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Design of a Low-Cost, Cloud-Based Environment Monitoring Smart Device (CEMSD)

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Abstract: The capacity to gather explicit Environmental discharges has widespread in metropolitan urban communities because of advances in innovation and quickened financial turn of events. The objective of this investigation is accordingly to plan an ease, cloud-based keen framework called Cloud-Based Smart Device Environment Monitoring (CEMSD) that tracks different natural boundaries, for example, air quality, clamor, temperature and stickiness. The Raspberry Pi 3 (RPi 3) Model B and thusly a microchip with DHT11 temperature mugginess sensor, Grove-Loudness sensor, Shinyei PPD42NS particulate issue (PM) woods dust sensor, COZIR wide range 100% Carbon Dioxide (CO2) sensor and MQ131 Ozone (O3) gas sensor are utilized to make the CEMSD. The CEMSD gathers and sends information from focused estimating areas to a cloud worker by means of remote organization or cell organization, where information is gathered, handled, and available through a PC or any savvy gadget.

Keywords: Raspberry Pi, Internet of Things, GPS, PYTHON ARM.

I. INTRODUCTION

Observing of environment is information assortment and environment parameters data gathering. Observing and surveying the maintainability of our regular health is additionally significant for proficient environmental arranging, policymaking and natural contamination goal. This conveys the wellbeing danger of manual observing for an incredibly polluted region. Building up a gadget would be a successful alternative for distant observing to such an extent that the checking can be performed with no human obstruction. As of late, researchers have been utilizing frameworks as information gathering instruments to all the more likely comprehend natural cycles [1]. Track climatic conditions and, at the front line, the most recent moving remote sensor request to send an adaptable and distant observing framework, an effective stage that empowers clients to control their regular introduction to air contaminations by giving data on air quality created by different detecting foundations. The sensors control the air quality on an intermittent premise. Information can be followed and gotten to utilizing mobile phones or an Internet-empowered PC from anyplace. The execution incorporates air quality, CO, CO2, and temperature and dampness sensors to screen the surrounding condition.

1.1 AIM OF THE PROJECT

The capacity to gather explicit Environmental discharges has gotten widespread in metropolitan urban communities because of advances in innovation and quickened financial turn of events. The objective of this investigation is accordingly to plan an ease, cloud-based keen framework called Cloud-Based Smart Device Environment Monitoring (CEMSD) that tracks different natural boundaries, for example, air quality, clamor, temperature and stickiness. The Raspberry Pi 3 (RPi 3) Model B and thusly a microchip with DHT11 temperature mugginess sensor, Grove-Loudness sensor, Shinyei PPD42NS Particulate Issue (PM) woods dust sensor, COZIR wide range 100% Carbon Dioxide (CO2) sensor and MQ131 Ozone (O3) gas sensor are utilized to make the CEMSD. The CEMSD gathers and sends information from focused estimating areas to a cloud worker by means of remote organization or cell organization, where information is gathered, handled, and available through a PC or any savvy gadget.

1.2 SCOPE

IoT is in boom today. This innovation is applied on the Internet of Things is the organization of physical items containing embedded technology that assists with building individuals to machines or machines communication. This venture essentially bolsters an independent system that offers a dynamic datasheet on the city condition's boundaries. The machine utilizes Raspberry Pi, a minimal effort low-power ARM based minicomputer. It can convey through Local Area Network (LAN) or outer module Wi-Fi. Client orders are handled utilizing the language of Python on the Raspberry Pi. Other terminal gadgets, for example, Laptop, Smart Phone and Tablet blessed with the web office can follow the information. This framework offers admittance to constant data about a metropolitan domain that incorporates boundaries, for example, temperature, humidity, pressure, CO and harmful outflows from air.

