Acoustic Traffic Monitor for a Smart City Concept

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***Abstract*—Acoustic Traffic Monitor for a Smart City Concept aims to create a high-performance sensor that can accurately detect and analyse sound waves. The sensor is designed to have a compact form factor, low cost, and energy-efficient operation, making it a suitable solution for a broad range of applications such as security surveillance, environmental monitoring, and industrial automation. The sensor uses advanced signal processing algorithms, including machine learning, to classify and identify different types of sounds, making it versatile in its applications. The project team will use a combination of experimental and parnumerical techniques to optimise the sensor's performance and explore different ways of integrating the sensor into existing systems. In addition to the technical aspects of the project, the team will also focus on creating a viable business and marketing plan. The project will involve market research to identify potential customers and competitors, as well as determining the best pricing strategy for the sensor. The team will also explore different distribution channels and work on creating a strong brand identity for the sensor. By creating a high-performance, cost-effective sensor and implementing an effective business and marketing plan, the project aims to bring a new product to the market that can have a significant impact on various industries. The successful development of this acoustic sensor concept has the potential to revolutionise sound wave detection and analysis, making it an exciting project with significant commercial potential.**

***Keywords*—**Acoustic sensor, sound waves, low cost, energy-efficient, signal processing algorithms, pricing strategy, brand identity, commercial potential.

I. INTRODUCTION

Urban noise pollution is a significant issue affecting cities worldwide, leading to various health problems. Cities are implementing noise monitoring systems using acoustic sensors to measure and control noise levels. These sensors detect sound waves and provide real-time data for urban planning decisions. [1] Noise pollution has been found to be widespread in Europe, with detrimental effects on health. It is also a problem in India. The design process for an acoustic traffic monitor involves understanding the problem, generating ideas, evaluating and selecting the best options, and iterating based on feedback. [2]

II. MATERIALS AND BOXING

After creating several sketches, we deemed it appropriate to develop two designs instead of just one. The first design takes the shape of a hollowed-out half-moon and is intended to be anchored to a pole, such as a traffic light or a lamppost. After conducting various studies using the Granta Edu Pack program, which is a material analysis software, we decided to utilize PLA as the primary material for this design. The most suitable process we found for manufacturing this PLA design was Injection Molding Thermoplastics. [3]

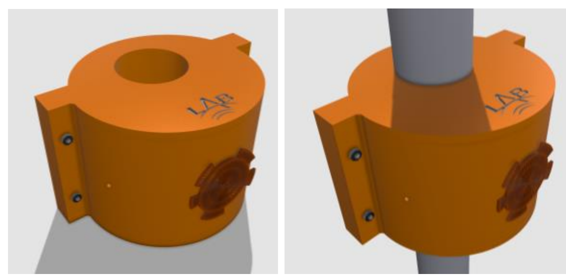

Fig 1. Design 1

The second design, referred to as Design 2, consists of an independent cylinder equipped with its own batteries. This allows it to be placed in the most suitable location to capture the maximum sound possible. LED lights will be placed on the top, serving to identify whether the captured sound is correct or incorrect. If the sound exceeds the permitted maximum decibels, the light will turn red, while if the sound falls within the allowed decibel range, the light will turn green. For this design, we also conducted material and process studies using the Granta Edu Pack program. We discovered that the materials best suited to meet the product's requirements were ductile cast iron for the metallic part and polycarbonate for the plastic part housing the LED lights. The recommended processes for these materials are Sand Casting Molds for the ductile cast iron and Injection Molding Thermoplastics for the polycarbonate. [4]

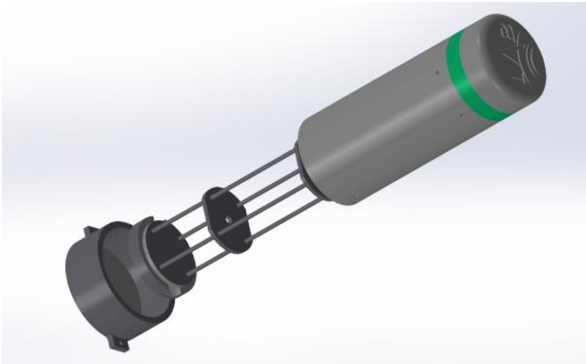

Fig 2. Exploded View Design 2

Fig 3. Design 2

III. HARDWARE AND SOFTWARE

Regarding the acoustic sensor hardware, it consists of a microcontroller board, a microphone, and a 3G module. The microcontroller board serves as the central processing unit, controlling the sensor's operations. The microphone captures sound waves and converts them into electrical signals, while the 3G module enables wireless communication for real-time data transmission and remote monitoring.

