

SMART CAMPUS

BY CAMERON CROSS

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STATEMENT OF PURPOSE

- The world facing the Covid-19 pandemic
- Allow CSU to monitor the spread of Covid-19
- Students can determine a good place to study
- Help me get an idea of what designing and implementing a real-world application looks like
- Allow me to further my knowledge of IOT devices, Python, and simple web design with database connection

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RESEARCH & BACKGROUND

- IR sensors would not be the best choice
- <https://tutorials-raspberrypi.com/raspberry-pi-ultrasonic-sensor-hc-sr04/>
- Raspberry Pi and their OS
- <https://www.tomshardware.com/features/raspberry-pi-vs-arduino>
- Raspberry Pi 4 would be the best choice
- MariaDB over MySQL
- <https://mariadb.com/resources/blog/why-should-you-migrate-from-mysql-to-mariadb/>

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PROJECT REQUIREMENTS

- Python, SQL, PHP, and HTML with CSS
- MariaDB and Apache
- Raspberry Pi 4, wires, breadboards, resistors, and ultrasonic sensors.

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PROJECT REQUIREMENTS

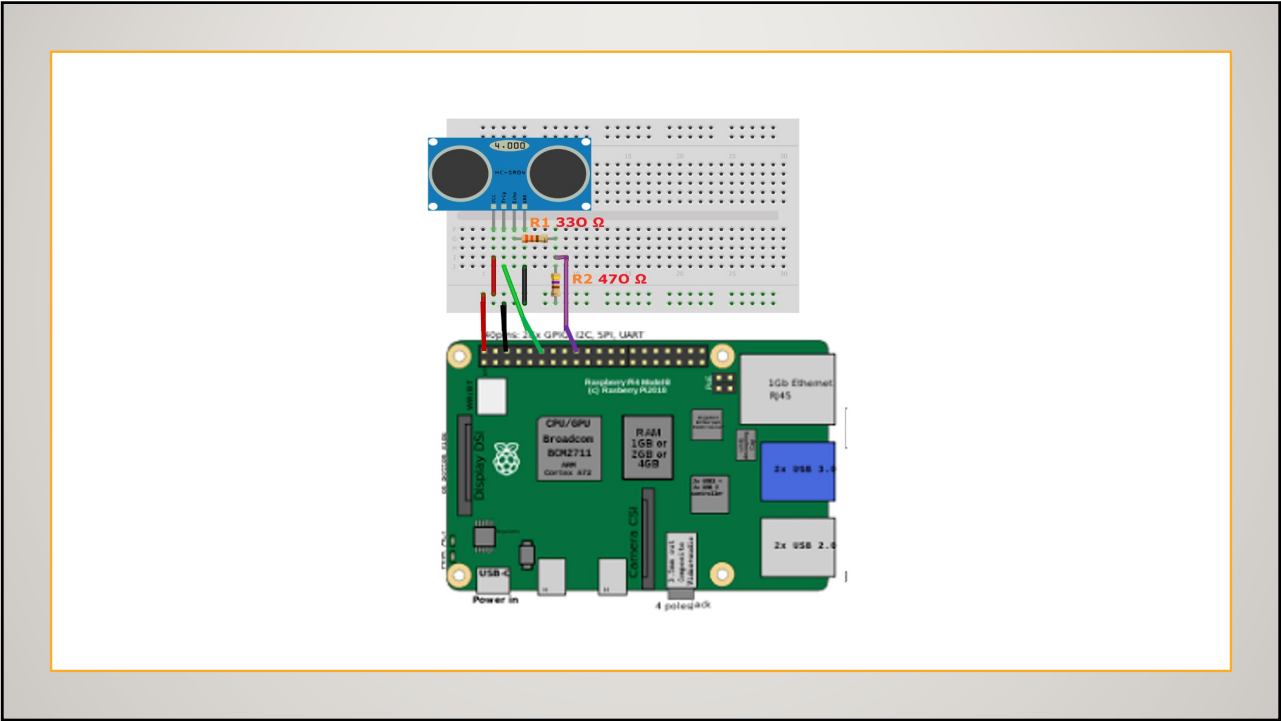
- PHP with embedded HTML on the webpages and CSS to style the webpages
- Python was used for its built-in libraries for sensors and database connection
- breadboards do not require soldering
- an array of wires
- 330 OHMS and 470 OHMS resistors
- HC-SR04 ultrasonic sensors

