

**OUTCOME SPECIFIC ASSIGNMENTS
USED TO ASSESS OUTCOMES**

ASSIGNMENTS FOR OUTCOME 3

An ability to communicate effectively with a range of audiences (Oral Communication)

**Electrical and Computer Engineering
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET
ELEG 4247 – Sr Design and Professionalism I
FALL 2021
Instructor: Turner / Musa**

Title of Assignment

Final Oral Presentation

Outcome Measured Using this Assignment

Outcome 3

**An ability to communicate effectively with a range of audiences
(Oral Communication)**

Check the communication characteristics related to this assignment

X	Involves ability to organize, plan, design/prepare and use appropriate visual aids for communication/presentation to a range of audiences (executives, technical and non-technical).
X	Involves ability to demonstrate technical knowledge and understanding of the subject, prepare and display prototypes or models when they are necessary, respond clearly to questions in a professional manner
X	Requires use of correct grammatical English and technical terms appropriate to technical area and audience type; ability to speak with clarity and confidence, maintain good posture and eye contact with the audience
	Geared to diverse groups of stakeholders (students and industrial representatives, etc.)

Brief justification of the suitability of assignment for the outcome

For ELEG 4247 Oral Presentation will be made for faculty and students only – we invite external and industry audience participation in the Spring for ELEG 4248 – it's not practical to expect industry reps to miss work for both Fall and Spring plus it's really in the Spring when Sr Design has a finished product

SAMPLE WORK OF STUDENTS

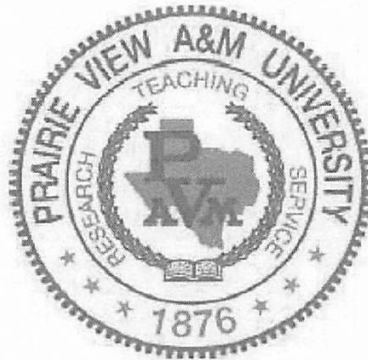
ABOVE AVERAGE

ELEG 4247 Senior Design

Fall 2021

Outcome 3 – Oral

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING**



**Senior Design & Professionalism I
ELEG 4247 – P01**

Final Exam Presentation

Due Date Monday November 15 by 5:00pm (Central Time)

Upload to Final Exam Oral Assignment

You will have 25 mins per team plus 10 mins for Questions

This document will serve as your final exam presentation

10-point reduction if late – PowerPoint Slides only no PDF slides

Each Team will control its own slides on day of presentation

Each person is expected to cover some portion of the presentation

Business Casual Dress (we might have guest) – Face to Face Only

To be fair to all teams no changes can be made after submitted

You will have 25 mins per team plus 10 mins for Questions

Use your mid-term presentation as a starting point, your Final presentation should include:

1. Project Title, List of Team Members with Picture including academic majors and team member roles – be sure to add Faculty Sponsor and Course Facilitator on either your cover slide or team intro slide
2. Problem Statement – what problem are you trying to solve
3. Project Objective – what are you doing to try to deliver or develop
4. Marketing and Engineering Requirements and Justification
5. Proposed Deliverables – what are you actually going to deliver
6. Constraints
7. Assumptions
8. Design Methodology
 - How did you arrive at your proposed design?
 - Show Math and/or Engineering Considerations used
9. Preliminary Design Concept
 - What is your preliminary design or proposal – need a diagram, schematic or picture of integration
10. Show your Project Acceptance Criteria
11. Include a comparison slide to show your product versus other options
 - Brief overview of the competitive landscape – what other concepts are you competing with (what you gained/learned from literature review)
 - List advantages/disadvantages of your proposed design
12. Show broader technical/societal/economic impacts – include data charts, graphs
13. High Level Project Schedule
14. Project Parts Summary
15. List of references from your literature review (refer to proper format on eCourse)
16. Snapshot of what your team has accomplished so far
17. At end of presentation a page should read “Questions “so we will know you are done presenting
18. After Questions slide – please have a slide called “Back Up “
19. Please number all slides
20. Everyone on the team should cover something in the presentation

(Refer to next page for some guidance)

Presentation Order

Wednesday November 17: Team 8

Thursday November 18: Team 1,2,3,4,5,6,7

Note – Order of Team Presentations may change pending outside guest schedule

All students must attend both days – you are not excused unless pre-arranged with Professor Turner

