ISSN: 2454-9940

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

E-Mail :
editor.ijasem@gmail.com
editor@ijasem.org

www.ijasem.org

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN 2454-9940

www.ijasem.org

Vol 19, Issue 2, 2025

An Examination of the Source's Sound Intensity During Motion

[1]J. Kiran Chandra Sekhar, [2]Putta Ganesh,[3]Suvvada S G S D A Swamy,[4]Muntha Vijaya Durga Kumar
[1]Associate Professor, Department of ECE, Rajamahendri Institute of Engineering & Technology.
[2,3,4]Student, Department of ECE, Rajamahendri Institute of Engineering & Technology.

Abstract:

Noise pollution monitoring, industrial safety, and environmental evaluations are just a few of the many important uses of sound intensity analysis. An external sensor, an ultrasonic sensor, a temperature and humidity sensor (DHT11), and three light-emitting diodes (LEDs) are used in this work to analyze the sound intensity of a moving source using a smartphone.
Measurement of noise from moving sources may be done in real-time using the Sound Sensor, which detects changes in sound intensity levels. If you want to know how far away anything is that's making noise, you may use the Ultrasonic Sensor to find out. Environmental factors like humidity and temperature are recorded by the DHT11 sensor and may affect how sound travels. Users may readily analyze data in real-time with the aid of three LEDs that show various intensity levels, providing a clear visual representation.
The data is sent to a cloud platform that is based on the Internet of Things (IoT) for remote monitoring and analysis after an Arduino microcontroller analyzes all the sensor inputs. Applications for the suggested system include industrial safety systems, traffic analysis, and urban noise monitoring; it also offers a scalable, efficient, and cost-effective solution for real-time sound intensity tracking.

INTRODUCTION

When it comes to physics, sound is paramount. One of the basic elements of sound is the sound intensity level. A measure of soundpower is the volume of audible sound. The power of the sound source determines the level of sound intensity. Both the number of sound sources and their distance from the observer have a significant role in this. Smartphones have the potential to revolutionize data collecting in formal physics labs and other fields due to their portability, high computing power, and ability to measure the external environment compared to early personal computers. [1]: Yes.

Smartphones are multi-function gadgets that combine many, separate operations. The device could

have an accelerometer, microphone, speaker, camera, or magnetic field sensor, among others. [2]. Sensors have recently been shown in a variety of educational and scientific applications, including physics experiments, demonstrating their value beyond the aforementioned typical use. [19]. They provide an affordable way to monitor motion in many physics investigations. The third.

LITERATURE REVIEW

The proliferation of universally compatible sensors is a direct result of the exponential growth in smartphone technology. As a measuring instrument in physics classes, students may use their smartphones to perform experiments. These are only a few examples: the physics toolbox, audacity, phyphox, acoustic, tone generator, and Arduino science. The use of digital technology has opened up new avenues of engagement for students, instructors, and student-generated material [5]. The widespread use of cellphones as a tool in classrooms throughout the world Students may learn which ideas or systems they should work on by using smartphones that combine theoretical concepts with simulations and self-evaluations. New opportunities arise as a result of the readily available electronics and built-in sensors of today's mobile gadgets. Students may use a range of programs on their mobile devices to conduct experiments in several subfields of physics [6]. Plus, with free software available in app stores, anybody may use their mobile devices for measuring, no other instruments needed. Even while there are numerous benefits to utilizing cellphones in labs instead of costly measuring equipment, the ability to conduct physical observations and measurements while carrying out everyday tasks promotes learning in a new manner. Students have hands-on experience with nature, measure various magnitudes using their own equipment, compare and contrast experimental findings with classroom knowledge, and discover real-world applications of classroom concepts. And

