and exchange data. One of the promising applications of IoT technology is environmental condition monitoring in homes. Our homes are our sanctuaries, where we spend a significant amount of time. The quality of the indoor environment directly impacts our comfort, health, and well-being. Traditional methods of environmental monitoring in homes, such as manual measurements or standalone devices, have limitations in providing real-time and comprehensive data. This creates a gap in our understanding of the indoor environment and hinders our ability to optimize comfort, energy efficiency, and health. The implementation of IoT in environmental condition monitoring offers a transformative solution. By integrating various sensors and devices throughout the home, homeowners can gather real-time data on key environmental parameters such as temperature, humidity, air quality, and energy consumption. These sensors can be connected to a central hub or a cloud platform, allowing homeowners to access and monitor the data remotely. By analyzing the patterns and trends in environmental data, users can identify opportunities for energy efficiency, make informed decisions regarding resource usage, and optimize their home environment accordingly. However, the implementation of IoT-based environmental condition monitoring in homes comes with its own set of challenges. These challenges include device compatibility, data privacy and security, data management and analysis, and user acceptance. Overcoming these challenges is crucial for the successful deployment and widespread adoption of IoT technology in residential environments. In conclusion, the integration of IoT technology in environmental condition monitoring for homes has the potential to revolutionize the way we manage our indoor environments. Enormous increase in users of Internet and modifications on the internetworking technologies enable networking of everyday objects [1]. “Internet of Things (IoT)” is

all about physical items talking to each other, machine-to-machine communications and person-to-computer communications will be extended to “things” [2], [3]. Key technologies that will drive the future IoT will be related to Smart sensor technologies including WSN, Nanotechnology and Miniaturization. Humans usually inside their home interact with the environment settings like light, air, etc., and regulate accordingly. If the settings of the environment can be made to respond to human behavior automatically, then there are several advantages. In the recent past, several research activities were actively involved with IoT such as [5][7]. Most of the research activities related to IoT are confined to management of resource constraint devices [8], and different mechanisms of interconnection [9], [10].

Existing system

In the existing system of environmental condition monitoring in homes, traditional methods and standalone devices are commonly used. These methods have limitations in terms of data accuracy, real-time monitoring, and comprehensive coverage. Here are some aspects of the existing system: Manual measurements: Homeowners may manually measure certain environmental parameters using separate devices such as thermometers, hygrometers, or air quality monitors. However, this approach is time-consuming, requires regular user intervention, and provides only limited data points at specific times. Standalone devices: Some homeowners opt for standalone devices that monitor specific environmental conditions, such as a thermostat for temperature control or an air purifier for air quality. While these devices offer more convenience than manual measurements, they often operate independently and do not provide a holistic view of the overall indoor environment. Limited connectivity: Many existing devices lack connectivity features, making it difficult to gather and analyze data in real-time. Homeowners may have to manually collect data from multiple devices and rely on their own judgment to assess the environmental conditions. Lack of automation and control: Without integration and automation, homeowners have limited control over the environmental conditions in their homes. Adjustments need to be made manually, and there may be a lack of intelligence or adaptability in responding to changing conditions. Limited data analysis and insights: The existing system often does not provide advanced data analysis or visualization capabilities. Homeowners may struggle to interpret the collected data effectively and derive meaningful insights for optimizing their living environment. Inefficiency and wastage: Without real-time monitoring and control, homeowners may unknowingly waste energy or resources. For example, heating or cooling systems may be left running even when the occupants are not at home, leading to unnecessary energy consumption. Lack of alerting mechanisms: In case of adverse conditions or emergencies, the existing system may not provide timely alerts to homeowners. This can be particularly crucial for addressing health risks related to poor air quality or extreme temperatures. While the existing system has served homeowners to some extent, it has limitations in terms of data accuracy, real-time monitoring, comprehensive coverage, and intelligent control. These limitations can result in suboptimal comfort, inefficient resource usage, and potential health risks. To overcome these limitations, an IoT-based environmental condition monitoring system is proposed. This system aims to address the shortcomings of the existing system by providing real-time monitoring, data analysis, automation, and intelligent control features. By leveraging IoT technology, homeowners can have a more comprehensive and integrated approach to monitoring and optimizing their home environment.

Proposed system

The proposed system for environmental condition monitoring in homes is an IoT-based solution that leverages connected devices, sensors, and data analysis techniques to provide real-time monitoring, intelligent control, and enhanced insights. Here are the key components of proposed system:

- Sensor Integration: The system involves the deployment of a network of sensors throughout the home to measure various environmental parameters such as temperature, humidity, air quality, light intensity, and energy consumption.