Project Presentation Evaluation Form
ECE Senior Design & Professionalism
Oral Presentation – Outcome 3

Title of Presentation: Team 4 – Converting Mechanical to Electronic Operated System						
Members: Armand Baweu, Jacqueline Torralba, Franky Lonfo, Francisco Hernandez, Eulises Garcia						
Date of Presentation: VST						
Name of Evaluator and Affiliation (University or Company name)						
	Excellent 99	VeryGood 89	Average 79	BelowAvg. 69	Poor 54	Comments
Organization						
Objective	✓					
Introduction of Presentation	✓					
Design Methodology (Design Process)						
Ability to stay within time limit						
Technical						
Technical content and demonstration of understanding of subject	✓					Really nice prototype
Quality of design/ Analysis/Construction	✓					
Creativity and originality of design concepts	✓					
Design within constraints	—					
Proper use of codes and standards in design	—					
Able to demonstrate broader impacts of project (where applicable on society, economics, technical, environmental, safety)	✓					
Quality and functionality of working prototype	✓					
Delivery						
Use of vocabulary appropriate to technical subject and audience, clarity and confidence	✓					Good Demo!
Attire, posture and eye contact	✓					
Efforts of all group members/Group dynamics	✓					Good Answering question
Ability to effectively answer questions						
Quality/Readability of slides	✓					
Relevance of Slides – use of modern techniques i.e. video, animation, sound clips etc.	✓					

slide 9 - color
 slide 11 Blue/Black
 slide 13 which one did you select?
VST=99 > 97
WUSA=90

Red light bouncing back
 Franky!
 slide 15/16

Project Presentation Evaluation Form
ECE Senior Design & Professionalism
Oral Presentation – Outcome 3

Title of Presentation: Team 4 – Converting Mechanical to Electronic Operated System						
Members: Armand Baweu, Jacqueline Torralba, Franky Lonfo, Franisco Hernandez, Eulises Garcia						
Date of Presentation: 11/18/2021						
Name of Evaluator and Affiliation (University or Company name) Musa						
	Excellent 99	VeryGood 89	Average 79	BelowAvg. 69	Poor 54	Comments
Organization						
Objective	✓					
Introduction of Presentation	✓					
Design Methodology (Design Process)	✓					
Ability to stay within time limit	✓					
Technical						
Technical content and demonstration of understanding of subject	✓					
Quality of design/ Analysis/Construction	✓					
Creativity and originality of design concepts	✓					
Design within constraints	✓	✓				
Proper use of codes and standards in design		✓				
Able to demonstrate broader impacts of project (where applicable on society, economics, technical, environmental, safety)		✓				
Quality and functionality of working prototype	✓					
Delivery						
Use of vocabulary appropriate to technical subject and audience, clarity and confidence		✓				
Attire, posture and eye contact		✓				
Efforts of all group members/Group dynamics	✓					
Ability to effectively answer questions						
Quality/Readability of slides	✓					
Relevance of Slides – use of modern techniques i.e. video, animation, sound clips etc.	✓					

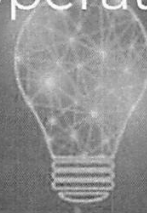
96

JT2

Converting a Mechanical Operated System to an Electronic Operated System

Team #4
Armand Feuba Baweu
Eulises Garcia Benito
Francisco Hernandez
Franky Williams Lonfo
Jacqueline Torralba

Instructor: Professor Turner
Team Sponsor: Professor Fuller
Team Facilitator: Professor Musa



1

JT3

Team #4

				
Scribe Eulises Garcia (EE)	Data Analyst Francisco Hernandez(EE)	Team Lead Jacqueline Torralba(EE)	Test Lead & Product Specialist Franky Williams(EE)	Software Developer Armand Feuba(CE)

2

JT1

Introduction

Problem Statement

Golf carts are used in many everyday settings, due to their compact size, and ease of use. Mechanical operated systems such as the mechanical shifter handles are prone to breaking. This issue leads an owner to additional cost for maintenance and potential unsafe situations.

Objective:

The goal of this project is to change the mechanical operated system switch of a golf cart, and design an electric operated system switch. This will reduce maintenance required and help golfers conveniently and safely use the golf cart.

3

JT4

Design Concept

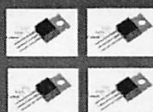
DC Permanent Magnet Motor
Electrical energy will be converted to mechanical energy and make golf cart go forward and reverse. (24V, 6000RPM)



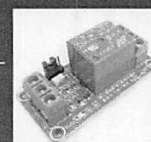
36V Battery
Supply sufficient voltage and amperage for system to run.



