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Development of Portable Wireless Environmental Monitoring System

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ABSTRACT—Raspberry Pi hardware board is an economical wireless system hardware platform that can be used for wide variety of applications. In this paper consideration has been done about the software and hardware platforms along with fulfillment of details for application related to environmental factors observations and control by using Raspberry PI 3 Model B. The DHT11 sensor is utilized to watch temperature and dampness to additionally control the cooling system. The FC-37 sensor is utilized to identify the precipitation and further control the sprinkling framework. The MQ135 sensor is utilized to identify the nearness of risky gasses in the earth. The advancement in inserted system has demonstrated to a dependable arrangement in observing and controlling nature checking systems. The venture goes for building a structure which can be utilized on all around at any scale to screen the parameters in a given domain. With the development of scaled down sensor gadgets combined with remote advances it is conceivable to remotely screen the parameters, for example, temperature, dampness, sum of CO2 in air and some more . We have utilized raspberry-pi as our primary load up and sensors will gather all the continuous information from condition and this ongoing information will be brought by the web server and show it. Client can get to this information from anyplace through Internet. The reason of unnatural and erratic climate ranchers these days confront expansive budgetary misfortunes because of wrong forecast of climate and mistaken water system techniques and the measure of pesticides and bug sprays utilized for crops. This system will end up being a critical part being developed in rural field.

Keywords: - Raspberry pi, environmental system, temperature sensor, humidity sensors.

I. INTRODUCTION

The advancement in remote sensor systems can be utilized as a part of observing and controlling different parameters in the horticulture field, climate station field. Because of uneven and common appropriation of rain water it is exceptionally troublesome for ranchers to screen and control the circulation of water to horticulture field in the entire homestead or according to the prerequisite of the product. There is no perfect and propelled water system strategy for every single climate condition, soil structure and assortment of harvests societies. In the specific situation, with the advancement of scaled down sensor gadgets combined with remote advances, it is conceivable remotely screen parameters, for example, temperature and dampness and daylight power. Climate checking assumes an essential part in human life. Farmers suffer huge financial losses due to incorrect irrigation methods, wrong prediction of weather and the also incorrect amount of pesticides and insecticides used for crops. With over a decade of intensive research and development, wireless network technology has been emerging as a feasible solution to many innovative applications. Wireless network (WN) is a low cost network which can monitor conditions related to physical or environmental conditions, like as moisture, temperature, vibration, pressure, motion, light, or pollution at various locations. In this case , these smart sensors comprise of a network topology through self-organization [1].

The sensors nodes can transmit the data detected by their own sensor and can also pass the data to the controller

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terminal. We have seen another rush of improvements in open-source equipment/programming, institutionalization, and commercialization of remote sensor arrange innovations. In this paper, we utilized open source raspberry pi implanted Linux board which chips away at open source Linux working stages [2] [3].

The rest of the paper is briefly organized as follows. In Section II, summarizes about the related work the present system, in section III overall system architecture and methodology is described. Then, in Section IV the system design is presented in details. In section V, some experimental setup and results are presented. Finally, the paper is concluded in Section VI.

II. RELATED WORK

The outdoor wireless monitoring system given in [4] is designed for monitoring and predicting droughts. This system uses Internet of Things (IOT) for monitoring. The outdoor wireless monitoring system given in [5] is designed for environment monitoring. This system is reliable and uses MAC for data synchronization. .Another system given in [6] is based on time-domain algorithm to perceive damage of structure by WSN. This system has decision support based on the hypothesis tests to decide whether damages occur. It additionally enables client to separate harm defenseless highlights from accelerometers and strain checks. Varma et al. used Rabbit processor as an embedded web server and also implemented a Denial of Service attack detection mechanism [7]. Ibrahim et al. [8] by making use of the module like raspberry pi computing board developed a low-cost environmental monitoring system. Sensors utilized as a part of this work are temperature sensor TMP36, Humidity DHT22, CO focus utilizing MQ-7, Earthquake thin-film-piezoelectric sensor LDT0028K. Chowdhury et al.[9]designed a raspberry pi based guest warning framework. They have interfaced a camera to take a photo of the guest and tell through twitter. Wi-Fi correspondence was utilized to interface the camera and Infra-Red (IR) sensor for human nearness sensing. Raspberry pi was arranged as an Internet server to remotely impart the data to anyplace the client needs. Street lights were robotized through IoT innovation utilizing raspberry pi by Leccese et al. in [10]. Ray [11] has completed a comparable work to screen MISSENARD record utilizing Arduino equipment stage and ThingSpeak and Plotly cloud programming stage. Other intriguing uses of Raspberry pi incorporate controlling an auto remotely [12], home automation [13]. Pavithra and Balakrishnan [14] proposed a productive system for checking and controlling the home machines by means of World Wide Web. In this work correspondence happens through web entryway by utilizing conventions like Zigbee, WiFi and so forth . Sandeep et al.[15]have proposed this computerization framework to control machines in research centers with high versatility and security. Electronic gadgets were interfaced to the raspberry pi and were remotely controlled through weaved texture cloud stage. The General Purpose Input Output (GPIO) pins of the raspberry pi board were controlled utilizing Webiopi programming. The raspberry pi was interfaced to Digiduino board for intensification, keeping in mind the end goal to associate the hand-off changes to control the outside gadgets. Aksh et al.
[16] design a raspberry pi task to control wheel seat through IoT utilizing WebIOpi system. Security is one the significant worry in IoT ventures. Interruption Detection Systems (IDS) and Firewalls [17] takes the front seat in ensuring the system edge alongside have based security apparatus and tools.