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II. LITERATURE REVIEW

Most importantly, the study was completed on wireless technologies to make an organization of remote sensors. The exploration proceeded to pick the necessary wireless advancements. It ought to be adequate in all zones, for example, the technological and economic. The essential issue that we should answer while picking the correspondence approach is choice of communication. A web source, the information can be shared through his IP address anyplace on the planet. Further exploration on picking the microcontroller has been performed. Execution of the gadget is contained with a mystery motivation behind accomplishing low force consumable arrangement.
Cloud-based Smart System for Environment Control" [1] by Biao Jiang and Christian F. Huacon, Natural contamination has gotten uncontrolled in the metropolitan urban areas because of advances in innovation and quickened economic growth. The point of this exploration is hence to plan a minimal effort, cloud-based brilliant gadget called the Cloud-based Environment Monitoring Smart Device (CEMSD), which screens different natural boundaries, for example, humidity, noise, temperature, and air quality. In their paper "IoT Based Urban Climate Monitoring utilizing Raspberry Pi" [2], by Rohini Shete and Sushma Agrawal, The IoT is the organization of physical items containing installed innovation that assists with setting up availability from man to machine or machine to machine communication. This venture basically strengthens an independent system that offers a dynamic datasheet on the city condition's boundaries. The machine utilizes Raspberry Pi, a minimal effort low-power ARM based minicomputer.
Sanjib Kumar Deb, Jahed Hossen Rokky, Ms. Juliana Shetara, Tuton Chandra Mallick, "Plan and Development of an Underwater Robot (IEEE)" in their paper [3], this task depicts a remotely worked submerged robot that can go submerged and can undoubtedly be worked even by an android smart phone. An arduino based stage utilized for the encoding, transmission and accepting of all data. With the headway of PC and data preparing innovations, there are numerous sorts of robots being assembled and built. In their paper "Internet of Things-IoT: Definition, architecture, characteristics, enabling technologies, future challenges, and applications", by Patel KK, Patel SM (2016) [4], have spoken in detail about Internet of Things, its history, characteristics of IoT. It also explains the IoT architecture in detail. The function of each layer such as gateway, network layer and sensor layer, management application layer and service layer are described in brief. Future technological developments of IoT have also been explained in this project. Different operational layers and different inter-operability concepts of IoT have also been covered in the project.

III. METHODOLOGY

In this section, the overall proposed technique methodology is explained and discussed. The proposed method involves several steps to explain each step in the proposed method.

- Block diagram of the proposed system
- Circuit diagram of the system
- IoT and ARM based system

Current environmental inspection frameworks referenced in this part are additionally being analyzed to clarify the idea of this work, with an attention on environmental sensors, automated frameworks and IoT. Cyber physical environmental observing framework with present progresses in remote sensor innovation, low-power single-board PCs, and short-path communication advances, remote sensing detecting applications have improved towards frameworks that acknowledge ubiquitous processing. When a Cyber-Physical framework was proposed for environmental observing of indoor encompassing specifications. Raspberry Pi atmosphere observing gives the framework to checking the air of the city. Low cost Raspberry Pi utilized as gadget set in. No accentuation has been put, be that as it may, on particulate issue which left the observing arrangement of the environmental inadequate. The above subject only notices a couple of the few arrangements proposed for distant checking of ecological conditions, essentially utilizing remote detecting strategies, GPS, advanced mechanics and IoT-based innovations. The majority of these arrangements, nonetheless, just talk about information gathering and information perception. To determine the issue of far off checking of the environment with the evasion of health dangers, it is basic that the gadget gather information distantly through an independent automated framework and move of pertinent perceptions to a cloud server.

IV. BLOCK DIAGRAM

The robotic gadget proposed was intended to coordinate the inserted equipment, programming, and IoT modules. The design of the gadget is appeared at fig. 1 which shows the IoT and ARM implanted automated gadget block graphs. There are two parts of the whole mechanical framework:
1. Environment Monitoring System: This framework is answerable for social event sensor information and transferring the information accumulated to the IoT stage.
2. Navigation and Control System: This framework's basic role is to explore and control the development of the automated framework as coordinated by the application.

