

Ultrasonic Occupancy Monitor

Visual and Auditory

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Abstract— The aim of this project is to create an occupancy monitoring device that tracks the number of people in any given space to ensure safety, according to fire and other safety protocols. Utilizing an Arduino Uno system, as well as ultrasonic sensors, the technology detects the presence of an object with either the designated entry or exit sensor and correlates this detection with the subsequent feedback provided by a buzzer, LED indicators, and a digit display. The design of this device is based on accessibility, with visual and auditory cues to serve a wide range of users. Furthermore, the device is optimal for mobility in use, as it operates with a 9V battery power source. Testing for this device realized various stages, with both small and large-scale tests, as well as varied speeds to ensure that detection of all movement would register with the ultrasonic sensors. As the device functions within these limits, the technology shows great promise with both its intended purpose as well as future involvement in more advanced products.

Keywords— *Ultrasonic, Sensor, Arduino, Electricity, Circuits, Occupancy, Safety, Counter, Monitor*

Abbreviations – *Artificial Intelligence (AI), Nine Volt (9V), Light- Emitting Diode (LED(s)) Resistance(R), Voltage(V), Current(I), Forward Voltage (Vf), Total Voltage (Vtotal), Battery Voltage (VBattery), Remaining Voltage (VR), Milliampere(mA)*

I. INTRODUCTION (*HEADING 1*)

It is standard convention to exercise a room occupancy threshold for businesses or similar entities that require a safety fire inspection to maintain licensure. According to fire safety standards, as referenced in [1], the need for a room occupancy threshold relates to the speed with which the room could be evacuated with the specified number of people at a rate that would allow for a measure of safety. Without such protocols, establishments are more likely to operate without the foresight needed to realize safety measures in the event of an emergency. As researched by [2], situations like these have been realized before, notably in disasters such as the Triangle Shirtwaist Factory fire, which led to the tragic, early deaths of many young women who were unable to escape their workspace as a deadly fire raged. In other, more recent instances, the need for room occupancy monitoring was especially vital during the most recent global pandemic. The disease was realized to spread through air particulates. It was therefore necessary to both monitor and reduce the spread of such a deadly disease wherever possible. Room occupancy became a significant factor in the fight against the disease, with businesses and establishments alike going so far as to station workers at entrances to deny customers entry or monitor the entrance and exit of those customers. Again, the use of room occupancy to ensure safety played a large part in the successful protection of public welfare.

Cases such as these highlight the need for evolving technologies to better equip society for long-held standards of safety, or those that may become relevant in the short term due to evolving issues such as a pandemic. Therefore, the question becomes: what technology is best equipped to adapt to changing standards of occupancy regulations? In response to this, the Arduino Uno setup was introduced into the framework, a device that easily enables any individual to set up technology of their own to fit a certain any given project. In combination with this, the use of ultrasonics sensors can be easily integrated with the Arduino circuit system to monitor the movement of bodies of mass around the equipment. These technologies combined create an opportunity for evolution in standard occupancy monitoring, a technology that can autonomously count those objects, in this case, people, entering and exiting any given space.

The methodology for creating this technology involves the use of the Arduino Uno circuitry and ultrasonic sensors to achieve a final goal, as has been laid out. The circuit-building aspect of this technology created a path to power and code the ultrasonic sensors in a way that specifies the direction traveled by a mass within the space of the radar, and the use of code to implement output mechanisms corresponding to the varied inputs. The research for this task lies within creative paths started by creators such as Ryan Chan, who's implementation and creation of similar designs allowed for the inspiration behind a project such as this.

The further utilization of this technology will be explained within the following sections of this paper, including the materials and methods used to implement the ultrasonic technology, the results and relevant topics of discussion this technology brings about, and the conclusions that can be drawn from this sequence of technology development and implementation.

II. MATERIALS AND METHODS

A. *Materials*

As previously implemented, the Arduino Uno kit was utilized to harness the technology needed to create a device such as the occupancy counter. The Arduino Uno, as pictured in Fig.3 is a microcontroller that uses code, an input from the user, to conduct processes through the utilization of a microprocessor and connected components. In this case, the Arduino is powered by a 9V battery, supplying constant energy to the circuit to power the processor and all parts of the technology. The Arduino connects to a breadboard, a constructed base used to create circuits and implement the flow of energy using wires. Wires are plugged into the corresponding slots for positive or negative connections, as well as being connected to the Arduino processor. The wires serve as directional implements to harness the energy from the battery into the breadboard, which then directs this energy into the other components, such as the previously discussed ultrasonic sensor, buzzer, and counter.

More specifically, ultrasonic sensors (HC-SR04) were utilized to detect the presence of bodies entering or exiting the specified area, as pictured below in Fig.4. The Arduino Uno kit came with one ultrasonic sensor, although two were required for the full functionality of the device. The sensor itself is made up of both a transmitter and a receiver. Where the ultrasonic sensor differs from radar lies in its ability to emit and receive signals. As explained by Danny Jost [5], the ultrasonic sensor works via the transmission of high-frequency waves through the medium of the air surrounding the device. These sound waves exist at a level outside the frequency range that humans can hear or comprehend. When the waves encounter a mass, they bounce off the object and transmit the information back to the device, which uses this data to calculate the distance of the object from the device based on the time it takes for the transmission to return. This calculation and repetition occur continuously, creating a real-time map of the object's position relative to the device, assuming the device itself remains stationary.