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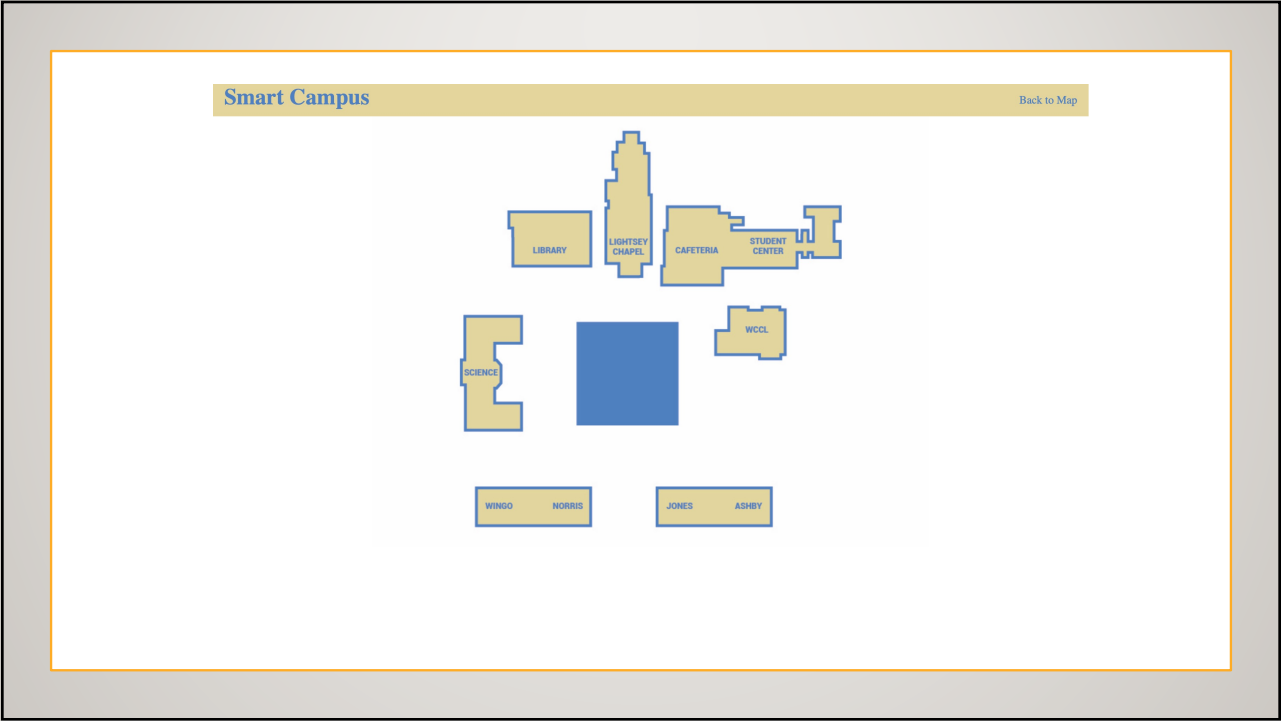
PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- Screenshots
- Snippets of code
- Any other diagrams that may be useful to recreate this project

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PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- Only included the code for the cafeteria as an example
- Links to these buildings are made through HTML image maps
- I used "poly" which allows me to input multiple points to make for an accurate linking area

```

<map name = "map">
  <area shape="poly" coords="411, 241, 411, 214, 415, 214, 415, 163, 419, 163, 419,
130, 494, 130, 494, 138, 498, 241" alt="Cafeteria" href="cafeteria.php">
</map>
```

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PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- Building page layout
- PHP to get information from the database