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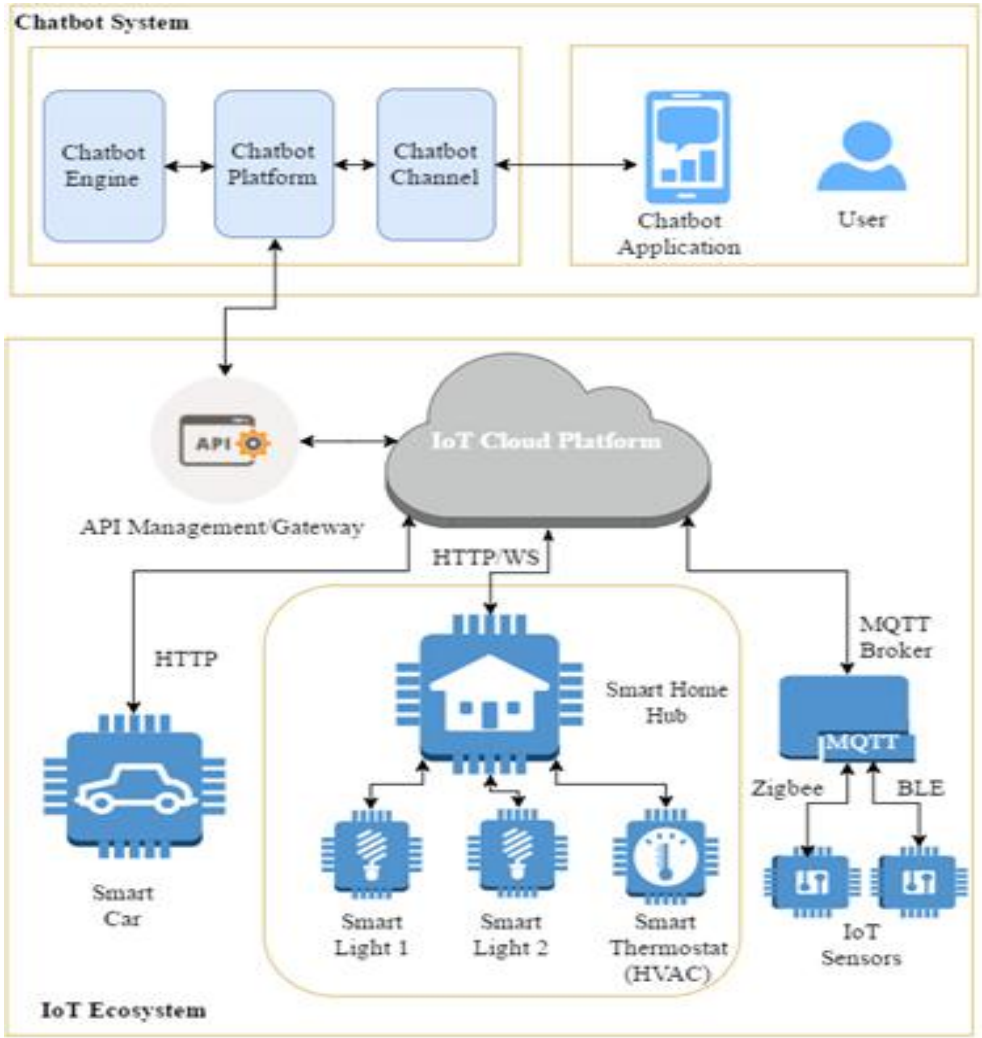

Fig -1: Block diagram of proposed system design

The Raspberry Pi is utilized by the natural observing framework to interface with three sensors, for example, the DHT11, the MQ135, and the MQ7 gas sensor. The Raspberry Pi assembles sensor information from focused areas and transfers information straightforwardly available by the client into the IoT organization. The robot is important for the Internet of Things since it needs network availability through a raspberry pi-associated GPRS module, it utilizes sensors to gather information on natural boundaries, and so negligible human communication is required for the gadget. The Arduino mega microcontroller, GPS and Compass module, DC engine, and robot skeleton comprise of a robot route and control framework. Arduino engine shield with L293D engine driver used to control the DC engine with Arduino. The route framework utilizes the Arduino to speak with the GPS module and the compass to explore and go from the underlying situation to the objective in a fixed way. We introduced an ultrasonic separation sensor for exact route, so it can keep away from deterrents. So as to give directions that can impart through the Bluetooth connect, an application has been made.

