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Raspberry Pi 3 Model B+ Based Endure Redicting Using Web of Things (WoT)

K. Manohara Rao[1], P V Subba Reddy [2], and M. Chaitanya Bharathi [3]

[1,2,3]Assistant Professor, Information Technology, PACE Institute of Technology and Sciences, Ongole, Andhra Pradesh, India

Correspondence should be addressed to K. Manohara Rao; manohar_k@pace.ac.in

ABSTRAC- The Web of Things (WoT) is a breakthrough technology that connects and controls the devices with the help of Web and make them smart and efficient. We build an WoT based Temperature and Humidity Sensing System using Raspberry Pi 3 Model B+. Endure is a vital feature in customary life, which plays a significant part in many deeds. Therefore, occasionally we need to know Endure parameter instantly. Raspberry Pi is a miniature standalone system with multiple functionalities were executed. You will interface a Digital Temperature and Humidity Sensor to receive regular updates about the Temperature and Humidity of a location remotely. The Sensor is connected to Raspberry Pi 3 Model B+, which you will program to send the readings to the Cloud Server through web, which in turn send update to Thing Speak. Thing Speak is an application platform, where the data is sent to the sever for live monitoring from anywhere in the world over web. Email notification to the user at intervals. The project deals about the Temperature and Humidity values, to read and monitor the values, using ThingSpeak system via Raspberry Pi 3 Model B+.

KEYWORDS- Raspberry Pi 3 Model B+, Raspbian OS, Debian Bullseye, Temperature, Humidity, Cloud Server, Thing Speak, DHT11 Sensor, Endure Predicting, Networking, System Etiquette, SSH Etiquette, HTTP, PuTTY, VNC Viewer.

I. INTRODUCTION

Endure is vital role in Natural Life. Endure have some parameters such as temperature, humidity, etc... Mostly, it will be useful for official people like government for aviation, transportation, fermentation, infrastructure, etc. It also useful for educational purposes too. We build a station, which is portable, high-speed, easily accessible. The data which were approach will be useful, when they receive immediately at accurate time, which can be done in latest endure predicting system. Transmission can be done in numeric ways like Wi-Fi, GSM, etc…. Mainly, it's useful for prediction, due to which we can avoid the loss by Endure monitoring system**.** [16, 12] In Future, WoT developers going to generate huge demand, it's going to attach more than 30 billion projects.

Using WoT concepts to develop a project, through which you can remotely monitor the endure of any location of your choice. The idea is to maintain the ambient humidity and temperature of a location remotely. DHT11 Sensor is a digital temperature and humidity sensor. The sensor sends out 40-bit serial digital data. The Raspberry Pi 3 Model B+ is the embedded environment to which the DHT11 sensor is interfaced. The Raspberry pi takes the input from the sensor, process the data and send out the approximate information through cloud server from Raspberry Pi Desktop through SSH Etiquette. The Raspberry Pi 3 Model B+ must have the access to the web, able to send information to the Application Programming Interface. The Network access can be given to either through the web or Wi-Fi. The python program written in Raspberry pi desktop Geany Programmer Editor. Output can be seen in thingspeak application or website through HTTP Etiquette. [2, 11] The process is shown in figure 1.

Figure 1: Process of the Endure Predicting based on Raspberry Pi 3 Model B+

The rest of the paper will be followed as: Literature Survey in section 2. Web of Things (WoT) in section 3. System Etiquette in section 4. Design Methodology in section 5. Proposed Methodology in section 6. Hardware Development in section 7. Software Development in section 8. Result and Discussion in section 9. And finally, Conclusion in section 10.

II. LITERATURE SURVEY

Arko Djajad et al. have proposed surrounding area parameters using WoT Sensor. WoT sensors related to Net Client and sequential interface like Modbus or I2C. Information Storing were transmitted to the Fog net by Web Etiquette. Information from all conservational, given as input to Arduino ATMega2560 board. Whereas, it's need Wi-Fi to connect network, to transmit the information to web page directly from Arduino by HTTP Etiquette. So, that they can view result in Graphical form, through free WoT server thing speak website or application. Entire

surrounding sensors castoff analog sensors. These sensors can be linked to analog pin of Arduino. Whereas, deuce communications are used, Serial-0 used for communication among Arduino then PC, and Serial-1 used for communication among Arduino then ESP8266. [15]

Tamilarasi B. et al. have presented their system that contracts with the efficient scheme and execution of WSN platform, which can be cast-off for longstanding conservational observing in WoT framework. [3]