Furthermore, other components complete the smooth operation of this technology, including a buzzer and a counter display, the TM1637 4-Digit Display, as pictured in Fig.6. The buzzer and counter work together to notify the user when the maximum capacity of the relevant space has been reached. Within the Arduino system, the buzzer is an audio feedback indicator that produces sound when powered on, providing input feedback to signal the need for a warning, in this case, a full occupancy warning, as pictured below in Fig.7. Similarly, the counter serves to display the number of people currently occupying the space, as well as account for any additions or exits at any given time. Like the buzzer, the counter operates through electrical signals as it is connected to the breadboard and stimulated by the processing code, which generates instructions based on the activity relayed by the ultrasonic sensor. The counter is a simple and effective way to monitor occupancy, especially when combined with the more intricate technology of the ultrasonic sensor. The room occupancy is also indicated through another visual element, with a series of LEDs corresponding to the current occupancy level of the room. The LEDs within the circuit are connected to both a resistor and the Arduino to provide power and a position within the circuit. The resistors, when in use with the 9V battery, has a value of 330 Ohms. This value was deduced from use of Ohm's Law. Red, yellow, and green LEDs correspond to occupancy levels, serving as a familiar format for the public to understand the status of any given room. An example of 330 ohm resistors are found pictured in Fig.8.



Fig. 3 Image of the Arduino Uno with wire connections.

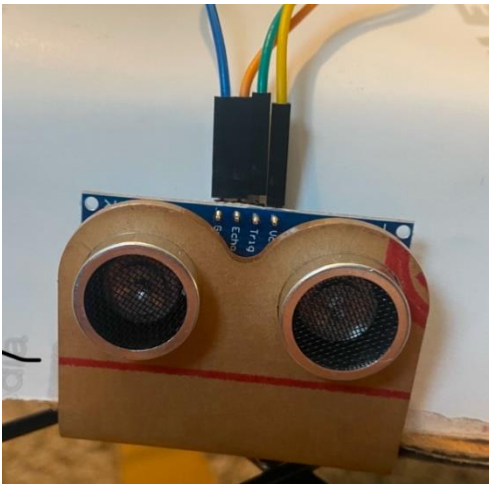


Fig. 4 The figure shows an ultrasonic sensor, one of two within this project.

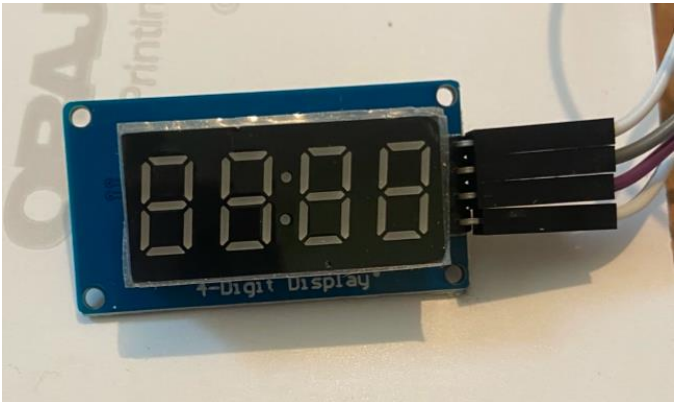


Fig. 6 The figure shows the four- digit display used as a counting system within this project.



Fig. 7 This image shows the buzzer used within the project.

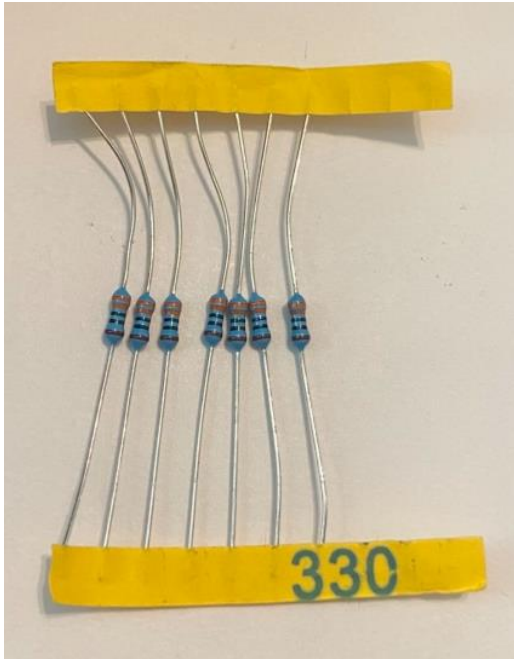


Fig. 8 The figure shows several 330-ohm resistors.

B. Equations

Ohm's Law was used within this experiment to calculate the resistance necessary to maintain safety in the circuit while the circuit was powered by a 9V battery. Ohm's Law, as follows

$$R = V/I$$

As well as use of LEDs in sequence, indicating a voltage calculated through the following,

$$V_{total} = V_{f1} + V_{f2} + V_{f3}$$

Here the forward voltage of the red and yellow LEDs are 2.0V, where green represents 3.0V. Furthermore, the voltage remaining for the resistor can be calculated using the following,

$$V_R = V_{battery} - V_{total}$$

The voltage of the battery being 9V, and the V_{total} having been calculated as 7.0V, V_R therefore is equivalent to 2.0V.