4.1 Hardware Components

Raspberry Pi 3B: The Raspberry Pi 3B (RP) is a solitary board PC dependent on ARM. It has a 1.2 GHz and 1 GB RAM Broadcom BCM2837 64bit ARM CortexA53 Quad Core Processor SoC. It has 40 broadly useful GPIO pins. It likewise includes remote LAN and Bluetooth network which makes it the ideal answer for effectively associated plans.

Arduino Mega: The Arduino Mega is an ATmega2560 based microcontroller board that incorporates 54 optical information/yield pins, 16 simple data sources, 4 UARTs (equipment sequential ports). ATmega2560 is our inclination since it is a simple choice to use in automated prototyping easily.

Ecological Sensing Sensors, for example, the DHT11 temperature and moistness sensor, the MQ-7 carbon monoxide gas sensor, and the MQ135 air quality sensor are utilized in the automated framework. The gadget can likewise follow natural

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boundaries, for example, CO2 and furthermore smoke. The DHT11 is a remote sensor of mugginess and temperature. To test the encompassing air, it utilizes a capacitive mugginess sensor and a thermistor and spits a computerized signal on the information pin. The air quality sensor is the MQ-135 sensor for the recognizable proof of the airborne harmful gases. Being a very destructive gas Carbon monoxide (CO) is scentless, dreary, making it difficult to smell, see, or taste, making it hard to recognize. MQ7 Carbon Monoxide (CO) gas sensor detects centralizations of CO noticeable all around and yields the perusing somewhere in the range of 20 to 2000ppm as a simple voltage. This sensor has a quick reaction time and high affectability. There is a screw potentiometer that takes into consideration manual acclimations to the sensor's yield gain. To change over simple information to computerized information acquired from the two sensors, the ADS1015 is utilized.

Route and Control Hardware: The gadget incorporates the Ubox NEO-6 M GPS module and the HMC5883L compass with Arduino super for route. A satellite-based route framework that furnishes the robot with basic situating capacities is the Global Positioning System (GPS). The ultrasonic separation sensor HC-SR04 is utilized for impediment identification en route. The engine shield of the L293D guides the development of the robot as per its route. The HMC5883L is a triple-pivot magnetometer that detects the north attractive pole utilizing the principal hypothesis behind electromagnets. The reduced sensor imparts utilizing I2C. The L293D, A motor driver is an incorporated circuit chip that is typically utilized in the robots to control engines.

ThingSpeak: It is utilized to gather and store sensor information in the cloud and aides in IoT application improvement. Programming interface keys to peruse and compose have been created on ThingSpeak. The Raspberry Pi associated with the web empowered GPRS module which sends the information incentive to the IoT stage from the sensors. ThingSpeak utilizes MATLAB apparatuses to perform constant representation. Indeed, even the information can be separated legitimately from the site and anybody can utilize any factual programming to measure and picture the data.

Equipment network gadget: The framework utilizes a HC-06 Bluetooth module to introduce individual zone organizations (PANs). To communicate with the App it was connected to Arduino. The SIM800L GPRS module permits Raspberry pi to associate through a comparing pin connect to the wide region organization (WAN). In this undertaking, the procedure utilized for correspondence with the fringe framework is I2C (Inter-Integrated Circuit).

4.2 Hardware Design

The automated gadget, which is of the wheeled kind, is developed utilizing mechanical and electrical segments. For the route and control framework, the Arduino super fills in as the focal part. The GPS module is mounted on the Arduino to stamp the robot's area with GPS facilitates. To quantify the separation between the robot and an obstruction, the robot is fitted with an ultrasonic sensor. The gadget moves as indicated by the guidelines of the application on a set way. Fig. 2 fits the whole machine circuit outline.

