International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Internet of Things (IoT) based Warehouse Monitoring and Control Interface Implementation

Tejas S Patil[1], Sagar R Khedkar[2], Mahesh S Jadhav[3]

[1]Student, Dept. of Electronics Engineering, Walchand College of Engineering, Sangli, Maharashtra, India.
[2]Asst. Professor, Dept. of Electronics Engineering, Walchand College of Engineering, Sangli, Maharashtra, India.
[3]Sr. Lead Engineer, Qualcomm India Pvt. Ltd. Bangalore, India.

Abstract –*Across the globes, food and medicine worth billions of dollars are wasted every year primarily because of improper storage and transportation of temperature, humidity, and various gas sensitive goods. To overcome this problem the proposed system is designed to monitor as well as control cold storage parameters. So the system provides an end to end IoT solution to monitor and control using wireless sensors system. The system solution monitors temperature, humidity and various gases like LPG, CO, and Methane, whereas also provide the location coordinates of the warehouse in real time to keep food, vegetables, medicines, and vaccines safe in addition to reduce wastage. This IoT compromises of most advanced sensors and Particle cloud software. The sensor data is sent from node to the base station then will process and displayed on LCD. The data is pushed and stored on particle cloud and can be accessed remotely using a mobile application Blynk. The software allows the control action that is relay to be configured remotely using a mobile application. The device monitors the temperature in cold rooms, refrigerators trucks, restaurant freezers, medical storages, and warehouses in real time. It alerts immediately in case of any temperature excursion. This alerting helps the business to act proactively and eliminate waste and stay compliant to view temperature and location data, whereas the client can set the alert limit using a mobile application. The device also updates data into an excel spreadsheet on time intervals and send a daily email notification. The device is battery operated, dust proof and robust for environmental conditions.*

Key Words: **IoT, Particle cloud, Warehouse Monitoring, Blynk, u-blox SARA Electron 3G kit, Excel spreadsheet.**

1. INTRODUCTION

Any production or trading has a want to keep their reserves or any useful stuff somewhere. This feature is performed by the means of warehouses or storages in maximum cases. The warehouse can be an open platform, that is used for material storage or it could also be complicated system, where the products are stored, which calls for observance of certain conditions. With a growth inside the range of warehouses, cold storages, and factories the need for tracking diverse attributes in such factories has turn out to be a thing of exquisite necessity. Automation has become an inseparable part of nowadays for which IoT has emerged as an exceptional platform providing connectivity among various sensors, controllers and internet that allows far-flung tracking and controlling of various environments concern to automation. Approaching IoT design and sensing element permit real-time far off monitoring and evaluation of a system as well as the opportunity to take instant remedial actions if necessary. This system offer various solutions for such monitoring purposes with serial terminal output on putty, cloud events dashboard, mobile blynk dashboard, excel spreadsheet, and email notification. Various warehouse used for storing medicine, food, veggies, etc. have temperature and humidity-controlled environments. Real-time monitoring result will frequently monitor the temperature and humidness of the location.The device will constantly report the statistics on itself and display on the LCD display show in addition to over the cloud, excel spreadsheet, and blynk application. The controlling and tracking system will work automatically and will also generate alerts for alert situations. The device will generate alerts if the temperature is going above or under the programmed limits. The system can send day by day or weekly information precise document from excel spreadsheet to email. Each sensor could have one-of-a-kind alert levels as in step with the requirement.

2. Related Work

In [1], the authors study have proposed the basics of warehouse management starting from the kind and nature of warehouses in conjunction with the take a look at of which sort of warehouse control device are available to assisting production technique proactively. The authors in [6] have implemented system which includes temperature and humidity maintenance with theft detection inside the warehouse. Controlling of all these operations accomplished via any remote clever tool or computer linked to internet but the paper did not provide any automated database updates so this paper introduces the Warehouse Automation machine which allows the proprietor of the warehouse to display the warehouse storage situations from everywhere and to take any controlling actions if required. In [2] system present an outline of the improvement of an IoT based clod warehouse monitoring device an entire system inclusive of the sensors for a cold storage monitoring system changed into successfully designed, advanced implementation put into effect this system able to

visualize and examine sensor records in a real-time environment the use of Zeppelin. The system was correctly capable of the fitness of a cold storage warehouse. In [4], the authors have designed Wireless Sensor Network using Bluetooth. The sensors utilized in devices are linked with the wireless community. Wireless network is used to lessen the cost and decrease the size and low cost consumption of the strength. Such devices organized into a community, present a powerful platform that may be used in lots of programs. Bluetooth is a low cost, brief range, Wi-Fi technology with small footprint, low power intake and affordable throughput. Bluetooth wireless technology has become global not just as a point-to-factor but become a community generation as nicely. In [5], the authors have created smart Random Neural Network Controller for heating ventilation and air conditioning (HVAC) systems Using cloud platform. This novel RNN based wise controller for HVAC manipulate. The RNN controller calculates the quantity of occupants, estimates the anticipated imply vote based set factors for heating and cooling, and learns the user options for controlling heating, cooling, and air flow. The power intake of the sensor nodes is a major hurdle in the usage of IoT. Three exceptional architectures for clever control of the constructing became offered and evaluated in phrases of battery lifestyles and control decision delay.