With a value of 6 mA, the calculation of required resistance can be evaluated using the previously mentioned Ohm's Law. The resistance for the LEDs in sequence was calculated as 330 Ohms. This calculated resistance falls well on the side of safety, as smaller resistance values would provide a brighter LED; however, the safety of the user was of upmost importance and influenced this calculation heavily. This resistance also relays a reliable use of the product for a longer duration, as a smaller resistance value would disallow longevity for the LEDs. Example LEDs, as described above, are pictured below in Fig.9.

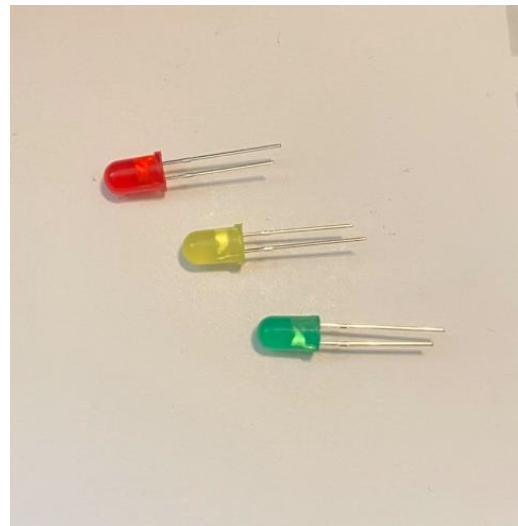


Fig. 9 The figure shows a red, yellow, and green standard LED for use with the Arduino Uno.

C. Methods

Furthermore, the methodology behind this project was varied, as the creation of the circuit involved tinkering and reworking to accurately interpret both movement in front of the ultrasonic sensors and the connection to the counting mechanism. To begin, the setup of the circuit itself was necessary. The figure below describes the circuit setup, created online using Tinkercad, as featured in Fig.10. The parts, as described above, were utilized in connection with the Arduino Uno and the breadboard to direct the current. While this setup describes the layout, except for a difference in counter display, the building of the real-world application involved experimentation

with wires and using space effectively, along with assorted changes as the circuit became more refined and reduced redundancy. Various layouts were tested; however, the result, as shown below, was the best product, allowing movement of the parts without a loss in current flow. As shown in the final picture, the device was ultimately powered by a battery rather than the USB Arduino cable, realizing another level of accessibility and mobility. The specific placement of the connecting wires also required a level of accuracy, as the power source for the various devices was not exclusive; however, the input necessary for the code to function was specific to pin numbers. The pin numbers, after tinkering with the real-world model, were cemented in design, and coordinated to fit the code. An image of the completed circuit is featured below in Fig.11.

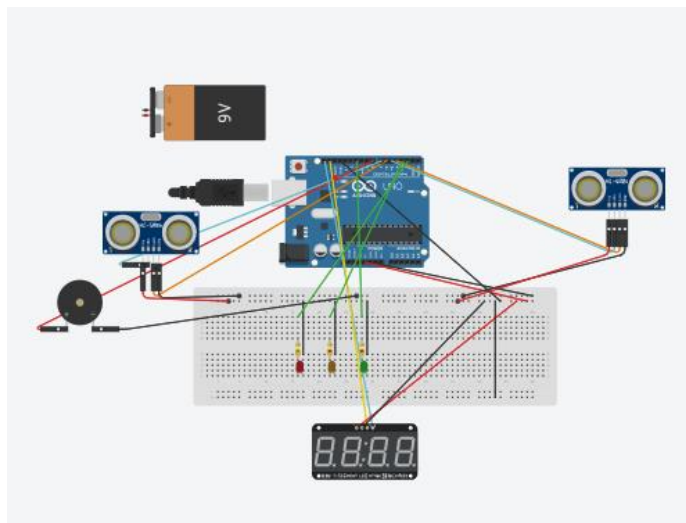


Fig. 10 This image is of the Tinkercad layout created to demonstrate the circuit layout.

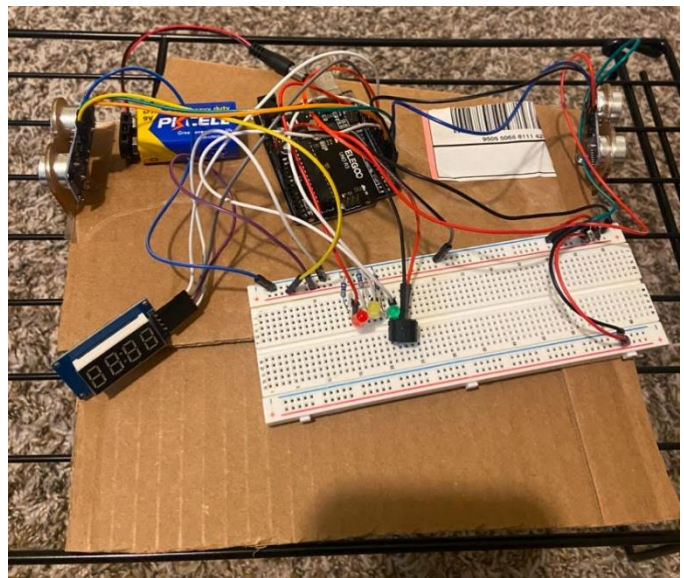


Fig. 11 This figure shows the full, complete setup of the circuit setup and final project layout.