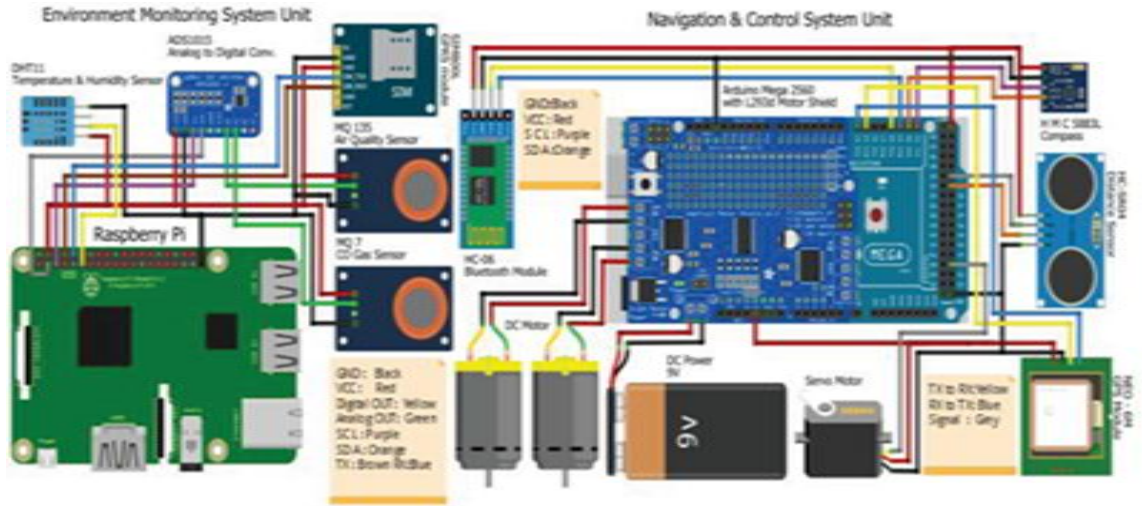

Fig -2: Circuit diagram of the system

To control the development of the robot, two DC motors are utilized. The Arduino is connected with HC-06, HMC588L, and Neo 6 M GPS Modules. Notice that the HMC588L compass ought to be found away from any ferromagnetic component; in any case the robot can be misled. For this reason, the compass has been mounted away from the fundamental body made of a ferromagnetic part in a surface made of plastics and wood. This implies the compass gets

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the robot's right course. For in any event four satellites, the GPS module look and gets a GPS area. Subsequent to getting a GPS position, it follows the product stream of the installed C code and goes to the GPS area of its objective, which App will give to the robot. For all modules VCC is 5V, and on Arduino board the GND is joined to the GND. Rest of pin associations from table 1 are followed. In the plan of the natural checking gadget, detecting simple incentive from the environment is the most significant segment. I2C sequential correspondence and just computerized input is empowered by the Raspberry Pi. The ADS1015 ADC that upholds I2C correspondence has been utilized to tackle this issue. The GPRS module is connected to the Raspberry Pi, guaranteeing a WAN association. Utilizing the ThingSpeak API key, the Raspberry Pi follows the program stream of Fig. 2 and utilizes an Internet association with start transferring sensor information. For a web association, the GPRS module incorporates a SIM card. The MQ7, MQ135, DHT11, sensors ought to be associated with raspberry pi by means of ADS1015. For all VCC modules 5V is ready, and the GND is joined to the GND.

V. ANDROID APP DEVELOPMENT TOOLS

The MIT Software Inventor is a visual, block-based improvement condition that needs no past information on programming. As the android application creation apparatus, we picked MIT App Inventor. Application Inventor was mutually made by MIT and Google and has picked up notoriety as a learning stage and a route for understudies to rehearse creative innovations.

VI. EMBEDDING CODE IN RASPBERRY PI

The python code is utilized by the program stream of fig. 2 for acknowledgment of the environment observing system in programming for raspberry pi programming. The essential capacity of the code is to gather sensor information and use API keys to transfer the information to the IoT stage. At first, to run any implicit component, the framework instates libraries and modules that are required. At the same time, we have put away the API key as a variable. I2C correspondence was then permitted so it could speak with ADC pins to get the sensor's simple worth. From that point forward, we indicated one capacity for perusing the estimation of ADC. The ADC pin can peruse information from the sensor and store the incentive inside a variable. Another component was set for transferring sensor information to the IoT stage utilizing the API key variable. At last, if the web is open, the two capacities are brought in a circle which rehashes the calling of the capacity.