Nikhil Ugale et al. have presented their system built on WoT for environmentally friendly ailment monitoring in residences. The projected system uses many sensors to collect information for residence and to monitor. PIC microcontroller used as monitor to senses the collection of information. Once, it turns on, send information to the user additionally to the server. They can receive information through SMS too. Whereas, the entire demonstration of the system architecture was successful, embedded system interconnected into the WoT Network. WoT friendly application were use in home automation. Where any device can connect. Information can be accessed widely. [1]

Kondamudi Siva Sai Ram et al. have presented their paper to collect data from particular place and to view information widely. This system is constructed for observing and monitoring the conservational circumstances such as temperature, relative humidity, light intensity and CO2 level using sensors also directs the data to the website or application. So, that they can view result in Graphical form, through free WoT server thingspeak website or application. Entire surrounding sensors castoff analog sensors. Information can be accessed widely. Information from all conservational, given as input to Microcontroller (LPC2148) and device are also connected. Whereas, it's need Wi-Fi to connect network, to transmit the information to web page directly from Arduino by HTTP Etiquette. deuce communications are used, Serial0 used for communication among Arduino then PC, and Serial1 used for communication among Arduino then ESP8266 having Web Etiquette interlinked on chip integrated to it. [10, 14]

Ms. Padwal S. C. et al. have presented their system to execute a WSN platform that can be castoff for a variety of elongated term conservational observing for WoT framework. It proposes practical project of WSN used for WoT framework. [9]

III. WEB OF THINGS (WoT)

The Web is the universal structure of interrelated devices. These devices endlessly exchange or share resources and services. The Web of Things is an Web Etiquette Network and all devices linked to it, must have an IP Address, which devices intersect through the IP Address. Web have traversed many stages for its expansion like Web of Boffins as scientists in 1969 to 1995, Web of Geeks as Technologists in 1995 to 2000, Web of Masses as Common people in 2000 to 2007, Mobile Web as Handheld Devices in 2007 to 2011, and to finish Web of Things in 2012 and further than.

Web of Things is where different objects of our world are connected and controlled with the help of the web. These things are able to sense or interact with the atmosphere and can retort to uses over the web with the aid of technology. It is fundamentally a combination of Processer based system and the corporal world. Using data and communication technologies we can improve the excellence of recital and interactivity of Airborne services. Basically, WoT has the capability to make our life harmless, stable and comfortable. The Web of Things activity as shown in figure 2.

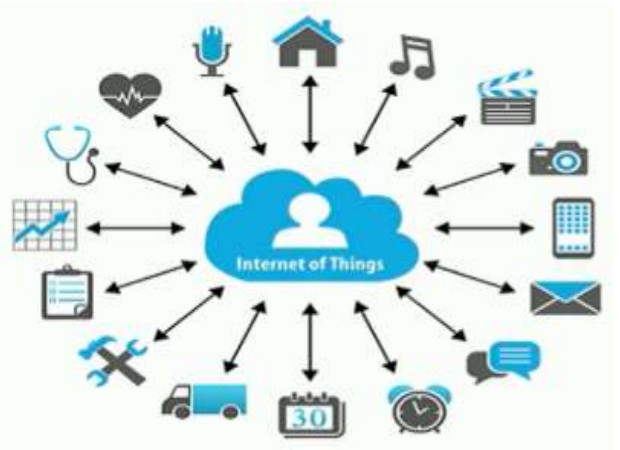

Figure 2: Web of Things (WoT)

Things, which can be no matter which, it can be observed or regulated. Things which interrelated with the embedded system, that includes sensors, etc. which is interact with user to retrieve the web. They can regulator or monitor the things occurring over Web of Things. WoT usually used Device to Device communication or Device to Cloud communication. Where Device to Device Communication join among one another. Rapidly, then over an intermediate application server. Device to Device communication communicate over many webs shown in figure 3. Then, in Device to Cloud communication attach directly to cloud server to exchange information and to prevent huge traffic. This approach regularly takes advantage of prevailing communication mechanism like traditional wired ethernet or Wi-Fi connection, to launch a system connection among WoT devices likewise IP Network. Which, otherwise attaches to the cloud server. Device to Cloud communication is shown in figure 4. [2]

