A Raspberry Pi Controlled Cloud Based Air and Sound Pollution Monitoring System using IOT and Prediction of Pollution Levels using ML

Samudareddy. B[0], Ashwini. A[1], Chandrika.V[2], Niveditha. V[3]

[0]BE Computer Science & Engineering, Cambridge institute of technology, Bengaluru, India

[2]BE Computer Science & Engineering, Cambridge institute of technology, Bengaluru, India

[1]BE Computer Science & Engineering, Cambridge institute of technology, Bengaluru, India

[3]BE Computer Science & Engineering, Cambridge institute of technology, Bengaluru, India

***Abstract* -In late day situation, the perpetual increment in air and sound contamination end up being a disturbing issue. It has gotten obligatory to control and fittingly screen the circumstance so the necessary strides to check the circumstance can be attempted. In this venture, an IOT-based technique to screen the Air Quality Index and the Noise Intensity of a locale, have been proposed. The suggested innovation contains four modules in particular, the Air Quality Index Monitoring Module, the Sound Intensity Detection Module, the Cloud-based Monitoring Module, and the Anomaly Notification Module. Initially, the Air Quality Index is estimated considering the nearness of the five rules air toxins. At that point the sound force is identified utilizing the separate sensor. From that point forward, the Cloud-based Monitoring Module guarantees the way toward getting the information with the assistance of the Wi-fi module present in Raspberry Pi which satisfies the target of the investigation of data on a periodical premise. At last, the Anomaly Notification Module cautions the client if there should be an occurrence of an undesired condition.. The paper is mainly to monitor, visualize the pollution data and its forecasting. Specifically, three machine learning (ML) algorithms were implemented to find out the best predictive model The ML algorithms used over here are Linear Regression, Random Forest.**

Keywords—Raspberry Pi 3B; MQ-135; Air Quality Index; Sound Intensity; IOT; Cloud.

I. INTRODUCTION

Air and sound contamination are a developing issue nowadays. It is important to screen the air and sound contamination levels to guarantee a solid and safe condition. With the quick increment in framework and modern plants, natural issues have incredibly impacted the need of keen checking frameworks. Because of its minimal effort, high proficiency and flexibility, Internet of Things (IOT) has become exceptionally well known now a days. Web of Things (IOT) permits connection among gadgets and people. It frames a correspondence medium from human to machine. Beforehand, information gatherers needed to venture out significant distances to the different areas to gather information after which the investigation was finished. This was extensive and tedious. In any case, presently, sensors and microcontrollers associated with the web can make ecological boundary observing more adaptable, exact and less tedious. At the point when the earth converges with sensors and gadgets to self-secure and self-screen it frames a shrewd domain. Installed insight causes nature to communicate with the items. In this model, we are utilizing a Raspberry Pi 3B microcontroller, which will have gas sensors and clamor sensors associated with it, to screen the fluctuating natural boundaries..

II. RELATED WORK

In the first place, L.Ezhilarasi et al. have proposed a checking procedure utilizing a Zigbee remote sensor system to screen the different natural boundaries. It utilizes RFID intends to store and recover information through electromagnetic transmission to a RF incorporated circuit. The WSN door strategy is utilized to advantageously gather the information whenever and place.

[1] Mahantesh B Dalwai et al. in their paper have utilized a GPRS/GSM module and a web worker to productively screen the different contamination levels. In the module the smoke sensor and commotion sensor will transfer the information to the worker or cloud at each moment of time with the goal that the contamination level can be checked utilizing the web.

[2] Arushi Singh et al. have proposed a framework which uses air and sound sensors to screen the information continually and afterward send the information. A raspberry pi module interfaces with the sensors and procedures the information along these lines sending it to the application.

[3] Dr. A Sumithra et al. have proposed the idea of the shrewd city. Innovation and correspondence are the premise of this keen city. Different sensors and modules have additionally been utilized to screen the different ecological boundaries. This framework utilizes air and sound sensors to screen the information and afterward transfer the information on the cloud worker as computerized information. The distributed storage administrators investigate the information and advice appropriately.