3. System Architecture

As shown in Figure-1 block diagram the proposed system is divided into two parts out of which the first one is the node which acts as a slave and the second one is base station which acts as a master. In the slave model, the particle electron board is interfaced with two DHT22 sensors, GPS module, and Bluetooth which is configured as a slave. Whereas in the master model the particle electron board is interfaced with DHT22 sensor, MQ2 sensor, Nokia display, relay, buzzer, and Bluetooth which is configured as master. The node transfer sensors data which is temperature and humidity of both the DHT22 sensor to the base station using wireless communication through Bluetooth. The GPS module is connected with an external antenna which gives coordinates of the current location of warehouse i.e. latitude and longitude which is displayed on the serial terminal of putty. The node sensor data is received by the base station via Bluetooth. The sensors interface with the base station gives temperature, humidity, and gases like LPG, Methane, and carbon monoxide value. All this data is processed in base station particle electron board where the minimum, maximum, and average values of DHT22 sensor are obtained, and MQ2 sensor gives values in voltage as well as in ppm that is parts per million. When the MQ2 sensor value goes above the threshold, it gives LPG detected signal on the serial terminal. As these two systems are battery operated it gives the battery charge status in percentage. When the battery level goes below 20% it gives low battery signal on the serial terminal. Here Putty is been used as a serial terminal, and the value of node and base station sensors are seen on the putty terminal. Whereas the slave 1 and slave 2 temperature and humidity values, master temperature and humidity values, and gas values like LPG, Co Methane are displayed on Nokia display. The slave 1 temperature and humidity data are pushed to cloud with minimum and maximum value of temperature. This data is auto updated in excel spreadsheet with the time interval of half hour where we can see the respective date and time duration of the temperature, humidity, threshold, minimum, maximum, and average value of slave 1 DHT22 sensor and their respective graph. The excel spreadsheet data is converted into pdf file and sent to email as notification of daily analysis. For remote controlling and monitoring the base station is linked with the blynk mobile application, where we can see slave and master sensor readings on GUI. For controlling purpose relay is used as on-off switch i.e. when the temperature goes above-set point we can turn the switch on i.e. cooling system to maintain temperature and humidity.

