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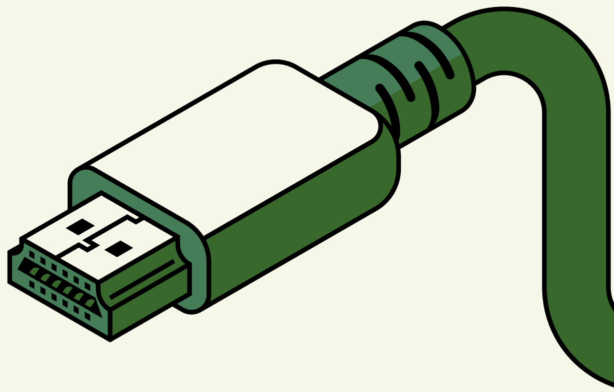
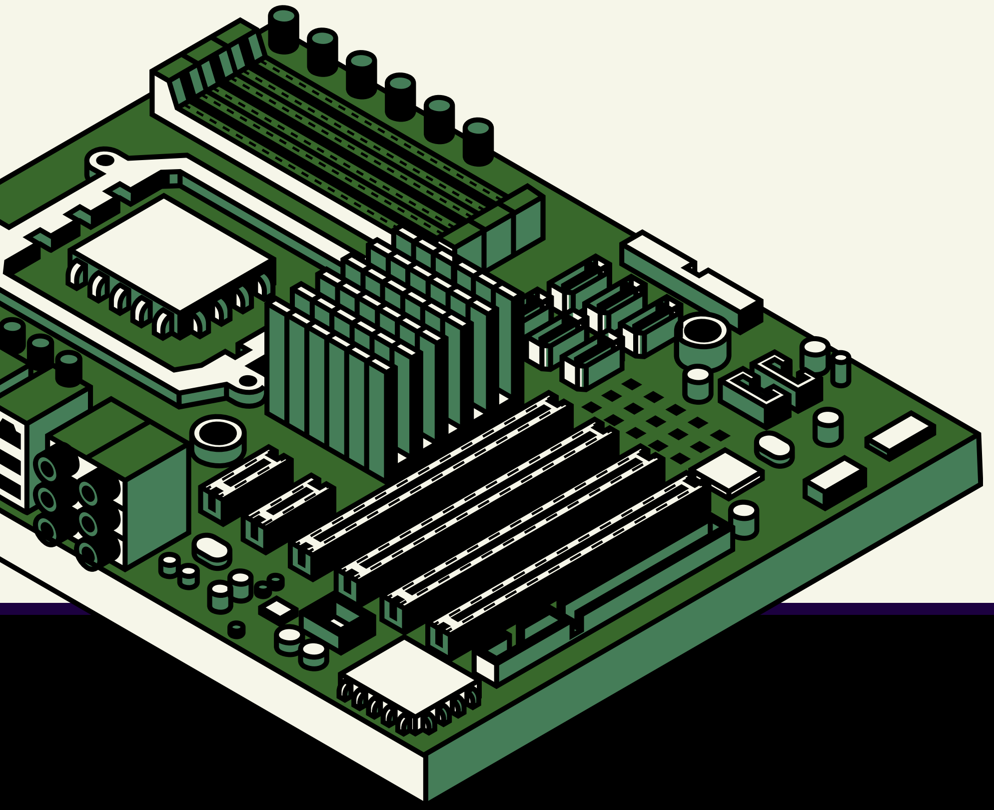


AUTOMATED CLASSROOM NOISE DETECTION SYSTEM WITH ALERT MECHANISM



INTRODUCTION

- The system successfully achieved its goal of detecting excessive noise and responding automatically.
- The final Bluetooth-based prototype worked accurately, measuring sound in real time and printing warnings when noise crossed the threshold.
- Prototype 1 failed because of a buzzer feedback loop.
- Prototype 2 faced USB communication issues.
- Prototype 3 became a reliable and fully wireless solution.
- The project showed that engineering involves continuous testing, learning, and improvement.
- It helped develop skills in electronics, programming, calibration, and problem-solving.
- The system can be used in classrooms, libraries, hospitals, offices, and exam halls.
- The project proved that simple components can create practical and effective innovations.
- Automation made learning environments more disciplined and efficient.
- With upgrades like data storage and mobile alerts, the system can become even more powerful and useful.