Arduino Uno
Will run software and make thyristors act as switches.



Thyristors
1.5A,
100V(limit)
Control electric power/current by acting as switch.



Relay Switch
5V
Electric operated switch to close and open contacts.



Software (C++)
Software will be used to communicate between hardware and Arduino

4

Acceptance Criteria

1) Embedded System:

- System must fit within the golf cart engine bay.
- System must be energy efficient and not consume a large amount of battery life
- System must have proper organized connections that can be identified easily.
- System software must communicate with the microcontroller to control the electronic switches.

2) Switch:

- Switch should make the golf cart go forward and reverse through the help of the electronic embedded system.
- Switch should be user friendly, and durable.
- Switch should run while other features of the golf cart are in use.

5

Marketing Requirement	Engineering Requirement	Justification
User friendly	Integrate electric switch into circuit correctly to control polarity contact	The switch will flip polarity contacts <i>by just a click</i> to make the golf cart move forward and backwards
Low cost	Use an affordable microcontroller	Maintenance's electronic or electric equipment is cheaper than the maintenance's of mechanical or mechanical's equipment
Use same battery source to power new control system	Arduino will use built in power source of golf cart	By not adding a new power source, will avoid unnecessary cost and materials to be used.
Electronic shifting requires less maintenance	By replacing a mechanical switch to an electronic switch that is controlled by an Arduino, the operated system will last much longer	Mechanical control switches are destined to eventually fail, while an electronic switch would last longer and be easier to change if needed
Low effort-shifting	Electronic shifting is faster than mechanical shifting based on the time response and the frequency of the data transmission	Response time: $0 < t < 1s$ $T <= 450ms$ (0.450s) $f = 16MHz$ Accel time responding is less than 1s on electronic devices compare to the load-bearing force of mechanical devices.

6

JT7

Project Impact Summary

Category	Project Applicability
Public Health, Safety, and Welfare	✓
Global	
Cultural	✓
Social	✓
Environmental	
Economic Factors	✓
Technical	✓

7

JT8

Project Impact - Safety

- Golf carts being are a popular mode of transportation in outdoor areas, an increasing level of nonfatal injuries are occurring.
- A study done from 1990 to 2015 "U.S. emergency departments visits for golf cart-related injuries tripled from 6,000 in 1990 to 18,000 in 2015".
- Of these incidents, 9.6% were when collision occurred with a vehicle or object and could be due to gear shifting issues.
- Having an electronic switch shifter would have less failure occurrence and lessen the number of cases.

Table 1. Primary causes of U.S. golf cart-related injuries

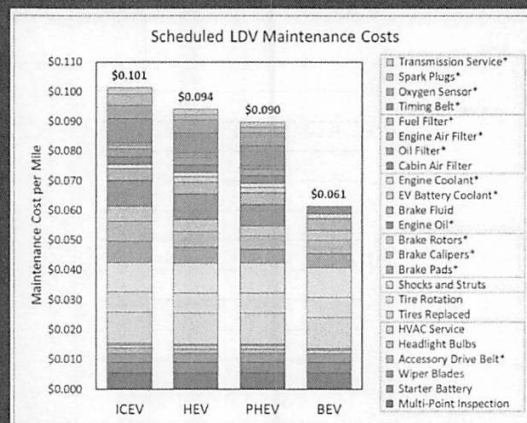
Cause of injury	Percentage of cases
Fell/jumped from cart	38.3
Struck/run over by cart	16.2
Collision with a vehicle or object	9.6
Cart overturned	8.9
Injury getting into or out of cart	4.9
Injury to protruding limb	3.2
Other/not specified	18.9

8

JT18

Project Impact - Economical

- Maintenance cost for electric vehicles(EV) is lower because of less moving parts:
 - no exhaust system
 - less need for cooling
 - less abrasive braking
- According to study by U.S. Department of Energy:
 - BEV(battery electric vehicle) are cheaper to maintain by \$0.06 per mile
 - ICEV (internal combustion engine vehicle) is \$0.10 per mile



ICEV (internal combustion engine vehicle)
BEV (battery-electric vehicle)

PHEV (plug in hybrid vehicle)
HEV (hybrid electric vehicle)

9

JT11

Project Impact - Cultural/Social

1.) Due to low effort-shifting elderly will still be able to drive golf carts with no problem.