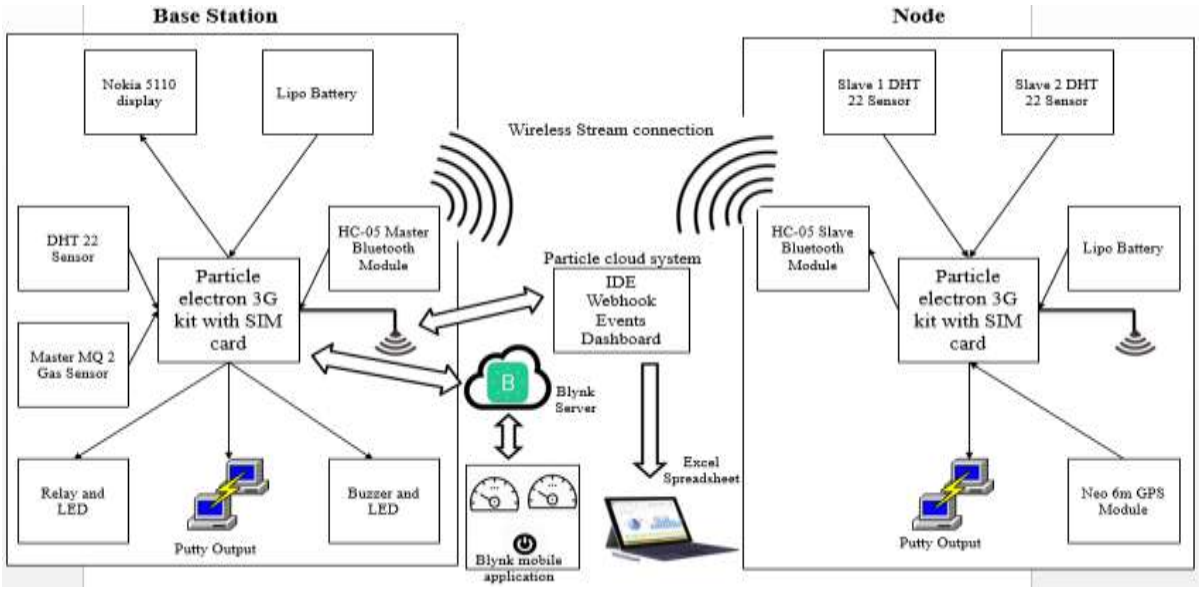

Fig- 1: Block Diagram of Proposed system

User can set this set point according to requirement from the blynk mobile application. On the blynk dashboard, there are two set points one is for above temperature and another one for below temperature. When the temperature goes above-set point the buzzer present at base station will make a beep sound, and led will turn on. To indicate that it has crossed the set point. For remotely alert it will send notification on the blynk mobile application. The base station containing gas sensor displays LPG detected on the blynk app when the values cross the threshold limit. It also displays maximum temperature and battery low signal on the blynk mobile application.

4. Software Tools and Setup

4.1 HC05 Bluetooth Configuration

To act HC05 as master and slave we have to configure one of the Bluetooth as master and another as slave. By using Ardunio serial terminal COM port for configuration of master and slave so, Ardunio is interface with Bluetooth module. To configure Bluetooth as slave and master we have to configure HC05 to enter in AT mode and then give commands in Ardunio serial terminal COM port.

The Slave's AT commands are as follows,

AT+RMAAD,

AT+ROLE=0,

AT+ADDR,

AT+UART=9600,0,0

The Master AT commands are as follows

AT+RMAAD,

AT+ROLE=1,

AT+CMODE=0,

AT+BIND= Slave address,

AT+UART=9600,0,0

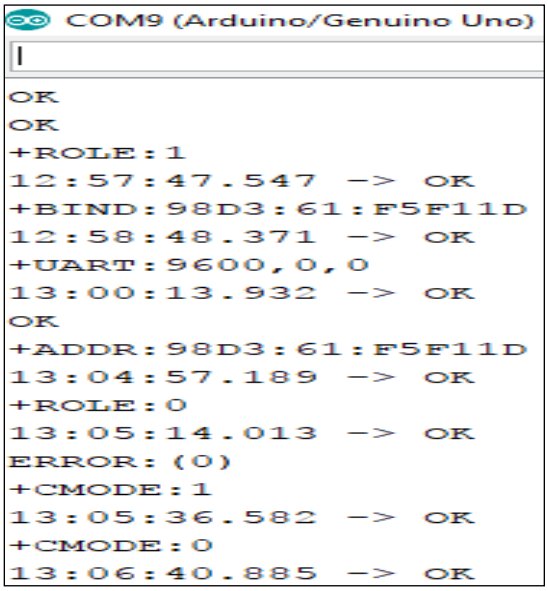

Fig-2: Ardunio serial terminal used for configuration as master and slave using AT command

4.2 Particle cloud

Particle cloud includes its own programming IDE which includes all hardware support library. It is very easy and convenient to compile the code. We can also remotely flash the code by using cloud service that is Over-The-Air. For serial flash we need to Program in Particle cloud IDE to create binary file. This file is downloaded from Particle cloud and then it is serially flashed through USB cable to particle electron by using command prompt. In command prompt we have to login as a particle setup by using particle cloud username and password. By using command particle flash --serial filename.bin flash the code in particle electron. The particle cloud dashboard is shown in figure 3.

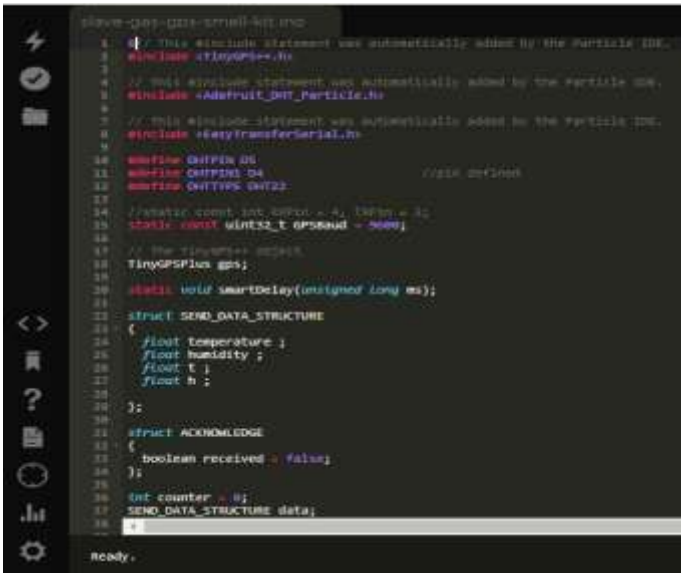

Fig-3: particle cloud platform dashboard

4.3 Blynk application

Blynk is an IoT platform which is used to interface particle electron board to blynk mobile application. It Consists of three major components: 1) The Blynk application, which is used to monitor and control device remotely it contain various widget like Button, gauge, Labelled value, joystick, slider, timer, Value Display etc. This application allows various interfaces to particle electron.2) The Blynk server, it interface our smartphone blynk application with particle electron board that is hardware device.it communicates between particle electron and mobile Blynk application.3) Blynk libraries, link to server and all command and function used are process in it they can be out coming and incoming. The detail view is shown in figure 4.