Smart Campus		Back to Map
Cafeteria		
Location	Population	
Cafeteria	13	

```
$sql = "SELECT Location, Population FROM Campus WHERE Location = 'Cafeteria'";
$result = $conn->query($sql);
```

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PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- PHP with embedded HTML
- Displayed in table form
- Generalized for all pages

```
if ($result->num_rows > 0){
    while($row = $result->fetch_assoc()){
        echo "
        <tr>
            <td>" . $row["Location"] . " </td>
            <td>" . $row["Population"] . " </td>
        </tr>";
    }
}else{
    echo "0 results";
}
```

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PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- Python script to handle the ultrasonic sensors
- RPi.GPIO as GPIO and time
- Python uses time between signals to calculate distance

```
while GPIO.input(GPIO_ECHO) == 0:
    StartTime = time.time()
while GPIO.input(GPIO_ECHO) == 1:
    StopTime = time.time()
TimeElapsed = StopTime - StartTime
distance = (TimeElapsed * 34300) / 2
```

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PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- mysql.connector library which is useful when working with databases in python
- The code requires the host device's IP address
- The username and password that was granted privileges on the host prior to connecting
- The database name

```
mydb = mysql.connector.connect(
    host = "10.127.98.154",
    user = "cam2",
    password = "XSW@2wsx",
    database = "SmartCampus"
)
```

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PROJECT IMPLEMENTATION DESCRIPTION & EXPLANATION

- Verify that the motion detected is not the same motion
- Prints "Motion Detected" as a debugging feature
- Loads the update statement into a sql variable and uses the mysql.connector library to execute and commit the changes to the database

```
if(alreadyDetected == False):
    alreadyDetected = True
    print("Motion Detected")
    sql = "UPDATE Campus SET Population = Population + 1 WHERE Location = 'Cafeteria'"
    mycursor.execute(sql)
    mydb.commit()
```

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TEST PLAN

- Two testing phases
- The first will take place in my dorm room
- The second will be in the cafeteria

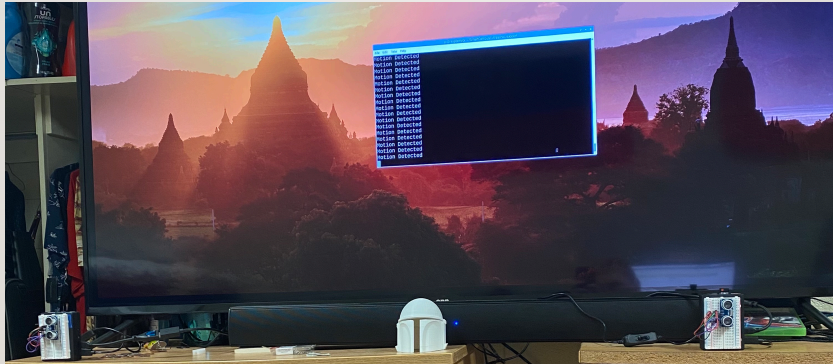
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TEST PLAN

- Participants will answer six questions
- The first five they are asked to rate from one to five
- Ease of Use, Design, Usefulness, Sensor Responsiveness, and Website Accuracy
- Additional Comments or Suggestions

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TEST PLAN



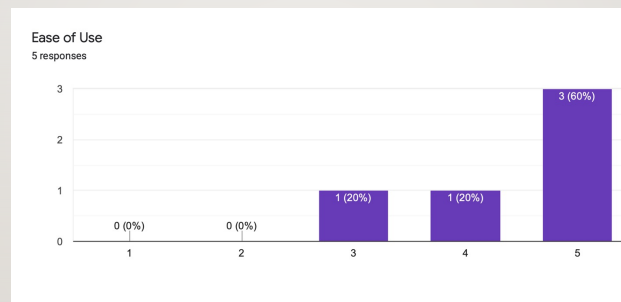
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TEST PLAN



