



ANALYSIS AND DESIGN OF PREDICTION SYSTEM FOR NOISE POLLUTION USING MACHINE LEARNING - A REVIEW

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Abstract –

Noise pollution is a developing problem now a days. The quickest effect is an illness of human mental health. Now days sleep disorder is a serious cause. Continuous propagation of noise can create frustration. Noise can make a more contribution to cardiovascular effect in human beings. That is a reason it is very difficult to live a healthy life for all. The proposed system work on the methods of Internet of Things (IOT) which is an evolving technology. It will also check the live intensity of generating noise in a particular area and also maintain a log over the internet for further analysis and prediction. The proposed system will be sensing the presence of dangerous noise range. A micro controller will be used to process the noise data and generate reports for authorities to keep a watch and take some precaution over the excessive noise. It will also classify the noise using machine learning algorithm and design prediction system for noise pollution. This system can be used in various areas. It will be used near school, college campus, hospital and no honking area and traffic areas. If more noise found in a particular area or city, it will get reported to the branch.

Keywords – Noise Pollution Monitoring System, Internet of things, Pollution Monitoring, Noise Level, IOT Base Noise Monitoring System..

INTRODUCTION

Internet of Things (IOT) is a system of interrelated computing devices. Means that have ability to communicate and transfer data over the internet. It does not need to monitor after configure. It means taking all the digital devices in one roof. In the next some years later, digital devices will offer advanced levels of services and change the way people live. When new device is found and try to connect. Means that it needs to send information to primary device e.g. if your mobile want to communicate with router, so you need to know SSID and password. This technology explains the general concept of network devices that are communicate and sense, and data is collected from external world. And also then share that data present over the internet. This data can analyze and process and utilized for various research purpose.^[1]



Fig. 1. Internet of Things conceptual figure

In this era of modernization, technologies are advancing rapidly. Lower back in time checking the pollution in a selected area was a very tedious. One of the latest works is done on internet of thing. To increase in utilization of web and interaction of human with every device. It allows alternate of records among various gadgets like refrigerator, washing gadget, cars etc. Sound pollutants can do more dangerous effect on humans. On survey said that, approximately 85% of swedes stay in city areas and the quality of lifestyles and the health of citizens

are suffering from noise. Noise is any uncomfortable sound present in environment. The arena health agency who recommends^[18] for properly snoozing much less than 30 dB noise level inside the bed room and for teaching, much less than 35 dB noise level.

Recent studies^[19] have located that exposure to noise pollution may also boom the risk for fitness troubles including coronary heart assault obesity impaired sleep or depression. Following the Environmental Noise Directive (END) 2002/49/EC, each EU member state has to assess environmental noise and develop noise maps every five years. As sources of noise like traffic volume, construction machinery, loud music etc. may change over time, for this it is necessary to monitor noise degree. Hazardous noise should high impact on human often occurs for only few minutes or hours, and it is not enough to measure the noise level every five years. Furthermore the sound at the same dB degree can be perceptive as disturbing noise or as a pleasant music. Therefore, it is necessary to go beyond the approaches that measure the noise only in dB.^{[20][21]} In keeping with the related to newspaper the dangers within the towns around the globe increases dramatically and new styles of pollution are discovered in lots of cities so that you could cater these issues an IOT module which helps attaching modules to the device and an studying device based totally on device gaining knowledge of is introduced.

High noise can produce mental disturbance in human being. As an example, People living near to industries, store mining, airports, and playground will be more noise in that area. Excessive noise degrees can damage hearing consequences. Measuring noise degree, workers' noise exposures is the maximum essential a part of an administrative center listening to conservation and noise manipulate software. It enables pick out work locations where there are noise issues, employees who may be affected, and wherein additional noise measurements want to be made. It is an objectionable factor. The below Fig. 2 Shows about how much noise generate by Heavy transportation vehicle, Human conversation, home appliances, aero plane, and shot gun, nearby construction site, mining, store crusher do more noise. The considerable noise level up to 97.60 dB obtained exceeded the WHO value of 50 dB allowed for residential areas.

