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Smart Sound Measurement and Control System For Smart City

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Abstract – The noise pollution is considered as the major problem that we all face in our day to day life. This is a major problem especially in areas where there are hospitals, schools, baby care center, etc. With rising noise pollution near hospitals, schools etc, it has taken a heavy toll on students, patients, etc. So a strict action should be taken and control the noise pollution. Although many decibel-meters are applied to that environment, which indeed must be kept quiet, the decibel-meters can only detect the noise pollution limited to the nearest area around the device. We will face the incorrect measuring data from the decibel-meters in bigger space like a library. According to such problems mentioned above, maybe we use more decibel-meters around different areas to a better solution.

We have such problems waiting to be solved like averaging the measuring data, inter-connecting the cross-data between the devices with the existing decibel-meters in the market. So our study wishes for implementing a portable, small-scale and internet-based sound-detective prototyping by using Internet of Thing (IoT) technology to offer a better solution mentioned above.

Our approach is to make use of cheaper materials and low-precision sensor and single-chip microcomputer like Arduino with WIFI connection ability to develop a dedicated sound-detective device. The devices can be developed under very low-cost without any display on it, but all sensor data will be sent into the clouding system and be displayed on mobile-devices by only using browsers.

Keywords: Sound Sensor, Buzzer, Smart City, ID3 (Iterative Dichotomiser 3), IOT.

1. INTRODUCTION

Nowadays noise pollution becomes a serious problem for the people. Mainly in hospitals baby cares and library. Decibel meters are applied to that environment, which indeed must be kept quiet, but the decibel-meters can only detect the noise pollution limited to the nearest area around the device.

An application of the developed real-time Voice Activity Detector app was used as an automatic switch for enabling noise classification in the absence of speech in a noise-adaptive speech enhancement pipeline. The automatic switching done by the VAD app was found to be same as that of the ground truth manual switching, indicating the effectiveness of the real-time VAD app. Implementation of a portable, small-scale and internet-based sound-detective prototyping by using Internet of Thing (IoT) technology to offer a better solution to avoid the problems like averaging the measuring data, inter-connecting the cross-data between the devices.

This web application along with the sound detecting system will perform various tasks for measurement of sound intensity in particular area and if sound crosses the sound limit alert is sent to the administrative authority. Authorities can see the history of sound levels in a particular area.

This project helps a better support and time-saving factor. The various types of reports will be available quickly without any effort so the authority can see the history of sound level in a particular area

2.RELATED WORK

In paper [1], the authors tried to implement a portable, small-scale and internet-based sound-detective prototyping by using Internet of Thing (IoT) technology to offer a better solution to noise pollution.They choose low-precision sensor and the single-chip microcomputer (MCU) with WIFI connection ability as a sound-detective device, all sensor data was sent into the clouding system and displayed on mobile-devices by only using browsers.And hence a system structure was developed which could use the sound-sensor to collect data and to send those data to the website and visualize the sound-sensor data from the website to users.

In paper [2] authors gave a solution for automatic surveillance systems that are used in audio-based systems. It presented some important advantages when compared to the video based systems. The system uses many features for these audio signals that are associated with the events. They are available as input data for two artificial neural networks (ANN) and act as pattern recognition components. There are two detection levels in this alarming event detection system. The first level detects only if the event is a dangerous one that means when the alarm is on or the normal one which means the alarm is off. In the second level, the system identifies the nature of events which are classified into four different classes: chainsaw, gunshot, human voice or tractors.The experimental results proved that the author's system is a very reliable one, which gave the maximum possible correct recognition rate of 100 percent for the first level and very high correct recognition rates for of 99.50 percent for the second level.

