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THE CREATION OF NOISE LEVEL ALERT DEVICE WITH THE USE OF SOUND SENSOR

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ABSTRACT

Noise pollution, accelerated by modernization and urbanization, requires noise monitoring to protect human health and productivity levels. This study utilized a quantitative approach and experimental design to collect data on the device's processing time, feedback speed, and distance parameters. This study focused on three decibel levels: 60 decibels, 80 decibels, and 100 decibels. The results proved that the Noise Level Alert Device is efficient, with its processing times averaging 0.23, 0.21, and 0.18 seconds, respectively. Feedback speeds were similarly swift, averaging 0.86, 0.15, and 0.12 seconds, respectively. Furthermore, the Noise Level Alert Device detected noise up to 60 centimeters for 60 decibels, and up to 1.5 meters for 80 and 100 decibels. The sound sensor was used to create an accurate Noise Level Alert Device. The device gives a voice alert whenever the noise exceeds the predetermined decibel while being an affordable Noise Level Alert Device. Based on the results, the Noise Level Alert Device can quickly process noise and give feedback with accuracy. Lastly, as it was capable of detecting noise from different distances, the device can be further improved by using a higher-grade sound sensor to have a smoother process in detecting sound waves and to be able to cover bigger spaces.

KEYWORDS: Decibel, Detect, Noise, Noise Level Alert Device, Noise Pollution, Sound Sensor

INTRODUCTION

As the world continues its path of modernization and urbanization, noise pollution becomes relentless. 46.2% of the population of the United States of America alone is said to be exposed to noise pollution that comes from a significant increase in noise levels across different environments and factors including urbanization and population growth (Hammer et al., 2014). The same can be said in Qatar, as the country becomes increasingly crowded, environmental noise such as traffic noise becomes an issue to the health and well-being of locals (Abdur-Rouf & Shaaban, 2022). Furthermore, the increasing urbanization in rural areas of the Philippines continues to be a problem in mitigating noise pollution (Espenido et al., 2018). The phrase "noise pollution" refers to the rise in ambient noise levels caused by human activity. Numerous factors contribute to its cause, such as crowds, traffic, industrial activity, air and water transportation, public events, domestic appliances, and natural sources. Noise from transportation, different industries, and even neighbors is already an eminent aspect of the environment that affects the health of people; hence, it is a major concern (Geravandi et al., 2015).

Prolonged exposure to loud noises may lead to several physiological and psychological problems, including stress, sleep disruptions, decreased productivity, and hearing loss. To add to that, noise pollution from human activities can distract humans themselves and hinder their ability to focus (González, 2014; Real, 2020). With this, there are prescribed decibel levels in different environments. Decibel (dB) is used to measure loudness; it is depicted as the unit dB. This is a method of describing a sound's intensity, which is defined as the energy it deposits in a certain amount of time (Morgan & Bell, 2023). The library is a quiet environment, which makes it great for students to be able to concentrate and work on their studies, but it could also mean that libraries are more sensitive to any noise that can be deemed to be disruptive, which can be identified as intermittent noise. With this in mind, the focus of the study revolved around the presence of intermittent noise in a library setting.

High work productivity is needed among students, especially at older levels, as the tasks brought onto them are harder and more numerous as compared to those of younger students. All the while, keeping on top of the schoolwork as a student is challenging—even more challenging if not done on time. Employee productivity is the measure of work a person has completed within a given period (Hanaysha, 2016). The three primary sources of noise, namely conversations, ringing phones, and machines, exhibited no variation in average annoyance ratings across individuals with low and high productivity levels, suggesting that they had a uniformly detrimental effect on all participants. (Mak & Lui, 2011). To achieve optimum work productivity, several indoor environmental quality factors, like noise, should be considered (Kang et al., 2017). In the same study, it was found that noise is the factor that has the most influence and most concern for the employees. Different types of noise affect the productivity of the workers in the office, which is supported by information that concludes that cognition impairment and the release of oxidative stress are due to chronic noise (Wang et al., 2016). In separate research, it was shown that increased levels of noise among a group of students led to a decline in their concentration levels, increasing errors made during a dictation test conducted as part of the study (Fernandes et al., 2019).