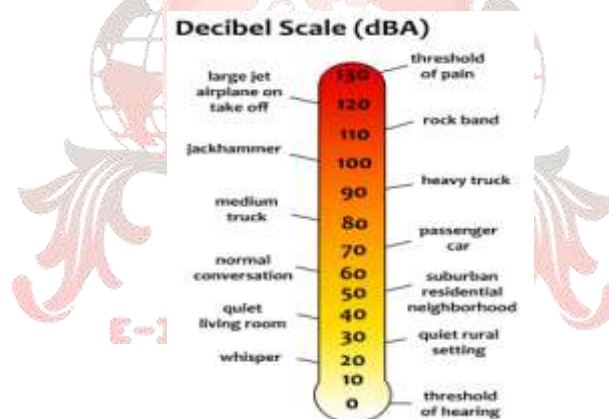


Fig. 2. Decibel Scale (dB)

High noise range can make contributions to cardio-vascular outcomes in human beings. Cardiovascular system. It is for import to flow the blood and circulate, delivery of vitamins which contains electrolytes, oxygen, carbon dioxide and blood cells to and from the cells for the better nourishment.

So, the aged person might suffer from also cardiac issues because of noise, consistent with the sector fitness agency, youngsters are particularly a problem of sleep disorder, and the results that commotion has on children might be everlasting. Earlier method work is manually maintained the data in each and every place which is time looser. So now the data loggers are used for data collection analyze it and perform some prediction and analysis over this data.

To provide the output. Sensors which can measures the sound and provide the visualize output after the further analysis. IoT gadgets that are dynamic are relied upon to develop to 10 billion by 2020 and 22 billion by 2025. Home automation is advancement over the internet of things that mild bulbs, plus other devices like wi-fi scales and wireless blood strain video display units this all are the supported content of IoT.

Motivation

Sound pollution can do serious effect. The major effect due to the noise is an illness, cause of human health. A sleep disorder is also a serious cause now a day. Excessive propagation of noise can increase

frustration levels. Noise can make a more contribution to cardiovascular problems in human beings. So, by considering all the source of noise pollutants, to propose a system to check the noise. And if excessive degree of noise is generated, then it will get reported. And also it is an approach to develop noise pollution and classification system by using machine learning over IoT Before that it is primary duty to control the sound level in the environment.

OBJECTIVES

- To study and make an analysis of sensors, which can be used for sensing the noise pollution in the environment.
- To monitoring the noise intensity and the problem of sound pollution.
- System involvement based on cloud based monitoring of the required parameters with the help of internet.
- To generate the report and make to datasets, if any critical condition of excessive noise.
- Applying machine learning algorithm for prediction of noisy data.

LITERATURE SURVEY

Noise pollution or sound pollutants, is the propagation of noise with harmful effect at the hobby of human or animal existence. The source of out of doors noise worldwide is specially resulting from machines, transport (especially planes) and Propagation structures. For city planning might also way to reduce commercial and residential noise pollution to residential regions. Concept of making clever town may be related to this technology, for this reason making the existence higher and also improving the excellent of services, therefore it meets every individual person need. Machine Learning is described by Mitchell ^[11] as follows, a computer program is said to learn from experience with respect to some class of tasks and performance measurement, if its performance at task that improves with experience. Commonly the supervised machine learning techniques are used for classification of data into different categories.

Supervised learning means building a model based on known set of data to predict the outputs of new data in the future. In the midst of the diversity of classification algorithms, selecting the proper algorithm is not straightforward, since there is no perfect one that fits with all applications and there is always a tradeoff between different model characteristics, such as complexity, accuracy, memory usage, and speed of training. With modern technology in fields of information and communication, it has become easy to interact with the authorized people of city to tell the area or city and achieve a better life quality. This proposed system will predict and analysis of noise pollution using machine learning concept. It will be the next step for the fulfillment of the goal. An area is analyzed for evaluating how much pollution is affecting the area. This sensor is being sense the real world data and delivery of this data through internet is presented.^[3] In Main focus was on the developing an environment noise pollution free for safe and healthy lifestyle.