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN 2454-9940

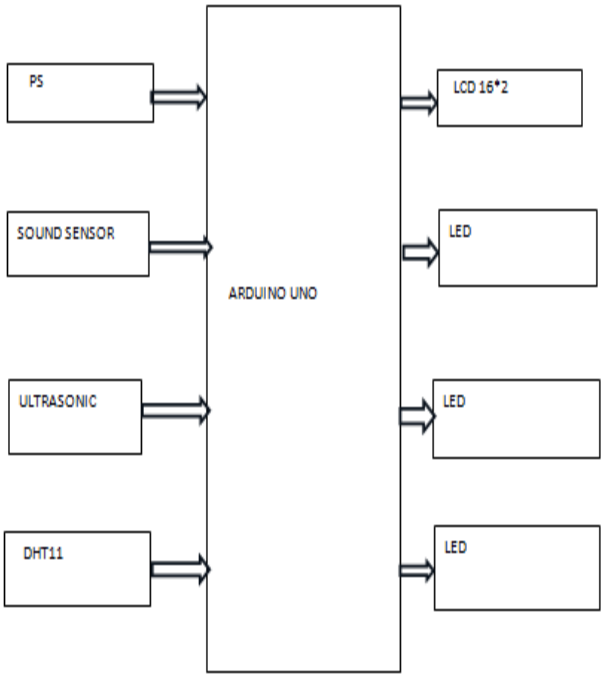
www.ijasem.org

Vol 19, Issue 2, 2025

since this can happen anywhere at any moment, students may learn physics more easily by turning the whole world into a lab on their smartphones and tablets [7]. The sophisticated electronics and integrated sensors found in modern smartphones make them ideal learning and testing aids. These sensors may measure acceleration, gyroscopes, magnetic fields, and light intensity, among other things. By creating low-cost, authentic experiments for smartphones, physics teachers may further exploit this second feature to increase student involvement. [9]. The use of mobile apps in scientific education has several advantages over more conventional forms of educational technology, such as portability, affordability, accessibility, compatibility, and multifunctionality. Through the use of various sensors, artificial things may see the cosmos in a way similar to that of God's created creatures, bridging the gap between the digital and physical realms [13]. Data analysis tools may be accessed by downloading and sharing the collected information from mobile sensors over email or the cloud. Another option is for students to just submit a data snapshot. It is possible to alter the frequency of the sound using apps for smartphones. More frequencies and an accurate number for sound intensity may be measured in this way [15]. Since this is the case, we provide a novel approach to measuring sound levels using a sound sensor in this research [16].

Using their mobile devices, students may better grasp scientific ideas when they are not in a classroom setting by visualizing physical interactions and collecting information outside of the classroom, such as at home or in the field [17]. The use of smartphones in the classroom has never been more crucial, given the increasing number of people who possess them, especially in underdeveloped and emerging countries. In order to assist students grasp concepts that may otherwise be difficult to grasp, digitally recorded video analysis can also provide measures of object distances, timespans, and trajectories. Consequently, to show a new and more comprehensive way of teaching physics, it is necessary to explore not only the capabilities of smartphones but also the many free applications given on the Google Play Store. With the help of supplementary hardware, modern cellphones can detect and remove ambient noise with remarkable accuracy [23]. The term "virtual laboratory" refers to an experimental activity that mimics the steps of a genuine experiment using computer software. Seeing animated or recorded data simulations in virtual labs allows students to actually understand certain ideas and concepts even when they are not engaging in the scientific process [24]. Naturally, with the advent of the smartphone, virtual labs and experiments were established, which recreate the behavior of an experiment using a computer program, photographs, and data. Coexisting and perhaps interacting in real time, physical and virtual objects are the norm in this kind of digitally simulated setting. A new dimension has been added to classroom activities via the creative use of smartphones in education [25]. But we can also use our phones to take readings from a plethora of sensors all at once. This is a huge benefit as it allows for several experiments to be conducted outside without the need for expensive and delicate electrical equipment [30].