METHOD

2.1 Research Design

The quantitative method and experimental design were utilized to systematically gather data regarding the processing time, feedback speed, and parameters of distance of the device.

2.2 Manufacture Design

The tool scheme that was created is as follows. Figure 1 shows the construction of the Noise Level Alert Device prototype, which is constructed around a tiny plastic Tupperware container. The sound sensor and speaker are housed in round holes on the front and back of the prototype, respectively. There is a USB port and a power port on its side.

Figure 1: Pictorial Diagram

Information:
1. Arduino Uno
2. 9V Battery
3. Jumper Wires
4. USB Type-B
5. Sound Sensor
6. Speaker

2.3 Electrical Design

The electrical design process involves the integration of pre-existing components into a unified system, with each piece serving a specific function.

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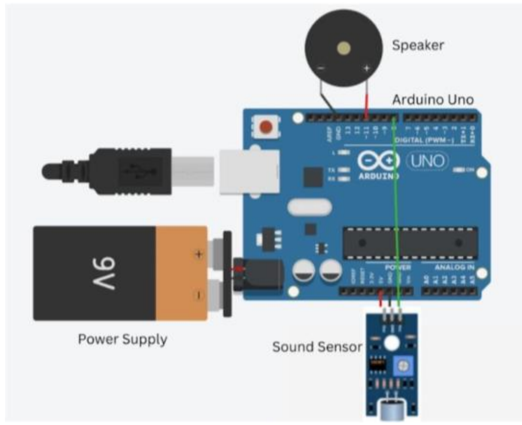


Figure 2: Schematic Diagram

2.4 Testing Tool

Sensor testing was done using a meter stick and a decibel meter. The test consisted of changing the location of the sound source at varying distances. The sound sensor test was carried out in a school library.

RESULTS

1. The processing time of the Noise Level Alert Device in terms of:

Table 1.1: The time that the Noise Level Alert Device Takes to Respond in Terms of 60dB

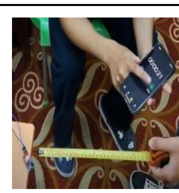
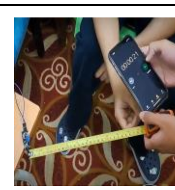
Trials	**1st trial**	**2nd trial**	**3rd trial**
Photos			
Recorded Time	0.28 sec	0.21 sec	0.21 sec
Average Time	0.23 sec		

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Table 1.1 shows the time that the Noise Level Alert Device takes to respond in terms of 60 Decibels based on its rapidity or delay in seconds in three attempts. It should also be noted that the testing was done in a quiet space to ensure no additional noise would be detected.

Table 1.1 reflects the amount of time the Noise Level Alert Device took to detect the 60 dB noise. For the first attempt, the Noise Level Alert Device took 0.28 seconds. In the second and third attempts, the result was 0.7 sec faster than trial 1 as it took 0.21 seconds to process the sound. Evaluating the results of the three trials, the average response time of the Noise Level Alert Device was 0.23 seconds. Further analyzing the results, this data shows that the Noise Level Alert Device displayed a quick response which exhibits effectiveness as there's not much difference in the recorded time for each attempt hence having a consistent result and average of 0.23 seconds. Moreover, the results of a similar noise level notifier reflected that their noise detection system responded well with the range of 50 dB to 100 dB (Dinesh & Yogesh, 2023). The same as the Noise Level Alert Device, it responded quickly with the help of LED as an indicator of response (Rajagukguk & Sari, 2018). Thus, the result shown in the table reflects the fast response time of the Noise Level Alert Device.