HYPOTHESIS

An automated noise detection system will control classroom noise more effectively than manual monitoring by teacher.

ABSTRACT

- Classroom noise reduces focus, causes fatigue, and disrupts learning.
- Project aimed to create an automated noise-detection and alert system using Arduino UNO.
- System provides fast, unbiased warnings without teacher intervention.
- Three prototypes were tested: buzzer, wired printer, and Bluetooth printer.
- Key variables tested were sound threshold, response time, and communication reliability.
- System triggered at 35 analogue units (~60 dB) with an average response time of 3 seconds.
- Visual ticket alerts helped reduce noise in classroom-like conditions.
- Final design was accurate, portable, reliable, and suitable for future upgrades.

BACKGROUND RESEARCH

- Sound is produced when objects vibrate, and its loudness is measured in decibels (dB).
- A quiet classroom typically ranges from 30–40 dB, normal talking is around 50–60 dB, and noise above 70 dB can disrupt learning.
- The WHO recommends keeping classroom noise below 35 dB to support better focus and concentration.
- Excessive noise makes it harder for students to hear the teacher, leading to stress, lower concentration, and faster mental fatigue.
- The KY-037 sound sensor contains a small microphone that detects sound and converts it into signals for the Arduino Uno.
- The Arduino checks if the detected noise crosses the preset limit and determines whether the classroom is too loud.
- The HC-05 Bluetooth module enables wireless communication between the system and the thermal printer.
- When the noise level exceeds the threshold, the Bluetooth module sends a signal, prompting the printer to produce a red-card warning to remind students to reduce their volume.

MATERIALS AND METHODOLOGY

This project followed an experimental engineering process where three prototypes were designed, built, and tested. Each version improved on the problems found in the previous one. Prototype 1 used a buzzer but failed due to a sound feedback loop. Prototype 2 used a wired printer but faced communication issues. Prototype 3 introduced Bluetooth, which made the system stable and fully functional.

In all prototypes, the Arduino Uno was the main controller and continuously read sound values from the KY-037 sensor. A threshold of 35 units (about 60 dB) was programmed into the system. Calibration was done using the sensor's adjustment screw to prevent false alerts from background noise.

The code was also improved so the alert triggered only if the noise crossed the threshold three times in a minute.