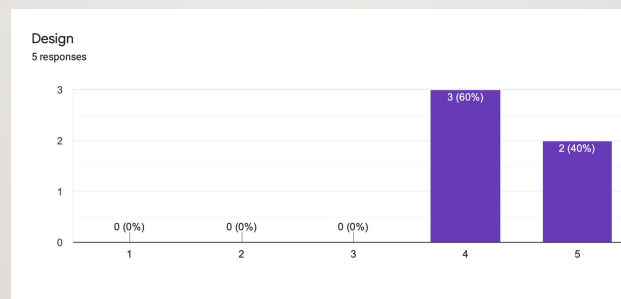
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TEST RESULTS



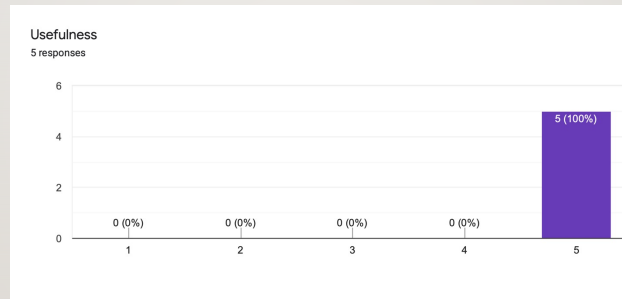
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TEST RESULTS



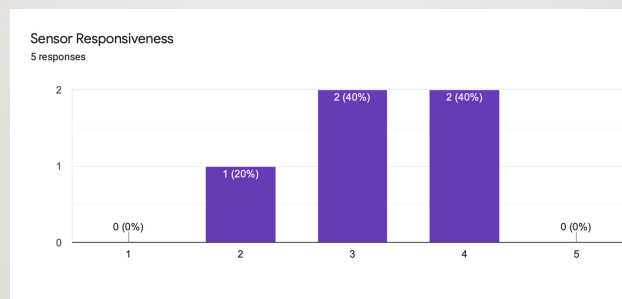
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TEST RESULTS



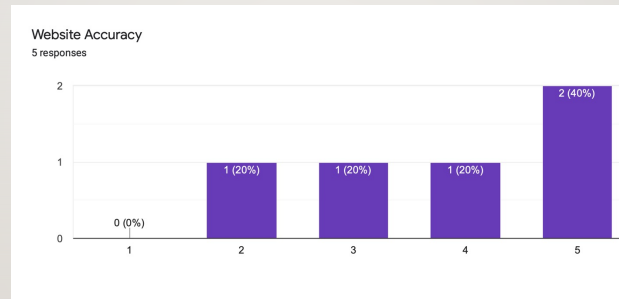
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TEST RESULTS



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TEST RESULTS



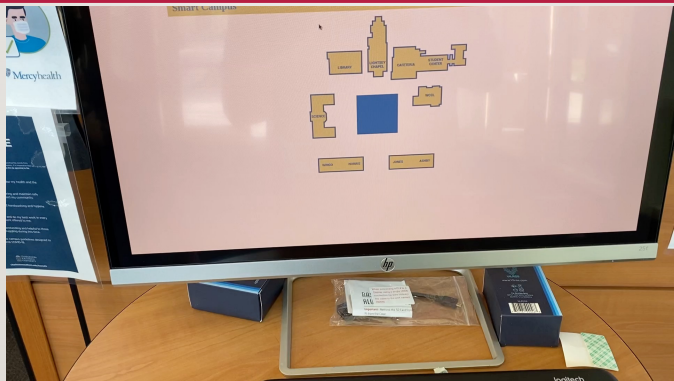
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TEST RESULTS

- “sensor to leave won't work sometimes and the one to enter is too sensitive.”
- “the website looks good and but the sensors seem buggy when walking fast”
- “the website is hard to get to. I had to type numbers that I was told was the IP address and then the website looked very simple but its is a good idea if the sensor works right.”
- “I'd like to see this at Charleston Southern in the future. it is cool and I think if the sensors were better the website would be more accurate.”
- “for me it worked well but it seemed the wifi is a problem and the sensors probably need some work.”