- There is a Village where most of the people are age 55+ and there is 65,000 golf carts reported in residence.

2.) Golf cart users will now be able to focus on enjoying the golf cart rather than getting the shifter fixed.

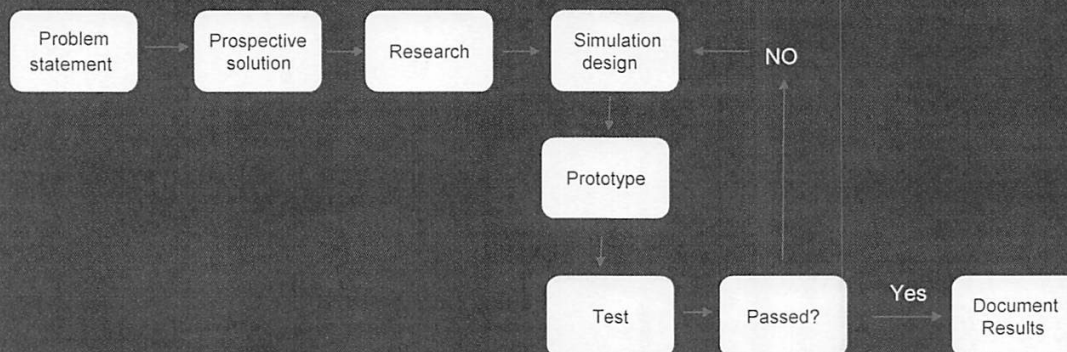
- A Mechanical Shifter on Amazon has 65 reviews for one year. Therefore, we estimate that around 65 – 200 shifters were sold within that year.



10

JT12

Engineering Design Methodology



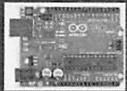
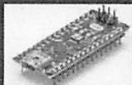
11

JT13

Constraints & Assumptions

- **Assumptions**
 - No time lag or transmission delay.
 - Linear and quick response and good accuracy
 - No entrainment or contamination in control medium
 - Integrated control system and easier interconnections.
 - Low Power re-equipment
 - Speed of response is substantially instantaneous.
 - Easy Maintenance and test kit re-equipment.
- **Constraints**
 - Complex Networks
 - Not possible for flame-proof areas
 - Skilled maintenance regulations
 - Expensive layout
 - Good and safe wiring layout required
 - Susceptible to line fluctuations of voltage and frequency

12

Project Comparison (Microcontrollers)				
Product	Pros	Cons	Cost	Reference
 Arduino Uno	- User friendly - More efficient within DC series motors	6 Analog inputs	\$23	"Arduino Uno REV3." <i>Arduino Online Shop</i> , https://store-usa.arduino.cc/products/arduino-uno-rev3?selectedStore=us .
 Arduino Nano	8 Analog inputs - Small profile	- Micro USB port - Requires other components	\$21	"Arduino Nano." <i>Arduino Online Shop</i> , https://store-usa.arduino.cc/products/arduino-nano?selectedStore=us .
 Arduino Mega	256 KB of flash memory - High I/O requirements 16 Analog Pins	- More costly - Big profile	\$41	"Arduino Mega 2560 REV3." <i>Arduino Online Shop</i> , https://store-usa.arduino.cc/products/arduino-mega-2560-rev3?selectedStore=us .
 Raspberry Pi 3	26 Analog Pins - Supports all types of codes - Faster Processor	- More expensive - Tends to overheat	\$85	<i>Amazon.com: Element14 Raspberry Pi 3 B+ Motherboard ...</i> https://www.amazon.com/ELEMENT14-Raspberry-Pi-Motherboard/dp/B07BDR5PDW .

13

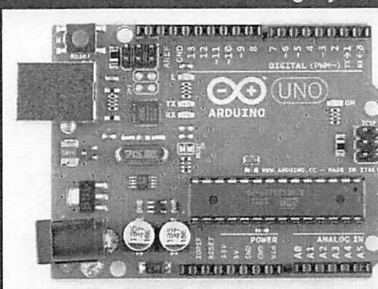
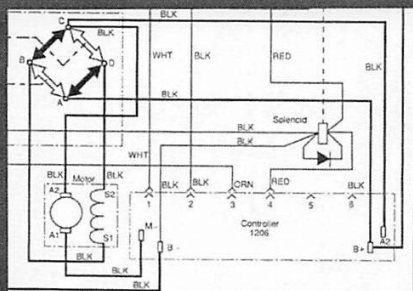
JT10

Project Impact - Technical

Based on the data analyst, low cost, safety improvement and low effort-shifting, we believe that controlling the golf cart by an electronic devices will make it cheaper and safe to operate compared to the mechanical operation which request a physical effort and load-bearing force applied on the armature.

