

A Survey paper on ARM based GPS Controlled Robot for Environment Monitoring using IoT

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Abstract

Environmental screening or monitoring is the process which helps to screen and identify the quality of specific environment. Environmental screening is extensively used in the environmental impact assessments and in situations when human activities can have a devastating effect on the nature. All the screening programs have tactics and agendas which can define the current state of environment or create patterns in environmental constraints. The obtained results are screened, analyzed in various ways and can also be published. Thus, the screening or monitoring task should contribute to put up final use before the process starts. This work elaborates the designing a robot, embedded with sensors to extract atmospheric data from the surroundings. This data is processed and used to monitor the environment, and thereby simultaneously updating the data to the cloud platform namely ThingSpeak. The system can update the sensor data to IoT server at a regular interval of time. The stored data can be used for the future analysis of environmental parameters like in the reduction of overall pollution, conservation of energy and also in providing a complete improved living environment. The above-mentioned robot is intended to use in workplaces where the human intervention is hazardous and sometimes may be fatal to workers.

Keywords: Raspberry Pi, arduino, internet of things, air purifier, smoke sensor, GPS, ARM embedded system

1. Introduction

Healthy environment is a vital requirement for the normal life of human beings. Due to many human activities, environment has become extremely polluted. It is essential to

monitor and safeguard ourselves from the effects of excess pollution and calamities occurring because of it. The above mentioned process is known as environment monitoring and the set-up for monitoring is known as environment monitoring system. Environment monitoring systems are of various types. They are:

- 1) Air monitoring: This deals with monitoring the air quality. Air sample is taken to record levels of greenhouse gases and air quality
- 2) Ecosystem monitoring: Ecosystem monitoring deals with striking the right balance between human development and environment. It ensures that environment is not being adversely affected due to human developmental activities.
- 3) Biodiversity monitoring: This deals with keeping record of the ratio between existing forests and agricultural farmlands.
- 4) Water monitoring: This deals with monitoring the water quality by keeping the track of the amount of chemicals and pollutants being extruded in water bodies.
- 5) Natural calamities monitoring: This is concerned with the early alarming and damage probability in case of forest fires, droughts, and floods.

Manual monitoring of environmental pollution is very difficult and it also comes at the cost of a health risk. To understand the environmental attributes better, robotic systems are being used to fetch the data and to process the data to perform tasks which in turn reduces the health risk attached to man power.

Global Positioning System (GPS) is being used to facilitate the liberty of expanding the targeted area depending upon the requirements. It is a satellite-based radio navigation system which helps in locating and identifying places as three-dimensional positioning with ultimate accuracy within nanoseconds. This advancement is connected to the robot because it provides worldwide services which is very helpful for a robot to identify locations for sample collection and monitoring.

ARM architecture: ARM belongs to the family of reduced instruction set computer. It is designed by Sophie Wilson and Steve Furber and produced by Acron computers or Arm limited. ARM processors are likely to be used in light, easily portable devices which are powered by battery and even smartphones. ARM processors are also effective because of the low cost, lower heat generation and low power consumption. Due to these advantages, they are also used in desktops and computers.

2. Literature Study

The works which are related to this project's theme have been reviewed and summarized below. Several works have been opted which concentrate on the individual sub-fields of this proposed project, guiding in understanding the approach much better.

Table 1. Literature Survey

Citation	Methodology	Applications	Attainments
[1]	Proposes the idea of a robotic system based on IoT, GPS and ARM. The prototype used ARM based processor for the implementation of environment monitoring process of the project with Arduino board for the implementation of Navigation and Control System.	Automobile Industries	IoT system implementation , processing of commands at Raspberry Pi using Python
[2]	Ability of robotic systems to efficiently and precisely measure and potentially reduce environmental events at scales that were never thought to be possible before.	Environment Monitoring sector	Usage of Robotics in environment monitoring
[3]	IoT refers to a type of network to connect anything with the Internet based on stipulated protocols through information sensing equipment to conduct information exchange and communications in order to achieve smart recognitions, positioning, tracing, monitoring, and administration.	Manufacturing Industries, Health care, Supply chain, automotive, etc.	A brief review on IoT technology, its architecture, and its potential in enabling future technologies
[4]	Proposes the idea of environmental monitoring system based on IoT and ARM and collection of sensor data to measure environmental parameters	Environment monitoring sector	Implementation of IoT, ARM and GPS based robotic system
[5]	Prototype of pollution monitoring robot was setup to measure the gas distribution	Environmental monitoring sector	Mobile robots for pollution monitoring

[6]	IoT -based framework that effectively monitors the change in an environment using sensors, microcontroller, and IoT based technology. Users can monitor both in indoor and outdoor conditions using web application.	Mining or heavy industries	An IoT based framework to detect temperature, pressure and harmful gases
[7]	The data is collected using robotic monitoring system from various sensors and uploaded to ThingSpeak for further investigation.	Environmental monitoring sector	Usage of low cost monitoring robot without human intervention
[8]	The ability to create a cloud -based framework to monitor air quality, stickiness, and temperature level, and made accessible using PC or any smart device	Environmental monitoring sector	Usage of cloud -based framework to monitor environment data
[9]	Proposes the idea about environmental sensing robot based on 3G GSM integrated to IoT for providing long distance navigation control and environmental data collection.	Environmental monitoring system	Robotic vehicle system implementation based on 3G GSM
[10]	Raspberry pi interfacing with a web server ThingSpeak for collecting and analysing the data through the web application.	Environmental monitoring sector	Raspberry pi - based embedded system interfacing with web application through python commands.