Preview Of Papers

Pantelis Moukas, John Simson, Leonard Norton-Wayne “Automatic Identification of Noise Pollution Sources” IEEE Volume: 12 September (1982)

Moukas et al. have proposed that automatic monitoring of noise and Instrumentation currently available for the automatic monitoring of noise nuisance has the shortcoming that although the intensity, duration, and time of occurrence of noises may be recorded, their source often cannot be identified. Research directed towards providing improved instrumentation which can identify sound sources is described. It has the shortcoming that although the intensity, duration, and time of occurrence of noises may be recorded our results suggest that application of statistical pattern recognition to recorded sounds can differentiate sources which are structurally dissimilar (e.g. trains, fixed-wing aircraft, helicopters) with an accuracy of better than 95 percent.^[14]

Somayya Madakam, R. Ramaswamy, Siddharth Tripathi “Internet of Things (IoT) : A Literature Review” (2015)

Mudakam et al. have proposed the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it” was Mark Weiser’s central statement in his seminal paper [Weis91] in Scientific American in 1991. There is a sea change in human’s daily life as well as in working conditions in organizations after the arrival of IT and ITeS technologies. This is becoming well-known concept across many horizontal and vertical markets including a common man’s everyday life in the society, as it has several applications. The development of the Internet of Things [IoT] has been primarily driven by needs of large corporations that stand to benefit greatly from the foresight and predictability afforded by the ability to follow all objects through the commodity chains in which they are embedded.^[4]

Anjaiah Guthi “Implementation of an Efficient Noise and Air Pollution Monitoring System Using Internet of Things (IoT)” (2016)

Anjaiah Guthi et al. have proposed the deals with the smart sensor network concept that is an emerging field of research which combines many challenges or computer science, wireless communication and electronics. In this research paper a solution of the monitoring noise levels in industrial environment and the area of interesting using wireless systems. While the whole representation of the hardware and its components is evaluated using original implementation using arduino UNO board, sensor and its supporting components.^[5]

Martina Marjanovic, Sanja Grubesa, Ivana Podnar Zarko “Air and noise pollution monitoring in the city of Zagreb by using mobile crowdsensing” (SoftCOM) (2017)

Martina Marjanovic et al. have proposed the rapid development of urbanization is main goal to monitor critical air and noise pollution. Consequently, vast studies attempt is focused on growing a fine-grained pollutants and noise maps to become aware of urban regions with important bad impact on human fitness. The traditional measuring methods typically use expensive and static equipment which is not suitable for dynamic urban environments because of the low spatio-temporal density of measurements. In this paper we present a mobile crowd sensing (MCS) solution for air quality and noise pollution monitoring. More specifically, we show a practical experience of a real-world system deployment, from sensor calibration to data acquisition and analysis.^[15]

Jorge Granda Cantuna & Santiago Solorzano “Noise Pollution Measurement System using Wireless Sensor Network and BAN sensors” (ICEDEG) April 2017

Noise pollution has negative consequences to human health such as hearing loss, stress, blood pressure changes, migraine, and insomnia, nervous system problems, productivity limitations, mental health problems, and other difficulties. This paper presents the design and development process of a Noise Pollution Measurement System which integrates a Wireless Sensor Network (WSN) and a Body Access Network (BAN) capable of measuring noise pollution levels as well as monitoring its health effects on humans. The WSN and BAN network developed in this paper can be implemented by government entities on a large scale to identify the risks of uncontrolled noise levels and its effects on the health of humans.^[17]

Kulkarni Chaitanya, Kulkarni Shruti, Bhopale Siddhi & Mrs. M. M. Raste “Sound and Air Pollution Monitoring System” (2017)