In terms of reducing the weight of a design, two options are proposed: using recycled plastic with the same thickness or reducing the thickness of the design while incorporating strategically placed ribs for structural stability and strength. These options aim to address the challenge of excessive weight while considering factors such as ease of handling, product performance, and associated costs.

In terms of solar-powered systems, it is important to note that the estimated charging time is approximately 6.5 hours under optimal conditions. However, variations in sunlight intensity, shading, and other environmental factors can affect the actual charging time. To account for this, planning the charging process during daylight hours is recommended to maximize exposure to sunlight. Incorporating suitable battery management features and monitoring systems can optimize charging efficiency and ensure the longevity of the Li-po battery. Understanding the expected charging time allows for effective power consumption management, uninterrupted operation, and adequate charging of the Li-po battery to power the Raspberry Pi 3 board in the project. [7] [8]

The software component of the sensor plays a crucial role in collecting, processing, and interpreting data. It includes various components such as the sensor driver, data acquisition modules, signal processing, calibration routines, and an interface module. The software acts as the brain of the sensor, orchestrating operations and algorithms necessary to harness the full potential of the sensor and provide valuable information to users.

The software block schematic provides an overview of the key components and their interactions within the software part of the sensor system. It outlines functional blocks such as microphone input, signal processing, event detection, alert generation, and data transfer. These blocks work together to enable intelligent acoustic traffic monitoring and efficient data handling. [9]

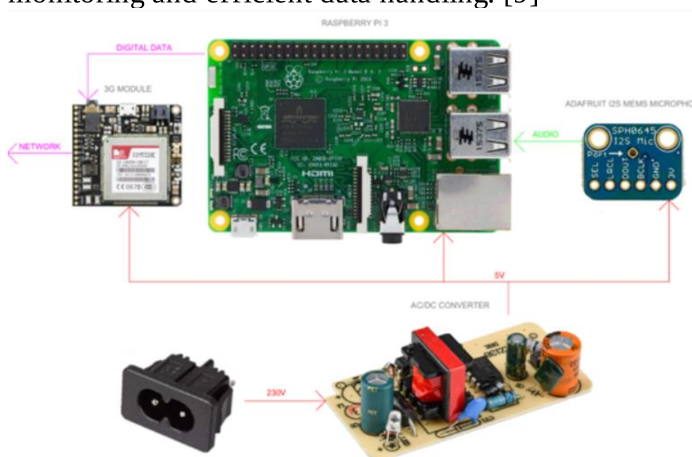

Fig 4. Hardwire unit

Prototype development involves utilizing a Raspberry Pi 3 board as the main component of an acoustic sensor. The prototype incorporates a USB microphone for sound capture, enabling seamless integration with the Raspberry Pi. It is designed to be portable and flexible, powered by a connected power bank for independent operation. A touchscreen display facilitates user interaction and displays relevant information. The prototype is capable of recording audio, generating graphical representations of decibel levels, and holds promise for applications in environmental monitoring, noise analysis, and acoustic research.

IV. MARKETING AND PLANNING

Our marketing plan aims to utilize various social media platforms to reach out to as many citizens as possible. The campaign focuses on social media marketing and uses a designated hashtag (#smartvilanova) to encourage citizen engagement and sharing of noise pollution experiences. For citizens not active on social media, traditional media outlets such as papers and posters are used. The plan includes creating an email for inquiries and feedback, as well as reaching out to the city council to plan an event for citizen interaction.

The marketing efforts also emphasize the eco aspect of the project, highlighting its ecological benefits. Environmental issues resonate with citizens, and showcasing how the project is eco-friendly can generate interest and support. Statistics demonstrating the positive impact of reducing noise pollution on air quality and carbon footprint are shared with the public through the city council.

Excessive noise levels can lead to various health problems and interfere with daily activities. Prolonged exposure to loud noises can cause hearing loss, stress, elevated blood pressure, sleep disturbances, and cardiovascular issues. By monitoring noise levels and ensuring they remain within acceptable limits, the project aims to improve citizens' quality of life and minimize disturbances.

V. AESTHETICS AND BRANDING

Brand aesthetics and logo design play an essential role in creating a consistent visual identity. The logo should reflect the brand's personality and values. The design process involves understanding the brand, sketching logo concepts, selecting appropriate fonts and colors, and ensuring the logo's versatility across different mediums. The company name "Aconic" is derived from combining the words "Acoustic" and "Sonic."

Fig 5. Designed logo "Aconic"

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