USER REPAIRABLE AND CUSTOMIZABLE BUZZER SYSTEM USING MACHINE LEARNING AND IOT SYSTEM

Leheng Huang[1] and Yu Sun[2]

[1]Arcadia High School, 180 Campus Dr, Arcadia, CA 91006
[2]California State Polytechnic University,
Pomona, CA, 91768, Irvine, CA 92620

ABSTRACT

The creation and sustainability of academic teams have long been unnecessarily difficult due to the exorbitant costs of purchasing and maintaining equipment [1][2]. These costs serve as a major barrier, especially in poorer areas where securing the funds for this equipment is difficult [3]. In addition, when the equipment eventually breaks, it is often difficult to repair, forcing academic teams to purchase a new set of equipment. This project attempts to provide a product that can drastically lower the equipment's costs and allow the user to modify and repair it as necessary. This project resulted in the development of the Argo Buzzer System which was created with input from experienced academic team members and it has proven that it is comparable to modern buzzer systems for a fraction of the cost [4].

KEYWORDS

Electronics, Machine learning, IoT system.

1. INTRODUCTION

Academic teams are an important aspect of school environments by providing a designated area for like-minded scholars to congregate and challenge themselves with real-world problems [5]. Locally, this will often create an environment that stimulates the exchange of ideas and collective growth of knowledge of the individual team. On a regional scale, academic teams and their associated competitions allow scholars to gauge their level of understanding relative to others in addition to promoting the meeting of individuals who are interested in similar topics [6]. Overall academic teams are vital to the positive development of scholarly students towards their academic goals. However, around the world, many academic teams struggle with financial limitations due to the excessively high cost of equipment and maintenance [7]. The issue is disproportionately disadvantaged towards poorer communities where many passionate students are unable to secure funding from their schools to establish these teams.

Currently, the main source of buzzers is made by a few companies [8]. However these systems often cost an exorbitant amount and once broken, are near impossible for the user to repair. The hefty procurement cost is often a big initial obstacle for those looking to start an academic team, and the recurring financial obstacle of purchasing a new system when the old one breaks is a constant threat to the existence of academic teams.

David C. Wyld et al. (Eds): AIFZ, SIGPRO, NWCOM, CLSB, MLNLP, DTMN, BDIOT, CSITY - 2022
pp. 81-88, 2022. CS & IT - CSCP 2022 DOI: 10.5121/csit.2022.121607

The method employed in this research paper was the design and construction of a new buzzer set. The design and construction of the new system adheres to the priorities on the academic teams and as a result features unparalleled user-friendliness and repairability [9]. This feature is seldom found on any other buzzer set if it can be found at all. In addition, the new system utilizes cost effective parts designed to lower cost while maintaining overall integrity of the system.

As part of multiple of the aforementioned academic teams, I was able to gather the opinions of many experienced and esteemed members of the community. Guided by their constructive criticism and factual evidence gathered through various means, this paper, and the associated patent seeks to provide an alternative by designing a product using cheap parts that can be easily sourced, assembled, and modified [6]. In addition to getting feedback from academic teams, I also conducted multiple tests on the buzzer system to assure the proper functioning of the system. During the tests, the buzzer pressed and the reset method was alterensnated multiple times to ensure that all systems functioned as designed.

The rest of the paper is organized as follows: Section 2 gives the details on the challenges that we met during the experiment and designing the sample; Section 3 focuses on the details of our solutions corresponding to the challenges that we mentioned in Section 2; Section 4 presents the relevant details about the experiment we did, following by presenting the related work in Section 5. Finally, Section 6 gives the conclusion remarks, as well as pointing out the future work of this project.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. Configuring the Product

A significant challenge that I faced during the creation of the product was determining the exact configuration of the machine. Each academic team had its own requirements and preferences, and sometimes it was hard to differentiate which was a requirement and which were not required but strongly preferred. In addition to these considerations had to be made for cost, engineering practicality, and personal sanity. Certain preferences would have added too much to the cost thus defeating its purpose, others would have made building and repairing unnecessarily difficult.