III. PROPOSED SYSTEM ARCHITECTURE AND METHODOLOGY USED

Motivation The Motivation of Project is in recent developments in wireless and micro sensor technologies have provided foundation platforms for considering the development of effective modular systems. They offer the prospect of flexibility in use, and network scalability.

The Raspberry Pi has turned out to be perfect as the center of such a framework. There are numerous other handy uses for nature screen including checking of temperature and stickiness in a home, storehouse, nursery, or even an exhibition hall although this has been intended for detached observing it is conceivable to have this utilized for currently telling somebody of a temperature change, turning on warming.

Problem Statement: Design and Implementation of Environment observing framework utilizing Raspberry-Pi which is interfaced with different sensors (temperature, Humidity, CO2, Vibration). Constant information will be gathered by every one of the sensors and will be brought by the Web server. This information can be gotten to

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by the client through web program.

HARDWARE AND SOFTWARE SPECIFICATION

FOR COMPUTER: Computer with Internet. For Raspberry-pi

1. SD card of 8GB or 4GB.
2. HDMI/DVI monitor for display.
3. Ethernet cable for internet access or WIFI.
4. Keyboard and Mouse.
5. 5 volt power supply.
6. Sensors.

Software Specification: **Languages**: Python for Raspberry pi Board: Operating system: NOOBS

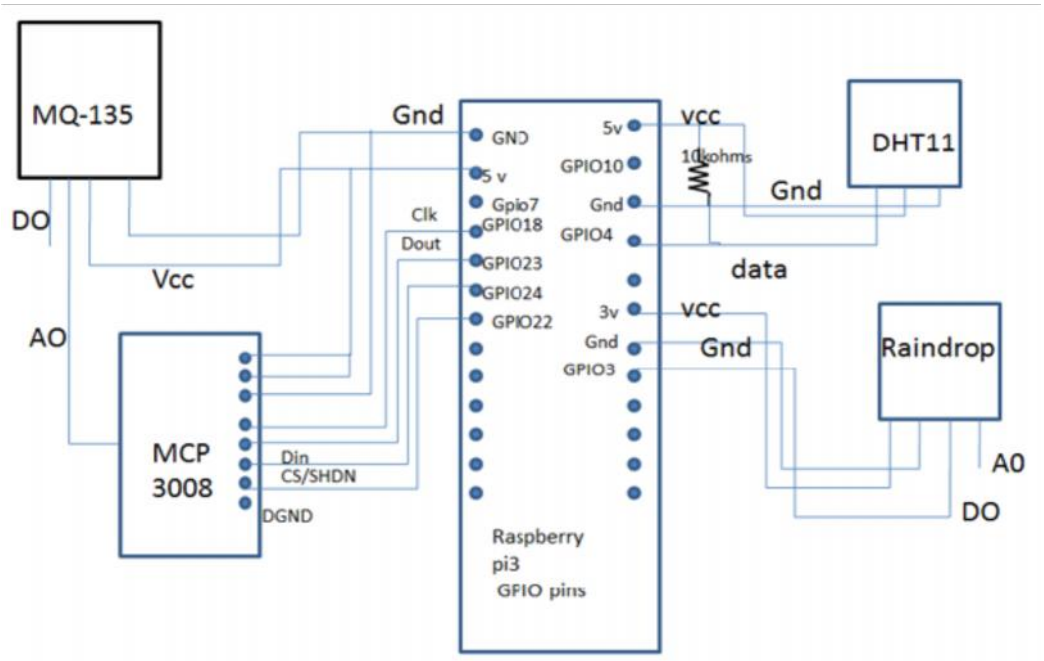

Fig 1: Proposed system architecture of a node.