[4] Mohammad Ibrahim et al. have proposed the structure of a financially savvy ecological observing gadget utilizing raspberry pi. The data is gathered by the sensors and transferred to the web where it could be gotten to whenever. The framework was seen as precise as far as estimating dampness, temperature and so forth.

[5] Giovanni B. Fioccola et al. have proposed Polluino, an Arduino based air contamination checking framework. The information is then transferred to a cloud-based stage which deals with the information originating from the sensors.

[6] SRM. Arthishri et al. have proposed observing the boundaries utilizing a PIC microcontroller which detects the air signals. Gas sensors are utilized to gauge the contamination level. This information is transferred on the web and can likewise be seen through an application.

[7] Seung Ho Kim et al. have planned a checking framework that utilizes an ecological boundary analyzer and sends the outcomes in a worker through a LTE correspondence arrange. The came about information was contrasted and the information got by the National Ambient air quality Monitoring Information System (NAMIS).

[8] Somansh Kumar et al. have given the possibility of a constant air quality checking framework including different boundaries like P.M. 2.5, CO2.

III. SENSORS AND MODULES USED

A. *LM393 Sound Sensor*

In this Project, to screen the sound contamination, a sound sensor, LM393 is utilized. This gadget comprises of two autonomous voltage comparators that are intended to work from a solitary force gracefully over a wide scope of voltages. Activity from double supplies additionally is conceivable if the contrast between the two supplies is 2V to 36V, and VCC is at any rate 1.5V more positive than the information regular mode voltage. At the point when sensor distinguishes sound, it forms the yield signal voltage which is sent to Raspberry Pi which again plays out the essential preparing required for checking the boundary.

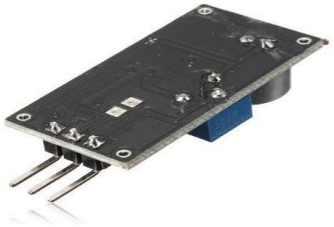


Fig.1. LM393 Sound Sensor

B. *MQ135 Gas Sensor*

In this task, to screen the air contamination and to decide the air quality record, a gas sensor, MQ135 is utilized. MQ135, gas sensor works at 5V voltage and 40mA current. It effectively recognizes the NH3, NO2, smoke and CO2 level in air. This sensor is picked for its wide distinguishing degree, quick reaction, high affectability, steady and long life and finally, a basic drive circuit. It is utilized in air quality observing gadgets in structures and homes.

Fig.2. MQ135 Gas Sensor

C. *DHT11 Temperature and Humidity Sensor*

In this task, to screen the temperature and mugginess levels in a locale, a dampness and temperature sensor, DHT11 is utilized. It very well may be interfaced with a Raspberry Pi module and can give prompt outcomes. We are utilizing this sensor to screen the changing stickiness and temperature levels.

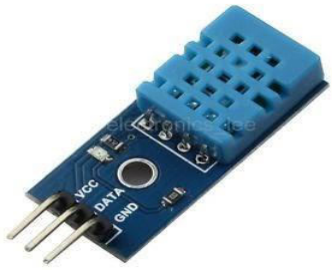


Fig.3. DHT11 Temperature and Humidity Sensor

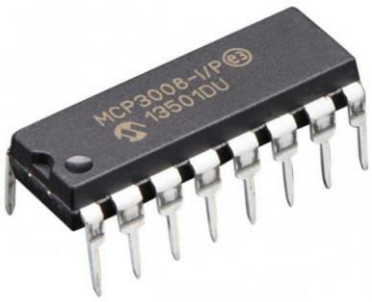


Fig.5. MCP3008 ADC converter

D. Raspberry Pi Model 3B

In this undertaking we are utilizing a Raspberry Pi 3B module. It is an ARM based charge card measured SBC (Single Board Computer) made by Raspberry Pi Foundation. A Wi-Fi and Bluetooth module are as of now present in the Raspberry Pi 3B. Utilizing this module, we can send the obtained changed over computerized partners of the boundaries, over the web, to a Cloud based capacity region. The spared information isn't just utilized for checking purposes, yet for breaking down the data procured, on a periodical premise.