2.2. Designing the Exterior

The design of the exterior shell falls into a separate field of study and requires a separate set of skills than designing electronics. Thus it is natural that most people who build electronics struggle to design an aesthetically pleasing and functional shell. The dilemma that confronts most people during design is the choice of the material. The list of possible materials that can be used is usually constricted by a multitude of factors from the environment to user-friendliness etc. From this resulting list, finding a material that balances all the factors is usually very difficult.

2.3. Determining the Activator

Choosing the proper activator is essential when designing buzzer systems because it determines the way the system will be used and its versatility. Most contemporaries feature 3 main types of activators: handheld buzzers, pedal buzzers, or tabletop buzzers. Each has its respective pros and cons, for example, the pedal buzzers allow for foot buzzing, etc.

3. SOLUTION

The Argo Buzzer System is a buzzer system that features unparalleled user-repairability and upgradability. At the heart of the Argo, Buzzer System is the Arduino Mega; the Arduino Mega microcontroller can be easily reprogrammed by the user which allows for very good adaptability [12]. The default system provides 8 simple handheld buzzers which are individually replaceable, in addition, individual buzzers can be removed or added based on the individual needs. The code provides support for up to 20 players, if the capacity is reached the code provides an input pin and an output pin so that 2 systems can be combined for a total capacity of 40 players. When the buzzer is pressed it completes a circuit that the Arduino detects, when the signal is detected it changes a boolean value and an output is sent to the buzzer and corresponding LED. In addition, all other players are locked out disabling their ability to buzz while the player who buzzed answers the question. To reset the system the operator can either manually press the reset button or activate the laser detection system. The button sends a simple signal to the Arduino after which the boolean is reset ending the lockout and resetting the system. The same procedure occurs with the laser. The major components of the system are as follows:

- Arduino Mega Microcontroller and the buzzer and lockout algorithm [13]
- The individual buzzers and their corresponding circuitry
- The reset button and the laser detection system
- The buzzer

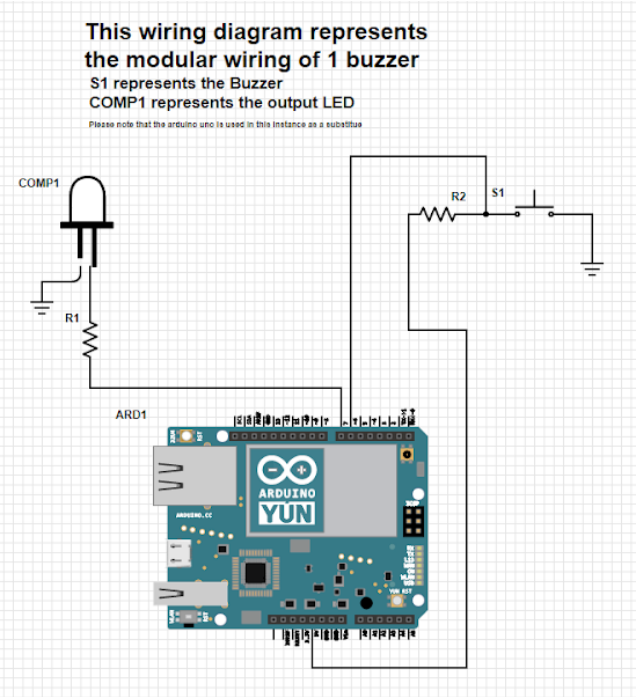

Figure 1. Overview of the solution

```
void RST2() {
  isActivate = false;
  Serial.println("yay");
  digitalWrite(buzzPin, LOW);
  digitalWrite(LEDpin1,LOW);
  digitalWrite(LEDpin2,LOW);
  digitalWrite(LEDpin3,LOW);
  digitalWrite(LEDpin4,LOW);
  digitalWrite(LEDpin5,LOW);
  digitalWrite(LEDpin6,LOW);
  digitalWrite(LEDpin7,LOW);
  digitalWrite(LEDpin8,LOW);
}
```