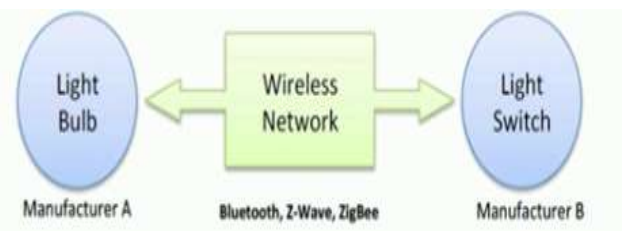

Figure 3: Device to Device Communication

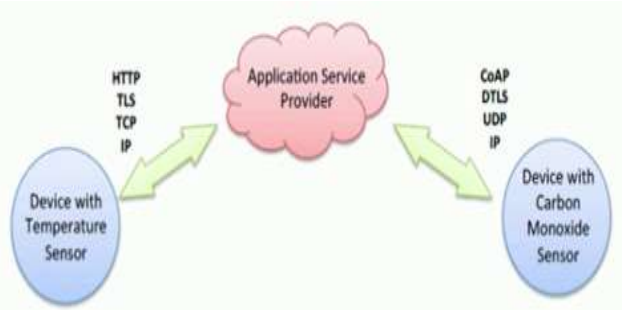

Figure 4: Device to Cloud Communication

IV. SYSTEM ETIQUETTE

Standard methods of communicating and administering various kinds of data are used, these methods called as etiquettes. Theses Etiquettes are established by worldwide agreement and guarantee that system everywhere can interconnect with each other. Where basically two operations are used to interrelated together, they are Transmission Control Etiquette (TCP) and Web Etiquette (IP). In fact, each as different function. The software program consecutively on the fixed web server follows the same layered construction as used in the TCP/IP etiquette suite. [8] Data send over the web and broken up in the mid of way into smaller particles as packets. These miniature transmission leads to different routes and reassembled in the terminus. TCP is the main for recreating it, at the terminus. The packet holds IP Address, show them where to reach shown in figure 5.

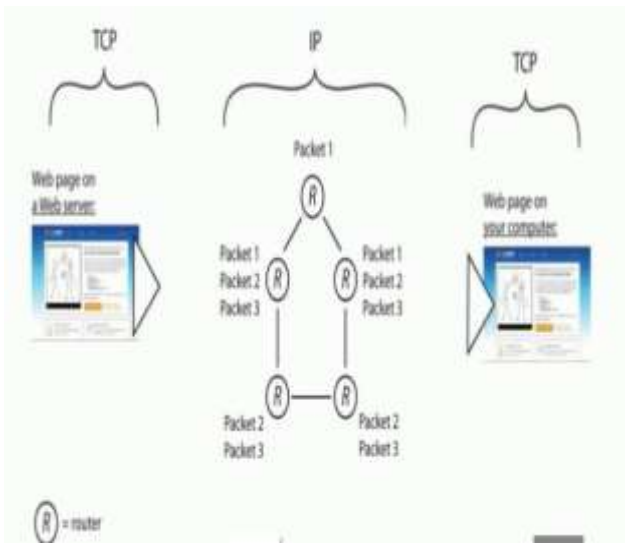

Figure 5: IP Address Packets to reach the terminus

Every System hardware or system will be given Unique IP Address. Hypertext Transfer Etiquette used to transmit HTML Page over the web. Which uses send data as well as receive too. Secure Socket Shell (SSH) as Unix based command interface and etiquette for securely receiving approach to remote system. Whereas, both end of the client server of the construction are authenticated using digital certificate and passwords are produced by the being enciphered. Implementation of SSH Etiquette proposals command-shell, transfer files, and remote access hang on on TCP/IP application through a secure tunnel. [4] SSH Etiquette are shown in figure 6.

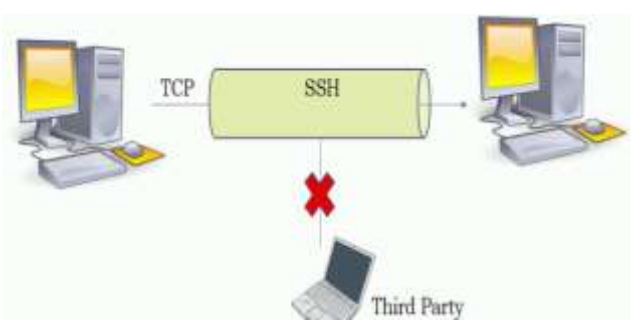

Figure 6: SSH Etiquette

V. DESIGN METHODOLOGY

Totally, three phases used in the project, Figure 7 shows the level of phases achieved.

Phase 1: Endure predicting site and framework expansion – These endure parameters using sensor and the raspberry pi 3 model b+ with built-in wi-fi or web is used to capture all the data from the endure sensor. The measurement taken include temperature and humidity.