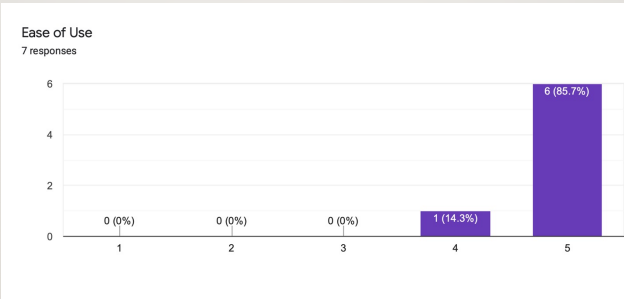
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TEST RESULTS



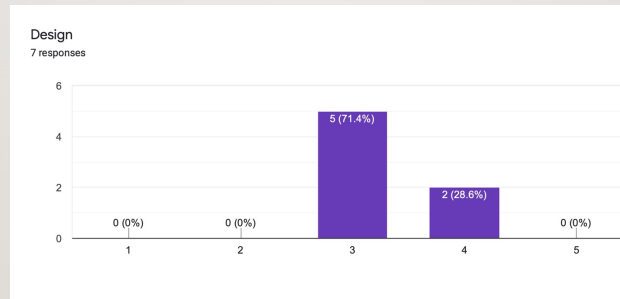
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TEST RESULTS



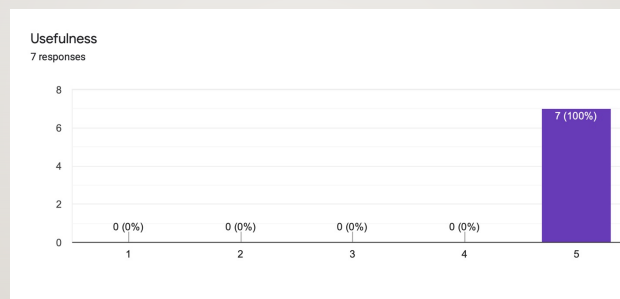
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TEST RESULTS



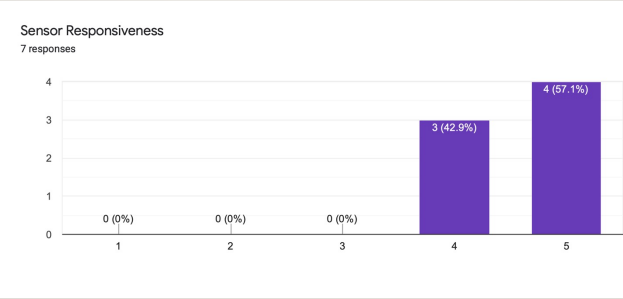
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TEST RESULTS



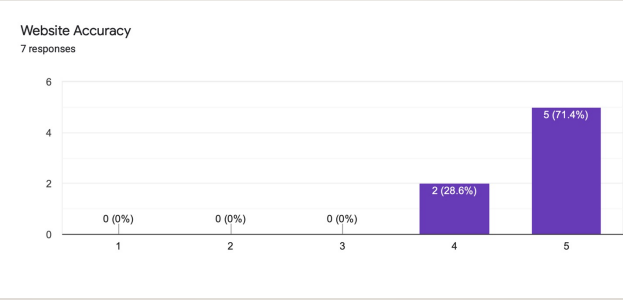
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TEST RESULTS



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TEST RESULTS



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TEST RESULTS

- “seems useful and works well”
- “Very cool everything worked great”
- “Good design and logic. Smart. Good for early development. The look could be better but understandable at this stage”
- “This is a cool idea. Need to focus on hiding the motion sensors and the cables. Website design looks good but is very plain.”
- “I think this is a great way to keep track of the number of people in a building.”
- “Sensor is too sensitive and the design of the sensor is bulky.”

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CHALLENGES OVERCOME

- I had to do a lot of “trial and error” work to figure out how to use the sensors with the correct distance to accuracy ratio
- Sensor sensitivity
- PHP to refresh the page every two seconds
- WIFI stability

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FUTURE ENHANCEMENTS

- LAN connection, an external wireless adapter with a little more range
- Stronger signal from the routers
- Increase the number of devices
- Display live data on the web pages
- Add extra checks to improve sensor sensitivity