Figure 2. Screenshot of code 1

```
int LEDpin1 = 8, LEDpin2 =9, LEDpin3 =10, LEDpin4 = 11, LEDpin5 = 4, LEDpin6 = 16, LEDpin7 = 2, LEDpin8 = 3;
int buttonPin1 = 12;
int buttonPin2 = 13;
int buttonPin3 = 14;
int buttonPin4 = 15;
int buttonPin5 = 17;
int buttonPin6 = 18;
int buttonPin7 = 19;
int buttonPin8 = 20;
int buzzPin =6;
int RST = 5;
int laserPin =7;
int buttonNew1,buttonNew2,buttonNew3,buttonNew4,buttonNew5,buttonNew6,buttonNew7,buttonNew8;
int buttonOld1,buttonOld2,buttonOld3,buttonOld4, buttonOld5, buttonOld6, buttonOld7,buttonOld8 = 0;
```

Figure 3. Screenshot of code 2

```
Serial.begin(9600);
pinMode(LEDpin1, OUTPUT);
pinMode(LEDpin2, OUTPUT);
pinMode(LEDpin3, OUTPUT);
pinMode(LEDpin4, OUTPUT);
pinMode(LEDpin5, OUTPUT);
pinMode(LEDpin6, OUTPUT);
pinMode(LEDpin7, OUTPUT);
pinMode(LEDpin8, OUTPUT);
pinMode(RST, INPUT);
```

Figure 4. Screenshot of code 3

As the centerpiece of the whole system, all inputs and outputs are directly connected to it. To detect the motion of someone pressing the buzzers, the individual buzzers and their corresponding circuits are constantly powered by a 5v current from the Arduino. When the buzzer circuit is open, the signal is read as “1”. When the buzzer circuit is closed, it completes the circuit and the signal reading changes to 0 and then back to 1 as the button is released. When the signal change is detected, boolean changes disable all other buzzers in the system and send a signal to the output pin, while simultaneously triggering the buzzer and activating the LED which corresponds to the buzzer. The reset button operates in a similar manner to the buzzers, it drops the voltage of the system triggering the Arduino. The laser reset system instead simply sends a voltage to the Arduino which the Arduino detects resetting the system.

4. EXPERIMENT

4.1. Experiment 1

The activator is one of the defining traits of any buzzer system as it determines the ways it can be used. The 3 types of buzzers which are widely used by contemporary systems are peddled tabletop, and handheld. However, for this specific instance, peddle-style buzzers are discounted on account of cost, and ergonomics. To determine between the remaining two choices, a survey will be conducted on the following parameters: sample size of 30 taken from players, participants will select either one of the choices or no preference.

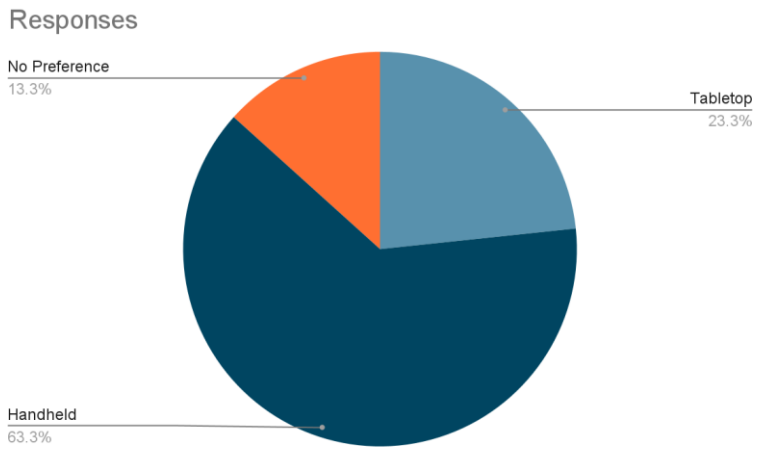

Figure 5. Responses of experiment 1

The result of the experiment showed an overwhelming majority of players preferred hand-held buzzers over tabletop buzzers. This opinion concurs with other surveys conducted online and by other organizations.