Kulkarni Chaitanya et al. have proposed the system which can detect the harmful gases and Excessive noise. This system is new concept which can detect both Air and Sound pollution. The main part of this system is to sense the environmental conditions. The sensor we are using here is MQ135 and Microphone sound sensor. Sensor MQ135 is air quality sensor which is used to detect the harmful gases like NH₃, CO, CO₂ and SO₂. The MQ135 sensor is sense the condition and gives the signal. The atmospheric condition is checking byte sensors all the time. When the sensed value reaches to the threshold point then sensor gives that information to the arduino.^[6]

Piyush Patil “Smart IoT Based System for Vehicle Noise and Pollution Monitoring” (ICEI) 2017

Piyush Patil have proposed system provides the solution to these problems with the help of internet of things. Our system Monitor the pollution and noise created by vehicle and if any vehicle crosses its threshold value then it will get reported to the traffic department and agencies of national environment.^[16]

“Arushi Singh”

Arushi Singh et al. have proposed a system which uses air and sound sensors to monitor the data constantly and then transmit the data. A raspberry pi module interacts with the sensors and processes the data thereby transmitting it to the application.

Dr. A. Sumithra, J.Jane Ida, K. Karthika & Dr. S. Gavaskar “A Smart Environmental monitoring system using internet of things” (IJSEAS) - Volume-2 March-2016

Dr. A. Sumithra et al. have proposed the concept of a smart city. Technology and communication is the basis of this smart city. Various sensors and modules have also been used to monitor the various environmental parameters. This system uses air and sound sensors to monitor the data and then upload the data on the cloud server as digital data. The cloud storage managers analyze the data and notify accordingly. SRM. Arthi Shri et al. have proposed the idea of monitoring the parameters using a PIC microcontroller which senses the

atmosphere signals. Gas sensors are used to measure the pollution level. This data is uploaded on the internet and can also be viewed through an app.^[7]

Thomas Zimmerman & Christine Robson “Monitoring Residential Noise for Prospective Home Owners and Renters” March 2019

Thomas Zimmerman and Christine Robson have proposed a noise model and data representation techniques that prospective homeowners. Residential noise is modeled as an ambient background punctuated by transient events. The quantitative noise model extracts noise features that are sent as SMS text messages. The noise analysis output sent over SMS text message when the peak value provides a quantitative analysis of the noise environment. A device that implements the noise model has been build, calibrated and verified.^[9]

Yasser Alsouda & Sabri Pllana “A Machine Learning Driven IoT Solution for Noise Classification in Smart Cities” arXiv [cs.CD] September 2018.

Alsouda have proposed a machine learning based method for noise classification using a low-power and inexpensive IoT unit. We use Mel-frequency cepstral coefficients for audio feature extraction and supervised classification algorithms (that is, support vector machine and k-nearest neighbors) for noise classification. The approach experimentally with a dataset of about 3000 sound samples grouped in eight sound classes (such as, carhorn, jackhammer, or street music). Explore the parameter space of support vector machine and k-nearest neighbors algorithms to estimate the optimal parameter values for classification of sound samples in the dataset under study. We achieve a noise classification accuracy in the range 85% to 100%^[19]

Summery And Discussion

Noise pollution is growing issue, Generation of excessive noise should harm or damage, hearing loss, increase blood pressure and sleep disruption. By considering all the above papers by different authors. The system to develop the noise pollution and prediction. The concept of noise pollution using machine learning is proposed. The proposed system will be able to check the noise intensity in particular area and generate the report for authority. With the help of this report, Authorities can keep watch on noise level. The proposed system is very much useful at noisy area, to reduce noise and maintain the noise level. But the main part of this system is to experience the pollution of noise. To sense actual noise, sound sensor is required. Monitoring noise is important, that system will need a sound sensor to sense the degree of noise. A micro controller will need to process and generate report to the server for further analysis.