Phase 2: Relocating Information to the cloud server – Raspberry Pi 3 Model B+ will stream the data directly to the cloud. Cloud platform that are suggested to be used. SSH Etiquette Connection can tenuously access the putty to open Raspberry pi desktop. Through which raspberry pi a miniature system can be accessed, that is Linux based Operating system. Whereas, VNC Viewer allow to tenuously to access the raspberry pi desktop. It streams data into the cloud and store and analysis data collection.

Phase 3: Implementation of Web of Things (WoT) – Set programming instructions and standards for accessing a web-based software application or web tool are readily defined in a web application programming interface. Even the browser that you use, to browse the web is an application programming interface, which takes the user data sends request to the server and then display the required data. Thingspeak plays vital in live streaming the data, that takes from server. Which it's store data in the cloud server. Output can be viewed to the user or client in the form of website or application as thingspeak.com or ThingSpeak.app for system or laptop or phone and networking HTTP Email also used. [17, 18]

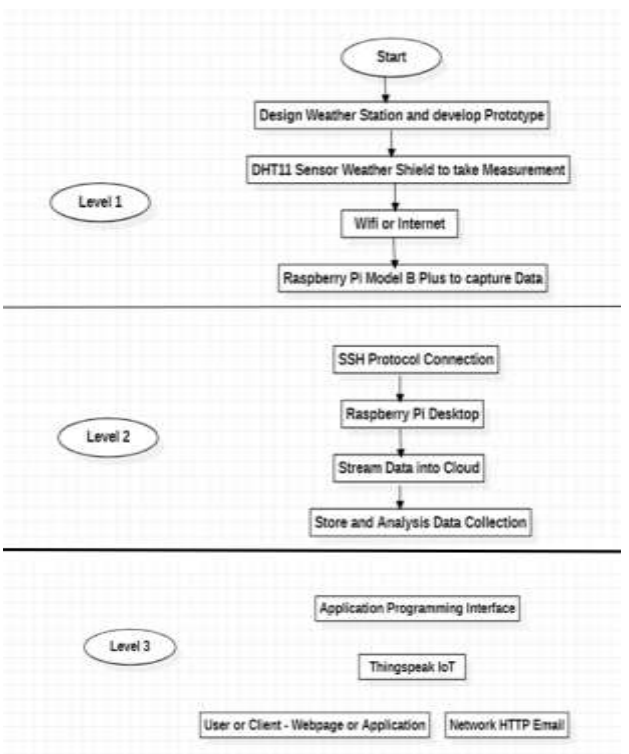

Figure 7: Project data flow

VI. PROPOSED METHODOLOGY

Raspberry Pi 3 Model B+ has latest technology, which is wireless. [6] The detailed system architecture is shown in the figure 8. The Raspberry Pi were connected with sensors, which will be hardware. Whereas, software collects information or data of the sensor. The framework

of the system where endure predicting site is developed and the framework were expanded. Relocating data or information to the cloud server. Implementation of Web of things take place. Mainly, it builds our system using raspberry pi 3 model b+, then remote desktop connection in networking, then application programming interface take place. Finally, Building of WoT Endure site or station take place. Where, some software implementation take place in GitHub [16].

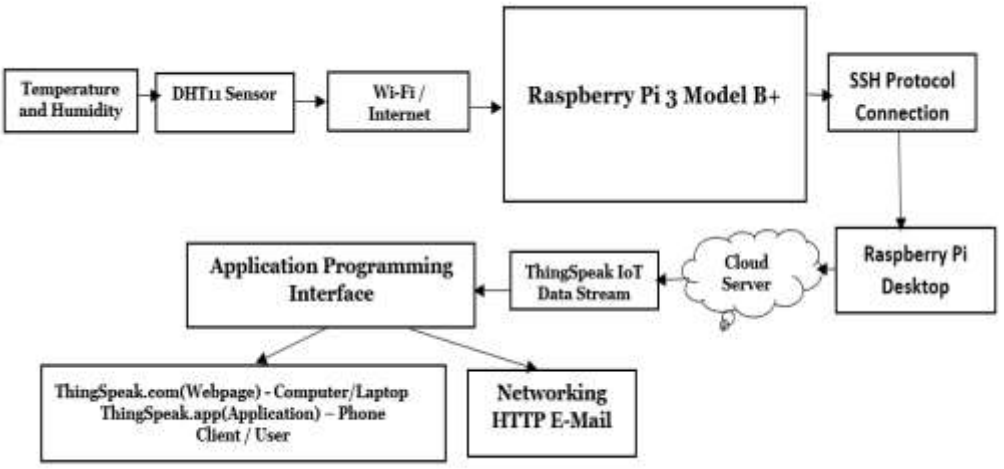

Figure 8: Architecture of proposed system

VII. HARDWARE DEVELOPMENT

A. Raspberry Pi 3 Model B+

Raspberry pi is an economical, miniature standalone system that pads over a laptop desktop or TV set, and practises a typical console and mouse. It can also use to play games or watch high definite video. Which is low cost, lower power consumption, listen working, instant start up, easy to program. Raspberry pi has launched up to 5 models. Model A is the basic once, where it has no inbuilt ethernet compared to model b, it has two extra USB port and micro-SD card slot. [13] The figure 9 shows the raspberry pi 3 model b+.

