Title: Design and Development of an Alert Prototype to Assist People with Simple Motor Seizures Events using Triaxial Micro-Sensors

ISEF Finalists

Endrick Y. García - Torres & Savdiel Ducret - Santana

School: Colegio Rosa Bell

City and Country: Guaynabo, Puerto Rico

All figures, diagrams, tables, and graphs were created by the researchers.
(2020 – 2021)

Introduction

- Epilepsy is a serious neurological disorder which affects every aspect of patients' life. (Stafstrom & Carmant, 2015; Tiwary, et. al., 2019).
- Exist concerns that unwitnessed seizures events, might cause injury or even death in people with epilepsy. (Lockman, et. al., 2011; Joo, et. al., 2017).
- There is also a growing interest in using wearable devices to detect seizures in epilepsy (Johansson, et. al., 2018) and help people by providing healthcare services such as monitoring that have the potential to change their lifestyle (Campos, et. al., 2016).
- Seizure alert devices are useful in letting family members know if a seizure is occurring, especially parents of young children (Shafer, 2018).

Problem

The literature (Lockman, 2011; Beniczky, 2018; Angelov, 2019) evidence a variety of monitors to detect seizures, however, their approaches are expensive, with issues in the identification of seizures and discomfort in patients, in terms of design and portability.

Engineering Goal

- Build and evaluate the effectiveness of an affordable prototype, to detect, alert and monitor simple motor seizures events using triaxial microsensors.

Our objective focused on design, engineer and test an alert prototype that can detect, measures and monitors a frequency of simple motor seizures events in patients with epilepsy and serves as an alarm that notify family members or people around.

Experimental Design

Phase 1. Design and Coding

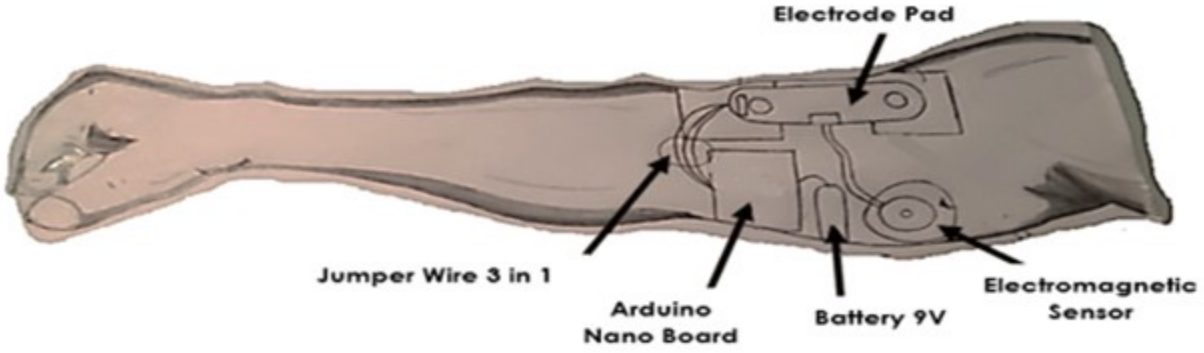


Figure 1. Initial prototype created by the researchers.