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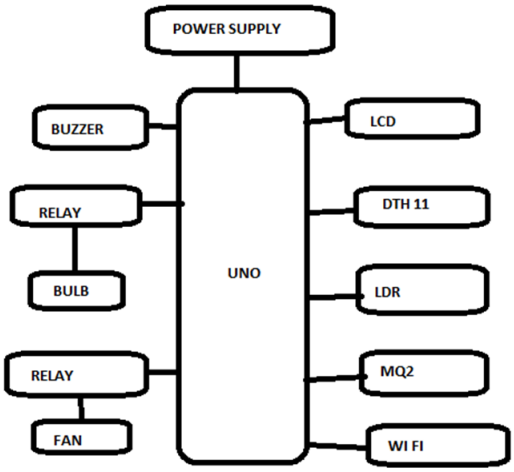
- Data Collection and Transmission: The sensor data is collected and transmitted to a central hub or cloud platform.
- Data Analytics and Visualization: The collected data is processed and analysed using advanced analytics techniques.
- Energy Optimization: The proposed system focuses on energy optimization by analysing energy consumption patterns and providing recommendations for efficient resource usage.

4.1 Block Diagram



4.2 Arduino UNO

In proposed model, arduino serves as the central processing unit or microcontroller of the project. It receives data from various sensors, processes that data, and controls the relay module and LCD display based on the received information. It is the brain of the project, managing the decision-making and communication with the IoT platform.

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turnit into an output - activating a motor, turning on an LED, or publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE)

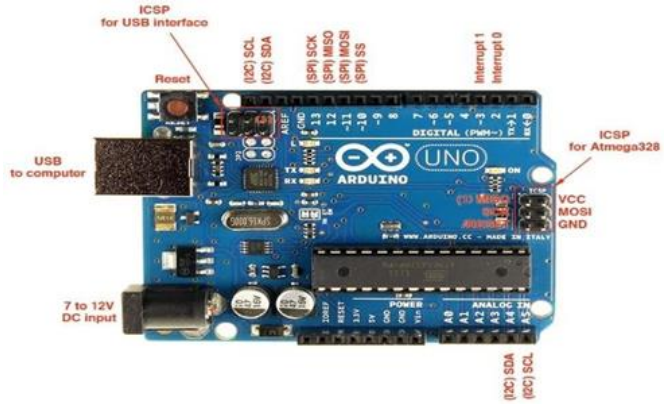


Table 2.1: Arduino Uno specifications

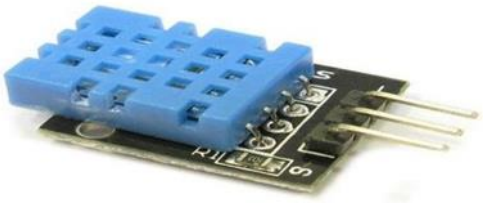
Microcontroller	Atmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (Atmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (Atmega328)
EEPROM	1 KB (Atmega328)
Clock Speed	16 MHz

4.3 DHT11 Sensor

The DHT11 sensor is used to measure temperature and humidity. It provides environmental data that canbe used to make informed decisions about energy consumption or to monitor conditions in the last

meterof the smart grid.

Parameters	Specification
Input Output Voltage	3V 5V
Humidity Range	20-80 perc
Temperature Range	0-50 deg C
Sampling Rate	1Hz
Response time	50ms



4.4 Relay module

The relay module allows the Arduino to control electrical devices. In the context of your project, it can be used to turn devices on or off remotely. For example, you could use it to control the power supply tocertain appliances or components of the smart grid.

Parameter	Rating
Supply voltage	3.75V to 6V
Trigger current	5mA
Active relay current level	70mA (one relay), 600mA (eight relays)
Relay maximum contact voltage	250VAC, 30VDC
Relay maximum current	10A

4.5 LCD Display

The LCD display serves as the user interface for the project. It can show real-time data, system status, or other information to users. This can be particularly helpful for visualizing data or providing feedback to users about the status of the last meter smart grid.