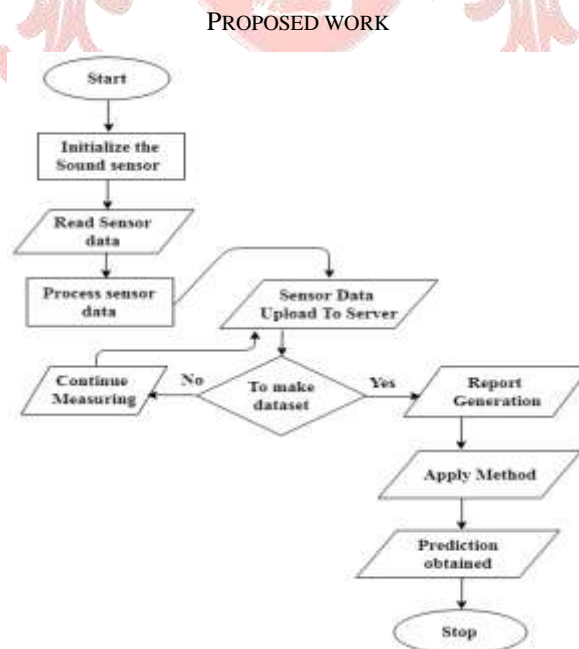


Fig. 3. Block diagram of noise monitoring system

The above block diagram shows, how the data is processed from sensor sensing to report generation and analysis.

Required Components

- **Node MCU** – It is a open source micro controller device for IOT base platform, that designs and manufactures single-board microcontrollers module. For building smart digital devices. These boards are able to read inputs from sensor, receive signal using additional components
- **Sound Sensor** – The sound detector is a small component that combines a microphone and a circuitry. It gives no longer simplest an audio output, however additionally a binary indication of the presence of sound, and an analog illustration of it is amplitude. At the initialization time sound sensor sense the current intensity of sound, and this data is process by the micro controller.
- The data will upload to the server, as well as microcontroller will also check for noise intensity level. Maintain the datasets for further analysis and prediction of noise intensity.
- If the intensity of noise is above the defined level, System will generate the report. After that the try classify the noise polluted data and generate visualize reports after analysis. Applying prediction system for noise data. Node MCU firmware for IOT platform. Any authorities want to check that data, they can able to access and visualize it. After that they can control and taking precaution.

Data Analysis and Prediction

Data analysis in the noise pollution monitoring system, and classification of sound level, Use to Naive Bayes Classifier. A classification of sentiments in a machine learning model that is use to recognize the different objects based on element. A adapted naïve bayes machine learning model that is required for classification task. The classification is based on the Bayes theorem.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \quad (1)$$

Using this, we can find the opportunity to measure the factors and happening, and that has come about. The assumption is made right here is that the predictors are unbiased. This is presence of one particular feature does not have an effect on the opposite.

Hence it is called naive. According to this example, Bayes theorem can be rewritten as

$$P(y|X) = \frac{P(X|y)P(y)}{P(X)} \quad (2)$$

The variable y is the class variable which represents if it is suitable to play golf or not given the conditions. Variable X represents the parameters/features.

X is given as they can be mapped to outlook, temperature, and humidity and windy. By substituting for X and expanding using the chain rule we get.

$$X = (x_1, x_2, x_3, \dots, x_n) \quad (3)$$

C. Data visualization

They can be mapped to outlook temperature and humidity and windy by way of substituting for x and expanding the usage of the chain rule we get. Meaning of data – Let's start with how we think about data and how it is processed, which is demonstrated very well by this data evolution flow:

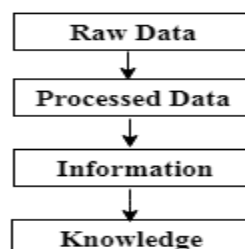


Fig. 3 : Data processing steps

Simply the raw data will recorded by sensors and that can be stored in number of fields, that means in symbols or words. So we can start making a datasets for sensor data. By using this datasets, further process is done. To analyze further data points, probability and consistent data parameters. How they relate to each other?

CONCLUSION

Important sources of noise must be known. Successful noise monitoring and reduction should be the fundamental issue. Noise pollution management should include measures to limit the noise sources. Noise pollution is hazardous to human health as well as animal. It is a major problem now days so, considering the above problem definition, the system is proposed to development.

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