Fig.4. Raspberry Pi Model 3B

E. ADC conveter

It represents Analog to Digital Converter. is a framework that changes over a simple sign, for example, a sound got by a mouthpiece or light entering an advanced camera, into a computerized signal. The MCP3008 is a 10bit 8-channel Simple to-modernized converter (ADC). It is unassuming, easy to interface and doesn't require any additional portions.

IV. METHODOLOGY

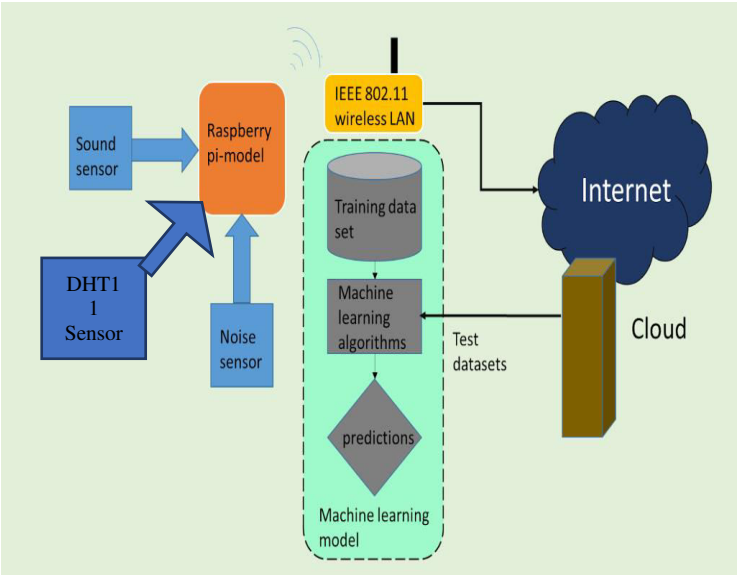


Fig.6. Block diagram of system

A. Air Quality Index

It is a worth that is conveyed by the legislature to the general population with regards to how dirtied the earth is or will turn into. As the AQI increments, different wellbeing perils come up. The AQI can be registered by computing the normal contamination focus over a predefined period.

B. Noise Pollution Level

Commotion contamination has the most destructive effect on human or creature life. Clamor contamination for the most part happens because of the sound originating from blaring vehicles, businesses, industrial facilities, substantial hardware, and so forth. Certain commotion guidelines are recommended by the administration that should be kept up.

The goal of our work is to screen the air nature of a locale and the recognition of commotion force to check the issue of sound contamination. The proposed technique includes cloud-based checking of the necessary boundaries with the assistance of the web. The ready framework guarantees that the client is advised about any troublesome condition which requests moment activity.

The proposed model comprises of the accompanying modules, to be specific, the Air Quality Index Monitoring Module, the Sound Intensity Detection Module, and the Cloud-based Data Monitoring Module.