With the creation of a fully formed circuit system, code was needed to implement the function of the design and create a system that accurately measures the occupancy of a room. The code was written using generative AI, specifically ChatGPT [12]. The AI system was prompted to write code for the Arduino Uno that would use the two sensors (one on either side) to add or subtract from a running total and use this information to regulate the buzzer and LEDs. The AI was instructed to match the code with the set pins, as the circuit had already been built, and to reflect these circuit connections within the code. The final code can be found in Figs. 13-15. This code works to detect movement with the use of one ultrasonic sensor and reflects this movement as an increase (+1) to the counter system. The code also displays the current occupancy of the room using green, yellow, and red LEDs. Green is used to indicate that the room holds up to 40% of its maximum occupancy, yellow indicates 41-99% occupancy, and red indicates full occupancy (100% or more). The code also triggers the buzzer with each addition to the occupancy count and continues sounding when the occupancy limit is reached. The code also uses the other ultrasonic sensor, located on the opposite side of the project layout, to mark the exit of people. While the code does not specify a buzzer sound for those exiting, it implements a stop to the continuous alarm once full occupancy is

reached and then subsequently reduced through the indication of the exit sensor. The “exit” occupancy counter works in opposition to the “entry” ultrasonic sensor, mimicking the same pattern but in reverse. When the sensor detects motion, it subtracts one from the count, and if applicable, the LED status changes to reflect this reduction. For testing purposes, the maximum occupancy was set to 6; however, this can easily be altered within the code. Furthermore, the detection area was set to detect a wide range of motion. This device was designed with a doorway or other small entrance in mind and would not be effective for mass entry or exit over a large area.

```
#include <TM1637Display.h> // TM1637 display library

// Pin assignments
#define TRIG_PIN1 2 // Entry sensor Trigger pin
#define ECHO_PIN1 4 // Entry sensor Echo pin
#define TRIG_PIN2 3 // Exit sensor Trigger pin
#define ECHO_PIN2 5 // Exit sensor Echo pin
#define RED_LED 6 // Red LED for full room
#define YELLOW_LED 7 // Yellow LED for moderate occupancy
#define GREEN_LED 8 // Green LED for low occupancy
#define BUZZER_PIN 9 // Buzzer pin

// Create TM1637 display instance
TM1637Display display(10, 11); // CLK, DIO pins

// Variables
int personCount = 0; // Number of people in the room
long previousDistance1 = 0; // Previous distance for entry sensor
long previousDistance2 = 0; // Previous distance for exit sensor
long thresholdDistance = 10; // Minimum distance to detect motion (in cm)

// Setup the sensors, LEDs, and display
void setup() {
    // Initialize pins
    pinMode(TRIG_PIN1, OUTPUT);
    pinMode(ECHO_PIN1, INPUT);
    pinMode(TRIG_PIN2, OUTPUT);
    pinMode(ECHO_PIN2, INPUT);
    pinMode(RED_LED, OUTPUT);
    pinMode(YELLOW_LED, OUTPUT);
    pinMode(GREEN_LED, OUTPUT);
    pinMode(BUZZER_PIN, OUTPUT);

    // Initialize the 4-digit display
    display.setBrightness(0x0f); // Set display brightness to max
    Serial.begin(9600); // Start serial communication
}

// Main loop
void loop() {
    // Get distances from both ultrasonic sensors
    long distance1 = getDistance(TRIG_PIN1, ECHO_PIN1); // Entry sensor
    long distance2 = getDistance(TRIG_PIN2, ECHO_PIN2); // Exit sensor
```

Fig. 13 This image contains the first of three images showcasing the code used to program this technology.

```
// Display the current number of people in the room
display.showNumberDec(personCount);

// Check for entry (if distance decreases, someone enters)
if (abs(distance1 - previousDistance1) > thresholdDistance && distance1 < 50) {
    // Entry threshold
    personCount++; // Increment person count
    if (personCount > 6) personCount = 6; // Limit to 6 people
    tone(BUZZER_PIN, 1000); // Sound buzzer if room is full
    delay(500); // Debounce delay
}

// Check for exit (if distance increases, someone exits)
if (abs(distance2 - previousDistance2) > thresholdDistance && distance2 < 50) {
    // Exit threshold
    if (personCount > 0) {
        personCount--; // Decrement person count
    }
    delay(500); // Debounce delay
}

// Update previous distances
previousDistance1 = distance1;
previousDistance2 = distance2;

// Control LEDs based on current occupancy
if (personCount >= 6) {
    // Red LED for full room
    digitalWrite(RED_LED, HIGH);
    digitalWrite(YELLOW_LED, LOW);
    digitalWrite(GREEN_LED, LOW);
    tone(BUZZER_PIN, 1000); // Buzzer on
} else if (personCount >= 3) {
    // Yellow LED for moderate occupancy
    digitalWrite(RED_LED, LOW);
    digitalWrite(YELLOW_LED, HIGH);
    digitalWrite(GREEN_LED, LOW);
    noTone(BUZZER_PIN); // Turn off buzzer
} else {
    // Green LED for low occupancy
    digitalWrite(RED_LED, LOW);
    digitalWrite(YELLOW_LED, LOW);
    digitalWrite(GREEN_LED, HIGH);
    noTone(BUZZER_PIN); // Turn off buzzer
}
```