00 Stop
 B+ A D S2 S1 A C Armature A2 A1 = Forward
 B+ A B S1 S2 D C Armature A2 A1 =Reverse

00 Stop
 01 Motor forward
 10 Motor reverse
 11 Ambiguity



Inputs		Output
A	B	L
0	0	0
0	1	1
1	0	1
1	1	0

14


```

Team_4_senior_design_project_update$
const int pwm = 4 ;
const int in_1 = 10 ;
const int in_2 = 11 ;

void setup()
{
  pinMode(pwm,OUTPUT) ;
  pinMode(in_1,INPUT) ;
  pinMode(in_2,OUTPUT) ;
}

void loop()
{
  //For Clock wise motion , in_1 = High , in_2 = Low

  digitalWrite(in_1,HIGH) ;// digit 1 Golf cart will move Forward
  digitalWrite(in_2,LOW) ;// digit 0

  //Clockwise for 3 secs . the golf cart will wait for reversal phase
  delay(60000);
  //For brake
  digitalWrite(in_1,HIGH) ;// digit 1
  digitalWrite(in_2,HIGH) ;// digit 1
  analogWrite(pwm,400); // maximum speed of the system
  delay(1000) ;

  //For Anti Clock-wise motion - in_1 = LOW , in_2 = HIGH
  digitalWrite(in_1,LOW) ;// digit 0
  digitalWrite(in_2,HIGH) ;// digit 1 the golf cart will move on reverse
  delay(60000) ;

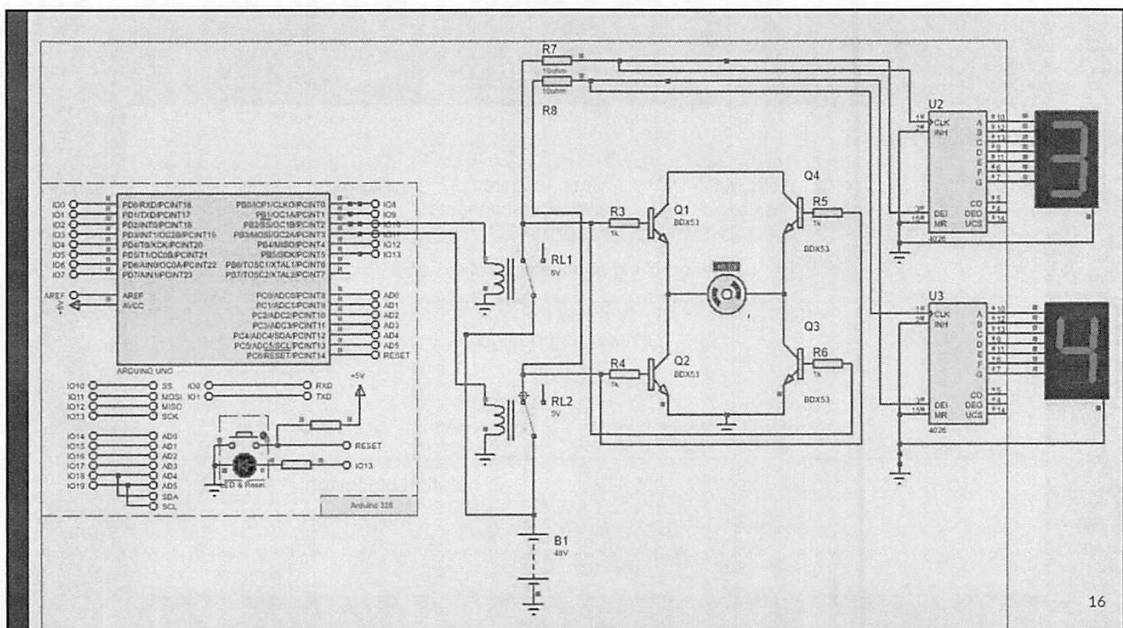
  //For brake
  digitalWrite(in_1,HIGH) ;// digit 1
  digitalWrite(in_2,HIGH) ;// digit 1
  delay(1000) ;
}

```

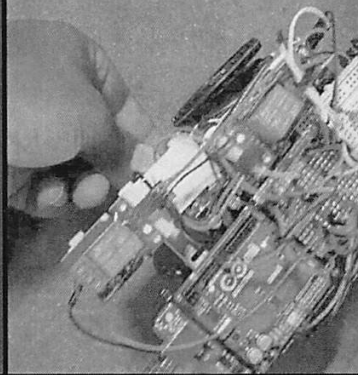
Done compiling.

