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IoT Based Artificial Intelligence Controlled Environment Monitoring Robotic System

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Abstract: ***In the recent years environmental safety has become one of the most concern in every part of the world.Breathing clean, fresh air has become nearly difficult due to the increase of air pollution. The Internet of Things is being used to measure and reduce contaminants in the environment. The Internet of Things (IOT) is a network of physical items comprised of intelligent devices for interacting and perceiving, or for changing human into computers or software for communicating with machines. The air filtration systems are frequently developed to measure and document an environment's present state or to create variations in environmental parameters. Asuggested robotic system that is built and installed to monitor environmental factors such as temperature, moistureand dangerous gas concentration. It has the ability to save statistics on the Blynk software IoT platform. A smart phone running an app created on the Android operating system controls the mobile robot. The entire system is accomplished using a low-cost ARM-based embedded platform named Arduino, which connects over a wireless connection to the IOT gateway, where data is saved, processedand accessible from anywhere using a laptop or any smart device.The system can update sensors, navigation and live stream date to IOT IP server every 5seconds and also give message alert to the user end about the atmospheric conditions. This multipurpose robotic system is capable of remote monitoring with no human intervention and keeping away environmental hazard risks.***

Keywords: Sensor, Robotic Vehicle, IOT Platform, Arduino, Node MCU, Cloud server

1. Introduction

Monitoring the environment is necessary to learn more about it and determine how well it supports the preservation of collections. The proposed framework entails analysing environmental quality in order to control risk. It is being created as the foundation for the creation of environmental impact assessments. This information is used to investigate natural changes and analyse present environmental conditions, as well as in the production of impact assessment and in other situations where human activities endanger the natural environment. The primary goal of this system is to track environmental parameters without the need for human involvement.Tracking all types of climatic conditions has become an efficient wayand remote monitoring frameworks have been implemented employing remote sensors. These sensors might be used to manage and monitor air quality. In remote places, the collected data will be accessible via mobile phones or PCs. The execution includes warmth, relative humidity, carbon monoxideand dust particles in the air to examine the environment state.Environmental conditions in any environment are monitoredand data is relayed to the cloud, most significantly in real time. Any irregularities in the atmosphere could be updated in the cloudand the situation can be accessed by anybody using the internet. The integration of the Internet and developing technologies like as relatively close communications, real-time localization and embedded sensors may aid us in understanding and reacting to our surroundings. This system allows for actions to be taken if the environment's condition becomes abnormal.

2. Methodology

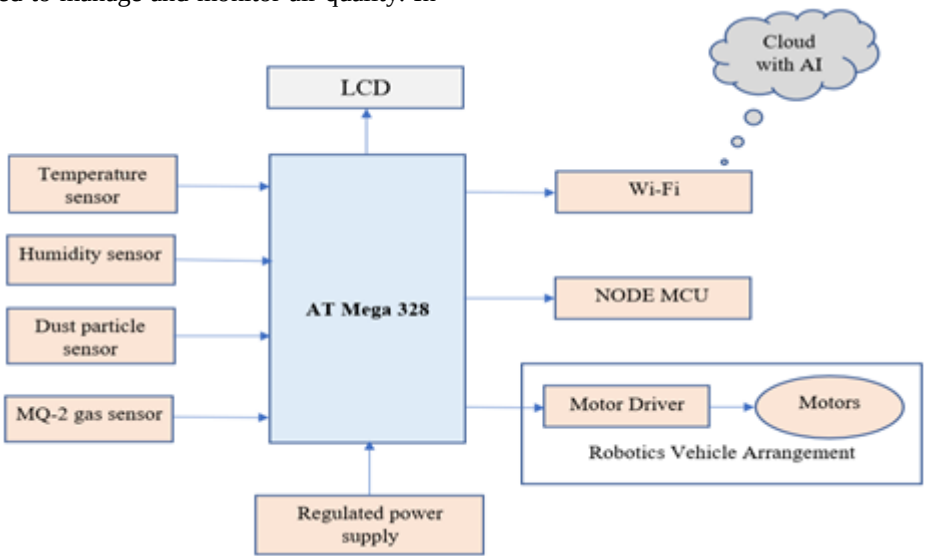

Figure 1: Block Diagram of Proposed System

FIG 1 depicts the suggested system's implementation. Its navigation and control software foundation of the whole process. It is used to help the robot with instructions, that is to steer the robot to the desired location. This detects the presence of hazardous gases in the environment. The amounts of air parameters are subsequently detected and transmitted through the internet to a mobile application, namely the blynk application.