Figure 9: Raspberry Pi 3 Model B+

Broadcom BCM2835 on the chip that system on chip or sac is integrated circuit, which integrates all the components of a system into single system. It made up of an arm CPU and video core graphics processing unit. This is the mind of the system. This CPU handles all the computation that makes system works, like taking input, doing calculation and producing output and GPU handles graphic output. Core frequency set to 700 Hz. Video core IV GPU with HDMI and compute output. Ability to boot from SD Card. Video core is a low power mobile multimedia architecture. Raspberry Pi doesn't have permanent storage of its own. Hence, uses the storage on SD Card. Even the operating system on the Raspberry Pi written on SD Card. GPIO Pin are the export journal purposes input output connection points. That allow interfacing of the sensors and actuators. There are 40 GB GPIO Pin on the board. RCA Jack that allows Connection on the Analog Television and other similar output like speakers and Microphone. USB Port is the common connection USB Port that connects peripheral devices like keyboard, mouse, printer, etc… CSI Camera Connector used to connect external camera to the board. HDMI Connector allow to hock up a high-definition television or other comparative devices with the HDMI cable. 5Volt Micro USB used to power up raspberry pi using USB Cable. Ethernet Port is used to connect raspberry pi to a wired network. SD Card Slot is the hard drive for the Raspberry Pi 3 Model B+. [5] The parts of the raspberry pi 3 model b+ shown in the figure 10.

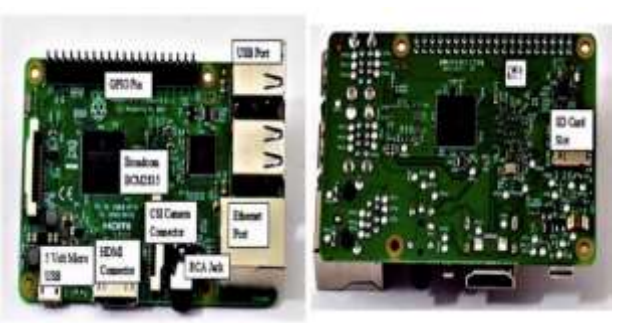

Figure 10: Parts of the Raspberry Pi 3 Model B+

B. DHT11 Sensor

Sensors are a device which measures physical quantity and record intimate or response to it. The DHT11 is a straightforward, ultra-lowest digital temperature and humidity sensor. [13] The sensor includes a resistive type humidity measurement component. NTC Temperature

measurement component, which are connected to the 8-bit microcontroller. It has operating voltage 3-to-5-volt, measurement range 20 to 90% RH and 0-to-5˚ C, humidity accuracy ±5% RH, temperature accuracy ±2˚C, resolution 1 and package 4 pin single row. Temperature which degree of heat present in an object or in atmosphere. Humidity is amount of water vapor present in air that is quantity of water in its gaseous state. This DHT11 Humidity and Temperature Sensor has 4 pins. Pin1 is the VCC or Voltage Supply pin. Pin2 is the Data Transfer pin. Pin3 is not connected. Pin4 is the ground pin. The data is sent seriously in digital format. The specification of the module is mentioned at the bottom surface are shown. The etiquette must be executed in the firmware of the microcontroller unit with exact control obligatory by the sensor. [5] The figure 11 shows the DHT11 Sensor.