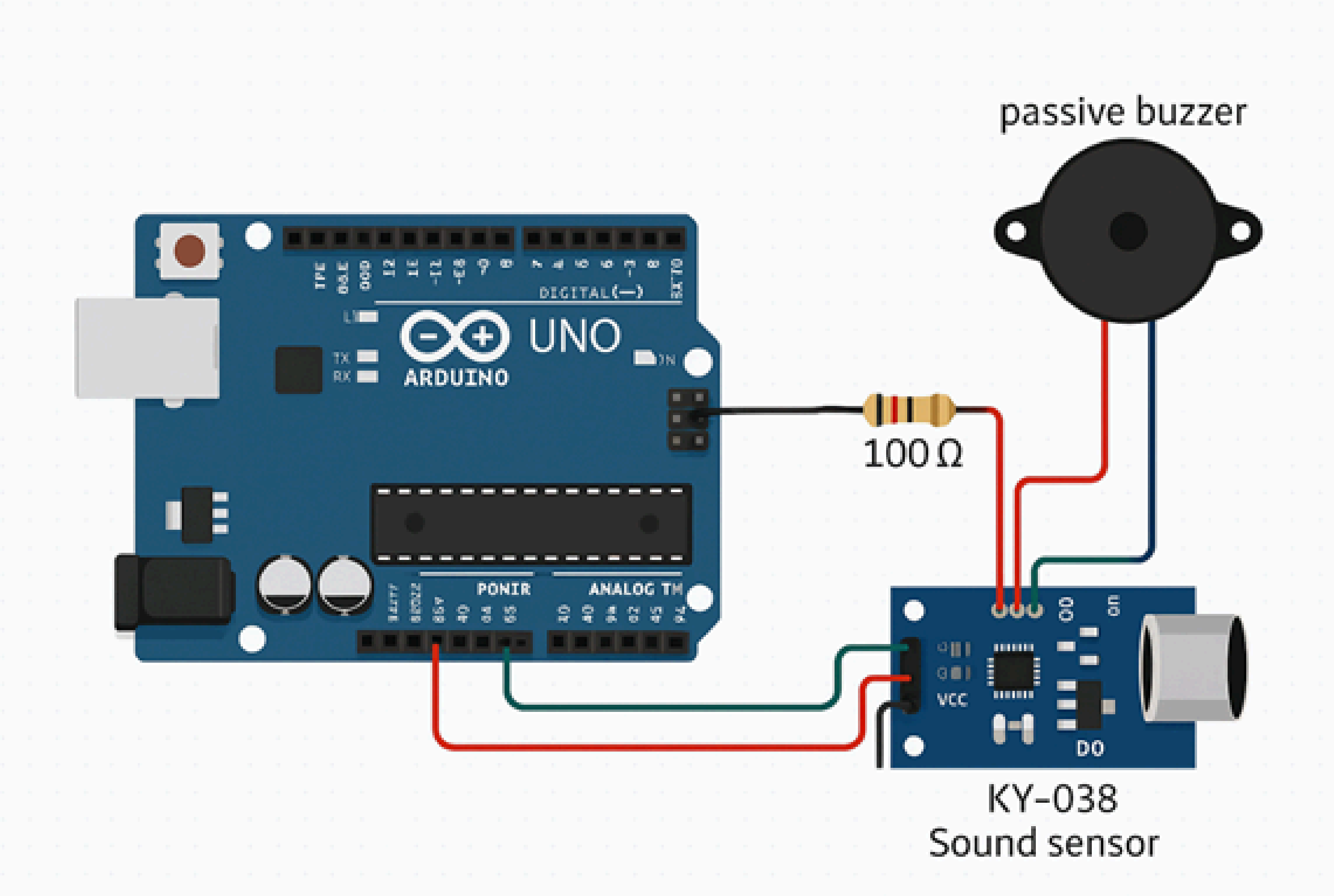
Each prototype was tested in quiet, moderate, and loud environments to measure accuracy and response time. Noise readings were recorded through the Arduino serial monitor, and the Bluetooth connection and printer were tested for reliability. These repeated tests helped refine the threshold level and confirm that the final prototype could consistently detect excessive noise and deliver alerts effectively.

MATERIALS AND METHODOLOGY

PROTOTYPE 1	PROTOTYPE 2	PROTOTYPE 3
Ardunio UNO	Ardunio UNO	Ardunio UNO
KY-037 Sound Sensor	KY-037 Sound Sensor	KY-037 Sound Sensor
Passive Buzzer	USB Host Shield	Bluetooth Module HC-05
-	Mini Thermal Printer XP-C230	Mini Thermal Printer XP-C230

PROTOTYPE 1

- However, a major issue appeared during these tests: the buzzer's own sound was picked up again by the KY-037 sensor.
- This caused a continuous feedback loop where the buzzer kept triggering itself over and over, even after the original noise stopped.
- Because of this endless loop, the prototype became unreliable and could not be used in real classroom conditions.
- This failure taught an important lesson—that using a loud alert system interferes with a sound sensor—and guided the next prototype toward using a silent, non-verbal alert method instead.