ITEM	SYMBOL	LEVEL	FUNCTIONS
1	VSS	0V	Power Ground
2	VDD	+5V	Power supply for logic
3	V0	—	Contrast adjust
4	RS	H/L	H:data L:command
5	R/W	H/L	H:read L:write
6	E	H.H→L	Enable signal
7-14	DB0-DB7	H/L	Data Bus
15	LEDA	+5V	Power supply for LED Backlight
16	LEDK	0V	

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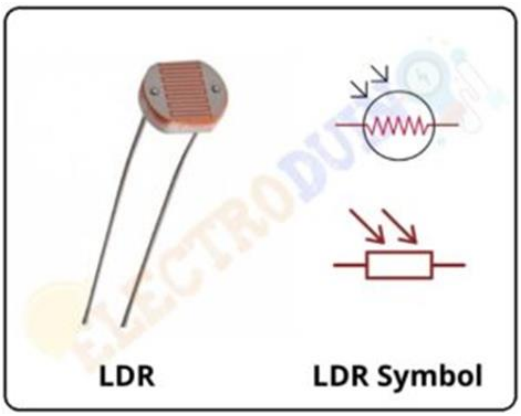
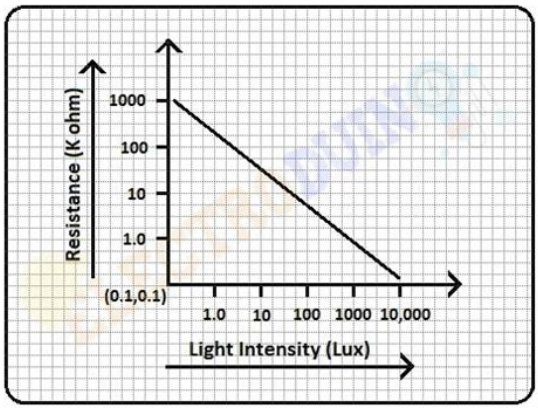
4.6 LDR Sensor

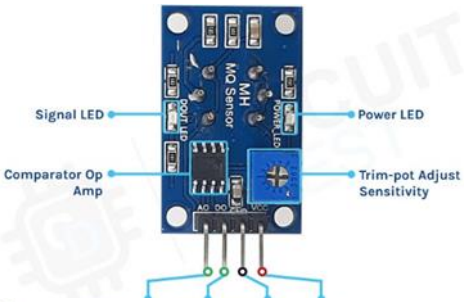
LDR sensor module is a low-cost **digital sensor** as well as **analog sensor** module, which is capable to measure and detect light intensity. This sensor also is known as the **Photoresistor sensor**. This sensor has an onboard LDR (Light Dependent Resistor), that helps it to detect light. This sensor module comes with 4 terminals. Where the "DO" pin is a digital output pin and the "AO" pin is an analog output pin. The output of the module goes high in the absence of light and it becomes low in the presence of light. The sensitivity of the sensor can be adjusted using the onboard potentiometer.





4.7 MQ-2 Gas and Smoke Sensor:

In most Arduino projects, the MQ-2 sensor is used to detect hazardous or flammable gas or smoke and hence this sensor is popular among beginners. Also, these are low cost, easy to use sensors featuring a wide sensing range that can be trimmed down to adjust the sensitivity.



Sensitivity characteristic curve

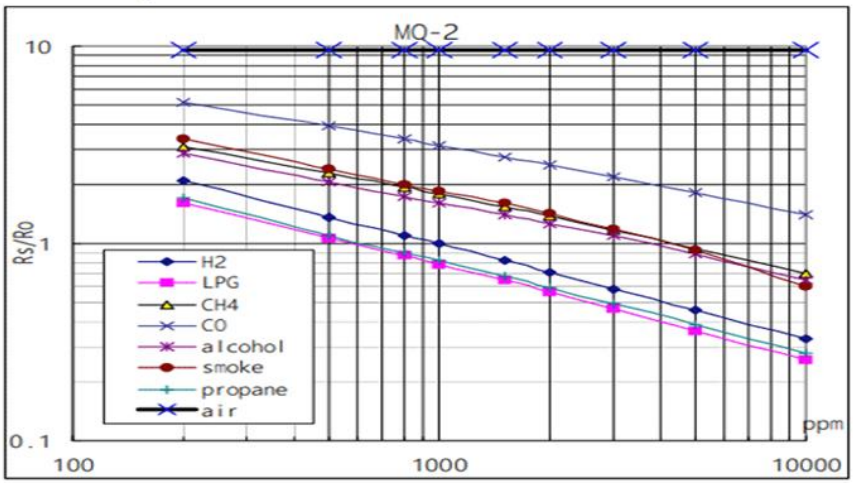


Fig. shows the typical sensitivity characteristics of the MQ-2 for several gases.
in their: Temp: 20℃、
Humidity: 65%、
O_2 concentration 21%
RL=5kΩ
Ro: sensor resistance at 1000ppm of H_2 in the clean air.
Rs:sensor resistance at various concentrations of gases.