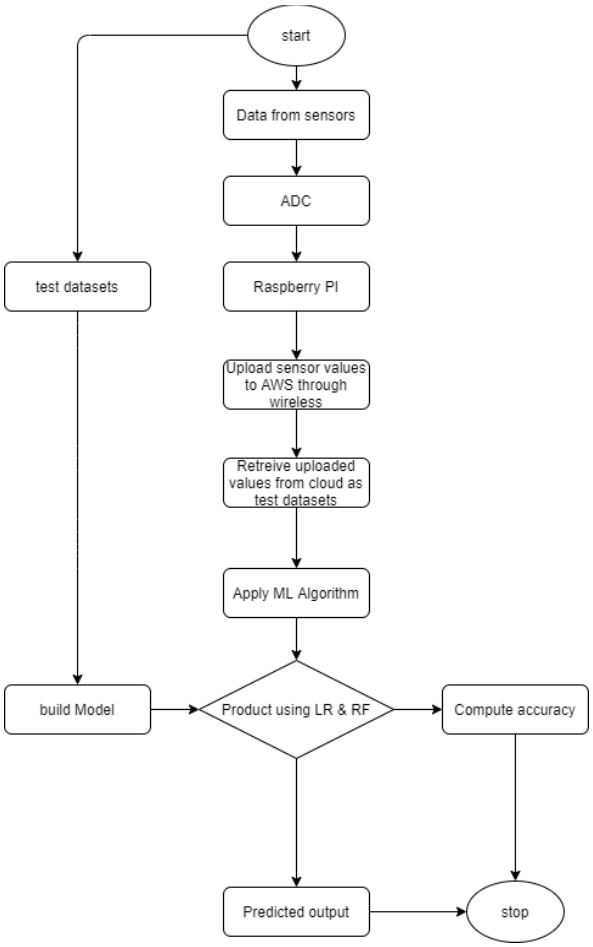


Fig.7. Flowchart

1) Air Quality Index Monitoring

Air Quality Index is estimated relying upon five rules poisons, in particular, ground-level ozone, particulate issue, Carbon Monoxide (CO), Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2). In this task, we are utilizing MQ-135 AIR QUALITY or GAS DETECTION SENSOR. It proficiently recognizes the NH3, NO2, smoke, and CO2 level noticeable all around. This particular sensor is picked for its sweeping distinguishing extension, quick reaction, dependability, and long haul soundness.

2) Sound Intensity Detection

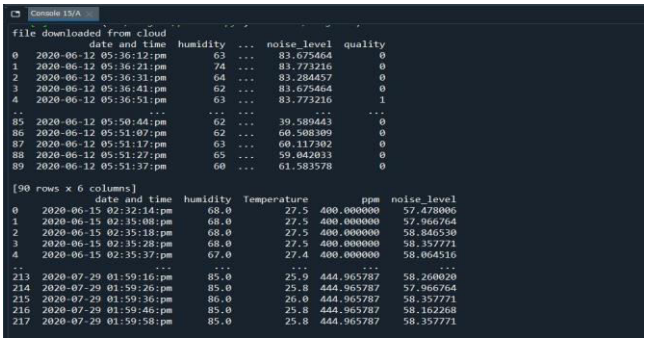
LM393 Sound Detection Sensor is used to gauge sound force with the thought process to screen Sound Pollution in a region. At the point when sensor distinguishes sound, it forms the yield signal voltage which is sent to Raspberry Pi which again plays out the vital handling required for observing the boundaries.

3) Humidity and Temperature Detection

DHT11 Sensor is used to gauge dampness and temperature in a zone. The sensor recognizes the mugginess levels and procedures the yield signal voltage, which is sent to the Raspberry Pi module. A basic python content has been executed to peruse, show, and send the perusing to the cloud.

4) Uploading Data to Cloud

For the consolidation of the cloud framework we need web get to. We have added a GSM module to the framework so the framework can interface with the Internet utilizing the versatile information. As per our necessities, we have to buy in to an arrangement for the SIM we will use in the GSM module. We have a Wi-Fi module present in the Raspberry Pi 3B. Utilizing this module, we additionally can send the procured changed over computerized partners of the boundaries, over the web, to a Cloud-based capacity region. The spared information isn't just utilized for observing purposes yet for breaking down the data procured, on a periodical premise.



```
file downloaded from cloud
             date and time  humidity  ...  noise_level  quality
0    2020-06-12 05:36:12:pm        63  ...    83.675464        0
1    2020-06-12 05:36:21:pm        74  ...    83.773216        0
2    2020-06-12 05:36:31:pm        64  ...    83.284457        0
3    2020-06-12 05:36:41:pm        62  ...    83.675464        0
4    2020-06-12 05:36:51:pm        63  ...    83.773216        1
..                      ...       ...  ...          ...      ...
85   2020-06-12 05:50:44:pm        62  ...    39.589443        0
86   2020-06-12 05:51:07:pm        62  ...    60.508309        0
87   2020-06-12 05:51:17:pm        63  ...    60.117302        0
88   2020-06-12 05:51:27:pm        65  ...    59.042033        0
89   2020-06-12 05:51:37:pm        60  ...    61.583578        0

[90 rows x 6 columns]
             date and time  humidity  Temperature         ppm  noise_level
0    2020-06-15 02:32:14:pm      68.0         27.5  400.000000    57.478006
1    2020-06-15 02:35:08:pm      68.0         27.5  400.000000    57.966764
2    2020-06-15 02:35:18:pm      68.0         27.5  400.000000    58.846530
3    2020-06-15 02:35:28:pm      68.0         27.5  400.000000    58.357771
4    2020-06-15 02:35:37:pm      67.0         27.4  400.000000    58.064516
..                      ...       ...          ...         ...          ...
213  2020-07-29 01:59:16:pm      85.0         25.9  444.965787    58.260020
214  2020-07-29 01:59:26:pm      85.0         25.8  444.965787    57.966764
215  2020-07-29 01:59:36:pm      86.0         26.0  444.965787    58.357771
216  2020-07-29 01:59:46:pm      85.0         25.8  444.965787    58.162268
217  2020-07-29 01:59:58:pm      85.0         25.8  444.965787    58.357771
```