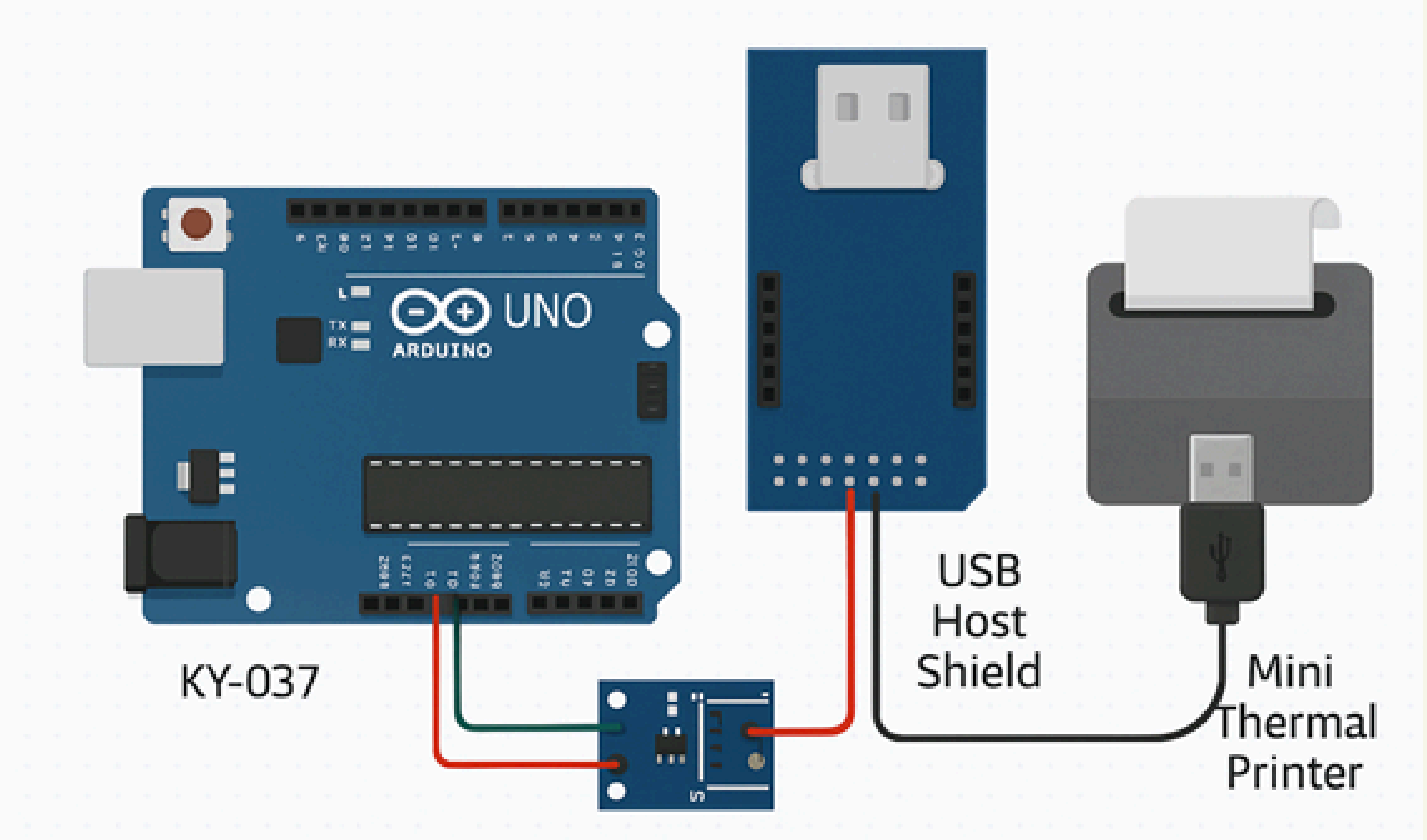


PROTOTYPE 1

- The first prototype was built to test the basic idea of detecting classroom noise using simple components. It used an Arduino Uno, a KY-037 sound sensor to measure sound levels, and a buzzer as the alert system.
- The Arduino was programmed so that if the sound level went above a threshold of 35 units, the buzzer would turn on immediately.
- Early testing showed that the KY-037 sensor could detect increases in noise accurately, which confirmed that the main concept of the project was working.

PROTOTYPE 2

- The second prototype was developed to overcome the feedback problem caused by the buzzer in the first design. In this version, the buzzer was replaced with a mini thermal printer to provide a visual alert instead of an audible one. The system used an Arduino Uno, KY-037 sound sensor, USB Host Shield, and a mini thermal printer. Whenever the detected sound level exceeded the preset threshold, the Arduino was programmed to send a command to the printer to generate a printed ticket as a warning.
- This design successfully introduced a silent alert mechanism, which prevented the system from triggering itself and ensured accurate noise detection. However, the inclusion of the USB Host Shield made the setup more complicated. It required precise wiring, additional power supply, and installation of specific drivers to enable communication between the printer and the Arduino.