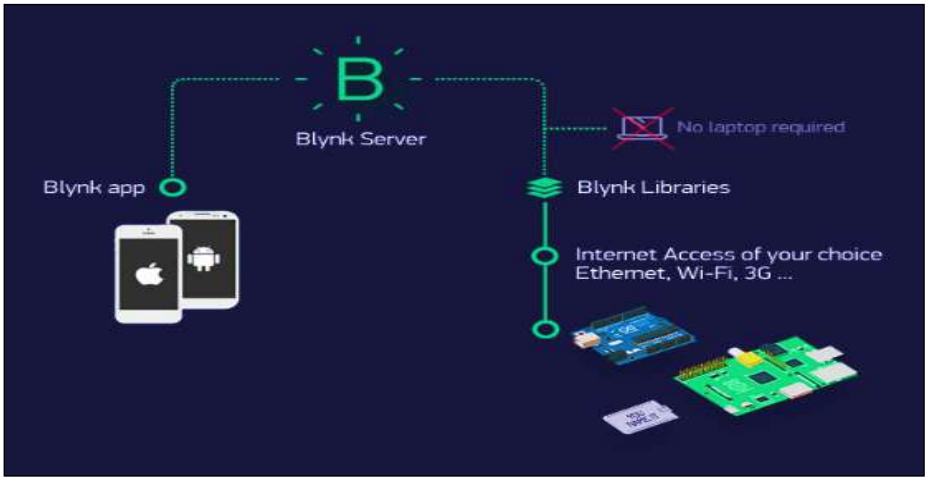

Fig- 4: Blynk Application working model

4.4 Excel Spreadsheet

Excel is used to update values of slave 1 DHT22 sensor in spreadsheet automatically using JavaScript in script editor. According to project there are three script written first for update of sensor value from cloud to excel spreadsheet, second to daily send email notification of excel file in pdf format and third clear data in excel spreadsheet per day To have automatically update of values we have to set the triggers according to timely basses.

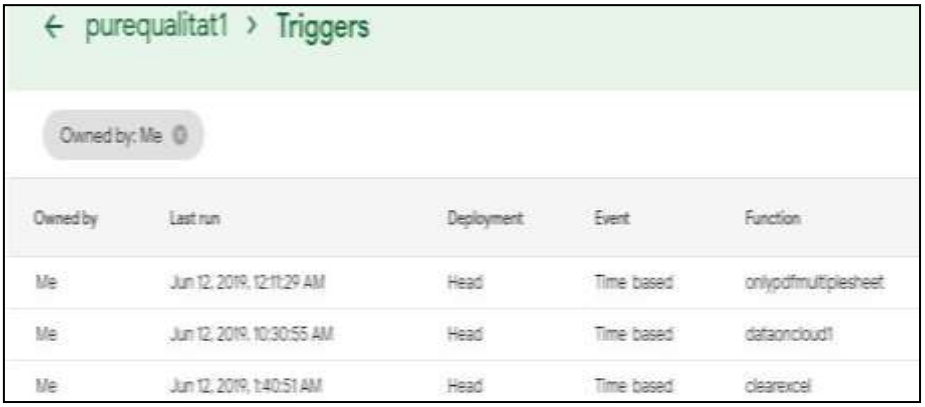

Fig- 5: Excel Spreadsheet Triggers

5. Hardware tools and setup

5.1 Particle electron board

The Electron board used is 3G variants cellular module as GSM; it consists of STM32F205RGT6 120 MHz ARM Cortex M3 microcontrollers. The important function of it is real-time operating system. The Electron can be powered via the VIN (3.9V-12VDC) pin, the USB Micro B connector or a LiPo battery. The general purpose input output (GPIO) pins are interfaced to communicate with a sensor input: 30 mixed-signal GPIO, 1MB flash and 128 KB RAM memories. The BQ24195 is power management unit.

