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Weather Monitoring System using IOT

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A B S T R A C T:

Internet of Things (IoT) is adding value to products and applications in the recent years. The connectivity of the IoT devices over the network has widely reduced the power consumption, robustness and connectivity to access data over the network. IoT is powering many frontiers of industries and is seen as a promising technology to take Big Data Analytics to a level higher. Weather monitoring system as a module is an issue among IoT research community and it has been widely addressed. A new weather monitoring system is developed using various sensors connecting to Raspberry Pi. The implementation and data visualization on the data collected are discussed in this paper in detail. Weather parameters like temperature, humidity, PM 2.5 and PM 10 concentrations and Air Quality Index (AQI) are monitored and visualized in graphical means using the Raspberry Pi as server and data accessed over the intranet or internet in a specified subnet or world wide web. The data visualization is provided as result and proves to be a robust framework for analyzing weather parameters in any geographical location studying the effect of smog and PM 2.5 working.

Keywords: *Internet of Things, Wi-Fi, Weather monitoring, Cloud, temperature and humidity sensor, soil moisture sensor, rain level sensor*

1. INTRODUCTION

Internet of Things is a novel paradigm combining telecommunications and any kind of device or applications using sensors, tags, microcontrollers and ARM processors. This paper proposes an implementation of weather monitoring system using Internet of Things (IoT). A raspberry pi based implementation is proposed to monitor PM2.5, PM 10, temperature, humidity and the air quality index (AQI) of the Particulate Matter pollutants qavailable. Internet of Things is playing a leading role in providing solutions to many applications with the support of software, internet and embedded systems. There are various IoT devices available in the market ranging from micro controllers to microprocessors. The microprocessors in IoT are normally ARM processors like Raspberry Pi and Intel Edison.

1.1 Structure

There are many technologies developed for weather monitoring using IoT devices and are discussed in section II. In countries like India , China and Thailand smog is a natural phenomenon affecting human lifestyle and daily routine of those cities. The implementation done in this paper is based on the heath issues faced by the people in Thailand. Studies have been done to analyze the PM 2.5 concentrations in Thailand for more than a decade, from all over Thailand. The data analyzed by states that the predictive analytics of PM 2.5 in Bangkok, Thailand using linear regression says that the parameters of various parameters of timestamp, temperature and humidity are responsible for the concentration of PM 2.5. The data of PM 2.5 was taken from Berkeley Earth database and temperature and other weather parameters are populated using API connectivity to a local weather station in Weather Channe

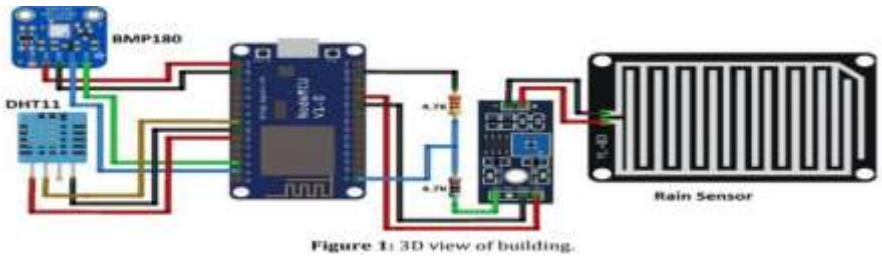

Figure 1: 3D view of building.

The data is not populated from the same geographic location. To address these issues, an IoT based weather monitoring system is designed and developed at Thai-Nichi Institute of Technology. The implementation details and the data analysis based visualization are discussed in detail in this paper. The literatures studied on the existing techniques, methodologies and simulations are surveyed in section II. Section III discusses about the implementation and data visualizations of the proposed.

2. RELATED WORK

Weather Monitoring System has been done extensively using IoT devices in the past. The wide range of literatures discussed provide information like a survey. The existing technologies are developed using microcontrollers like Arduino, Node MCU etc and ARM processors like Raspberry Pi. The implementation proposed in [9] shows that a Raspberry Pi based weather monitoring system is developed using pollution sensors. Apart from temperature, pressure and humidity, carbon monoxide concentration is also monitored. This is not purely Raspberry Pi based implementation, but a combination of Pi and Arduino Nano. An IoT node based framework. This methodology uses PM 2.5 sensor and monitor it periodically and stores in a cloud server.

A raspberry Pi based weather monitoring system is proposed. This gets basic parameters like temperature, humidity and few other parameters. A weather monitoring system for agriculture was developed by using Node MCU. This uses a temperature and humidity sensor and soil moisture sensor for monitoring weather with respect to agriculture. A higher resilience based weather monitoring system using microcontroller was developed by. This was done mainly to target under developed and developing economies. This used temperature, humidity and rain gauge systems to obtain data in real time. A data logger based weather monitoring system is proposed by using a microcontroller uses temperature, humidity, light and CO sensors. There are many weather monitoring systems proposed using simulation as in using Labview based interface.