Table 1.2: Time that the Noise Level Alert Device Takes to Respond in Terms of 80dB

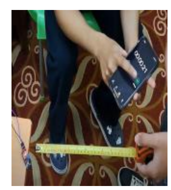
Trials	**1st trial**	**2nd trial**	**3rd trial**
Photos			
Recorded Time	0.21 sec	0.21 sec	0.21 sec
Average Time	0.21 sec		

Table 1.2 reflects the amount of time the Noise Level Alert Device took to detect the 80 dB noise. For the first attempt, the Noise Level Alert Device took 0.21 sec. In the second attempt, it took 0.21 sec. Lastly, for the third attempt, it took 0.21. Evaluating the results of the three trials, the average response time of the Noise Level Alert Device was 0.21 seconds. From the result of another study regarding noise detection alarms, their results showed their device's response to noise ranging from 44-94 dB (Edgar et al., 2021). With the consistent results of the device, the quick response time is then again evident.

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Table 1.3: Time that the Noise Level Alert Device Takes to Respond in Terms of 100dB

Trials	**1st trial**	**2nd trial**	**3rd trial**
Photos			
Recorded Time	0.21 sec	0.17 sec	0.15 sec
Average Time	0.18 sec		

Table 1.3 reflects the amount of time the Noise Level Alert Device took to detect the 100 dB noise. For the first attempt, the Noise Level Alert Device took 0.21 sec. In the second attempt, it took 0.21 sec. Lastly, for the third attempt, the device gave out a 0.15-second result. Evaluating the congruous results of the three trials, the average response time of the Noise Level Alert Device was 0.18 seconds. With the three different set decibel parameters along with its three trials each, the device showed steady and unchanging results leading to the conclusion that the time that the Noise Level Alert Device takes to respond is only 0.18 seconds. Likewise, the loudest decibel in 100 dB was detected faster by the device (Rajagukguk & Sari, 2018).

Overall, the results of Table 1 showed that it does not take long for the Noise Level Alert Device to respond in different decibels, with an average response time of 0.23 sec for 60 dB, 0.21 sec for 80 dB, and 0.18 sec for 100 dB. The results of some trials exhibited slight differences in the numbers like in Table 1.1 for 60 dB, the second and third trials were 0.7 seconds faster than the first trial. Also, in Table 1.3 for 100 dB, each trial was 0.3 seconds faster than the previous trial. The increase and decrease in the response speed can be due to a lot of factors including the varying environmental conditions during the trials such as temperature and ambient noise (Guidara et al., 2018). Another is the quality of the hardware components used like the mic, processor, and other parts of the device can also be the cause of the delay (Luo et al., 2020).

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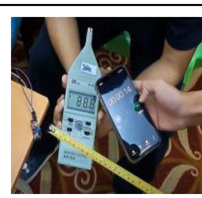
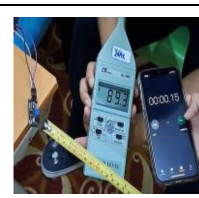
2. The feedback speed of the Noise Level Alert Device in terms of:

Table 2.1: Time that the Noise Level Alert Device Takes to Give Feedback in Terms of 60dB

Trials	**1st trial**	**2nd trial**	**3rd trial**
Photos			
Recorded Time	0.62 sec	0.96 sec	1.0 sec
Average Time	0.86 sec		

Table 2.1 illustrates the response time of the Noise Level Alert Device in providing feedback for a noise level of 60 dB. The initial trial of the noise level alert gadget recorded a response time of 0.62 seconds. The second attempt was completed in 0.96 seconds. Finally, on the third try, it took 1.0 seconds. Upon evaluating the outcomes of the three experiments, it was determined that the average response time of the Noise Level Alert Device was 0.86 seconds. Upon further analysis, the data indicates that the noise level alarm device provides rapid feedback, demonstrating its efficiency and that it is productive (Kortum et al., 2019). This is evident from the small variation in recorded time for each attempt, resulting in a steady average of 0.86 seconds.