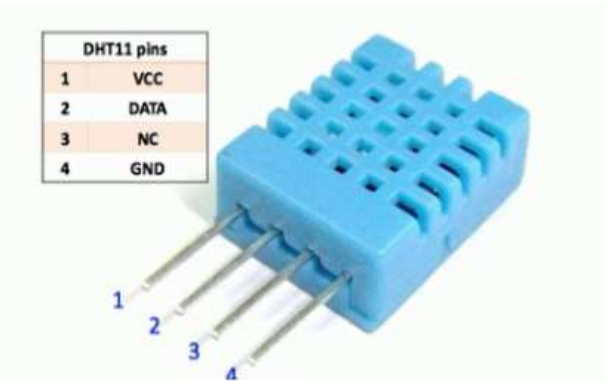

Figure 11: DHT11 Sensor

VIII. SOFTWARE DEVELOPMENT

C. Raspberry Pi OS

Raspbian is open software program. Raspberry has its own operating system called Raspbian. It is Linux based operating system mounted on SD Card. Raspbian is official operating system. [6] Windows as also launched Windows WoT-Core Operating system, which runs on raspberry pi. Programming Language can use in raspberry pi such as Python, Java, C, C++, HTML5. Recently, Raspberry Pi Imager is the quick and easy way to install an operating system to a micro–SD Card ready to use with your raspberry pi. Alternatively, we can also choose the operating system which we need to download. The Recommended software port of Debian Bullseye with the Raspberry Pi Desktop, which released on 30th October,2021. Totally, it supports nine architecture such as amd64, i386, ppc64el, s390x, armel, armhf, arm64, mipsel, mips64el. The Figure 12 shows Raspberry Pi Desktop.

Figure 12: Raspberry Pi Desktop

D. PuTTY

PuTTY is free execution for windows, Linux and Window WoT-Core, along with the terminator. It was developed by Simon Tatham for Windows. It mainly used for remotely access the raspberry pi operating system. It easy to use. It mainly recommenced to use Package file, window installer 64-bit x86. Figure 13 shows the PuTTY View. We can enable the graphical user interface. Which mainly, use to open VNC Viewer atomically, and access properly.

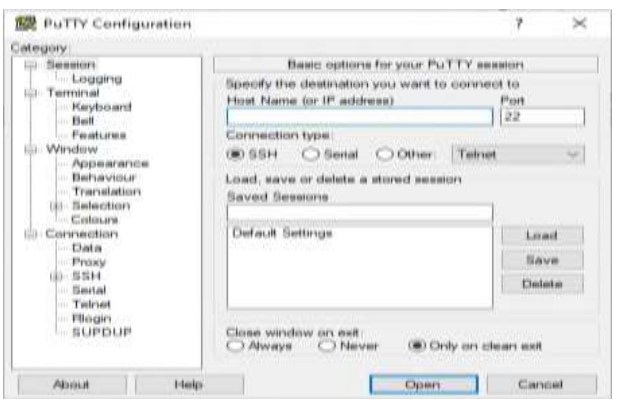

Figure 13: PuTTY

E. VNC Viewer

VNC Viewer a, which is known as Virtual Network System. This application will allow you to view the desktop interface of the raspberry pi on the remote system. VNC Viewer is the free source. Whereas, it transmits the devices from one user to another, by updating the graphical screen along with the network. It's recommenced to execute with x64/x86 version. Figure 14 shows the VNC Viewer.

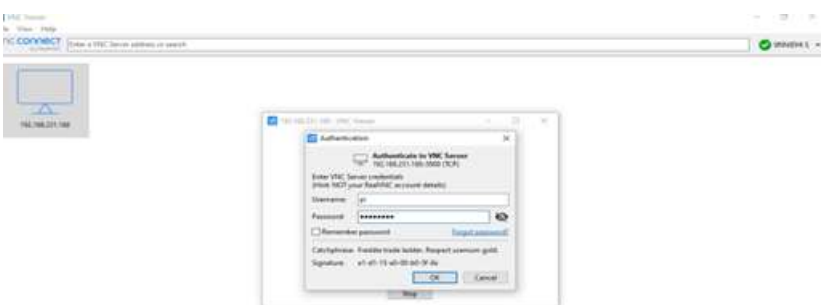

Figure 14: Virtual Network System

F. Python

Python is called Interpreted Program Language because you don't need to compile the code that you write before running it. Python is user friendly, commonly used. Python is an interpreted, collaborating, object-oriented, basic and high-level language. Python can execute on Linux operating system. [12] In this, we use Geany Programmer Editor in raspberry pi desktop. Geany Programmer Editor are shown in figure 15. Its free and less weighted Integrated Development Environment. It supports C, Java, PHP, HTML, Python, Perl and Pascal.