Fig.8.Data from cloud

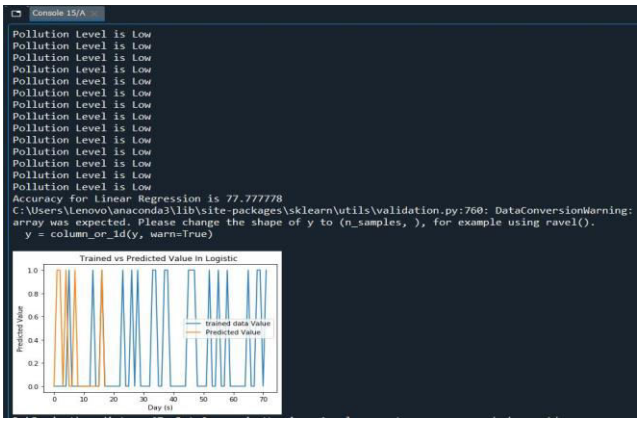


Fig.9. Accuracy for Linear Regression

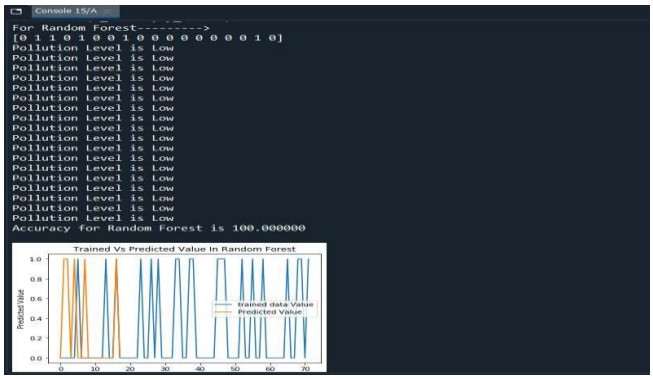


Fig.10. Accuracy for Random Forest

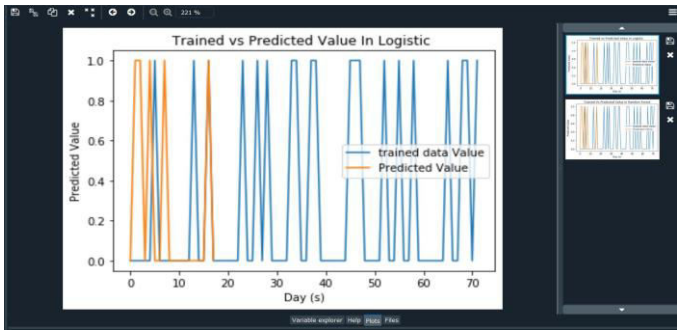


Fig.11. Graph of Logistic/Linear Rgression

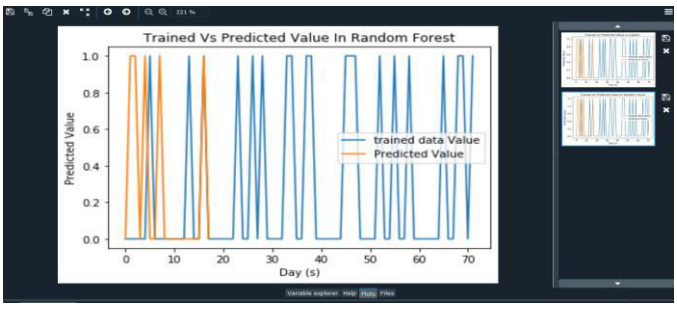


Fig.12. Graph of Random Forest

V. CONCLUSION

Numerous potential arrangements have been featured in this paper, regarding how we can screen air and sound contamination levels alongside stickiness and temperature utilizing the Internet of Things (IoT) and the idea of AI with the goal that we can conjecture the conceivable natural information. Our proposed model gives us continuous information with the goal that we can examine the ecological boundaries. It gives a gauge of the up and coming climate conditions and makes a mindfulness among people in general. People are viewed as liable for this dirtied and hazardous condition. This is a significant worry for the entire world. In this manner, a shrewd method to screen the different ecological boundaries utilizing a Raspberry Pi module has been talked about in this paper. It is a minimal effort, exact, and effective technique for checking. The checking of amassed information in the distributed storage assists with investigating the different examples in the natural boundaries and appropriately tells people in general.

REFERENCES

[1] L. Ezhilarasi, K. Sripriya, A. Suganya, K. Vinodhini, " A System For Monitoring Air And Sound Pollution Using Arduino Controller With IoT Technology." , International Reasearch Journal in Advanced Engineering And Technology (IRJAET)

[2] Mahantesh B Dalawai, Siva Yellampalli, Pradeep S.V, " IOT based Air and Noise Pollution Monitoring in Urban and Rral Areas, Important Zones like Schools and Hospitals in Real Time.", International e-Journal for Technology and Research-2017.

[3] Arushi Singh, Divya Pathak, Prachi Pandit, Shruti Patil, C. Golar, " IOT based Air and Sound Pollution Monitoring System.", International Journal of Advanced Research in Electrical.