3. Proposed Work

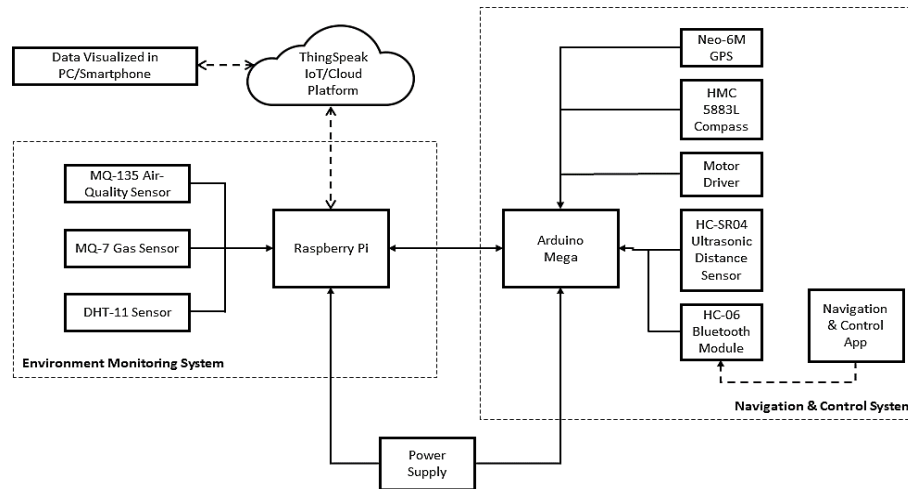


Figure 1. IoT and ARM -based GPS controlled Robotic environment monitoring system [2]

This work involves several steps to implement the set-up. The whole project is divided into two parts namely environment monitoring system and navigation control system.

The main components used in this project are:

- Raspberry Pi Model 3B
- Arduino Mega 2560
- MQ-7 Gas Sensor
- MQ - 135 Air Quality Sensor
- NEO-6M GPS Module
- DHT-11 Humidity and Temperature Sensor
- HMC 5883L Compass
- HC06 Bluetooth Module
- Servo motor
- HC SR04 Ultrasonic Sensor
- SIM800L GPRS Module

The proposed model has two main working units. The Environment Monitoring system and the Navigation and Control system. Each unit are inter-related to each other and work hand in hand. IoT and Cloud platform is also used in the project. ThingSpeak from MathWorks is the best software to use for the IoT and cloud platform to record the sensor data. The environment monitoring system is the heart of this project. It consists of Raspberry pi board which contains the ARM processor. It uses the ARM cortex A53 processor which is

a SoC running at 1.2 GHz and 1 GB of RAM. The processor is connected to various sensors which are sensitive to environment parameters. The MQ-7 and MQ-135 air quality and gas sensors, and the DHT-11 temperature & humidity sensors are all interfaced on to the Raspberry pi board. The sensor data is uploaded to the ThingSpeak IoT platform at a regular interval of time and the uploaded data can be visualized using a PC or smartphone device. The control & navigation system [5] is the mobility unit of the robot. The environment monitoring system is housed on the navigation and control system. The microcontroller unit used is Arduino Mega which uses the ATmega2560 microcontroller, and can be remotely controlled by using a smartphone. The GPS module, compass helps in navigation and the motor driver, ultrasonic distance sensor, and Bluetooth module help in controlling the robot. The robot can be controlled using smartphone through an application.

4. Results and Discussion

The above literature survey throws light on many options that have been put forward for remote screening of the environment conditions. Here, various technologies have been used like wireless technology, GPS, IoT and Robotics. These solutions discuss data accumulation and observation. In order to avoid human health risks in remote environmental screening, the aforementioned system that can collect data via a self-sustained robotic system and upload the observations into a cloud server is a requisite. The uploaded data can also be further processed in order to make reasonable conclusions.

5. Conclusion

This project has illustrated the design and working of a robot embedded with sensors that fetches atmospheric data from the surroundings and updates the data to the cloud platform, ThinkSpeak. This stored data can be used to monitor and reduce the pollution, conserve energy, and deliver a complete healthy environment. The future research direction includes the following.

- A solar power can be incorporated to the existing system. This would help in using renewable resource to minimize the dumping of chemicals into the nature.
- The system can be updated to detect radiations and other harmful gases which affect the human health.
- Drone technology can be used to make the system travel in air and to acquire more data.

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