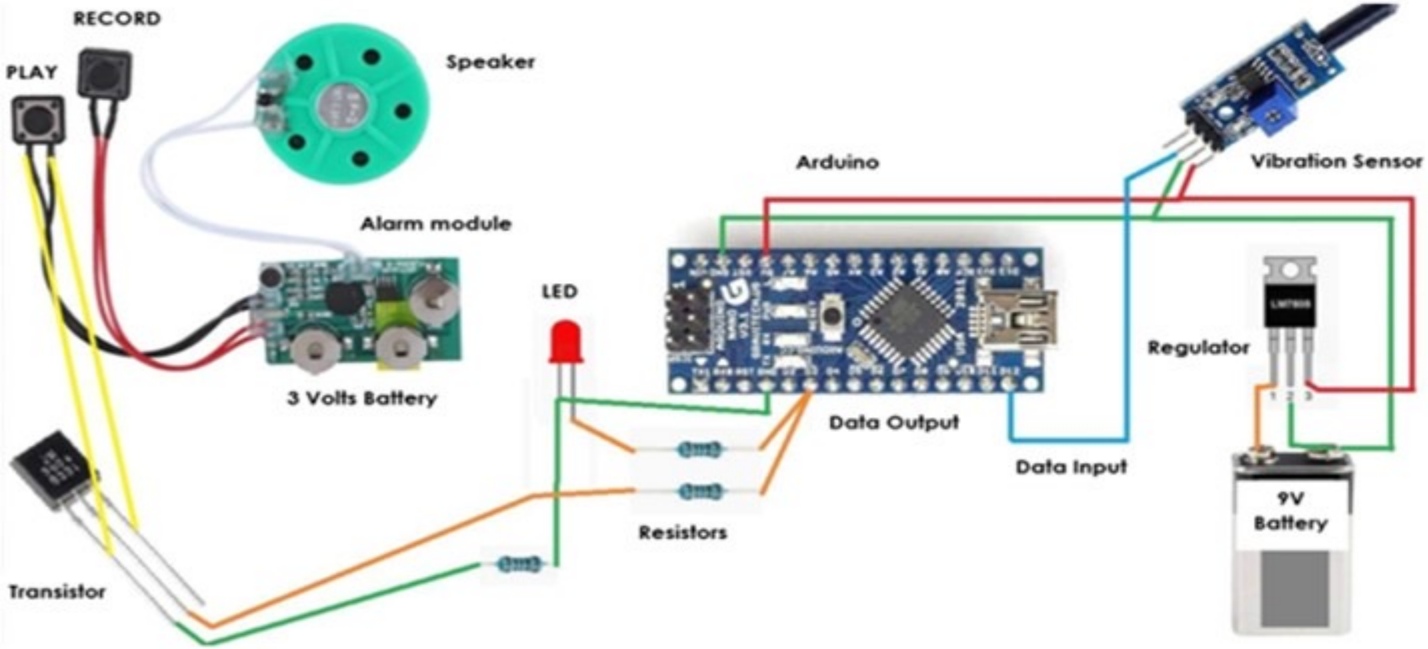
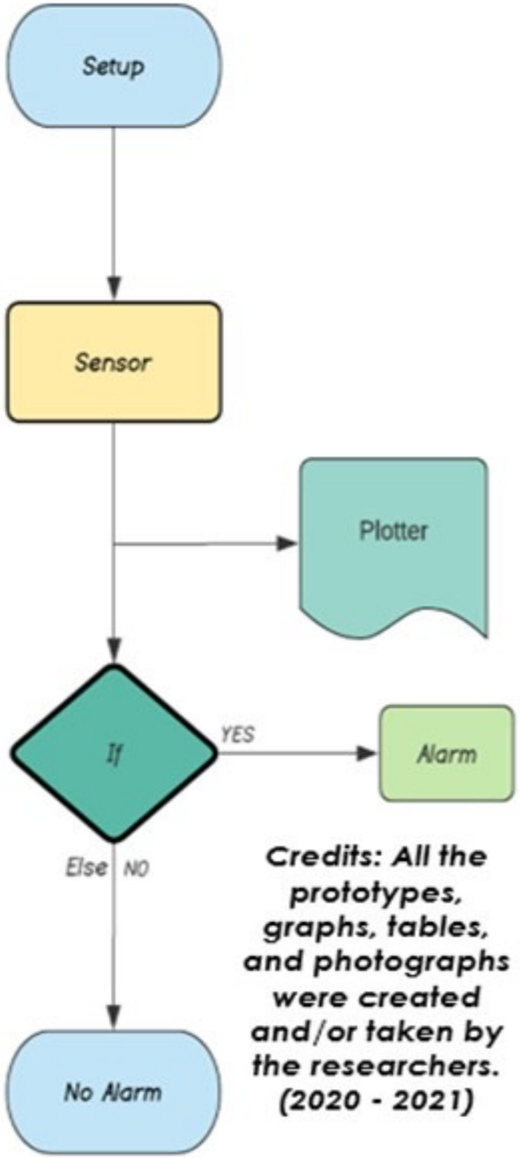


Figure 3. Prototype circuit layout with the Arduino sensors.

Figure 2. Prototype's flowchart



Credits: All the prototypes, graphs, tables, and photographs were created and/or taken by the researchers. (2020 - 2021)

Phase 2. Prototyping and Testing

Figure 4. The arm model was set in the wood stand and connected to the oscillating multi tool.

Figure 5. Electronic parts were connected or soldered to create the circuit board with the Arduino.