Fig. 14 This image contains the second of three images showcasing the code used to program this technology.

```
}

delay(100); // Short delay to allow for stable readings
}

// Function to get distance from the ultrasonic sensor
long getDistance(int trigPin, int echoPin) {
    digitalWrite(trigPin, LOW); // Ensure trig pin is low
    delayMicroseconds(2);
    digitalWrite(trigPin, HIGH); // Send a pulse to the trig pin
    delayMicroseconds(10);
    digitalWrite(trigPin, LOW); // End the pulse

    long duration = pulseIn(echoPin, HIGH); // Measure the time the pulse takes to
    return
    long distance = duration / 58.2; // Convert time to distance in cm
    return distance;
}
```

Fig. 15 This image contains the third of three images showcasing the code used to program this technology.

III. RESULTS AND DISCUSSION

The creation of this project being laid out, it becomes relevant to further discuss the relevance and product of the technology itself. As previously mentioned, this device serves to monitor the status of a space, the occupancy as it fluctuates, in accordance with the

relevant safety standards, such as fire code safety standards that relate to the safe evacuation of any given space. To achieve this, the use of ultrasonic sensors, in coordination with various other parts, monitors and alerts the user to the occupancy of a given space, as it is altered or added to. The device is as accessible as possible, as it is applicable to both audio and visual inclusion. The building of this device was described above, in detail. It is also important to highlight the testing, results, and implications of said results.

The testing process, while rigid in its qualification process for success, also included many intermediate steps that allowed for a sense of security in each section of the building and finalization process. To begin, the reliability of each ultrasonic sensor was tested with a series of experiments, both with objects and human movements in front of the sensor. This process affirmed that both sensors worked correctly, with a simple circuit system and code to showcase the sensors' imaging directly. Furthermore, simple tests of the buzzer, LEDs, and display showed that each piece of equipment worked independently of each other. This led into the building of the circuit as described above.

As the circuit was built and uploaded with the correct code to run effectively, the trials of the system were able to begin. To satisfy the requirements of the original design and requirements of a useful technology, the device needed to detect motion as it was presented to ultrasonic sensors and use this data to inform the visual and audio cues for the intended audience. The testing, for technology with safety implications such as these, requires a level of security that cannot be doubted.

Testing proceeded in several major categories: related to the detection of an object, detection of a person, detection of a moving person at various speeds, as well as overall reliability of the counter system with each step of the process. These tests were performed with me as a stand-in person walking through the sensors, and various objects, such as a toy train or the wave of a hand to act as various stand-ins to test for accuracy on a smaller scale. First, detection of an object with each

ultrasonic sensor was tested. These tests were all run three times, each time the device was powered to determine accuracy. For the larger scale testing, I walked past the entrance sensor several times, and each time the sensor was able to accurately detect the presence and mark this occurrence with a sound from the buzzer and a subsequent addition to the display. Furthermore, the sensors accurately reacted to a change in the buzzer and responded with a shift in power to the correct LED. This experiment was also run on a small scale and reacted correctly with the same results. The smaller scale testing involved first the use of a small toy train, with fluid motion to replicate that of an object passing through the ultrasonic sensors' area of detection. With the success of this test, the introduction of a faster motion, that of a hand quickly passing by the sensor, was introduced to test the reliability of the product on a smaller scale. This test being successful indicated that all walking speeds would be detected by the system, reliably. To further cement the validity of these results, all tests were rerun at various speeds. In terms of the use of this product, the device was tested at slow, normal, and fast walking speeds. As previously mentioned, the tests were run three times to assure validity and reproduced on both small and large scales. These tests proved successful at all speeds, and no significant differences in the performance of the device, with the detection of an object, were detected. For example, even if a human were to run past, this motion would be detected by the sensor and correctly regulate the further function of the technology. These tests were also related to each sensor, as the speed at which each person may walk through the detection area of the device cannot be cemented or known. The patterns for which the sensor needed to be accurate and react to on a regular basis were all analyzed and proved successful at each experimental step. The observed reactions were to be expected and matched with the intended purpose of the project. As an example, figures showcasing the display count and corresponding LED color, related to occupancy percentage, are shown below in Figs. 16-18.