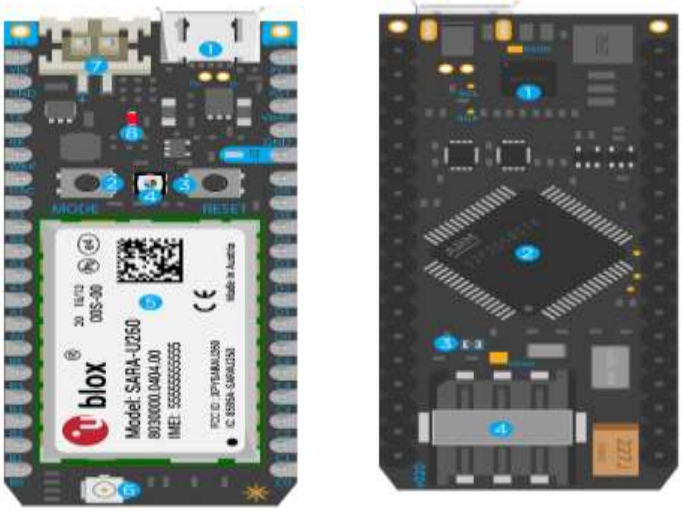

Fig-6: Particle electron board

5.2 DHT22 Sensor Module

DHT22 Sensor module is used for temperature and humidity readings it operates on 3.3V- 6V DC. It works on one wire protocol. While requesting data it uses 2.5mA maximum current. Good for 0-100% humidity readings accuracy and -40 to 80°C temperature readings accuracy. Sampling rate is 0.5 Hz. As per requirement of project it works on battery operated and give temperature and humidity readings.

Fig.-7:DHT22 Sensor Module

5.3 MQ2

Gas sensor is used measure LPG, Alcohol, Propane, Hydrogen, CO and even methane but in this project only LPG, CO and methane is detected. It operating Voltage is +5V, excessive sensitivity and fast reaction.

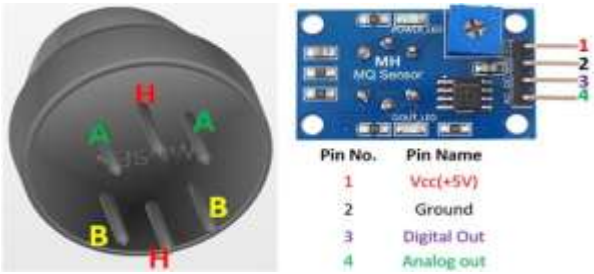

Fig.-8: MQ2 Gas Sensor Module and Its Pin Configuration.

In Fig-9, the graph show that the minimum concentration is able to test is 100ppm and the maximum is 10000ppm, the attention of gas between 0.01% and 1%.

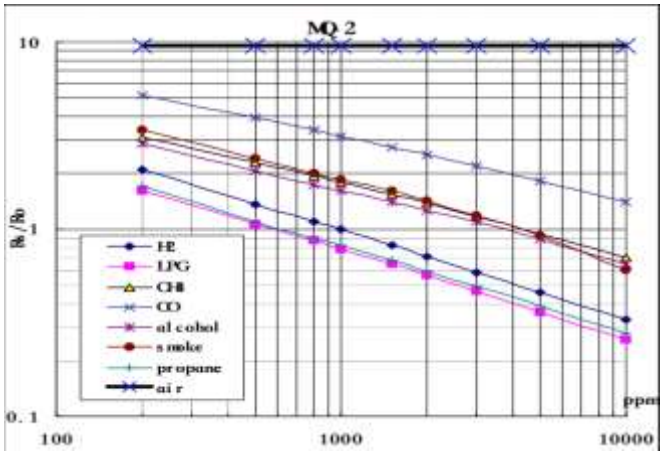

Fig.-9: Various Configurations of Gases

5.4 HC05 Bluetooth Module

HC05 Bluetooth module is used for wireless communication between Node and Base station. The Bluetooth uses SPP (Serial Port Protocol) for transparent wireless serial connection. It uses UART interface with programmable baud rate with integrated antenna. The serial communication used is (UART) universal synchronous and asynchronous receiver-transmitter with 9600 baud rate programmable. Operate on Power 1.8V to 3.6V I/O PIO control. It has -80dBm sensitivity and as much as +4dBm RF transmit power. Paring pin code is 0000 defaults and it re-connect automatically in 30min. Slave and Master default Baud rate is 9600.