4.2. Experiment 2

The functionality of the buzzer system should be comparable to its peers on the market to ensure that academic teams would have all they need. An experiment will be conducted on the following premises to ensure proper functionality: the system will be run 50 times, each handheld buzzer will be cycled through, and the reset method will alternate between the button and the laser activation.

Runs	Buzzer	Buzzer functioning	Reset Method used	Reset functioning
1	1	yes	Button	yes
2	2	yes	Laser	yes
3	3	yes	Button	yes
4	4	yes	Laser	yes
5	5	yes	Button	yes
6	6	yes	Laser	no
7	7	yes	Button	yes
8	8	yes	Laser	yes
9	1	yes	Button	yes
10	2	yes	Laser	yes
11	3	yes	Button	yes
12	4	yes	Laser	yes
13	5	yes	Button	yes
14	6	yes	Laser	yes
15	7	yes	Button	yes
16	8	yes	Laser	yes
17	1	yes	Button	yes
18	2	yes	Laser	yes
19	3	yes	Button	yes
20	4	yes	Laser	yes
21	5	yes	Button	yes
22	6	yes	Laser	yes
23	7	yes	Button	yes
24	8	yes	Laser	yes
25	1	yes	Button	yes
26	2	yes	Laser	yes
27	3	yes	Button	yes
28	4	yes	Laser	yes
29	5	yes	Button	yes
30	6	yes	Laser	yes
31	7	yes	Button	yes
32	8	yes	Laser	yes
33	1	yes	Button	yes
34	2	yes	Laser	no
35	3	yes	Button	yes
36	4	yes	Laser	yes
37	5	yes	Button	yes
38	6	yes	Laser	yes
39	7	yes	Button	yes
40	8	yes	Laser	yes
41	1	yes	Button	yes
42	2	yes	Laser	yes
43	3	yes	Button	yes
44	4	yes	Laser	yes
45	5	yes	Button	yes
46	6	yes	Laser	no
47	7	yes	Button	yes
48	8	yes	Laser	no
49	1	yes	Button	yes
50	2	yes	Laser	yes

Figure 6. Result of experiment 2

During all 50 test runs, the activators all functioned as expected: when pressed, the buzzer buzzed and the corresponding LED lit up. When resetting, the button functioned also as expected, resetting the system when pressed. However, during testing, it was found that the laser reset was occasionally unable to detect when it was being activated due to strong ambient light present during testing. As a result, the laser detection was unable to properly reset the system upon attempted activation.

Experiment 1 regarding the style of the buzzers was within expectations. As a player myself, I preferred handheld buzzers over tabletop buzzers, and many of my fellow players have often complained or expressed dissatisfaction regarding the tabletop buzzers. The experiment confirmed that this was indeed the majority opinion and quantified my suspicions. Experiment 2 regarding the functionality of the buzzer system was within expectation with the exception of the laser reset module. The laser system malfunctioning was a surprise because my previous experience with this particular model of laser module did not have this problem, granted the previous application was used in a dark environment.

5. RELATED WORK

Buzzer systems developed and is currently selling multiple models of their buzzer system [11]. Their models range from 4 players to 16 players with the ability to link up their systems. They sell 2 main types of buzzers, a lockout system, and a special lockout system that shows the orders the players buzz in on. However, their systems are not user customizable or easily repairable as opposed to the Argo Buzzer System. In addition, their systems are ludicrously expensive which are damaging to academic teams.

A similar company by the name of Anderson Enterprises also sells buzzer systems similar to the aforementioned company Buzzer Systems [14]. However, their products suffer from the same issues; poor user repairability and high costs.