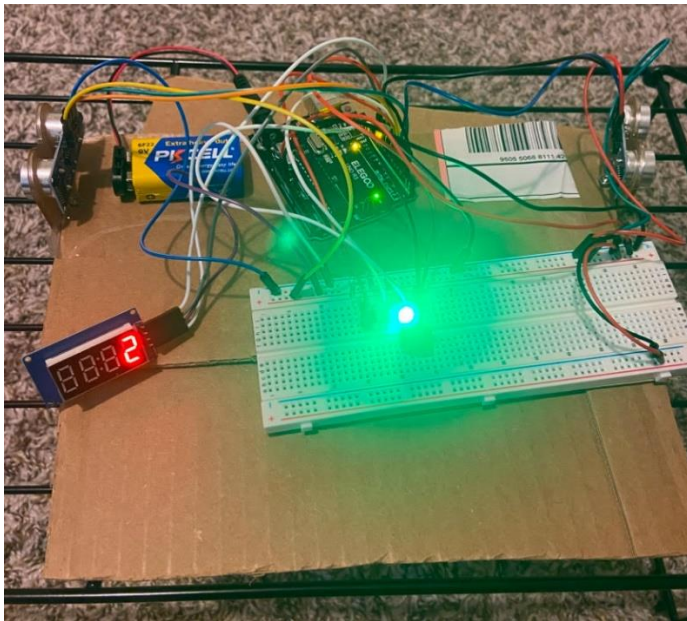


Fig. 16 This figure showcases a low occupancy percentage, indicated by the activation of the green LED.

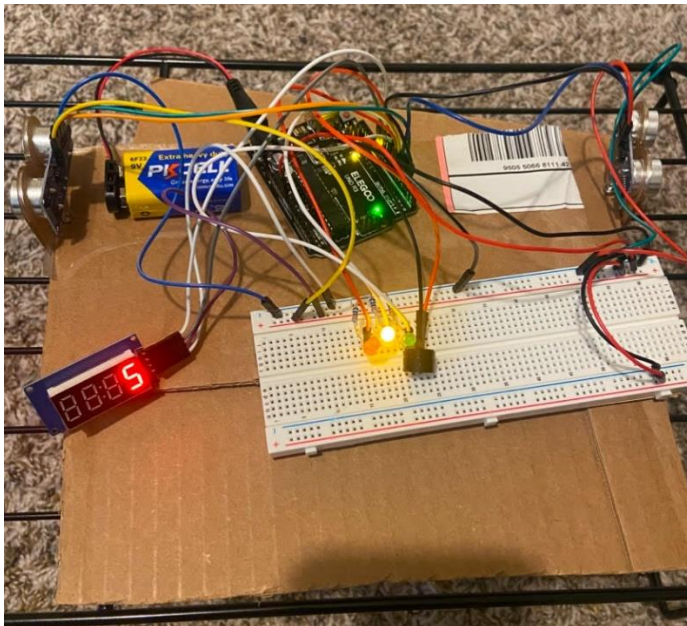


Fig. 17 This figure showcases a medium occupancy percentage, indicated by the activation of the yellow LED.

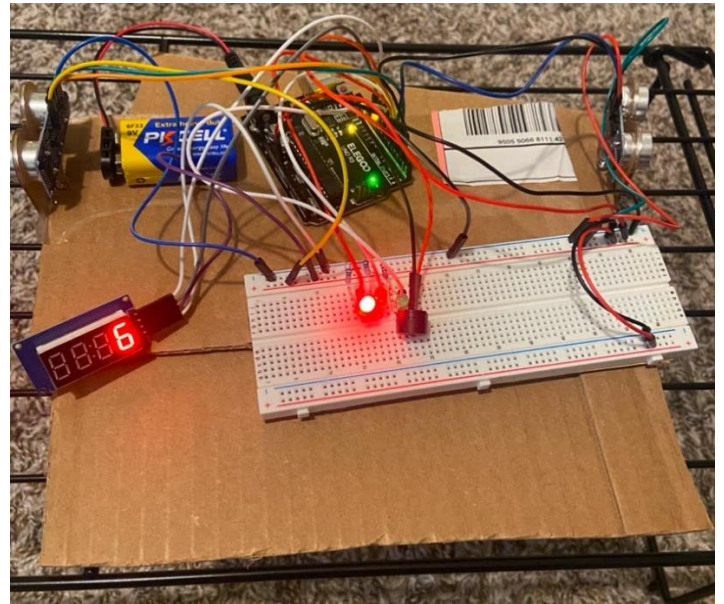


Fig. 18 This figure shows a full occupancy, as indicated by the activation of the red LED.

There were several challenges encountered during testing, as the complicated wiring of this project corresponded to the code in a very specific way, resulting in the building of the circuit having to be reimagined many times. These challenges led to insights gained into the process of testing this technology, as well as the use of the technology altogether. The design of the circuit was reimagined several times, each time to afford the technology better usage and reliability.

Testing challenges were also relevant, as the intended purpose of the technology was cemented; however, the limitations of the product also needed consideration. In testing, it became clear that, as with any sensor, the device has limitations as far as the distance that the device can detect. While this limitation would not affect the use of the technology as it was intended, to mark a doorways, the testing failure of the device should be marked. Furthermore, there came into question the reliability of the sensor as multiple objects passed through the sensor field together, almost as one unit. The sensor, through various testing practices, counts this as only one unit and the addition or subtraction of the movement only indicates one detection. This limitation is marked, as the occupancy counter would relate to a single file entrance or exit only. While this is not ideal, the basis for the design was intended for a doorway like setup,

which, as tested, works while the sensor detects one motion at a time.