VII. EMBEDDING CODE IN ARDUINO MEGA 2560

In an incorporated improvement condition (IDE), the Arduino mega is customized with an inserted C language. At fig. 2, the Embedded C code program stream is given. At first, to run any inherent element, the framework initializes libraries and modules that are required. Simultaneously, the gadget starts with Bluetooth, Compass and GPS module sequential correspondence and I2C transport. The GPS module starts to look for and get at any rate four satellites from the outset to get a GPS coordinate. The machine gets robot's compass heading subsequent to getting the current GPS position. The client would then be able to set the GPS arrange as a waypoint to move the robot will be following. The waypoints are put away in a cluster so they can be utilized by the program to give the robot five areas that are pronounced by a waypoint exhibit, and a course is planned by a lot of waypoints. Each one of those measures should be possible by the application. We need to click "completed" in the application for affirmation subsequent to setting the waypoint. Next, to check the most recent GPS data, experience the waypoints, or reset the put away waypoint, the gadget is hanging tight for a Bluetooth signal. In the wake of accepting the App request "go to waypoint," the robot begins making a beeline for the first waypoint. On the off chance that it gets a "stop moving" request during the exchange to the objective, it will freeze the robot immediately. Until the stop signal is gotten, the robot will keep on refreshing the heading of the compass and GPS data, just as move to objective. Stream of the Embedded C Code application. The robot continues running until zero is equivalent to the separation to the objective. What's more, the calculation for conduct control is utilized to hold the robot on the correct course for a deviation of under 15 degrees. For deviations of under 15 degrees, deterrents of under 30 cm ought to be maintained a strategic distance from. On the opposite, its course or definite way finding the most limited turn range is changed by the fluctuation of in excess of 15 degrees and turns left or right. Provided that this is true, the robot pushes ahead towards the objective without any snags found inside 30 cm. It again looks for the most limited turn sweep when impediments are experienced and turns left or option to arrive at the objective. At long last, when it hits a waypoint, it advises the client of the current area and tests if this is the last waypoint. The robot stops in the event that it isn't the last waypoint and keeps on driving towards the following waypoint. Every one of these methodology continue during this, until the last waypoint is reached. At last, the robot finishes its ride in the wake of hitting a definitive waypoint. Alongside every one of these things, there is additionally the alternative to free the first set from 96 waypoints to reset the robot and restart the whole cycle.

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VIII. IOT AND ARM BASED SYSTEM

Fig 3 the full prototyping of the robot checking condition worked by GPS dependent on IoT and ARM and the Navigation and Control application. In far off regions, the model can work adequately to assemble information, alone or in groups. Contrasted and other current methodologies that require a more prominent number of equipment frill, the proposed framework is very financially savvy. Fig. 3 shows that the robot can viably catch and transfer natural information to the IoT stage worker, ThingSpeak. The direct update time in the field takes at least 15 seconds. The sensor information put away in the stage can be utilized to show and assess the natural boundaries. The carbon monoxide and carbon dioxide gas sensor information in ppm, temperature sensor information in degree centigrade and dampness sensor information in percent relative stickiness (percent RH) separately are additionally appeared in Fig. 3.