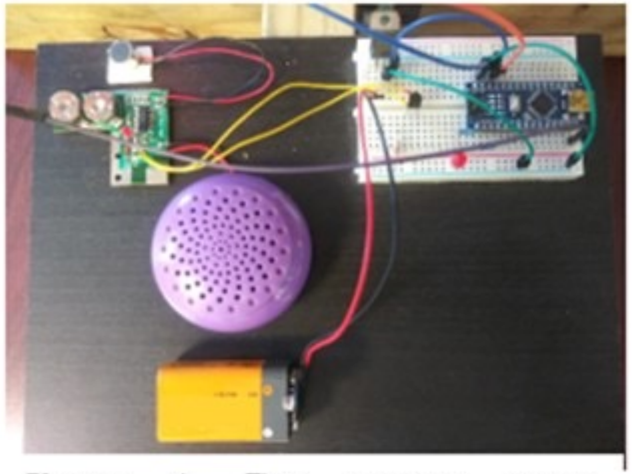


Figure 6. The sensors were connected and placed in position to adapt Arduino and the programming codes

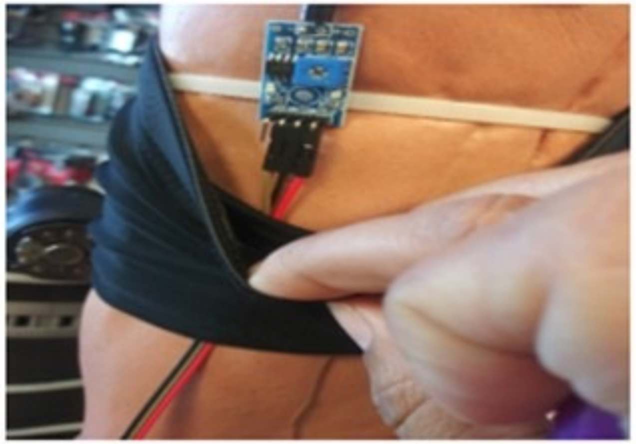


Figure 7. The prototype was connected to the computer and tested the reactions frequencies and times using the serial plotter.

Key Results

Table 1. Simple motor seizure events reference frameworks and prototype's reactions

Motor seizure event simulated - Clonic	Motor seizure event simulated - Myoclonic	Motor seizure event simulated - Tonic
Reference framework – rhythmic event that varies from 20Hz to 50Hz Prototype reaction : ~ 26 Hz in milliseconds / Alarm - activated	Reference framework – sudden and single event that varies up to 50 Hz Prototype reaction: ~ 30 Hz in milliseconds / Alarm - activated	Reference framework – sustained and increased contractions that varies from 40Hz to 50 Hz Prototype reaction: ~ 53 Hz in milliseconds / Alarm - activated

