IoT based noise pollution monitoring system

Introduction:

Presently, noise pollution has become a very big issue around the world. The adverse effects of this pollution include hearing impairment, negative social behavior, annoyance, sleep disturbance and intelligibility to understand people's speech. In learning context, noise can affect understanding and behavior of people and places with high noise level are not suitable for learning and teaching process.

Internet of Things **(IoT)** technology is one of the best choices to monitor the noise or sound intensity in the environment for the safety of human being[1].

1. **Problem Statement Understanding :**

While at university students are exposed to various types of noise including external, environmental noise and noise generated within the classroom.

Earlier researches have shown that sound-pollution has detrimental effects upon student's performance at university, including reduced memory, motivation, and learning capability.

The noise impact on student and their lecturers have been inspected by researchers in the past 40 years. It is generally accepted that noise has a detrimental effect upon the cognitive development of students.

Noise pollution is the inordinate noise measure or pesky sounds that unsettle students and distracting them in the lecture halls and workplaces. This kind of pollution has different effects on students' health, physically and psychologically . Main sources of noise pollution inside campus are high volumes of outside traffic and human-based sounds.

In classrooms, the noise levels are equal to residential environments and accepted are those which not exceed 65 dBA during the day . Accepted standards for recommended permissible exposure time for continuous time weighted average noise, stated that for every 3 dBA over 85 dBA, the permissible exposure time before possible damage can occur is cut in half, e.g., 85 dBA is linked with a permissible exposure time of 8 h; 88 dBA for 4 h, 91 dBA for 2 h .The use of percentile levels in the acoustic analysis helps to have an understanding of the noise fluctuations over time.

These are commonly used for environmental noise monitoring, such as road traffic or community noise

assessments. With the use of long-term measurements, changes on the levels can be observed from the data, and more advanced studies can be performed in order to evaluate the noise volume.

Monitoring these sources of noise pollution is crucial for the comprehension of how these sounds evolve with time, in order to study it, control it and prevent it[2].

2.Software and Hardware Requirement:[3]

2.1 Hardwares:

I.Arduino controller: Arduino Uno R3 microcontroller. It is the most flexible hardware platform used based on ATmega328P which can be programmed according to the function where it is to be used. It has 6 analog inputs, 14 digital input/output pins(6 pins of these can be used as PWM outputs) , a USB connection, a 16 MHz quartz crystal, SPI, serial interface, a reset button, a power jack and an ICSP header.

Arduino Uno board [3]

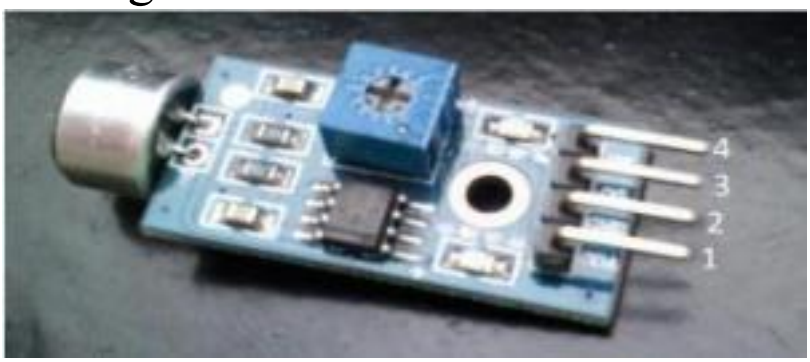
It is the primary component of the framework. In addition, it is an open source microcontroller device with easily accessible software/hardware platform and is compatible with many sensors available. Everything needed for its working is present on the board; we only require a USB cable to directly connect it to the computer or give power using battery source or AC to DC adapter to get started.

Also, it is not expensive and can be assessed with free authoring software i.e. IDE. With the availability of a large no. of source codes over the internet, the programming of Arduino becomes easy. The online growing community backing Arduino consists of programmers like us that share their examples for others to make it a more reliable platform

Parameter	Value
CPU type	8-bit AVR
Performance	20 MIPS at 20 MHz
Flash memory	32 kB
SRAM	2 kB
EEPROM	1 Kb
Pin count	28-pin PDIP, MLF, 32-pin TQFP, MLF
Maximum Operating Frequency	20 MHz
Number of touch channels	16
Hardware Q-Touch Acquisition	No
Maximum I/O pins	26
External Interrupts	2
USB Interface	No

II. Sound Sensor: The sound sensor module provides an easy way to detect sound and is generally used for detecting sound intensity. This module can be used for security, switch, and monitoring

applications. Its accuracy can be easily adjusted for the convenience of usage. It uses a microphone which supplies the input to an amplifier, peak detector and buffer. When the sensor detects a sound, it processes an output signal voltage which is sent to a microcontroller then performs necessary processing.