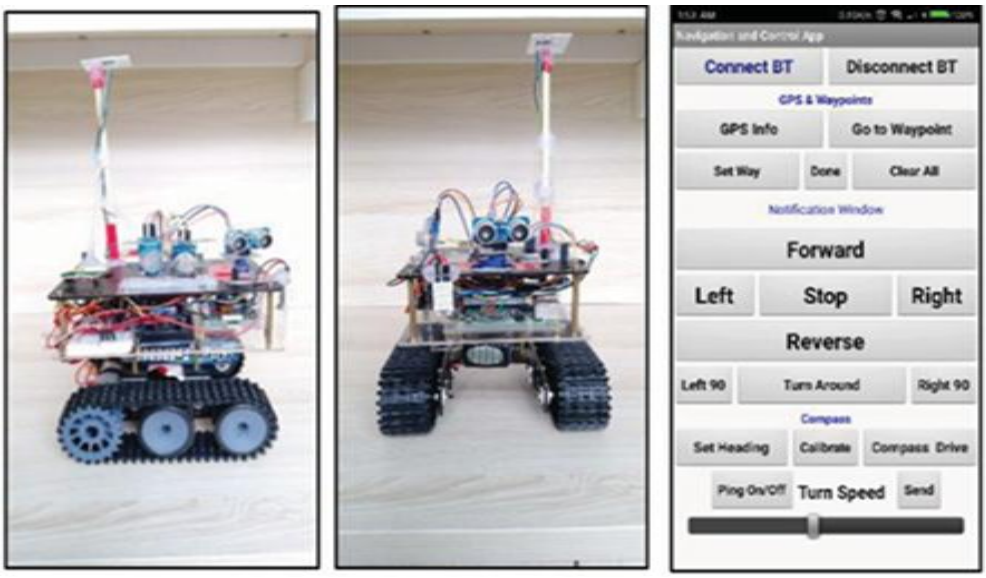

Fig -3: IoT and ARM based

Robotic gadget encourages clients to rapidly control the robot and move it. The GPS-controlled component permits it to move independently too isolated areas and presents the information gathered to the IoT server and presentations it for elevated level information examination and preparing on the site. Confirmation from graphical perception uncovers that the robotic framework works adequately. Moreover, the framework's principle focal points are the instinctive User Interfaces in the App and Autonomous development in the wake of accepting client direction. The gadget is practical, as well, and the expense is not exactly USD 80. In like clockwork it refreshes the sensor information to IoT worker. Safe IoT stage information, and available from anyplace on the planet. Future work incorporates numerous highlights including sunlight based force and inventive rustic systems administration arrangements. The gadget can be altered to independently recognize radiation, and considerably different dangerous gas structures, to forestall dangers to human hazard. Additionally, to make it much more unique, the plan approach can likewise be utilized in drone innovation.

IX. SOFTWARE AND HARDWARE DESCRIPTION

Software requirements for the project:
Robostic system
IoT and ARM
GPS controlled
Environment system
Libraries attached:
TinyGPS++
DHT11 PIN 3
Liquid crystal
Software Serial

Hardware requirements
Arduino, fire, gas, rain, lcd , DC motor sensor, USB Cable
Personal computer

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X. SOURCE CODE FOR SENSORS

While using Android studio to create any application, the following steps are to be followed.
Step 1: A Java record called MainActivity. PYTHON is the primary action code. This is the genuine application record that will at long last be meant an executable from Dalvik and will run your application.
Step 2: The activity_main.xml is an arrangement document accessible in the res/setup catalog that your application can reference as it develops its GUI. Frequently, you can alter this document to adjust your application's design.
Step 3: Whatever include you make as a feature of your application, you should pronounce the entirety of its segments in a manifest.xml that lives at the foundation of the task catalog for the application. This record goes about as an interface between your application and Android OS, so on the off chance that you don't proclaim your thing in this document, the OS won't acknowledge it.

10.1 Main Activity Python
The following code gives the actual program that connects the c with the client i.e. the android phone and the pc using the connect method. The publish and subscribe functions are written to publish a message to the broker from the personal computer based on the topic name and subscribe it from the broker and show it in an android phone.

The following functions are being used in MainActivity:
crystal(): The function, username and password of the are used in the function to build a secured connection with the broker. publish() and subscribe() functions are being called here within this function to exchange messages. It is this connect() function which is called in oncreate() function of MainActivity.pyton. Rest are all sub functions.

Software():, the device or the personal computer passes message to the broker along with its TOPIC name in this function.

TinyGps(): based on the TOPIC name, i.e. if the name displayed in the broker matches with the subscribers topic name, then the message gets displayed on the subscriber. In this case, it is displayed in the android phone.