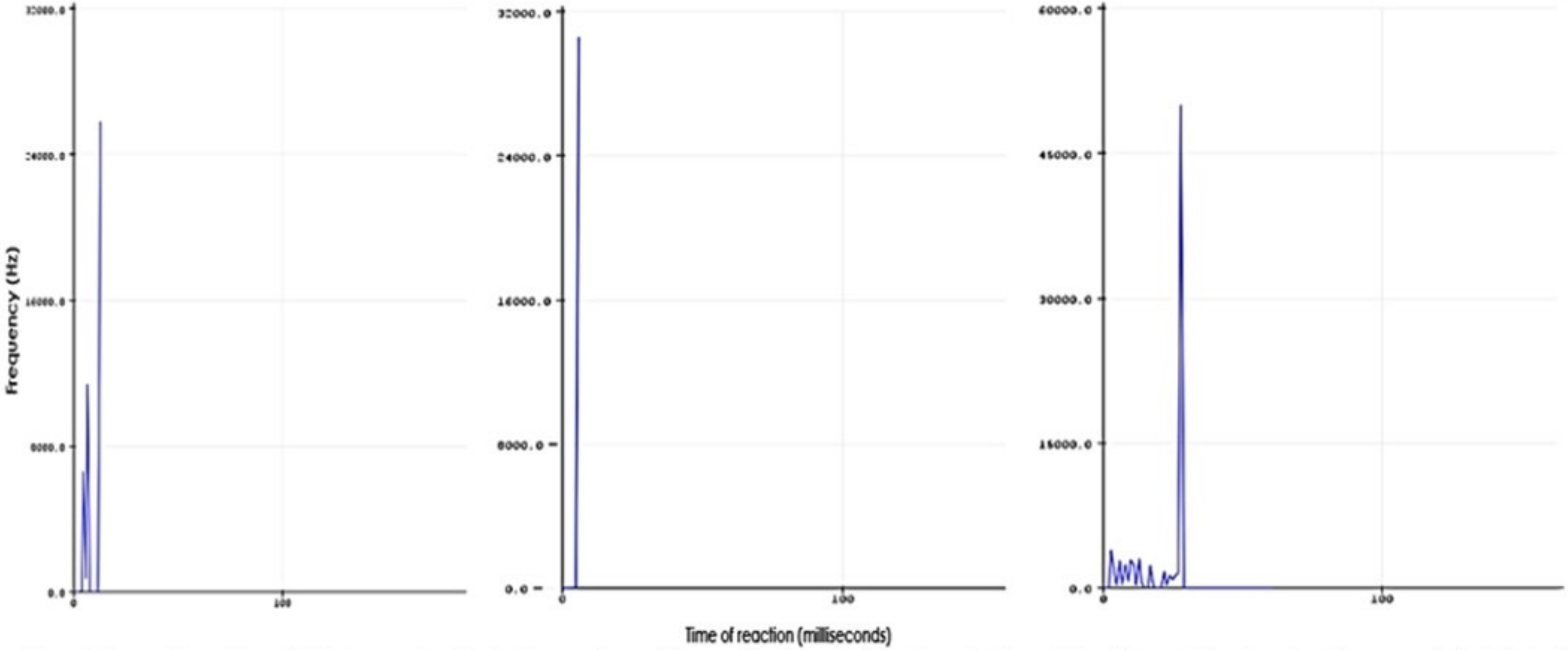
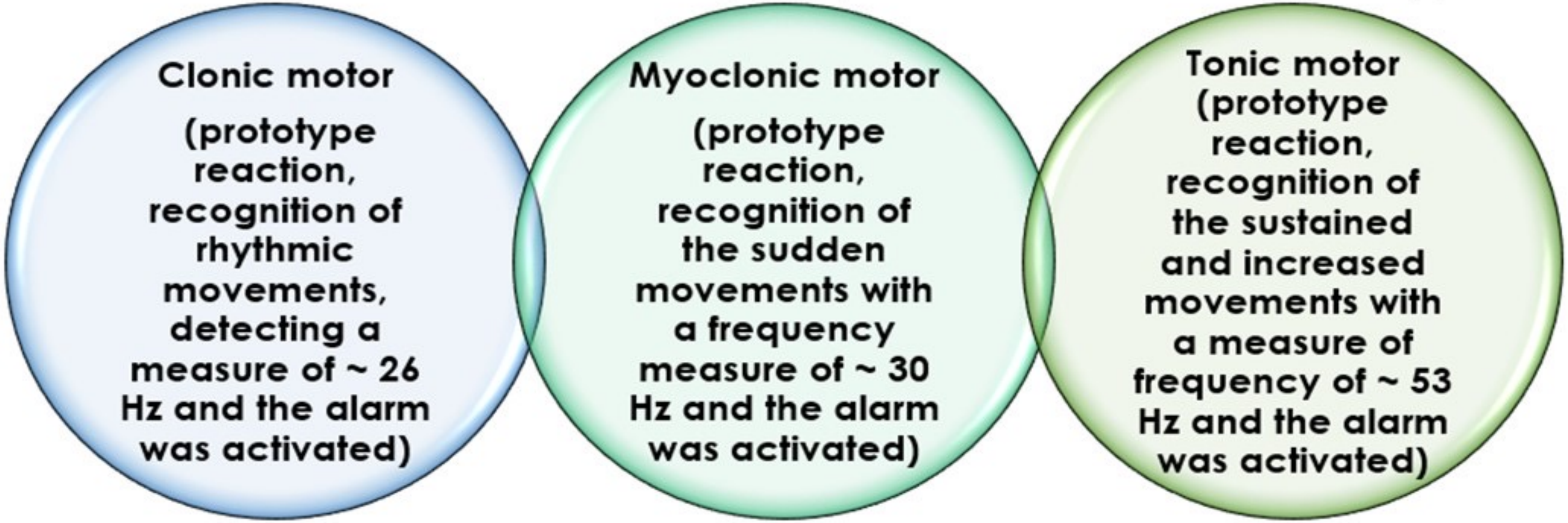


Figure 8. Comparison of the serial plotter graphs with the frequencies and the reaction times obtained from the three different types of simple motor seizures events simulated.

Analysis

- The values and graphs generated by the device during the epileptic seizure simulations were detected and analyzed by the serial plotter in the application.
- The analysis of the data obtained was based on comparisons of each seizure event reference frameworks obtained from the literature review and the reactions in term of frequency and time in the arm prototype.