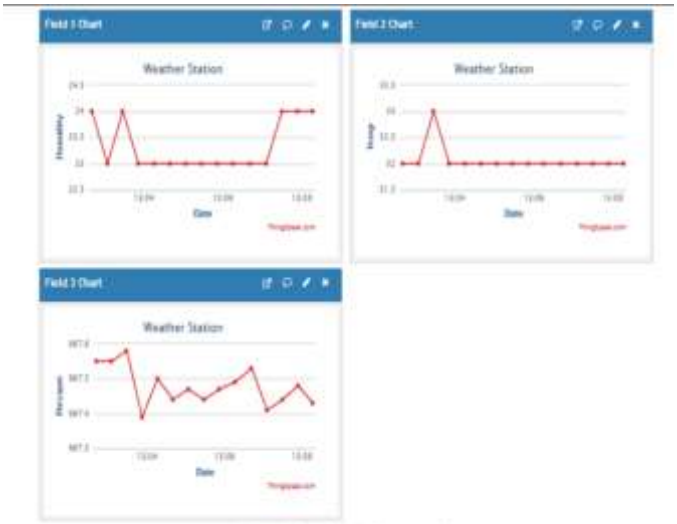

Figure 2: Display On Thingspeak

3. PROPOSED METHODOLOGY

The detailed architecture of the system implementation is given in fig 1 below. It shows the hardware connected to the raspberry Pi and the software used in managing the data collected using the sensors. The scope of this framework is to store the data in a cloud server but the implementation reports in the availability of data over the intranet of a specified subnet. Data collected is made available to download in CSV format and the latest weather data in JSON format is made available to share data online over the network. The software implementation of this proposed system is available in GitHub and it can be accessed from the link http://www.github.com/ferdinjoe device is set to run 24x7, a cooling fan is attached to the Pi to emanate the heat generated by the sensors and Pi. This cooling fan is of 0.12A power and works well with 5V power source. In addition to this cooling fan, SDS 011 sensor also has a fan to maintain the ideal working temperature of the device.

TABLE 1: DHT11

PARAMETER	TIME	VALUE
TEMPERATURE	10AM	24~28 C
TEMPERATURE	1PM	29~31C
TEMPERATURE	10PM	27~29C
HUMIDITY	10AM	78
HUMIDITY	10PM	77

TABLE 2: BMP180

PARAMETER	TIME	VALUE
PRESSURE	10AM	1001~1800
PRESSURE	1PM	1006~1829
PRESSURE	10PM	997~1560

Figure. 3 - Table

Python code is written to run the sensors once an hour continuously until an interrupt is given. The temperature and humidity from DHT 11, PM 2.5 and PM 10 from SDS 011 are obtained and stored in a JSON file and appended as a record to a CSV file in the root directory of the lighty web server. Lighty

web server is a light weight web server framework for ARM devices like Raspberry Pi and has support to most of the tools used in web technology. Fig 2 shows the final design and implementation of the system. A web based interface is designed as in fig 5 using HTML, CSS and JavaScript to generate reports from the sensor data populated in the JSON and CSV files. Dimple JS library [21] is used to generate data visualization. This web interface is made available to anyone who can access a specific subnet of the intranet. Fig 3 and 4 shows the data visualization . The experiments were conducted in an intranet based IP. This can be made public, if the data storage is provided with a public IP.

4. ADVANTAGES

- IOT weather mentoring system project using Arduino Uno is fully automated.
- It does not require any human attention.
- We can get prior alert of weather conditions
- The low cost and efforts are less in this system Accuracy is high.
- Self Protection
- Smart way to monitor Environment
- Efficient

5. APPLICATIONS

- The weather forecasting plays very important role in the field of agriculture.
- It is also helpful at places like volcano and rain forests.
- It is quite difficult for a human being to stay for longer time at such places.

6. FUTURE SCOPE

- One can implement a few more sensors and connect it to the satellite as a global feature of this system.
- Adding more sensor to monitor other environmental parameters such as CO2,Pressure and Oxigen Sensor
- In aircraft, navigation and military there is a great scope of this real-time system.
- It can also be implemented in hospitals or medical institutes for the research & study in “Effect of Weather on Health and Diseases”, hence to provide better precaution alerts.

7. CONCLUSION

The implementation of weather monitoring system using Raspberry Pi is done as per the specifications above and the data insights are generated in web based portal. The access to this data is available in the intranet with the current level of implementation and it could be made public when the data is made to store in cloud servers or other sources in the internet. This proposed system is the most compact unit for measuring weather parameters in regions suffering from the PM 2.5 pollution. This device in multiple nodes can be connected to the internet from various locations of study. This connectivity will aid the user to monitor the weather metrics corresponding to pollution over a centralized data analytics server.

Future scope:

- An alarm can be added to the circuit to notify the user in case of excess smoke conditions i.e. Smoke alarm.
- An SMS can be sent to clients notifying them with the temperature/humidity/smoke parameters

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References

1. L. Atzori, A. Iera, and G. Morabito, “The Internet of Things : A survey,” Comput. Networks, vol. 54, no. 15, pp. 2787–2805, 2010.