Software and Circuit Schematic

15



What we have
accomplished
so far :



17

Project Schedule

Project Month	Aug	Sept	Oct	Nov	Dec
Stage 1: Project Research	Project Assigned	Cont. research of electrical components			
	Researching about electrical systems				
Stage 2: Project Design		Presenting design to advisor			
			Ordering Parts		
Stage 3: Testing			Simulation of Design		
				Mock Trial in Lab	
				Putting Design Together	

18

References

JT15

- "Electronic and pneumatic controls analyzed," *Bright Hub Engineering*, 28-Oct-2009. [Online]. Available: <https://www.brighthubengineering.com/commercial-electrical-applications/53898-pneumatic-vs-electronic-control-mechanisms/>. [Accessed: 04-Oct-2021].
- K. Z. Horvath, et. al, "Fun Ride or risky transport: Golf cart-related injuries treated in U.S. emergency departments from 2007 through 2017," *Journal of Safety Research*, 16-Nov-2020. [Online]. Available: <https://www.sciencedirect.com/science/article/abs/pii/S0022437520301237?via%3DIihub>. [Accessed: 04-Oct-2021].
- T. Mohn, "The (mostly) safe golf cart," *The New York Times*, 04-Mar-2017. [Online]. Available: <https://www.nytimes.com/2017/03/04/business/retirement/the-mostly-safe-golf-cart.html>. [Accessed: 04-Oct-2021].
- H. Tremura and O. Toker, "Vehicle Level Software Design of the Florida Polytechnic Autonomous Golf-CART," *SoutheastCon 2021*, 2021.
- "Arduino Uno REV3," *Arduino Official Store*. [Online]. Available: <https://store.arduino.cc/products/arduino-uno-rev3>. [Accessed: 04-Oct-2021].
- "Arduino Nano," *Arduino Official Store*. [Online]. Available: <https://store.arduino.cc/products/arduino-nano>. [Accessed: 04-Oct-2021].
- "Arduino Mega 2560 REV3," *Arduino Official Store*. [Online]. Available: <https://store.arduino.cc/products/arduino-mega-2560-rev3>. [Accessed: 04-Oct-2021].
- S. J. Chapman, *Electric Machinery and power system fundamentals*. Boston: McGraw-Hill, 2002.

19

Questions

?

20

Back Up

21

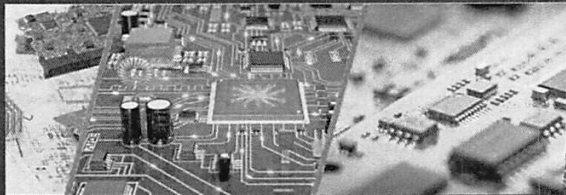
UT5

Prospective Solution

The using of advanced engineering technology on this project will change the concept and the future of the golf cart.