The working/methodology is as follows:
Once the power supply is connected to the system microcontroller input/output pins, the timer and LCD will be initialized.Temperature and Relative Humidity (DHT11) sensor, MQ-2 gas sensor, Dust particle sensor, WIFI-ESP8266, NODE MCU and Motor driver are all connected to the controller on the robotic vehicle.Robotic Vehicle is controlled remotely through Internet using a Node MCU and the Blynk app, which controls the robot's movement such as Forward, Reverse, Left, Right, and Stop.The live video monitoring could be viewed remotely over the internetand the robot can be operated by viewing the live video.Sensed data will be transferred to the cloud via the ESP8266.Machine learning methods such as the SVM Algorithm will be used to forecast whether the environment is good or harmful based on the detected data and trained data.After forecasting good or poor weather, the device will send an SMS notice to the user via the cloud regarding the good or bad weather.

System Components

Atmega328:
The ATmega328 is a single-chip microcontroller, it is an Advanced Virtual RISC (AVR) microcontroller and also supports 8-bit data processing. It has 28 I/O pins with clock speed 16MHz. The main advantages easy to interface for beginners and speedy processing.ATmega328 is our choice as it is an easy option for use in prototyping with ease in robotics.

WIFI-ESP8266:
The ESP8266 is a UART to Wi-Fi module that provides a low-cost and simple means to link any tiny microcontroller platform to a network, which is beneficial to any computer systems.Data can be sent to the cloud for storage, computing, or monitoring.

Node MCU (Node Micro Controller Unit):
The NodeMCU (Node Micro Controller Unit) is a freeware software and hardware development platform based on a low-cost System-on-a-Chip.NodeMCU is a gadget similar to an Arduino. The ESP8266 is its key component. It includes programmable pins. It has WIFI integrated in.

Wireless Sensor Networks (WSN)
Wireless sensor network (WSN) made up of base stations and a number of clusters (wireless sensors).This channel is used to detect environmental or physical factors such as humidity,concentration of gases, dust particles which in air and temperature to collaboratively transmit data to a central point over the network.

(1) DHT 11 Sensor
The DHT11 Temperature and Humidity sensor is equipped with a humidity and temperature sensor complex and a standardized digital signal output.A NTC thermistor, or negative temperature sensitivity thermistor, is used to measure the temperature.A humidity dependent resistor is used to detect humidity. It has two electrodes and a moisture retaining substrate that holds moisture between them. The resistance between two electrodes is used to calculate relative humidity.

(2) MQ-2 Gas Sensor
MQ2 is one of the most regularly adopted gas sensors in the MQ sensor line. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor. It is dependent on the resistance change of the sensing material when the Gas comes into contact with it. Gas concentrations can be measured with a simple voltage divider network.

(3) Dust Particle Sensor:
The GP2Y1010AU0F is a dust particle sensing optical air quality sensor. This gadget contains an ultraviolet generating diode as well as a phototransistor placed diagonally to monitor the light reflected of dust in the air. It is very excellent at detecting tiny particles such as cigarette smoke and is widely used in air purification systems.

Navigation and Control System:
This structure is in charge of controlling the automated design via application.All of the components are interfaced to the Arduino microcontroller in this step. The motor driver will allow the robot to move from one location to another. The sensors will collect data and send it to cloud. With the help of Node MCU program the robot movement can be controlled and then sent to a Smartphone application called Blynk IoT.

Environmental Intellection:
The mobile camera system provides environmental intelligence by installing the IP webcam software. With the use of a camera in a sensing element network, one can create vital applications such as video surveillance, which is commonly used in environmental monitoring.

Cloud Computing with Artificial Intelligence
Cloud computing refers to the storage and access of programs and data on remote servers hosted on the internet rather than a computer's hard drive or a local server. Cloud technology is also known as Internet computing. The SVM algorithm is a supervised machine learning algorithm that is commonly used for classification and regression challenges.

Support Vector Machine
SVM is a common Supervised Learning method.SVM selects the highest points/vectors that aid in the creation of the hyperplane. These extreme examples are referred to it as support vectors, and also the method is known as the Support Vector Machine.

User Interface for Environmental Monitoring: In general, the focus on the user design is to create a user interface that makes operating a machine simple, productive, and user-friendly.