Through the testing and trials that revealed the scope of this product, some insights gained from the testing of this project are communicable to the larger understanding of the project altogether. There are several theoretical versus practical applications to this project that could not have been assumed from a broad scale understanding of this project; namely, the limitations of the ultrasonic sensor technology. As has been described, the ultrasonic sensor technology is not foolproof when the sensor has distance limitations as well as a lack of ability to distinguish objects moving through the sensor as one. The basis for this project is one to add a layer of safety to the everyday experience for those within any given space or those operating within a space. As such, this project, while conceptually simple, has important implications that demand a reliable base from which to work. The identification of limitations is necessary; however, the reliability of the product, within working conditions such as have been laid out, is undeniable.

It is further relevant to reveal the insight gained by the level of accessibility this project was built to accommodate. Technology that has safety implications must be reliable and accessible for all users. To allow for accessibility, audio and visual cues were featured. While these additions also indicated an extra layer of work and planning that had not originally been considered, the addition of accessibility for all was crucial to the fundamental basis of safety technology and could not be left out, ethically, for a technology that provides safety for all. The motivation for the design of this product was fundamentally to provide a solution to a safety concern, and to do so with the general audience in mind. The user, with audio and visual cues as found in this project, has several layers of security with which they can reliably utilize this product as intended.

The future of this project could extend to even larger fields or remain within the scope of the project as it has been laid out. This project has both the potential to remain in its original format or grow to monitor

even larger areas and lend itself to more productive projects altogether. Where ultrasonic sensors are involved, the options are limitless. It is also more than possible that aspects of this project could be reevaluated to serve different purposes altogether. The use of sensors to monitor occupancy could be transferred to manufacturing purposes, to count and alert workers to an excess of product. There are also possible uses in agriculture, as this product could be used for tracking vaccination or general counting of cattle or other animals as they are transferred to and from areas. The automation of tedious counting, where possible influences the encompassing nature of this product. The technology was specifically designed with the user interface to allow accessibility for all users; however, this could be easily reevaluated to have even larger goals. The data acquired by the product could be easily monitored and regulated by a second party, even that which is not physically present; and in the case of occupancy control, this product could be used to automate the regulation of the process completely. The technology could grow to control the entrance and exit areas, to allow for entry dependent on occupancy data; however, this automation involves a layer of future work that lies outside of the scope of this product. While fire safety standards and social distancing purposes were the highlight of this project, the options are unlimited. Any space in need of monitoring could benefit from the use of this project. Furthermore, the accessibility of this project, both as it stands now and in the future, is undeniable and could only grow to serve more users as the technology evolves.

As far as future work and utilization are concerned, another large area of work could go into the enclosure for this project, as mobility and ease of use were large factors in the design and could be implemented by use of an enclosure. The project is, as mentioned previously, powered by a 9V battery. This battery allows for a mobile project, one which operates in many conditions. As the device was intended to provide mobility, an enclosure would allow safety in movement. While simple, example enclosure schematics are pictured below. The layout was heavily influenced by that of Ryan Chan; however, altered to fit the specifications and

differences of this project from the original. The enclosure uses open space to allow for the function of ultrasonic sensors, one to be found on each side, as well as visibility of the counter and the LEDs. The space enclosed by the enclosure allows for the safety of the user from the wire setup, as well as a firm structure for which the wires go without displacement, which would cause a loss in function. Enclosures for a project such as this would work well with several materials, dependent on the intended environment and user preferences. Rough sketches of the layout for a potential enclosure are pictured below in Figs.19-20.

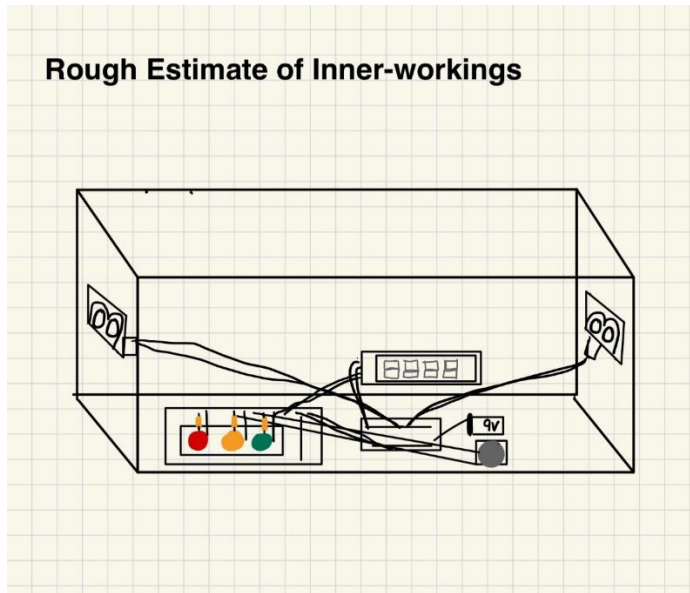


Fig. 19 Diagram showcasing innerworkings of hypothetical enclosure.