In paper [3] the authors have presented a comparison of several states of the Deep Learning models on Detection and Classification of the Acoustic Scenes.They classified sounds into one of the fifteen common indoor and outdoor acoustic scenes, such as vehicles like bus, train, library etc. The author studied a diverse set of deep acoustic scene recognition task. And borrowed ideas from various signal processing techniques and also from recent advancements in automatic speech recognition. The dataset contains 15 diverse indoor and outdoor locations.They presented a comparison of the most successful and complementary approaches to sound event detection on Detection and classification of the acoustic scenes. This will be implemented on top of the evaluation system in a systematic and consistent way.

In paper [4] the authors tried to develop an effective system for automated detection of gunshots in open nature. This will alert police of poachers. The system made is used for gunshot detection, feature linear predictive coding coefficients, cepstrum, noise analysis. The gunshots detection module is integrated into the GPS collar. After an incident, the information about the poaching event along with its location can be sent to police. Then, an anti-poaching team could react promptly to against the poachers at the place of the crime. A good working gunshot detection system was developed which had a simple structure of signal processing.

In the paper [5] the authors studied to propose a WSN platform for continuous monitoring the sound by using static smartphones for measuring the noise. This platform carried out various tasks like noise sensing, noise monitoring and used smartphones as sensors which can be installed on a software or App. This application not only works for noise measuring but it also works for weather data. Then the author described some platforms to access the measured data or noise maps around the world. The author developed an architecture for sound noise data gathering through smart-phones as sensors were developed.

The paper [6] is the study of machine learning as emerging field, which can detect noise and make decisions on how to react is done. The main objective of this study is noise sensing and machine hearing. In machine hearing, the author focuses on pragmatic system structures and real applications involving realistic sound mixture in the real environment and bring all the speech, music, and hearing researchers closer together by focusing on more general sound processing that provides a clear opportunity for leverage via collaboration. The machine hearing field is starting to find its feet. Applications are abundant and many are easy to address with known auditory front ends, combined with known feature extraction and machine learning techniques.

In the paper [7] the author tried to analyze the adopted strategy for sparse coding. The result was presented on new management and then they presented this preliminary work in the extraction of knowledge from SLAs that were based on different cloud services. In the result, they discovered that a tests design for determining whether the coding strategy had the intended feature of robustness or not. The main aim was to retrieve the sound, ranking and machine hearing. For audio-file ranking and retrieving from text queries, was based on stabilized auditory images. The author took a multi-scale approach, by using vector quantization for choosing one sparse feature in each overlapping regions of different scales. Hoping that in some regions the features for a sound would be stable even when another sound interferes. The results suggested that this multi-scale feature extraction from auditory images is a good approach.

In the paper [8] the authors have tried to create a dynamic webpage. This webpage can be used for publishing, in real time, the data from the Environmental Noise Monitoring station installed at the Association for the Development of Industrial Aerodynamics (ADAI). The main objective of the webpage was e-learning, remote laboratory, environmental noise and indoor environmental quality. The participants that were the course participants had been instructed to go to the ENM station webpage. They were said to observe for a few moments the noise data being displayed in real time along with the online camera image. This refreshes at a rate of one second. The course participants should then choose one particular date from the last few days or weeks and select download, to retrieve 24 h of archived noise measurement data, in text format, corresponding to that particular date. The data was then been used in application exercises. It was used for the acoustics module of the distance learning course. The existing ADAIs Environmental Noise Monitoring station was adapted into a more flexible server-client architecture. The purpose of this was to facilitate the real-time publishing of environmental noise data to the World Wide Web.

In the following paper [9], the authors proposed a sound event detection system which is trained by using a minimally annotated dataset of a single sound. The main aim was to bootstrap this minimal data and to learn new sound which will lead to a better sound detection system. Using an autoencoder the system uses a Feed Forward Neural Network with a single hidden layer. Sounds and vectors are used for training the neural network using backpropagation. Polyphonic sounds are pre-processed using Principal Component Analysis (PCA) and Non-negative Matrix Factorization (NMF) for obtaining source separated sounds. These sounds are then tested for sound classification using the feed-forward algorithm. This system was implemented successfully using the test datasets. Currently, two sound events per instance were used so in the further work the number of sound event classes per instance will be increased.