Table 2.2: Time that the Noise Level Alert Device Takes to Give Feedback in Terms of 80dB

Trials	**1st trial**	**2nd trial**	**3rd trial**
Photos			
Recorded Time	0.15 sec	0.14 sec	0.15 sec

Average Time	0.15 sec

Table 2.2 displays the response time of the Noise Level Alert Device in providing feedback for a noise level of 80 dB. The initial trial of the noise level alert gadget recorded a response time of 0.15 seconds. The second attempt was completed in 0.14 seconds. Finally, on the third try, it only took 0.15 seconds. Based on the analysis of the three trials, the Noise Level Alert Device demonstrated an average feedback speed of 0.15 seconds. Upon further analysis, the data indicates that the noise level alarm device provides rapid feedback, demonstrating its efficiency. This is evident from the minimal variation in recorded time for each attempt, resulting in a steady average of 0.15 seconds. Therefore, the table displays a heightened rate of feedback and effectiveness for the Noise Level Alert Device (He et al., 2016).

Table 2.3: Time that the Noise Level Alert Device Takes to Give Feedback in Terms of 100dB

Trials	**1st trial**	**2nd trial**	**3rd trial**
Photos			
Recorded Time	0.11 sec	0.12 sec	0.12 sec
Average Time	0.12 sec		

Table 2.3 shows the Noise Level Alert Device's 100-dB feedback reaction time. In its first test, the Noise Level Alert Device responded in 0.11 seconds. The second attempt took 0.12 seconds. Finally, the third attempt took 0.12 seconds. Based on three tests, the noise level alert gadget had an average feedback speed of 0.12 seconds. Further investigation shows that the noise level alert system provided timely feedback, proving its efficacy. This is shown by the low variety in attempt times, averaging 0.12 seconds. Thus, the table shows the Noise Level Alert Device's maximum feedback rate.

Overall, the results of Table 2 revealed that it does not take long for the Noise Level Alert Device to give feedback in terms of different decibels, with an average response time of 0.86 sec for 60 dB, 0.15 sec for 80 dB, and 0.12 sec for 100 dB. The results of the trials exhibited slight differences in the numbers like in

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table 2.1 for 60 dB, the second was 0.34 seconds slower than the first trial, and the third trial was .04 seconds slower than the second. Also, in Tables 2.2 and 2.3, there was a difference of 0.01 seconds in the trials. The evident slight decrease in each trial regarding the device's feedback time can be due to the influence of various environmental and technical factors during the duration of the trials (Guidara et al., 2018).

3. The maximum distance at which the Noise Level Alert Device can detect the noise from the source every 30-centimeter interval up to 1.5 meters in terms of:

Table 3.1: Maximum Distance at which the Noise Level Alert Device Can Detect the Noise from the Source Every 30-centimeter Interval up to 1.5 Meters in terms of 60 Decibels

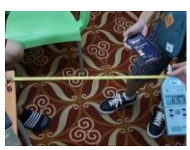
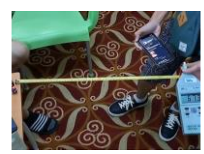
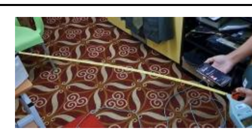
Trials	Trial 1	Trial 2	Trial 3
30cm	 Detected	 Detected	 Detected
60cm	 Detected	 Detected	 Detected
90cm	 Detected	 Not Detected	 Not Detected
1.2m	 Not Detected	 Not Detected	 Not Detected
1.5m	 Not Detected	 Not Detected	 Not Detected

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Table 3.1 shows how far the Noise Level Alert Device can detect noise from the source, providing readings at 30 cm intervals up to 1.5 meters, all measured at 60 decibels. Three trials were conducted for each meter to ensure accuracy. Upon detecting the noise source moving away every meter, the device indicates detection by providing feedback. Notably, at 30cm and 60cm distance from the noise source, the device was also able to detect the noise in all three trials. At 90cm, the sound sensor was able to detect noise on the first trial. Lastly, at 1.2 and 1.5 meters, the device failed to detect the noise source throughout the three trials. The trials indicate the device's detection range capability at 60 decibels (De Lauretis et al., 2021).