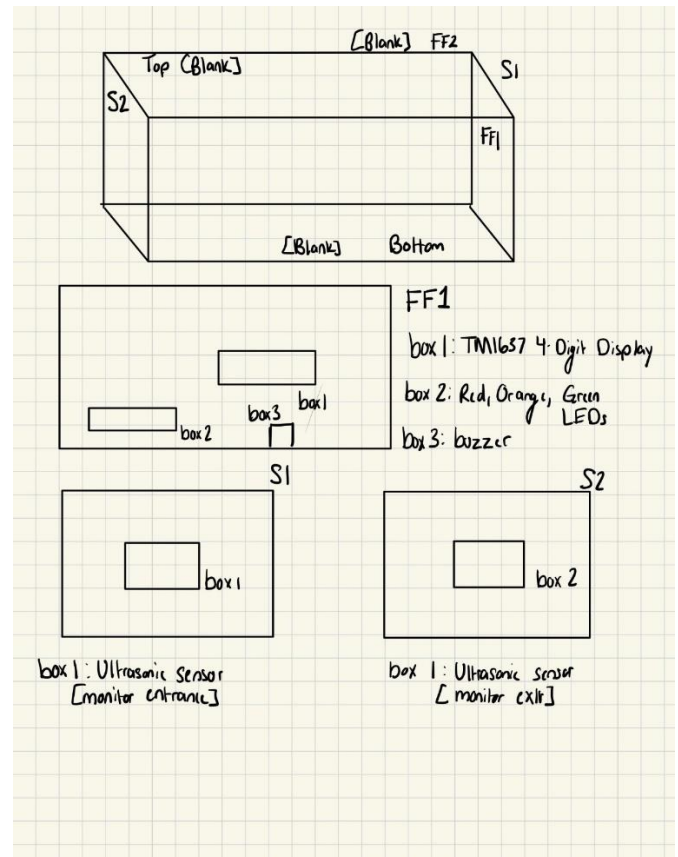
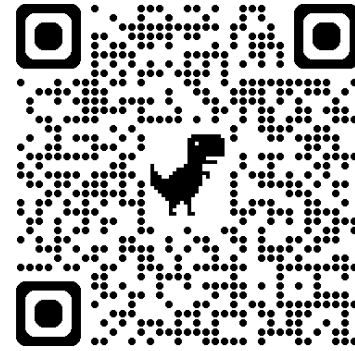


Fig. 20 Dimensions and layout for hypothetical enclosure.

IV. CONCLUSIONS

The occupancy room monitor uses ultrasonic sensor to detect motion and use this information to inform a display counter, buzzer system, and LEDs to cue the user, using visual and auditory cues to inform the user as to the occupancy of any given space, as it alters with interaction. The testing of this product, both using real-world examples and on a small scale, indicates the reliability of the product, through various successful scenarios, such as differed speeds and distances from the sensor. Through this testing, the limitations of the product are easily available; however, the further cultivation and evolution of this product could define a product with various expanded purposes. As has been laid out above, the specific idea, assembly, and ultimate creation of an occupancy counter using ultrasonic sensors could benefit a large range of audiences, as well as aid in the future of safety-based technology. Fire safety standards are in place as they are necessary to ensure the safety of those who occupy any given space. A disregard for these standards has proven fatal in the

past, as has been highlighted by the tragedy of the triangle shirt waste factory, in specific. This technology could also benefit standards of disease safety, as have recently been seen with the global pandemic and the necessity for new and specific occupancy standards, to stop the spread of such a deadly disease. As was also discussed, the future of this technology is limitless, with possibilities in manufacturing and agriculture, to name a few. While the limits of this project have been discussed in detail, the possibilities are endless with the improvement and automation of this technology.



[McKORcid QR Code]

Acknowledgments

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Ultrasonic Occupancy Monitor

Arduino Uno and Ultrasonic Sensor Technological Project – ECE301

By McKenzie Deichert – m659@vols.ulk.edu

Introduction

Problem Definition and Background

- Ultrasonic sensors to solve a problem
- Fire safety and other occupancy standards

How could automation technology be used?

Project Goals

- Create an occupancy monitor using the Arduino Uno and Ultrasonic sensors to create a device that will work to monitor and alert the user to the status of any given area, in terms of fire safety standards and occupancy ideals.

Technical

Approach & Design

- Entry and Exit Ultrasonic Sensor
- Audio – Visual Cues
- Code
- Accessibility
- Functionality
- Mobility



Materials

- Arduino Uno
- Ultrasonic Sensors (2) (HC SR04)
- TM1637 4 Digit Display
- Buzzer
- LEDs (3 – Red, yellow, green)
- Breadboard
- 9V Battery
- Wires
- 330 Ohm Resistors (3)

Methods – Creation

- Placement of sensors
- Resistor calculation
- LEDs in sequence



Results/ Discussion

Methods – Testing

- Testing and Success Requirements
- Small Scale
 - Objects, Small Distance
- Large Scale
 - Humans, Larger Distance

Results

- Ultrasonic Sensor detects motion
- Counter (+1,-1)
- LED response
- Buzzer correspondence
- Functionality

Discussion

Design specifications
Challenges faced

Future Work

Larger Scale
Enclosure – Mobility



100%

41-99%

0-40%