Execution

Arduino is powered using USB cable and the four sensors are connected to the Arduino board and LED is connected for the alert signal. IOT module also connected to the Arduino board for getting input from the sensors and it is powered using the adapter. The USB cable not only gives power to the

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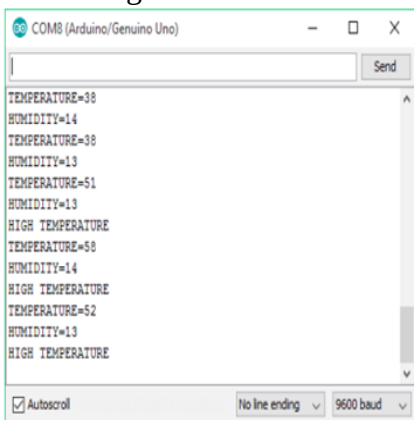
Arduino board but also transfers data from the Arduino board to computer. Those data can be analysed and result can be shown in the computer and indication is done using LED lights.

Results

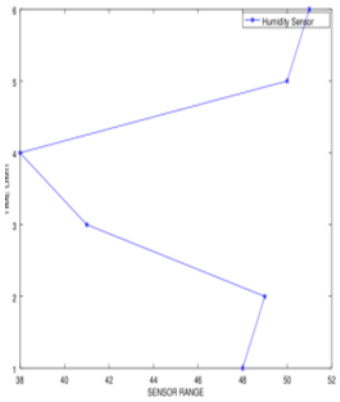
Connections of one sensor and another sensor can be done separately or combinable with the Arduino board and IOT module.

6.1 Range of Sensor

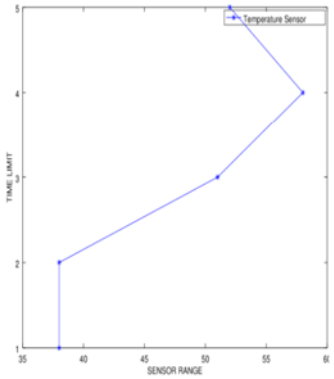
- The result of an environment condition monitoring system is based on different inputs for the different sensors. The temperature should be below 48. If value exists above 48, it gives the alert message.



Measurement of Temperature Sensor.

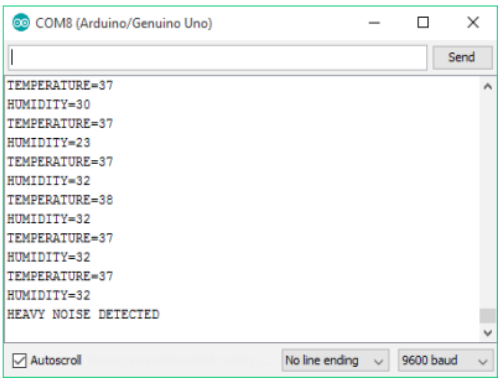


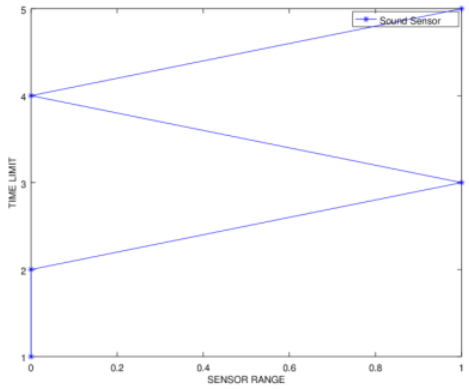
Graph of Humidity Sensor.



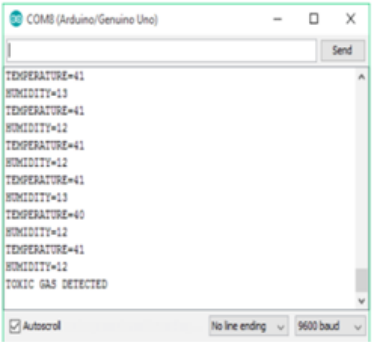
Graph of Temperature Sensor

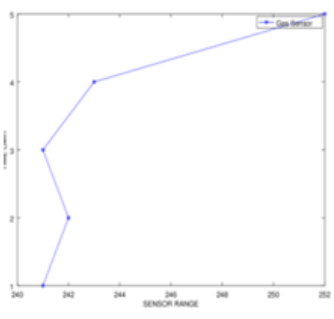
- The noise sensor value is the binary value and it should high. If it goes high, it gives the alert message.





- The gas sensor value should be below 240. If it exists above 240, it gives the alert message.





Conclusion

This System monitors the changes happening over the environment and provides the sufficient ways for the users to access the information from anywhere through cloud. The temperature and humidity sensor will monitor and gives the details about the changes happening over the climate. The gas and sound sensor are used for monitoring the pollution over environment. The Monitored condition will be updated in the cloud.

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