10.2. RESULT AND DISCUSSION
In this section gives the outcome and exploration of both the programs and the output as seen from system. We use more than two sensors and motor. They are,
1. Rain, soil, gas, fire
2. DC motor

Case 1: Rain, Soil, Gas, Fire

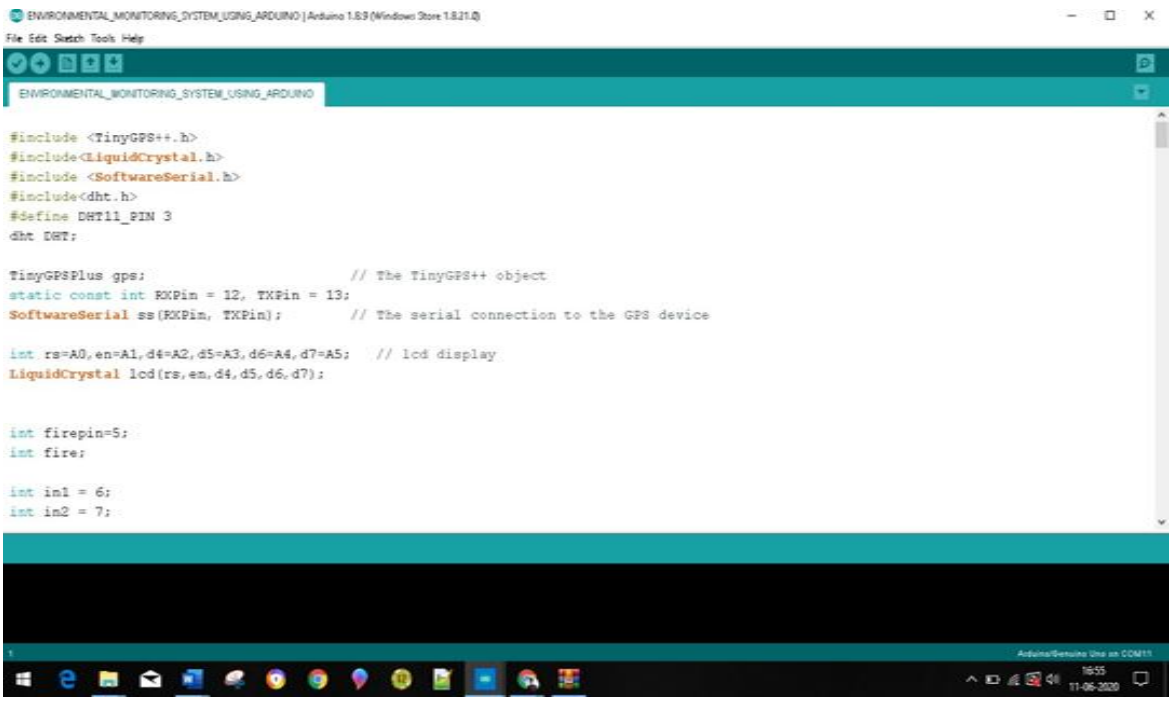

Fig 4. Rain, Soil, Gas, Fire sensors

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XI. CONCLUSION AND FUTURE SCOPE

CONCLUSION

Study and execution of a structure is done to follow environmental boundaries utilizing a situation. A low-power answer for setting up an environmental framework is given by the framework. The gadget is tried in both indoor and outside settings, and the ecological conditions from sensor information are effectively adjusted. Plan and usage of a GPS-controlled robot for IoT and ARM-based observing of natural boundaries have been accomplished. The manufactured ARM-based installed gadget with the IoT stage can follow the ecological boundaries, and conservative and practical air quality estimation. The outcomes got are viewed as helpful in checking the natural conditions progressively. The assembled App empowers clients to handily control and explore the robot.

FUTURE SCOPE

Many devices can be connected together, and a complete IoT application can be created by making little changes in the program.

Real time sensor data can be collected in the broker and can be subscribed to whoever requests for it using different topic names in the subscriber function using cloudmqtt broker. For example: android supports different inbuilt sensor values such as temperature, pressure, humidity, and intensity of light. They can be easily collected in a broker and read as and when required. External sensors connected to a device can also be read and shown.

Using the secure Wi Fi connection details, devices from different areas can be connected and the communication is established.

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