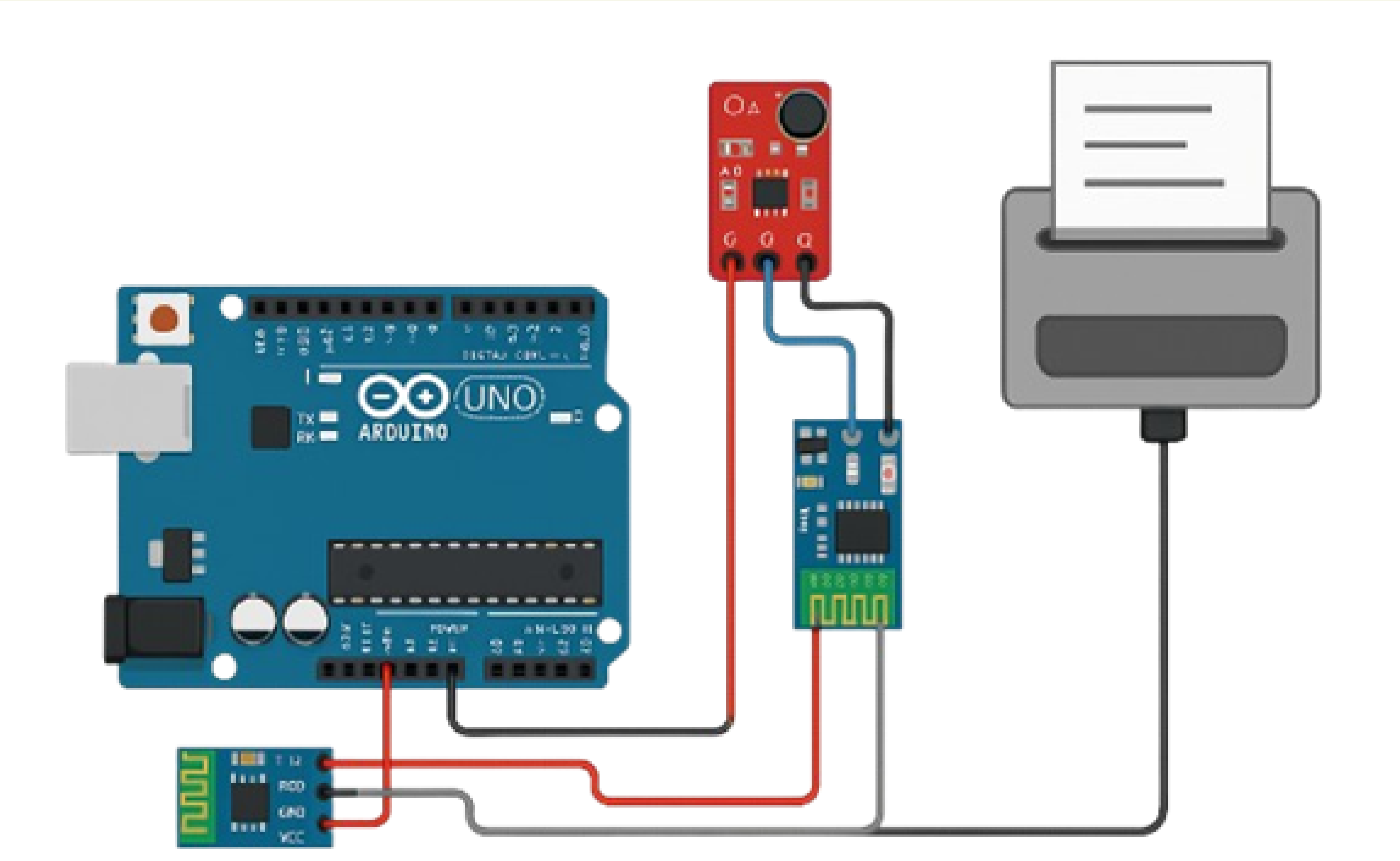


PROTOTYPE 2

- During testing, the printer frequently failed to respond or printed inconsistently due to unstable communication between the Arduino and the USB Host Shield. These issues made the system unreliable and difficult to maintain, especially for long-term or classroom use.
- Although the prototype did not function effectively, it was an important step in the development process. It highlighted that while a visual alert was necessary, the wired USB connection was not practical. This led to the conclusion that a wireless communication method would offer a more stable, efficient, and user-friendly solution for future designs.