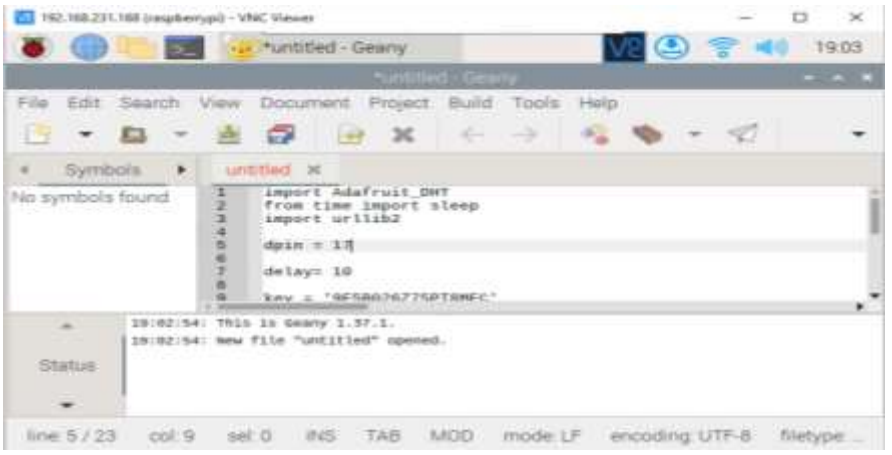

Figure 15: Geany Programmer Editor

G. Thing Speaks

Thing speak is an open data platform. where the data is sent to the sever for live monitoring from anywhere in the world using HTTP Etiquette over web as well as Local Area Network. Thing Speak permits the formation of sensor logging applications, site tracking tenders, and a communal network of things with status updates. [18] Create a Thingspeak account https://thingspeak.com/ and create the station to view the endure parameters. [7] Figure 16 shows the Thingspeak account. Where, generally, to able to access the data from Application Programming Interface, you need API Key, which is the code passed in by the system programs calling an API, to an identify the calling program, its developer or its user to the website. We will use Thingspeak API as part of the project to display historical data that the DHT11 Sensor reads.

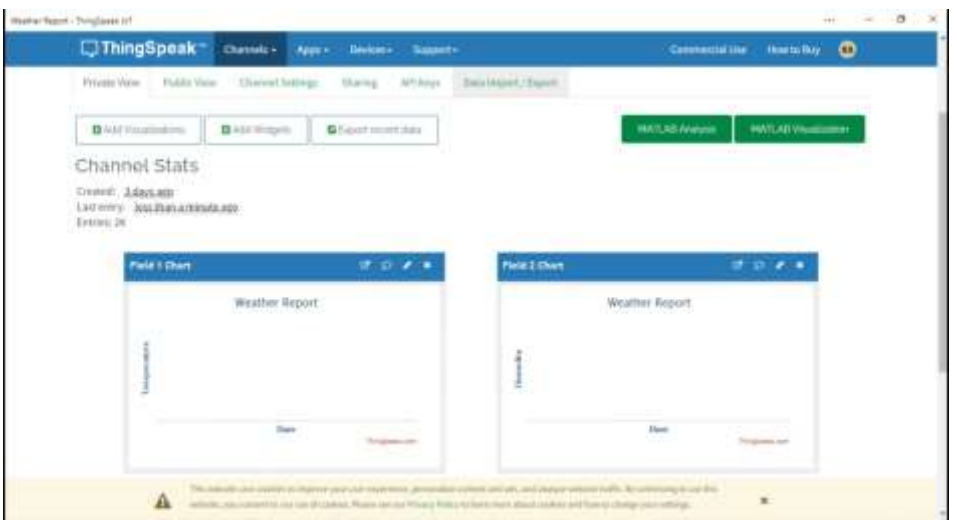

Figure 16: Thing speak Account

IX. RESULT AND DISCUSSION

At first, Raspberry Pi 3 Model B+ connected to the Ethernet cable via Wireless network. Raspberry Pi 3 Model B+ were powered up. The Software that is Raspberry Pi OS, which is Debian Bullseye stored in SD Card, which minimum need 16 GB WITH SSH File and Conf file. Conf file is for wireless network via bridge connection done. Then, booting up process take place. Meanwhile, Advanced IP Scanner, PuTTY, and VNC Viewer were stored. Advanced IP Scanner used to scan IP Address of the Raspberry Pi 3 Model B+. PuTTY is used remotely access the Raspberry Pi Operating System were SSH Etiquette take place. VNC Viewer which allow you to view desktop interface of the raspberry pi on the remote system. With, PuTTY codes were written to start VNC Viewer automatically. Raspberry Pi desktop occurred; program was written in Linux operating system. Some Libraries too stored to access DHT11 Sensor. Thingspeak account were created and create the station to view the endure parameters were HTTP Etiquette take place. Correspondingly, Hardware setup were done. Program were run to view endure predicting of Raspberry Pi 3 Model B+ with DHT11 Sensor of Temperature and Humidity. Cloud Server stores the data or information. Thingspeak used for

data stream. Where result, can be viewed in website or application for user as well as client. Full circuit for WoT Endure station are shown in figure 17.