In the paper [10], the authors tried to understand the management of cloud services. The main objective was to study Cloud Computing. They discussed in detailed all the challenges required for automating cloud services centralized cloud management system will be useful to manage the existence of multiple cloud providers.

In the paper [11] the author tried to design, implement and evaluate a prototype. This prototype localizes a sound source when processed through acoustic signal measurements. The author made use of Arduino sensors and Arduino based wireless sensor network. Work done in this paper implements an acoustic event localization system. This system accurately locates an acoustic source. These acoustic signals are acquired through low-cost microphones incorporated in a WSN based on the Arduino hardware. Despite the challenges of acoustic signal processing and real-time event localization, the average error obtained in the system is as low as 22 cm inside an area of 2×2 m.

3. PROPOSED SYSTEM

As city inhabitants Play loud music during festive seasons, a sound sensor needs to be fit in various areas of the city. Sound intensity needs to be calculated and if it continues to be more than 70 DB for a residential area and 65db for commercial areas and remains loud for more than 15 minutes, then an alert needs to be sent to the nearest police stations.

If the sound level goes beyond the residential and commercial limit, then the LED light starts glowing as a warning so that local residents can reduce the volume. The data generated by the sensors on nodes must be sent to the server at regular intervals. For this, we include a Wifi module into the system that would sync data with the server at periodic intervals. It would also be used to update any settings on the nodes. Depending upon the conditions of the sound levels, the system needs to find the nearest police station and inform them. We aim to provide an optimal route for the same purpose.

This will make the police officials reached the spot in minimum time. In case of continuous loud sound, authorities must be informed instantaneously. This would be achieved by sending SMS or email to concerned authorities for further action. Authorities can see the history of sound levels in a particular area. This Feature would help generate reports for authorities and users to check if the sound control has been properly followed in the city.

In the program architecture the User Android App will be an Android App for police authorities by which they will get notification via E-mail and SMS about the area wise sound.

The Area Admin will keep the records of area wise sound intensity. The main system will consist of Apache Tomcat Server, MySQL database. This will let us store information in the database and it will also view the shortest distance.

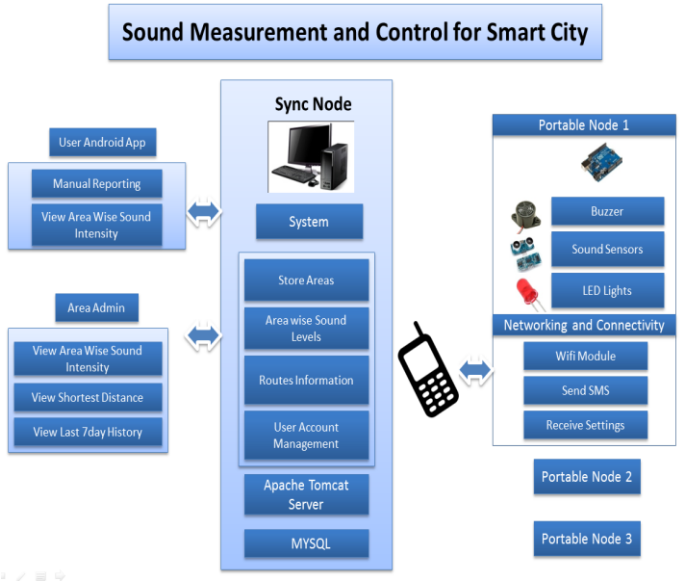

Fig.1 Architecture of the Smart Sound Measurement and Control System For Smart City

In every portable node, there is a buzzer, LED lights, Sound Sensors, GSM module.

4.CONCLUSIONS

We implemented a portable, small-scale and internet-based sound-detective system using Internet of Thing (IoT) technology to offer a better solution to avoid the problems like averaging the measuring data, inter-connecting the cross-data between the devices. It helps in city-wide sound management and Implements the sound limit rule for everybody at all the time.

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