[4] A. Sumithra, J. Jane Ida, K. Karthika, S. Gavaskar, " A Smart Environmental Monitoring System Using Internet of Things.", International Journal of Scientific Engineering and Applied Science (IJSEAS)

[5] Giovanni B. Fioccola, Raffale Sommese, Imma Tufano, Roberto Canonico, Giorgio Ventre, " Polluino: A productive cloud-based administration of IoT gadgets for air quality checking." IEEE second International Forum on Reasearch and Technologies for Society and Industry Leveraging a superior tomorrow (RSTI), 2016

[6] SRM. ArthiShri, NB. Keerthana, S.Sandhiyaa, P. Deepa, D. Mythili, " Noise and Air contamination Monitoring System Using IOT." SSRG International Journal of Electrical and Electronics Engineering-(ICETM-2017)

[7] Seung Ho Kim; Jong Minjeong; Min Tae Hwang; Chang Soon Kang, "Advancement of an IoT-based climatic condition checking framework," Interantional Conference on Information and Communication Technology Convergence(ICTC)., 2017

[8] Somansh Kumar, Ashish Jasuja, " Air quality checking framework dependent on IoT utilizing raspberry Pi.", International Conference on Computing, Communication and Automation(ICCCA), 2017

[9] World Health Organization, "Checking surrounding air quality for wellbeing sway assessmeny," WHO Regional Office Eur., Copenhagen, Denmark, Tech. Rep. 85, 1999

[10] International Agency for Research on Cancer (IARC), "Outside air contamination a main natural reason for disease passings", Worth Health Org., Geneva, Switzerland, Tech. Rep. 221, 2013.

[11] J.S Hwang and C.C Chan, "Impacts of air contamination on day by day facility visits for lower respiratory lot ailment.", Amer. J. Epidemoil., vol. 155, no. 1, pp. 1-10, 2002.

[12] World Health Organization. Word related and Environmental Health Team. (2006). WHO Air quality rules for particulate issue, ozone, nitrogen dioxide and sulfur dioxide: worldwide update 2005: rundown of hazard evaluation Geneva: World Health Organizationhttp://www.who.int/iris/handle/10665/69477