Another similar company by the name of zeecraft also sells buzzer systems, their buzzer systems are also similar to the previous companies [15]. However, their buzzer systems are priced at an even more exorbitant amount. In addition, the buzzer system suffers from issues mentioned with the previous buzzer systems.

6. CONCLUSIONS

This paper and its associated product/application were created in response to the growing costs of sustaining and creating an academic team, and to allow for academic teams to upgrade and modify their own buzzer set according to their needs. Through the use of a programmable microcontroller and other easily obtainable parts, the product is completely modular and allows users to repair or modify with basic electronic knowledge and equipment. The design of the product was also designed specifically to suit academic teams and implement feedback given by experienced academic team members as seen in experiment 1. In addition, the product/application has proven that it does function properly with only minor issues that could be easily remedied during experiment 2.

Due to lack of resources, the inputs for requirements, suggestions, and other such opinions were local in scale such the majority opinion may be different in other local areas. The small sample size could also be a liability as it could have inflated or underrepresented certain opinions.

In future, these limitations could be mitigated in the future with larger-scale surveys. In addition, the survey could be improved by asking for more feedback from the participants, especially regarding their reasoning for why they preferred one choice over the other.

REFERENCES

[1] Wilkinson, Adrian, Malcolm Hill, and Paul Gollan. "The sustainability debate." International Journal of Operations & Production Management (2001).

[2] Wadhera, Sidhant. "Exorbitant Costs and Minimal Benefits: the Impact of Hosting the Olympics." Chicago Policy Review (Online) (2020).

[3] Malafeyev, O. A., et al. "The optimization problem of preventive equipment repair planning." AIP Conference Proceedings. Vol. 1978. No. 1. AIP Publishing LLC, 2018.

[4] Tait, Jasmine. "A Comparison of Acoustic Effects of Two Stopper and Crown Systems in the Modern Flute." Canadian Acoustics 29: 40-44.

[5] Gordon, Rick. "Balancing real-world problems with real-world results." Phi Delta Kappan 79.5 (1998): 390.

[6] Dunnell, Robert C., and William S. Dancey. "The siteless survey: a regional scale data collection strategy." Advances in archaeological method and theory. Academic Press, 1983. 267-287.

[7] Jardine, A. K. S., and J. A. Buzacott. "Equipment reliability and maintenance." European Journal of Operational Research 19.3 (1985): 285-296.

[8] Tyson, John J., Katherine C. Chen, and Bela Novak. "Sniffers, buzzers, toggles and blinkers: dynamics of regulatory and signaling pathways in the cell." Current opinion in cell biology 15.2 (2003): 221-231.

[9] Darbyshire, Philip. "User-friendliness of computerized information systems." Computers in nursing 18.2 (2000): 93-99.

[10] Abbott, Ann A., and Sharon C. Lyter. "The use of constructive criticism in field supervision." The Clinical Supervisor 17.2 (1999): 43-57.

[11] Robertson, Leon S. "Safety belt use in automobiles with starter-interlock and buzzer-light reminder systems." American Journal of Public Health 65.12 (1975): 1319-1325.

[12] Bolanakis, Dimosthenis E. "A survey of research in microcontroller education." IEEE Revista Iberoamericana de Tecnologias del Aprendizaje 14.2 (2019): 50-57.

[13] Tazi, Imam, Kuwat Triyana, and Dwi Siswanta. "A novel Arduino Mega 2560 microcontroller-based electronic tongue for dairy product classification." AIP Conference Proceedings. Vol. 1755. No. 1. AIP Publishing LLC, 2016.

[14] Robertson, Leon S., and William Haddon Jr. "The buzzer-light reminder system and safety belt use." American Journal of Public Health 64.8 (1974): 814-815.

[15] Ibrahim, Mochamad, et al. "Buzzer detection and sentiment analysis for predicting presidential election results in a twitter nation." 2015 IEEE international conference on data mining workshop (ICDMW). IEEE, 2015.