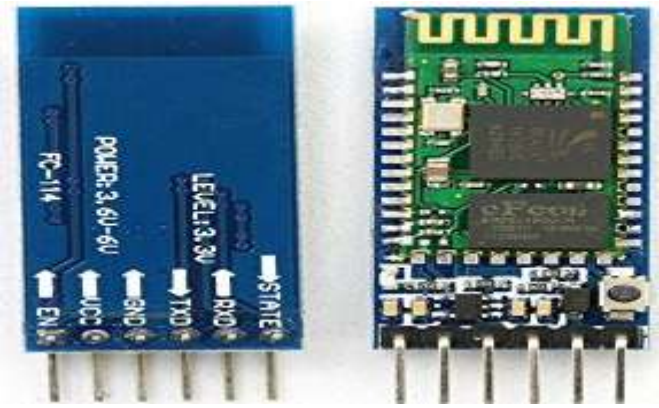

Fig.-10: HC05 Bluetooth Module front and top view

5.5 Neo 6m GPS Module

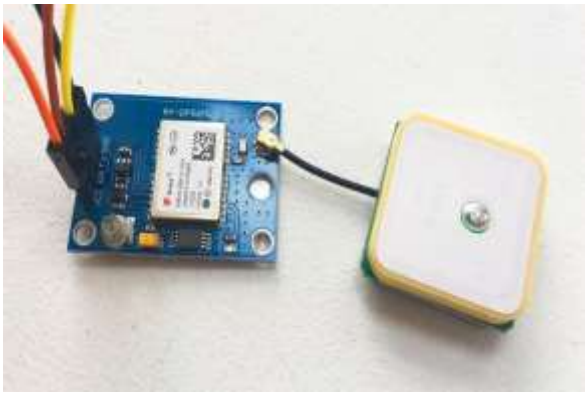

Fig.-11: GPS module with antenna connected

GPS is used for detecting latitude and longitude coordinates of warehouse. GPS receiver detect ranging signal from various satellite and it compare time of arrival with time of transmission to obtain range. To locate GPS it must find three satellite of known position. Satellite contains atomic clock whereas receiver contain cheaper clock. Operating temperature range is -40°C to 85°C.

5.6 Nokia 5110 LCD Module

LCD display is used to display Sensor data it is interface to node and base station It Operates on voltage between 2.7V to 3.3V and low Current consumption of 6mA.Works using SPI interface. It supports respectable images of bitmap photos and containing in Blue Backlight. Consists of forty eight rows and 84 columns monochrome pixels display.

Fig.-12: Nokia 5110 LCD Module

6. Proposed System Setup

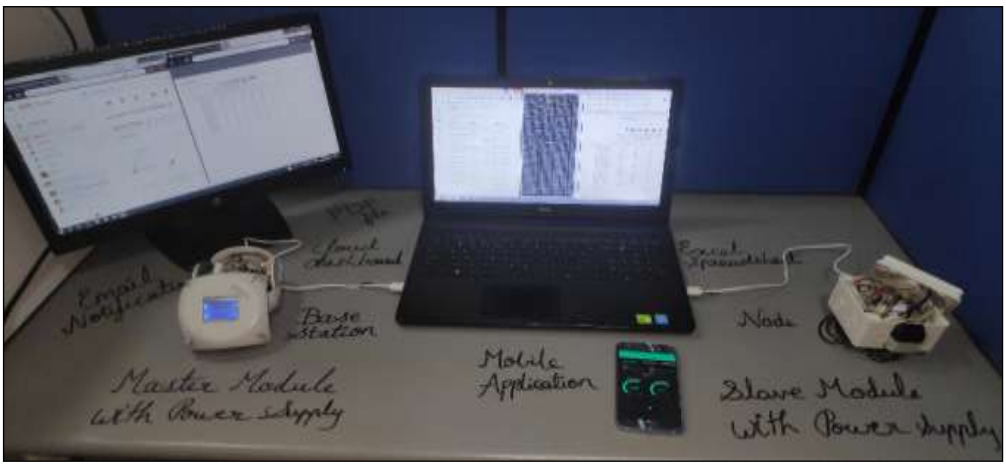

Fig-13: Project Setup with power supply

The Above figure-13 shows overall setup with battery operated device the node include two DHT22 sensor and GPS module shows data in coordinates of latitude and longitude whereas DHT22 send temperature and humidity data to base station using Bluetooth communication. The master module includes lcd display which display node sensor value. These values are monitored at blynk application and excel spreadsheet. The client can view temperature and control it using blynk application. In Blynk application user can set threshold so that notification or alert can be generated when temperature exceed above limit.