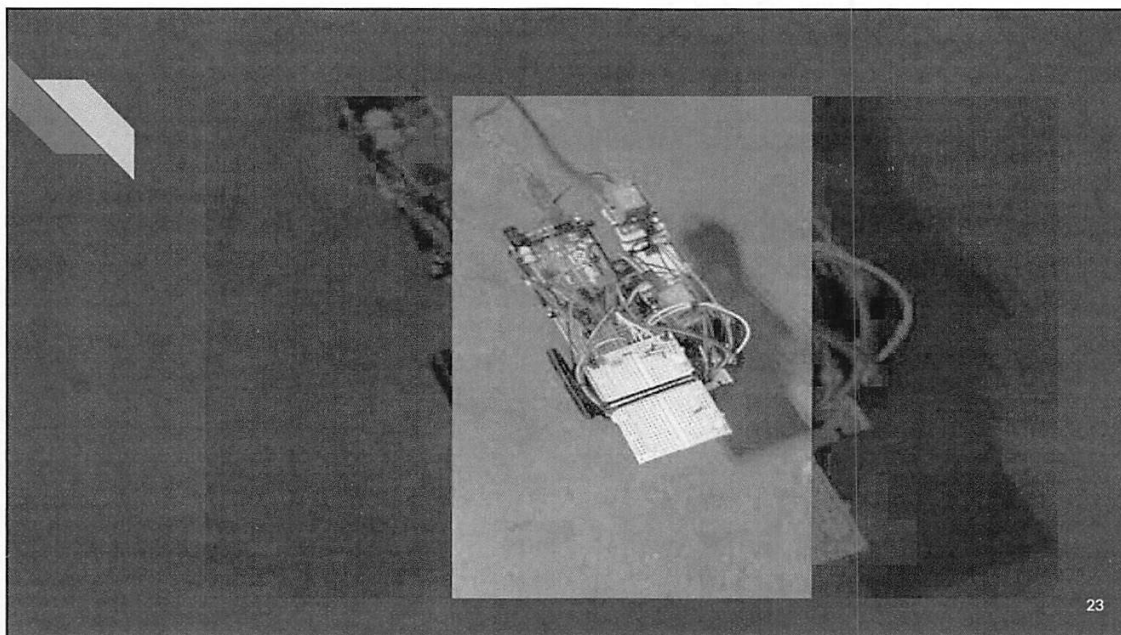
The implementation of Arduino microcontroller through the golf cart system will change the operation mode of the entire system and making easier for the golfer operator or owner to both operating and performing maintenance.

Engineering design approach will cover everything from analog and power, connectivity, display, lighting, processor, sensor and more.



22

11/17/2021



23

AVERAGE

Senior Design ELEG 4247

Outcome 3 – Oral

Average Example

Project Presentation Evaluation Form
ECE Senior Design & Professionalism
Oral Presentation – Outcome 3

Title of Presentation: Team 8 - Security Threats and Countermeasures in IoT Networks						
Members Oluwadamilola Oboye, Ryan Johnson, Alfredo Hurado, Hillel Lands, Abel Mendoza, Juwan Byers						
Date of Presentation: 11 / 17 / 2021						
Name of Evaluator and Affiliation (University or Company name) Musa						
	Excellent 99	Very Good 89	Average 79	Below Avg. 69	Poor 54	Comments
Organization						
Objective			✓			
Introduction of Presentation			✓			
Design Methodology (Design Process)			✓			
Ability to stay within time limit		✓				
Technical						
Technical content and demonstration of understanding of subject		✓				
Quality of design/ Analysis/Construction			✓			
Creativity and originality of design concepts			✓			
Design within constraints		✓				
Proper use of codes and standards in design			✓			
Able to demonstrate broader impacts of project (where applicable on society, economics, technical, environmental, safety)		✓				
Quality and functionality of working prototype			✓			
Delivery						
Use of vocabulary appropriate to technical subject and audience, clarity and confidence		✓				
Attire, posture and eye contact			✓			
Efforts of all group members/Group dynamics		✓				
Ability to effectively answer questions						
Quality/Readability of slides		✓				
Relevance of Slides – use of modern techniques i.e. video, animation, sound clips etc.		✓				

84

Project Presentation Evaluation Form
ECE Senior Design & Professionalism
Oral Presentation – Outcome 3

Title of Presentation: Team 8 - Security Threats and Countermeasures in IoT Networks						
Members Oluwadamilola Oboye, Ryan Johnson, Alfredo Hurado, Hillel Lands, Abel Mendoza, Juwan Byers						NOT Business Casual #
Date of Presentation:						
Name of Evaluator and Affiliation (University or Company name)						
	Excellent 99	Very Good 89	Average 79	Below Avg. 69	Poor 54	Comments
Organization						
Objective		✓				
Introduction of Presentation		✓				
Design Methodology (Design Process)			✓			
Ability to stay within time limit						
Technical						
Technical content and demonstration of understanding of subject		✓				M/Land did a nice job Slide 9 - need to explain the chart
Quality of design/ Analysis/Construction						
Creativity and originality of design concepts		✓				
Design within constraints		✓				
Proper use of codes and standards in design	N/A					
Able to demonstrate broader impacts of project (where applicable on society, economics, technical, environmental, safety)	✓					
Quality and functionality of working prototype	✓					
Delivery						
Use of vocabulary appropriate to technical subject and audience, clarity and confidence		✓				Arrows explaining Concept (u) Abel - Speakup Slide 14 - Spicame
Attire, posture and eye contact		- 2 people ✓				
Efforts of all group members/Group dynamics		✓				
Ability to effectively answer questions						
Quality/Readability of slides		✓				
Relevance of Slides – use of modern techniques i.e. video, animation, sound clips etc.	✓					

