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"Doorbell" Alert System

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Introduction

The purpose of this project was to design and fabricate a working prototype of a “doorbell” alert system to be used in the barn of a hard-of-hearing farmer. This project was completed in conjunction with AgrAbility, an organization that develops and provides assistive technology to agricultural workers [1]. The problem is that a deaf farmer is unaware of when people come to the barn doors looking for them, as they may be in a stall on the other side of the barn.

Specifications

Performance

- Range: 100-200 feet
- Last at least 8 hours
- Work without cell phone service or WiFi
- Successfully get the farmer’s attention 95% of the time

Safety

- Withstand dirt and moisture
- Not cause alarm to barn animals or nearby people

Ease of Use

- Have clear instructions for visitor use at a fifth grade reading level

Components

Figure 1: Wireless DC transmitter and receiver

Figure 2: Arduino Nano

Figure 3: Tamiya plug connectors

Figure 4: Bluetooth modules (HC-05)

Figure 5: Wire clips

Figure 6: LED light strip

Figure 7: Belt pouch

Figure 8: 12V 2000mAh Nickel-metal hydride battery pack

Design

Our main goals when designing this alert system were to maximize durability and reliability. Working distance and battery life were key factors in the design process. The system needed to work for up to 200 feet to ensure functionality throughout the entire barn [2]. The eMylo DC transmitter and receiver allowed us to achieve this requirement [3].

Next, we wanted to make sure our battery could withstand a normal eight-hour workday. The Tenergy Nickel-Metal Hydride Battery has a capacity of 2000 mAh, which allows for at least eight hours of constant power before needing to be recharged [4]. This battery powers the receiver, LED strip, and Arduino Nano in the wireless version. The LED strip is a simple strand trimmed to the appropriate length and connected to the receiver.

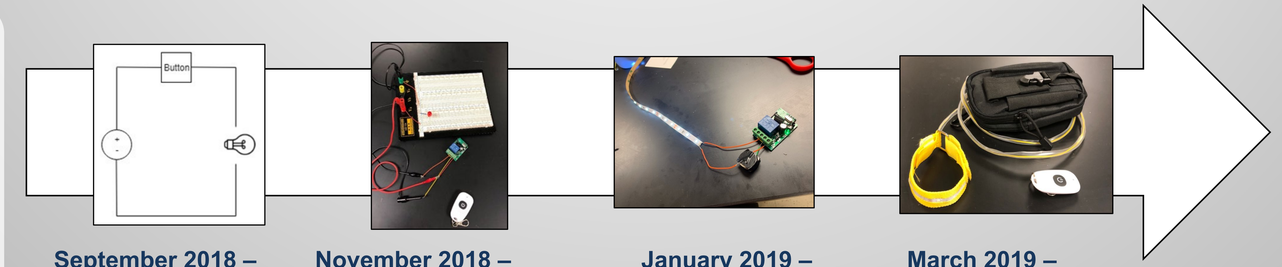
The Arduino Nano can be used with the Bluetooth modules, which would allow the battery pack to be attached to the farmer’s belt while the LED strand is secured around the wrist [5, 6]. Lastly, the battery is easily detachable from the holster to allow for charging. Connections between the battery, charger, and receiver were achieved using the Tamiya male and female plug connectors.

Testing

To verify the functional distance of the wireless transmitter and receiver, we connected a strip of LED lights and tested various scenarios of distance and obstacles. The system worked through concrete walls and floors and functioned across a maximum distance of about 200 feet.

To ensure the system lasts for an eight-hour workday, we tested various batteries connected to the wireless receiver, including a 9-volt battery, 3-volt watch batteries in series, and a 12-volt A23 battery. The system was turned on once every hour to determine if it was still functional. When these batteries could not power the system for eight hours, we measured the current requirements of the system and calculated the required amp-hours for our battery system based on a standard workday. We then purchased a battery with increased amp-hours to meet our calculated requirement.

We also explored using Arduino HC-05 Bluetooth modules to make the system wireless. We verified that we can pair the two modules using an Arduino, and are attempting to wirelessly transmit the signal from the receiver to the LEDs using Bluetooth. We also experimented with a smartwatch for illumination and vibration alerts.



September 2018 – October 2018
- Project selection
- Background research
- Initial conceptual design

November 2018 – December 2018
- Define problem statement
- Initial conceptual design
- Initial prototyping: wireless transmitter and receiver

January 2019 – February 2019
- Continued prototyping: LED strip
- Troubleshooting: battery life

March 2019 – April 2019
- Detailed design: battery pouch and Bluetooth transmitter
- SCAD presentation

Figure 9: Timeline showing project progression from Fall 2018 through Spring 2019

Conclusion

The goal of this project was to create a functional alert system to be used in lieu of a doorbell in the barn of a hard-of-hearing farmer. We created a functional prototype and instructions for how to use the system. Although there is no feedback from the system to the user to indicate if the farmer has noticed the alert, this would be a highly possible and valuable improvement to our system. A two-way communication system would require additional research and prototyping, taking the timeline past the scope of this project.

Through designing, testing, and implementing the system, we applied knowledge that was acquired through coursework. We also enhanced our skill sets by experiencing a variety of new techniques and skills. These include soldering, measuring and calculating current requirements, researching and documenting the project, developing design specifications based on client feedback, and creating detailed designs using CAD.

References

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[6] HC-05 Bluetooth Wireless RF Transceiver Module. [Online]. Available: www.amazon.com. [Accessed Mar. 1, 2019].

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