Figure 17: Full circuit for WoT Endure station

The result can view thingspeak.com. Thingspeak website shown in figure 18 with endure report. DHT11 Sensors accurate the reads to Raspberry Pi 3 Model B+, sends to the cloud server and then reached in Laptop or Phone. The Temperature given in y-axis and date given in X-axis, which shows approximate data in a form of graph via Humidity. Figure 19 and 20 shows the Real-time graph of Temperature in ˚C and Real-time graph of Humidity in %. Which we can use further for calculating the circumstance or prediction regarding future endure temperature via Humidity. Mainly used in aviation, transportation, infrastructure, etc… which rapidly expand to many domains.

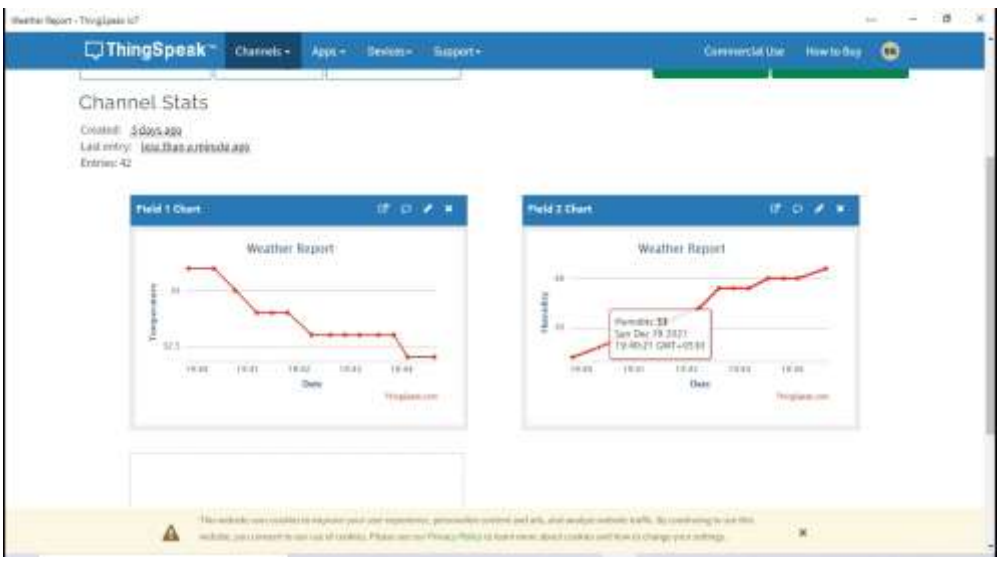

Figure 18: Thing speak Website

Figure 19: Real-time graph of Temperature in ˚C

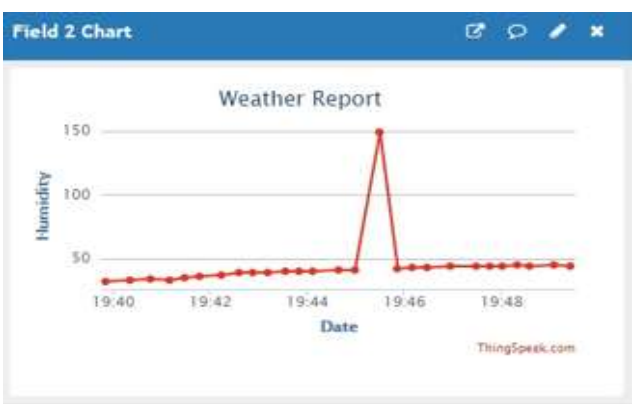

Figure 20: Real-time graph of Humidity in % . The analysis of results by using machine learning algorithms [19-23] give perfect prediction.

X. CONCLUSION

In Conclusion, a endure predicting system was gathered using Thingspeak and Raspberry Pi 3 Model B+ with DHT11 Sensor as the passage between sensor and WoT Platform. Data can view anywhere in the world through Application programming interface and in the form of graphical interface, which can be accessible by both administrator as well as user. By using the endure predicting system, the user can view as well as monitor and predict the current parameters without unwanted additional usage. Mainly, WoT Station application used for aviation, transportation, infrastructure etc.… This endure predicting system was efficiently useful because it's low power consumption, small in size, data transfer easily, good in performance, and remotely accessible. In preliminary

stage, the endure predicting system was done by tenacity method. However, exactness was low due to lacking data.

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