Fig-14: Project Setup with Battery Operated

7. RESULTS

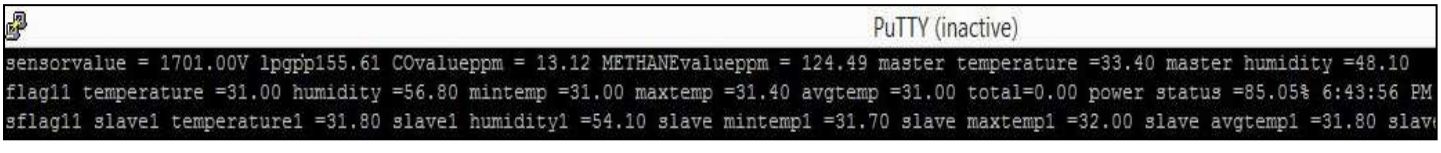

Fig-15: Serial monitor putty output reading values of DHT22, MQ2 sensor and battery status of board.

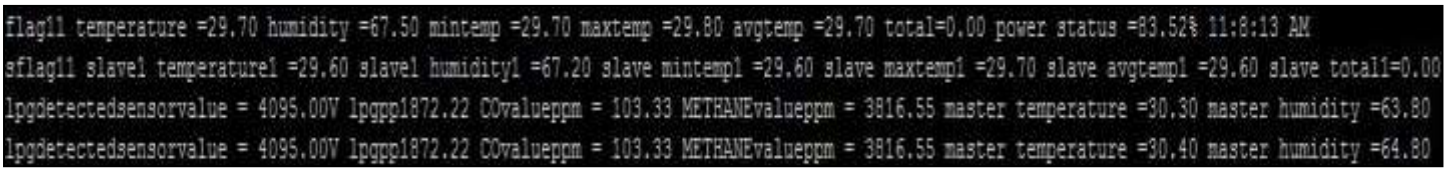

Fig-16: Serial monitor Putty showing alert message lpg detected when lpg ppm value goes above set limit.

Fig-17: Serial monitor Putty showing GPS cordinates that is Latitude and Longitude of current location of warehouse.

Fig-18: Slave 1 DHT22 Sensor Readings on Particle Cloud That Is Temperature, Humidity, Minimum And Maximum Temperature.

Fig-19 A: GUI Display of Slave 1 Module

Fig-19 B:GUI Display of Slave 2 Module

Fig-19 A: shows slave 1 GUI at Node side with two set point that is below and above the limits. The gauge to display temperature and humidity readings and LPG detected message when LPG gas exceed above limits. Fig-19 B: shows slave 2 GUI at Node side with displaying temperature and humidity readings on gauge.

Fig-19 C:GUI Display of Master Module

Fig-19 D:GUI Display notification

Püre Qualität Industries

Registered under MSME Gov. of India. UAN# MH26D0035066
Flat No. 103, Blue Bells, Balewadi High-street, Balewadi
Pune India. 411045

Date And Time	Tempe	Humidity	Threshold	Maxtempe	Mintempe	Avgtempe
6/23/2019 1:47:44	30.1	63.7	40	30.8	29.9	30.1
6/23/2019 1:48:04	30.2	63.8	40	30.8	29.9	30.2
6/23/2019 2:01:02	30.4	62.8	40	30.8	29.9	30.4
6/23/2019 2:31:07	30.9	60.8	40	30.9	29.5	30.9
6/23/2019 3:01:02	31.1	59.8	40	33.4	29.5	31.1
6/23/2019 3:31:04	31.2	59.7	40	33.4	29.5	31.2
6/23/2019 4:01:04	31.2	59.7	40	33.4	29.5	31.2
6/23/2019 4:31:09	31.2	59.7	40	33.4	29.5	31.2
6/23/2019 5:31:02	31.2	59.7	40	33.4	29.5	31.2
6/23/2019 6:01:02	31.2	59.7	40	33.4	29.5	31.2

Fig-20: Excel Spreadsheet Updating Data Of Salve 1 DHT22 Sensor

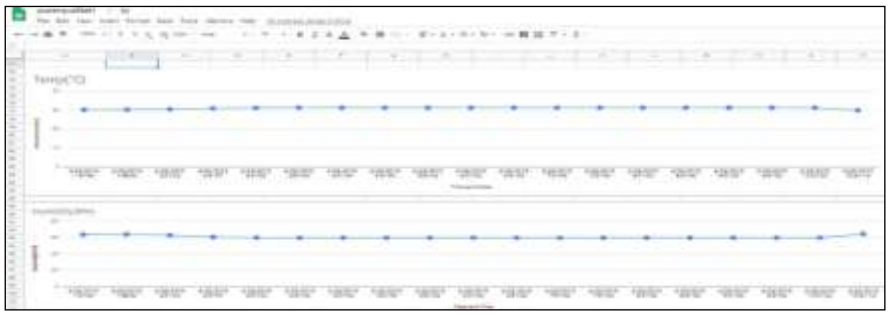

Fig-21: Graph of Excel Spreadsheet of Tempearture and Humidity with Respective Time and Date.