2. Z. Chowdhury et al., “Speciation of ambient fine organic carbon particles and source apportionment of PM2. 5 in Indian cities,” J. Geophys. Res. Atmos., vol. 112, no. D15, 2007.

3. R. K. Pathak, W. S. Wu, and T. Wang, “Summertime PM 2.5 ionic species in four major cities of China: nitrate formation in an ammonia-deficient atmosphere,” Atmos. Chem. Phys., vol. 9, no. 5, pp. 1711–1722, 2009.

4. S. Pongpiachan et al., “Chemical characterisation of organic functional group compositions in PM2.

5 collected at nine administrative provinces in northern Thailand during the Haze Episode in 2013.,” Asian Pacific J. cancer Prev. APJCP, vol. 14, no. 6, pp. 3653–3661, 2013. 5. S. Pongpiachan, D. Tipmanee, C. Khumsup, I. Kittikoon, and P. Hirunyatrakul, “Assessing risks to adults and preschool children posed by PM2. 5-bound polycyclic aromatic hydrocarbons (PAHs) during a biomass burning episode in Northern Thailand,” Sci. Total Environ., vol. 508, pp. 435–444, 2015.

6. F. C. Tsai, K. R. Smith, N. Vichit-Vadakan, B. D OSTRO, L. G. Chestnut, and N. Kungskulniti, “Indoor/outdoor PM 10 and PM 2.5 in Bangkok, Thailand,” J. Expo. Sci. Environ. Epidemiol., vol. 10, no. 1, p. 15, 2000.

7. U. Vinitketkumnuen, K. Kalayanamitra, T. Chewonarin, and R. Kamens, “Particulate matter, PM 10 & PM 2.5 levels, and airborne mutagenicity in Chiang Mai, Thailand,” Mutat. Res. Toxicol. Environ. Mutagen., vol. 519, no. 1–2, pp. 121–131, 2002.

8. S. Boonvanich, “PM 2.5 and Data Science,” GitHub, 2019. [Online]. Available: https://github.com/gain9999/PM2.5.

9. R. Shete and S. Agrawal, “IoT Based Urban Climate Monitoring using Raspberry Pi,” in International Conference on Communication and Signal Processing, 2016, pp. 2008–2012.

10. P. P. Ray, “Internet of Things Cloud Based Smart Monitoring of Air Borne PM2 . 5 Density Level,” in International conference on Signal Processing, Communication, Power and Embedded System (SCOPES), 2016, pp. 995–999.

11. S. S. Sarnin, A. Akbar, W. N. W. Mohamad, A. Idris, N. f. Naim, and N. Ya﷯acob, “Maleficent Mirror with ALEXA Voice Services as an Internet of Things Implement Using Raspberry Pi 3 Model B,” in TENCON 2018 - 2018 IEEE Region 10 Conference, 2018, pp. 1202–1207.

12. Y. Alif, K. Utama, Y. Widianto, Y. Hari, and M. Habiburrahman, “Design of Weather Monitoring Sensors and Soil Humidity in Agriculture Using Internet of Things (IoT),” Trans. Mach. Intell. Artif. Intell., vol. 7, no. 1, pp. 10–20, 2019.

13. D. Strigaro and M. Cannata, “Boosting a Weather Monitoring System in Low Income Economies Using Open and Non-Conventional Systems : Data Quality Analysis,” Sensors, vol. 19, no. 5, pp. 1–22, 2019.

14. K. Siva, S. Ram, and A. N. P. S. Gupta, “IoT based Data Logger System for weather monitoring using Wireless sensor networks,” Int. J. Eng. Trends Technol., vol. 32, no. 2, pp. 71–75, 2016.

15. S. T. Thilagam. J, T. S. Babu, and B. S. Reddy, “Weather monitoring system application using LabVIEW,” in 2018 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2018 2nd International Conference on, 2018, pp. 52–55.

16. R. K. M. Math and N. V Dharwadkar, “IoT Based Low-cost Weather Station and Monitoring System for Precision Agriculture in India,” in 2018 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2018 2nd International Conference on, 2018, pp. 81–86.

17. J. Shah and B. Mishra, “IoT enabled environmental monitoring system for smart cities,” in 2016 International Conference on Internet of Things and Applications (IOTA), 2016, pp. 383–388.

18. C. Xiaojun, L. Xianpeng, and X. Peng, “IOT- Based Air Pollution Monitoring and Forecasting System,” in 2015 International Conference on Computer and Computational Sciences (ICCCS), 2015, pp. 257–260.

19. N. Tianlong, “Application of Single Bus Sensor DHT11 in Temperature Humidity Measure and Control System [J],” Microcontrollers Embed. Syst., vol. 6, p. 26, 2010.

20. T. DiCola, “Adafruit Python DHT.” AdaFruit Industries, 2014.

21. E. Johnson, “Evaluation and Integration of a JavaScript Graphing Library for a Nationwide Honey Bee Hive Scale Network,” 2015.

22. Available: http://www.halcyon.com/pub/journals/21ps03-vidmar