Table 3.2: Maximum Distance at which the Noise Level Alert Device can Detect the Noise from the Source Every 30-centimeter Interval up to 1.5 Meters in terms of 80 Decibels

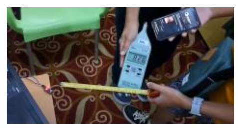
Trials	**Trial 1**	**Trial 2**	**Trial 3**
30cm	 Detected	 Detected	 Detected
60cm	 Detected	 Detected	 Detected
90cm	 Detected	 Detected	 Detected
1.2m	 Detected	 Detected	 Detected
1.5m	 Detected	 Detected	 Detected

Table 3.2 shows how far the Noise Level Alert Device can detect noise from the source, providing readings at 30 cm intervals up to 1.5 meters, all measured at 80 decibels. Three trials were conducted for each meter to ensure accuracy. Upon detecting the noise source moving away every meter, the device indicates

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detection by providing feedback. Based on the findings, the device can detect the noise source at distances 30 cm, 60 cm, 90 cm, 1.2 m, and 1.5 m as there is detection throughout the three trials for each measurement. The trials indicate the device's detection range capability at 80 decibels (Latha et al., 2016).

Table 3.3: Maximum Distance at which the Noise Level Alert Device can Detect the Noise from the Source Every 30-centimeter Interval up to 1.5 Meters in terms of 100 Decibels

Trials	Trial 1	Trial 2	Trial 3
30cm	 Detected	 Detected	 Detected
60cm	 Detected	 Detected	 Detected
90cm	 Detected	 Detected	 Detected
1.2m	 Detected	 Detected	 Detected
1.5m	 Detected	 Detected	 Detected

Table 3.3 shows how far the Noise Level Alert Device can detect noise from the source, providing readings at 30 cm intervals up to 1.5 meters, all measured at 100 decibels. The distance between the sound source and the Noise Level Alert Device was calculated using a tape measure and sound waves from the sound

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source to the Noise Level Alert Device (Kelemen et al., 2015). Three trials were conducted for each meter to ensure accuracy. Upon detecting the noise source moving away every meter, the device indicates detection by providing feedback. Similar to Table 3.2, the device can detect the noise source at distances 30 cm, 60 cm, 90 cm, 1.2 m, and 1.5 m as there is detection throughout the three trials for each measurement. The trials indicate the device's detection range capability at 100 decibels (Rajagukguk & Sari, 2018).

Overall, the results of Table 3 revealed that it does not take a loud noise for the Noise Level Alert Device to be able to detect in terms of different decibels, with 60 dB being able to detect 60cm consistently while still able to pick up 90cm from time to time, 80 dB being able to detect sound from 1.5m consistently. 100dB is also able to detect sound from 1.5 m consistently.

DISCUSSION

Based on the results, the Noise Level Alert Device (NLAD) was efficient and effective in terms of its processing time, feedback speed, and maximum distance. The processing time displayed compelling and swift results, having an average of 0.23 seconds for 60 decibels, 0.21 seconds for 80 decibels, and 0.18 seconds for 100 decibels. In terms of the feedback speed, the NLAD recorded a convincing average time of 0.86 seconds for 60 decibels, 0.15 seconds for 80 decibels, and 0.12 seconds for 100 decibels. Lastly, the NLAD had favorable results in terms of its maximum distance. At 60 decibels, the NLAD was capable of detecting noise from 60 centimeters, while the NLAD recorded a positive result of 1.5 meters for both 80 decibels and 100 decibels. In comparison to the processing speed of a similar noise level notifier, the results reflected how well the noise detection system also responded with the range of 50 decibels to 100 decibels (Dinesh & Yogesh, 2023). As for the feedback speed, the data indicates that the noise level alarm device provides rapid feedback, proving its efficiency (He et al., 2016). Lastly, the NLAD is proven to be capable of detecting noise within a certain range of 60 centimeters to 1.5 meters. (Latha et al., 2016). The significance of the findings establishes the distinction between the NLAD and other noise detectors since the NLAD's results demonstrate a significant difference in its rapid and effective use.

CONCLUSION

To conclude, the results indicate that it is feasible to create a Noise Level Alert Device with the use of a sound sensor. Based on the outcomes of the study, the NLAD can suitably function in giving feedback, alerting, and monitoring noise levels.

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