PROTOTYPE 3

- The third and final prototype represented the most advanced and successful version of the Automated Classroom Noise Detection System. It used the same core components as the earlier versions—an Arduino Uno and a KY-037 sound sensor—but replaced the complicated USB Host Shield with an HC-05 Bluetooth module. This single change made the entire system far more stable, portable, and easier to manage. Instead of sending printing commands through a wired USB connection, the Arduino communicated wirelessly with the mini thermal printer. This eliminated the wiring problems and power issues faced in Prototype 2 and allowed the system to remain neat, reliable, and flexible enough for long-term classroom use.



PROTOTYPE 3

- In this prototype, the Arduino continuously monitored the sound sensor's readings and compared each value with the preset noise threshold of 35 units. To prevent false alerts, especially from brief sounds, the system was programmed so that an alert would only trigger if the noise level crossed the threshold three times within one minute. This improved logic ensured that only real, disruptive noise would activate the alert mechanism. Whenever this condition was met, the Arduino sent a wireless signal to the paired Bluetooth printer, which immediately printed a warning ticket reading, "You have been issued a red card because of the violation of the noise level." Because the alert was silent and printed, it avoided the problems that occurred in Prototype 1, where the buzzer created a feedback loop.
- During testing, Prototype 3 proved to be highly accurate and dependable. The Bluetooth connection remained stable throughout long sessions, with no unexpected disconnections. The sound sensor responded correctly to different noise levels, whether it was light tapping, regular conversation, or loud movements. The printer also worked smoothly and produced a ticket within two to three seconds of the alert being triggered. After confirming reliability, all the components were neatly mounted on a single board, the wiring was organised, and the setup was made compact and user-friendly. This final prototype successfully met all the design goals, providing a clean, wireless, and efficient solution that was ready for real classroom application.

RESULTS

- The system successfully detected excessive noise and responded automatically using the final Bluetooth-based prototype.
- Prototype 1 failed due to buzzer feedback, and Prototype 2 had USB issues, but Prototype 3 became a stable wireless solution.
- The project showed that engineering requires testing, learning, and constant improvement.
- It helped develop skills in electronics, programming, calibration, and problem-solving.
- The system can be used in classrooms, libraries, hospitals, offices, and exam halls.
- The project proved that simple components can create practical and effective automated solutions.
- With future upgrades like data storage and mobile alerts, the system can become even more advanced and useful.

CONCLUSIONS

- The system successfully detected excessive noise and responded automatically using a reliable Bluetooth-based design.
- Prototype 1 failed due to buzzer feedback, and Prototype 2 had USB issues, but Prototype 3 became the stable wireless solution.
- The project highlighted the importance of testing, improvement, and problem-solving in engineering.
- Students learned key skills such as electronics, programming, calibration, and debugging.
- The system can be used in classrooms, libraries, hospitals, offices, and exam halls to maintain quiet environments.
- The project proved that simple components can create practical and effective innovations, with future upgrades like data storage and mobile alerts offering even more potential.

REAL-LIFE APPLICATIONS

- Classrooms: acts as a “silent supervisor” and helps maintain discipline without interrupting lessons.
- Libraries and study areas: keeps the environment quiet by giving silent reminders.
- Hospitals: useful in recovery rooms and waiting areas to maintain a calm atmosphere.
- Offices and workplaces: reduces distractions and improves focus in open workspaces.
- Exam halls, computer labs, and homes: helps maintain silence and reduces disturbances.
- Simple, affordable, and easy to install, making it suitable for many quiet environments.

FUTURE SCOPE

- The system can be improved by adding IoT so schools can monitor noise levels from multiple classrooms on one device.
- Data logging can be added to store every noise violation, helping teachers understand when and why classrooms get noisy.
- Machine learning can be used so the system learns from past data and adjusts the noise threshold automatically.
- It could also learn to tell the difference between normal sounds and actual loud disturbances.
- A mobile app can be created so teachers get silent notifications instead of printed tickets, reducing paper use.
- The device can be made portable with a rechargeable battery for temporary classrooms or outdoor events.
- A digital display can be added to show real-time noise levels to students.
- Smaller microcontrollers like ESP32 or Arduino Nano can make the system more compact.
- Better Bluetooth or Wi-Fi modules can be used to improve communication.
- With smart analysis, mobile alerts, and better hardware, the system can become more effective and useful in many settings.

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