IV. PROPOSED SYSTEM DESIGN

This work proposes a smart environmental parameters monitoring and control system using Raspberry Pi 3Model B. Three different sensors are used to monitor the temperature and humidity, rainfall, and hazardous gasses. The block diagram is as shown in Fig.1. A picture of the project hardware is shown in Fig.3. Proposed system .Figure.1 shows the block representation of the proposed Environment monitoring and control system. It has the following parts. a. Central Monitoring Unit , b. Sensor and Control Nodes d. Central Monitoring Unit (CMU) is connected to the internet. Through internet it can communicate with any internet enabled computer terminal or a mobile terminal which can be a smart phone. The sensor data is displayed on remote computer terminal and mobile terminal. The control command can also be initiated from the remote computer terminal or mobile terminal. The system makes utilize quick and exact Google spreadsheet administration to log the information on the web. The control activity is started utilizing the Google shapes benefit. As the reaction is gotten the focal observing unit distinguishes the reaction and gives the summon to the control hub. Sensor hub persistently screens the temperature and mugginess and sends the incentive to control unit which at that point stores esteems in the Google spreadsheet. This spreadsheet can hold the data for any amount of time and this data can be used for analysis purpose. So Record of data is always available online.

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About the sensors used in the system

Temperature Sensor: The Temperature sensor is used to measure the temperature. It converts physical quality – temperature to a signal suitable for processing electrical signal using a display unit that is attached to a system which uses an inter integrated circuits for communication

DHT-11 is a temperature and humidity sensor, shown in Fig.3.

The benefit of this sensor is it is very dependable, low value, great quality, quicker reaction time, and surmising free outline. This sensor can quantify temperatures running from 0 to 50oC with a mistake of give or take 2oC. The scope of mugginess measure that DHT11 can bolster is 20 to 90% RH with an admissible mistake of 5%. It can specifically give an advanced yield its own serial correspondence convention. It can work at a low supply voltage of least 3V up to 5.5V. It has just three pins, for Vcc, information, and ground. It utilizes Negative Temperature Coefficient (NTC) based temperature detecting segment, and dampness substrate based moistness detecting segment.

FC-37: It is a raindrop sensor, shown in Fig.4. It contains two sections, one board is the electronic board and the other one is the rain drop gathering board. It has both simple and in addition advanced yield. The advanced yield is one piece double to demonstrate if there is rain or not. It works on a 5V supply. The computerized yield stays at an abnormal state when the surface is dry and yield goes to a low level when the surface is wet.

Power Supply: A power supply is a device that supplies electrical energy to one or more electric loads.. The supply voltage is 12v. The supply voltage is provided with the use of battery.

FIG 2: Different Sensors Used- Temperature, Humidity, Gas, Rain Drop, and LPG Gas Sensor.

MQ-6: This is a simple-to-use liquefied petroleum gas (LPG) sensor which is suitable for sensing LPG concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm. Here it is assumed that it is composed of mostly propane and butane

This sensor has a high affectability and quick reaction time. The sensor's yield is a simple protection. This sensor module uses a MQ-6 as the touchy part and has an insurance resistor and a flexible resistor on board. The MQ-6 gas sensor is exceedingly delicate to LPG, iso-butane, and propane and less touchy to liquor, cooking smoke and tobacco smoke. It could be used in gas leakage detecting equipment's in family and industry. The resistance of the sensitive component changes as the concentration of the target gas changes. USB Camera: USB Cameras are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data.

USB camera: This is used intended to effectively interface with committed PC frameworks by utilizing the same USB innovation that is found on generally PCs. The camera display utilized here is USB Camera show 2.0. The openness of USB innovation in PC frameworks and additionally the 480 Mb/s exchange rate of USB 2.0 makes USB Cameras perfect for some imaging applications.