Discussion and Conclusion

- Based on the data collected and the analysis, the hypothesis was retained. The device effectively detected and respond with the different types of frequencies that simulates the epileptic seizures.

- The researchers expect to continue this project to transform the prototype into a wireless printed circuit board to be used in daily routine, with the ability to send emergency and location alarms to mobile devices of patient's relatives.

Future Engineering Projection and Application

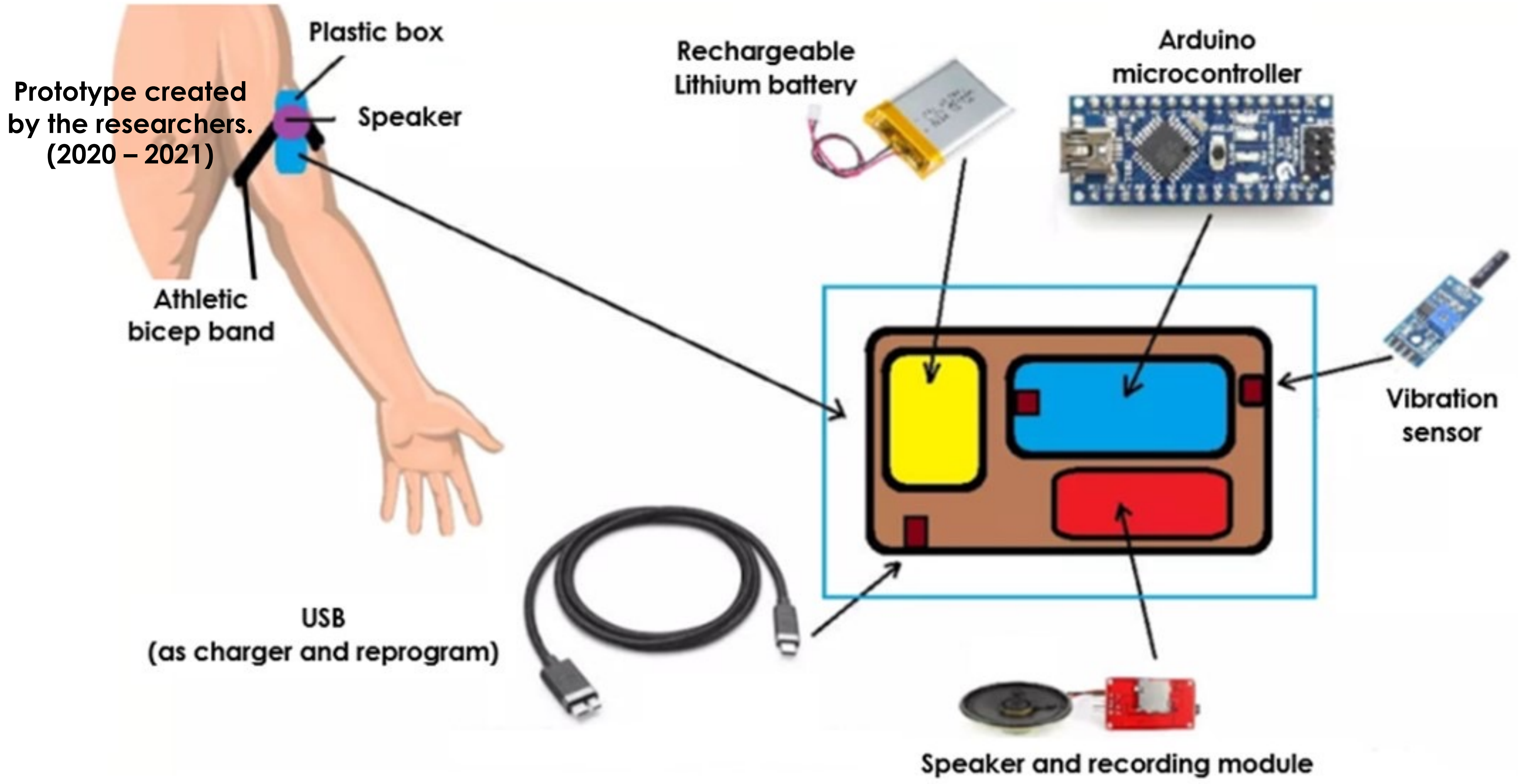


Figure 9. Future portable and rechargeable prototype projection of the alert device created by the researchers.

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