Sound Sensor and its Pin-Out [3]

Specification of Sound Sensor:

· Operating voltage 3.3V-5V

· Output model: digital switch outputs (0 and 1, high or low level)

· Voltage Gain 26dB

· Microphone Impedance 2.2kΩ

· Microphone Frequency 16.20 kHz

Pin Configuration:

1. VCC: 3.3V-5V DC
2. GND: ground
3. DO: digital output
4. AO: analog output

4. ESP8266 Wi-Fi model: ESP8266 is an impressive, low cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing microcontroller project via a UART serial connection. The module can even be reprogrammed to act as a standalone Wi-Fi connected device

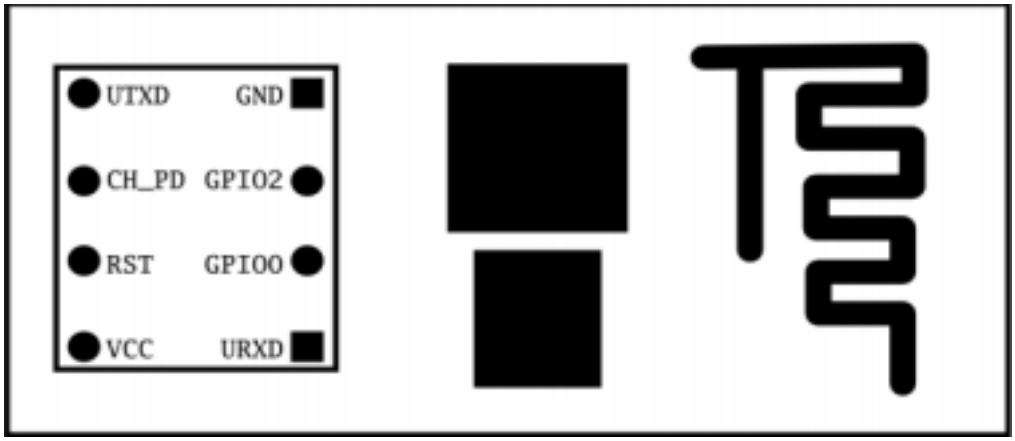


Fig 6: Wi-Fi module and pin out (ESP8266) [3]

Specification and Pin-Out of Wi-Fi module:

· 802.11 b/g/n protocol
· Wi-Fi Direct (P2P)
· Integrated TCP/IP protocol stack
· Integrated PLL, regulators, and power management units
· +19.5dBm output power in 802.11b mode
· Integrated temperature sensor
· Supports antenna diversity
· Power down leakage current of < 10uA
· Integrated low power 32-bit CPU could be used as application processor

2.2 Softwares:- [3]

I.Proteus: The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and electronic technicians to create electronic schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Lab center Electronics Ltd and is available in English, French, Spanish and Chinese languages.

II. Arduino IDE: A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a

message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

3.Addition and Updates: we can add some code so that when the noise range exceeds over some 70-80dB which is harmful so our device example: Mobile should vibrate or rings to notify us as we cannot be present all time in front of mobile screen.[3]

4.Applications , Advantages and Challenges:

4.1. Applications:

- Industrial pollution monitoring.
- Public places.
- School area.
- Environmental Section.
- Installed in Vehicles.

4.2. Advantages:

- Remotely we can Monitor Pollution.
- Cheap In Cost.
- Data can be used to control pollution.
- Small in size.
- Data is useful for government Health departments.[3]

5.Conclusion: People thought that noise pollution is merely an annoyance but it is actually very important to monitor noise level because according to research, people who are exposed to noise for a long duration of time can have hearing loss, sleep disturbance, high blood pressure and injuries[1]. So this research proposes a smart noise monitoring system which keeps track of quality/range of noise and continuously giving updates on our device.

References:

[1] M B Badruddin , S Z A Hamid ,R A Rashid &S N M Hamsani "IoT Based Noise Monitoring System (NOMOS)" Sustainable and Integrated Engineering International Conference 2019 (SIE 2019)

[2] Aram Mohammad Abdulqadir & Mohammed Hussein Shukur "Development of an IoT-based Noise Monitoring Network" Cihan University-Erbil Scientific Journal Special Issue No.1, July 2017

[3] Prof. Kaushik Vipul R., Dr. Tanaji Dabade, Dr. Vijay N. Patil "IOT BASED AIR AND SOUND POLLUTION MONITORING" SYSTEM- A REVIEW