Raspberry Pi: The raspberry pi is a low cost, low power credit size single board computer which has recently become very popular [18]. The raspberry pi is the least expensive ARM11 fueled Linux working framework fit single board PC board. This board runs an ARM11 microcontroller @700MHz and accompanies a 512 Mega Bytes of RAM memory .In this paper, raspberry pi B+ display is utilized as appeared in figure 4, as this model has better determinations when contrasted with other raspberry pi models. It bolsters various working frameworks including a Debian-based Linux distro, Raspbian which is prescribed by raspberry pi establishment, which is utilized as a part of our outline. Raspberry Pi can be associated with a neighborhood through Ethernet link or USB Wi-Fi connector, and after that it can be gotten to by in excess of one customer from anyplace on the planet through SSH remote login or by putty programming by simply putting raspberry pi ip address in it. The raspberry pi is booted by outside SD or miniaturized scale SD card.

The board contains different highlights like camera connector, port for Ethernet, GPIO pins for interfacing

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sensors and more switches, The USB ports utilized for to associate with outside Devices The HDMI port to interface to screens to such an extent that LCD screens, projectors, TVs and so on and furthermore a sound jack is accessible. The Raspberry Pi has no inward mass stockpiling or implicit working framework and subsequently it requires a SD card preloaded with a form of the Linux Operating System.

Programming using python: Python have been used to program the raspberry pi. WI-FI port has been used to communicate with remotely located central processing/ monitoring unit. Also raspberry pi stores the data in the Google spreadsheet. Following libraries are required to be installed before writing down the main program. The python script starts at the boot and it looks for the available internet connection and if there is active internet connection then it sends the command to the nodes to get the latest values of the sensor parameters then it store these values to the spreadsheet. Python is a broadly utilized universally useful, abnormal state programming dialect. Its outline logic stresses code intelligibility, and its sentence structure enables developers to express ideas in less lines of code than would be conceivable in dialects, for example, C++ or Java. The dialect gives develops planned to empower clear projects on both a little and expansive scale. Python support various programming ideal models, including object-situated, basic and useful programming or procedural styles .It includes a dynamic sort framework and programmed memory administration and has an extensive and far reaching standard library.

V. EXEPERIMENTAL HARDWARE AND SIMULATION ALGORITHM

HARDWARE:

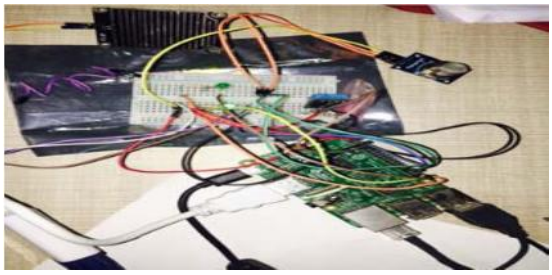

Fig 3: Hardware Module of system developed.

Fig 4: Basic Raspberry Pi module

ALGOROTHM USED

The algorithm that is developed for environ mental monitoring and control is as shown as under:.

Step1: start

Step2: declare variables humidity, temperature, gas, gas1, state, rain, sprinkler,

Step 3: loop

Step 4: reads humidity and temperature values from DHT11

Step 5: if temperature > 40, ac =on else ac = off

Step 6: reads state from FC-37

Step 7: if state==1 rain= rainfall detected and sprinkler = off else rain= not detected sprinkler= on **Step 8**: reads gas value from MQ-135

Step 9: if gas <180: gas1="normal gas " else if gas < 400 and gas> 380 : gas1= "co2 " else if gas < 440 and gas > 400 : gas1= "benzene " else if gas < 700 and gas > 680 : gas1= "alcohol "

Step 10: return temperature, humidity, rain, ac, sprinkler, gas, gas1 to webpage

Step 11: end loop Step 12: stop

VI. CONCLUSION

These paper designs a low cost Wireless environmental monitoring system including sensor node built on Raspberry Pi as remotely located node. The system designed here is easy to deploy having low cost, low power consumption, more reliable and simple to handle. One major advantage provided by the system is that, it has gateway node of Wireless Sensor Network, database server and web server into a single compact credit sized micro-computer Raspberry Pi. In addition, this system allows us to integrate other hardware components with the Raspberry Pi as a credit size microcomputer. Considering the system ability more sensing node can be added for application specific designing. The detail design and measurement result demonstrated shows the usefulness of this system. It is proposed to enhance this scheme for underwater applications.

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