Methodology



Block diagram

Working

To provide real-time noise monitoring and analysis, the proposed Internet of Things (IoT) system incorporates a Sound Sensor, Ultrasonic Sensor, DHT11, and three LEDs. When anything is moving, the Sound Sensor may pick up on changes in volume and audible changes in sound. The distance to the sound source may be determined with the aid of the Ultrasonic Sensor, which allows for the analysis of how the sound strength varies as

ISSN 2454-9940
www.ijasem.org
Vol 19, Issue 2, 2025

one moves. The DHT11 sensor keeps track of humidity and temperature, so the system can adapt its values to the current setting. Three light-emitting diodes are used as indicators:

Green light indicates low intensity, yellow light indicates moderate intensity, and red light indicates high intensity, warning level. An Internet of Things (IoT)-based cloud platform receives data from sensors and analyzes it, allowing for remote monitoring, all under the direction of an Arduino microcontroller. A online dashboard or mobile app gives users access to real-time data, allowing for effective measurement of sound levels in various contexts.

Included in the proposed system are key characteristics such as: • A Sound Sensor that can detect the intensity of sounds in real-time. Using an ultrasonic sensor to follow the source's movement across a distance. Using the DHT11 sensor, environmental factors may be adjusted. Intensity levels may be easily understood with the help of LED-based visual indicators. Remote monitoring made possible by the Internet of Things for endless data tracking and analysis. Smart city applications, industrial safety, and automated real-time sound analysis are some of the many uses for this technology.

Arduino uno

A microcontroller board based on the Atmega328, the Arduino Uno is described in the datasheet. A 16 MHz crystal oscillator, 6 analogue inputs, 14 digital input/output pins (including 6 PWM outputs), 1 USB port, 1 power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

Because it forgoes the FTDI USB-to-serial driver chip, the Uno stands apart from all previous boards. In its place, you'll find the Atmega8U2 configured to convert USB to serial. "Uno" signifies "One" in Italian and is chosen to commemorate the impending release of Arduino 1.0. Going forward, the Uno and version 1.0 will serve as the reference versions of Arduino. See the index of Arduino boards for a comparison with earlier generations; the Uno is the newest in a series of USB Arduino boards and the platform's standard model.

The USB port or an external power source are both viable options for powering the Arduino Uno. It chooses the power source mechanically. You may use a battery or an AC-to-DC converter (wall-wart) to power it from the outside (not via USB). It is possible to attach the adapter by inserting a 2.1mm center-positive connector into the power port on the board. The POWER connector's Gnd and Vin pin headers are suitable for inserting battery leads. The board is compatible with power sources ranging from 6 to 20 volts. But if the voltage is lower than 7V, the 5V pin could not give 5V and the board might become unstable. The voltage regulator might become too hot and ruin the board if you use more than 12V. A voltage range of 7 to 12 volts is suggested.

LIQUID CRYSTAL DISPLAY

In front of a light source or reflector, a thin, flat display device called a liquid crystal display (LCD) arrays a large number of color or monochrome pixels. Pile of liquid crystal molecules held aloft by two transparent electrodes and two polarizing filters, whose polarity axes orthogonal to one another, make up each pixel. If there weren't liquid crystals interposed, one would block the other from light. Light that enters one filter is able to pass through the other because the liquid crystal bends its polarity.

A program's ability to communicate with the outside world depends on its input and output devices, which in turn rely on human communication. An LCD display is a typical accessory for controllers. The 16x1, 16x2, and 20x2 LCDs are among the most popular types of displays that are attached to the controllers. This equates to sixteen characters on a single line. The first set has 16 characters on each line while the second set has 20 characters on each line.

BUZZER

In a magnetic transducer, the circuitry includes an iron core, a yoke plate, a wound coil, a permanent magnet, and a vibrating diaphragm that can be moved. The magnet's field gently draws the diaphragm up nearer the core's surface. A positive alternating current (AC) signal causes the diaphragm to move up and down, which in turn vibrates the air. This is achieved by the current passing through the excitation coil, which forms a fluctuating magnetic field. A resonator, which is composed of a cavity and one or more sound holes, may amplify vibrations in order to generate a loud sound.