Software used:

- **Eclipse IDE:** A basedjava development platform known for its plugins that allows developers to develop and test code written in other language.
- **Java Development Kit**: It is a development environment for building applications and components using the java programming language.
- **Tomcat server:** Apache tomcat also known as tomcat server.It is an open source and popular choice for web developers building and application based on the java software platform

3. Results and Discussions

An artificial intelligence driven robot system for monitoring environment factors based on IOT was developed. This prototype used to monitor the temperature, relative humidity, carbon monoxide and dust particles present in air. The code has written to interface the wireless sensor such as DHT11, MQ-2 Gas sensor and GP2Y1010AU0F to detect the dust particles, Node MCU with built in wi-fi for robotic movement.

After executing the code, it automatically displays the temperature in degrees, percentage of relative humidity, concentration of carbon monoxide in ppm and particle matters present in atmosphere, the screen shot is as shown in the picture.

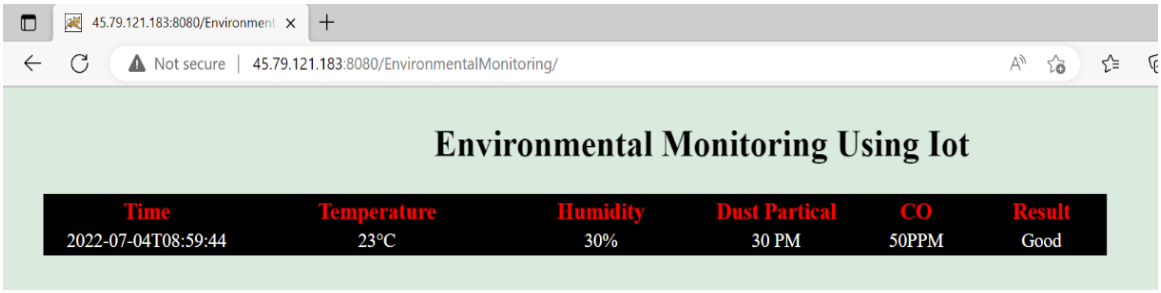

Figure 8.1: Output of environmental monitoring parameters

Environment parameters are measured in three different locations, figure below shows the parameters values.

Table 1: Monitoring of Environmental Parameter In 3 Different Locations

Sl no	Locations	Temperature in degrees	Humidity	Carbon monoxide	Dust particles	Results
1	Classroom	23	30%	50ppm	30PM	Good
2	Hostel	26	78%	90ppm	50PM	Moderate
3	Roadway	28	86%	1007ppm	149PM	Hazardous

Advantages

1) The system's main advantages are the application intuitive user interfaces and automated movement after receiving instructions from the user.
2) Simple to implement.
3) It uses very little power.
4) Data access from a remote location.
5) Removes the need for the time-consuming download process.
6) Indoor and outdoor air quality can be measured.

Applications

1) Industrial Monitoring Systems.
2) Health Care Professionals.
3) Responder to an emergency.
4) Clean Air Monitoring in cities.
5) Carbon dioxide surveillance in buildings and homes are two clear examples of air pollution monitoring.
6) Gas surveillance is used to verify that poisonous, flame sensor, or pyrophoric (highly flammable in air) gases are planned safely.
7) In mining activities, hazardous gases are monitored.

4. Conclusion

The design of an artificial intelligence driven robot system for monitoring environmental factors based on IOT was developed. The tiny and cost-effective robotic system that can monitor environmental parameters and measure air quality. The usage of node MCU allows users to manage the robot from a greater distance efficiently and without delay. Smartphones can handle navigationand IOT clouds can store environmental data. The ambient visualization may be monitored via an android application retrieved via the system's camera. If the current and voltage above the threshold valueand the concentration of polluted gases is detected by corresponding sensors, an alarm message is sent to the user's end regarding the atmospheric conditions. IoT and the Android app provide remote monitoring without the need for human interaction. Arduino controls the entire machine.This smart gadget is excellent for both indoor and outdoor monitoring. The sensorsperceived ambient conditions are efficiently matched. The results show that it is beneficial in progressively tracking environmental conditions.

5. Future Scope

This system may be expanded to include numerous gadgets

in the future by linking them. By altering the code, an IoT application might be created. The suggested system changes the threshold values of the sensors. There is potential for the construction of an environment that can be automatically managed depending on monitoring system alarms. For example, if the temperature reaches the threshold value, coolers will switch on automatically to the desired temperature.

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