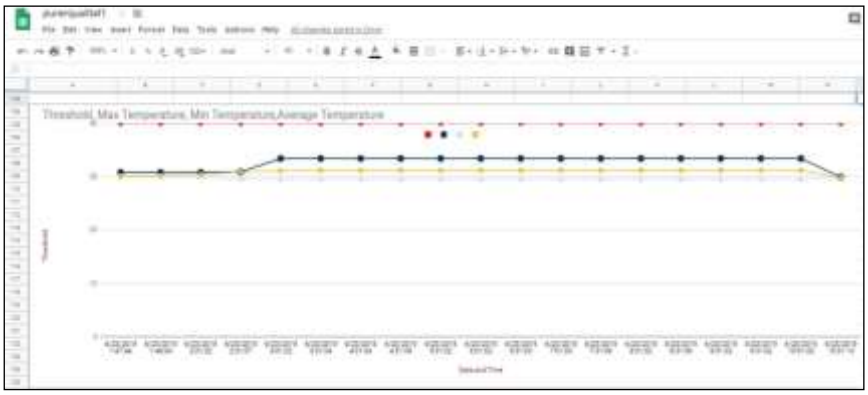

Fig-22: Graph of Excel Spreadsheet with Threshold, Minimum Temperature, Maximum Temperature and Avearge Temperature Readings.

Fig-23: Gmail Notification with Attachment of Excel Sheet in Pdf Format

8. CONCLUSION

The device will play an important role in warehouse industries as the system is designed for real-time monitoring of the parameter as well as controlling the environmental condition with wireless sensor and battery operated device by using IoT. As the product is reliable and fast which helps workers in the warehouse to monitor location, temperature, humidity and gases configuration effectively this help them to take corrective measure for the protection and keep food safe. The wireless network is used to reduce the cost and reduce the size and low-cost consumption of power. The device is a handy power source. Battery operated device can be charged and the power stored in the battery can be used later when there is a power outage. Monitoring various parameters from remote places not only helps it enables in higher utilization of the manpower but additionally increase the quality of the materials. The amassed records may be used for planning the strategies to get higher output within the future.

ACKNOWLEDGEMENT

We would like to pay our sincere gratitude to the Sr. Lead Engineer Mr. Mahesh S Jadhav as an industrial guidance and Asst. Professor Sagar R Khedkar M.Tech project guide for their continuous support, meaningful insights and encouragement.

REFERENCES

[1] Rao Aamir Khushnaseeb, Nuzhat Younis, Sajid Hussain, Uzmakausar, "Next Big Thing: Voice Centric andRFID Base Warehouse Management System", International Journal ofManagement Sciences andBusiness Research, 2013 ISSN (2226-8235) Vol-2, Issue 12.

[2] Chandanashree V C, Prasanna Bhat U, Prasad Kanade, Arjun K M, Gagandeep J, Rajeshwari M Hegde, "Tiny OS Based WSN Design For Monitoring Of Cold Storage Warehouses Using The Internet Of Things",2017 IEEE

[3] V.Ramesh, M.Sankaramahalingam, Divya Bharathy M S , Aksha R, "REMOTE TEMPERATURE MONITORING AND CONTROL USING Iot", Department Of Computer Science And Engineering Kalasalingam Institute Of Technology, Krishanankoil, Proceedings Of The IEEE 2017 International Conference On Computing Methodologies And Communication.

[4] Gurpreet Singh, Opinder Singh, Dr. Jatinder Singh, "Wireless Sensor Network Using Bluetooth", Computer Science Department, Khalsa College Chawindadevi, Amritsar, Punjab, International Journal Of Computer Science And Technology IJCST Vol. 3, Issue 2, April - June 2012

[5] Abbas Javed, Hadi Larijani, Ali Ahmadinia, andDes Gibson. "Smart Random Neural Network Controller For HVAC Using Cloud Computing Technology", IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS, VOL. 13, NO. 1, FEBRUARY 2017.

[6] Prof. Dr Dipashree Bhalerao, Priyanka Ramesh Deshmukh, "An Implementation of MQTT through the Application of Warehouse Management System", Proceedings of the 2nd International Conference on Communication and Electronics Systems (ICCES 2017) IEEE Xplore Compliant - Part Number: CFP17AWO-ART, ISBN: 978-1-5090-5013-0.

BIOGRAPHIES

	Tejas S Patil student of M.Tech, Departments of Electronics Engineering of Walchand College of engineering, Sangli, Maharashtra, India.
	Sagar R Khedkar is working as an assistant professor in department of Electronics Engineering of Walchand college of engineering, Sangli, Maharashtra, India.

Mr. Mahesh Jadhav is working as a Sr. Lead Engineer in QualComm India Pvt. Ltd. Bangalore, India.