ISSN 2454-9940

www.ijasem.org

Vol 19, Issue 2, 2025

ESP8266 Wi-Fi Module

This project revolves on this. The module plays a crucial role in the project as it is centered on WIFI control of appliances. A low-cost Wi-Fi chip with full TCP/IP capability, the ESP8266 Arduino compatible module has an amazing built-in MCU (Micro Controller Unit) that allows you to control I/O digital pins using a simple programming language that is almost pseudo-code like. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget. In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. The MCU can establish basic TCP/IP connections and connect to WiFi networks with the help of this little module. In his Many hackers and tech enthusiasts were interested in exploring and using it for a wide range of projects because to its tiny size and very inexpensive pricing (1.7$ to 3.5$). Since it has been so successful, Espressif has released other variants with varying proportions and technological specs. Among the following is the ESP32. Numerous projects and applications, such as home automation, may be found online.

RELAYS

Many household and commercial equipment, as well as industrial control systems, make use of electrically controlled switches called relays. By using a relay, two independent voltage sources may be isolated from one another; in other words, a little quantity of voltage or current on one side can manage a big amount of current or voltage on the other side, and vice versa.

Ultrasonic Sensor

One tool that may estimate the distance to an item using ultrasonic sound waves is an ultrasonic sensor. Simply put, an ultrasonic sensor is... A transducer allows the device to transmit and receive ultrasonic pulses, which in turn provide data on the proximity of an item. When high-frequency sound waves travel over different surfaces, they create unique patterns of reflection called echos.

To operate, ultrasonic sensors emit a sound wave at a frequency that is audible to humans but not to other creatures. The sensor's transducer takes the role of a microphone, transmitting and receiving ultrasonic waves. A single transducer is used to transmit a pulse and receive the echo by our sensors, as is common with many others. By timing how long it takes for an ultrasonic pulse to travel from source to receiver, the sensor may calculate the distance to an object. An ultrasonic sensor relies on this procedure.

DHT11

Humidity is a measurement of the amount of water vapor in the air. Humidity influences many chemical, biological, and physical processes. When it comes to industrial applications, humidity has the potential to impact product costs, personnel health, and safety. Therefore, humidity measurement is crucial in the semiconductor and control system sectors. Gases may be a combination of water vapor, nitrogen, argon, or pure gas, and the quantity of moisture in them can be determined by measuring their humidity. The units of measurement distinguish between two main kinds of humidity sensors. One measures absolute humidity, while the other measures relative humidity. One such digital sensor is the DHT11.

SOFTWARES

The Arduino platform is an open-source, user-friendly hardware and software environment for prototyping. It is comprised of a programmable circuit board (also called a microcontroller) and an Integrated Development Environment (IDE) called Arduino that is pre-made for writing and uploading code to the physical board.The main characteristics are:

• Many sensors can send signals in digital or analog formats to Arduino boards, which may then be used to activate motors, control LEDs, establish connections to the cloud, and much more.
• The Arduino IDE (also called "uploading software") allows you to command your board's operations by communicating with the microcontroller on the board. • A separate device, known as a programmer, is not required to load fresh code into an Arduino board, in contrast to most prior programmable circuit boards. The usage of a USB connection is all that is required. • The Arduino IDE employs a streamlined version of C++, which facilitates programming learning. Last but not least, Arduino offers a standardized form factor that simplifies the microcontroller's tasks.

ISSN 2454-9940

www.ijasem.org

Vol 19, Issue 2, 2025

Now that we know what the Arduino UNO board is and how it works, we can go on to setting up the Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

CONCLUSION

An automated, intelligent, and efficient method of tracking noise levels in real-time is offered by the sound intensity analysis system. Accurate noise measurement, source distance tracking, and ambient condition changes are achieved by the integration of a Sound Sensor, Ultrasonic Sensor, DHT11, and LED indicators in the system. In contrast to traditional sound monitoring systems, this solution allows for remote monitoring via Internet of Things connection, automates data collecting, and gives real-time visual warnings. Users are able to engage more effectively because to the usage of LED indications, which make it easy to distinguish between acceptable and dangerous noise levels. Advanced noise mapping for smart cities, integration with AI-driven predictive analytics, and machine learning-based noise pattern detection are all potential future advancements. Improved noise management, pollution control, and safety enforcement are just a few of the many benefits that different sectors may reap from this scalable and inexpensive system's sound analysis applications.

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