* What have you accomplished
 score

Everyone stands behind podium

VST=90
 MUA=84 > 87

SECURITY THREATS AND COUNTER MEASURES

ORAL PRESENTATION
OCTOBER 6 2021

TEAM #8

ABEL MENDOZA
RYAN JOHNSON
DAMI OBOYE
ALFREDO HURTADO
JUWAN BYERS
HILLEL LANDS

Instructor: Dr. Turner
Team Sponsor: Dr. Annamalai
Team facilitator: Dr. Musa



Juwan Byers
E.E
Team lead
Secondary Data Analyst



Abel Mendoza
E.E
Test lead
Purchasing Lead



Oluwadamilola Oboye
E.E
Main Scribe
Presentation Manager



Alfredo Hurtado
C.E
Presentation Manager
Secondary Scribe



Hillel Lands
E.E
Main Data Analyst



Ryan Johnson
E.E
Purchasing Lead
Secondary Test Lead

2

INTRODUCTION :

Problem Statement:

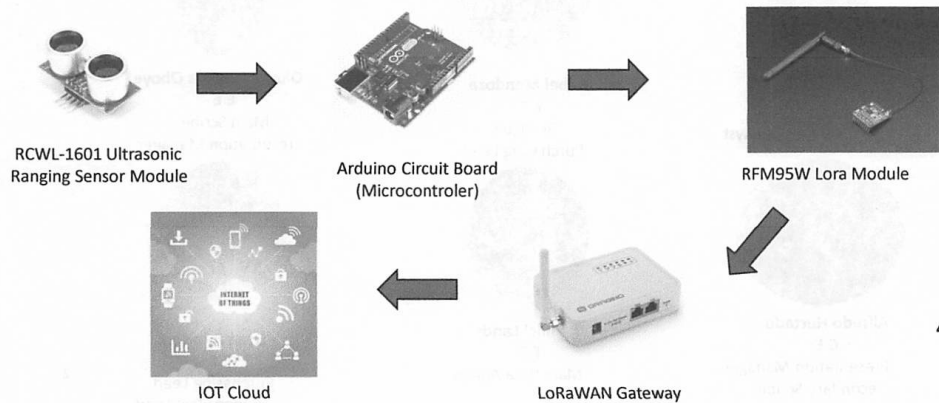
The vulnerabilities of IoT devices and security risks in the IoT network.

Objective:

Discover and analyze security vulnerabilities of LoRaWAN such as a replay attack that leads to a selective denial-of-service on individual IoT devices, plaintext recovery, malicious message modification, falsification of delivery reports, battery exhaustion attack, among other types of communication security threats that compromises the availability of the network.

3

PRELIMINARY HARDWARE DESIGN CONCEPT



Marketing Requirement	Engineering requirements	Justification
Secure and make difficult to hack network	Troubleshoot the existing code and develop secure access.	All sensitive information is kept safe
Having a long-range access to the data	Use a LoRa module	This is a device that is designed for long range data transfer
Accurately detects threat to network	Use trustworthy LoRaWAN Join Server with access to the root keys	Enables verification and authentication testing
Able to perform with minimal maintenance	Use Arduino microcontroller operated by 9V battery	Devices will not have to be maintained and replaced
Low maintenance and inexpensive sensing network.	Battery operated sensor, with a minimum 1 year+ battery life will be used to send data back to network	The cost to set up a network can be affordable in a large areas
Prevent components exposure to the environment	3D print a rigid case to protect the components	This will minimize the damage if any to the sensitive components within

5

CONSTRAINTS

1. Arduino uno only operates with sensors
2. The 3D printed enclosure must be low enough for vehicles to park through.
3. LoRaWan network only transfer low data rates
4. Bandwidth of frequency must be low in order to travel far distances.

ASSUMPTIONS

1. The sensor will accurately detect moving vehicle
2. The initial code will run with no errors
3. The network will cover a large area

6

Project Impact Summary

Category	Project Applicability
Public Health, Safety, and Welfare	★
Global	
Cultural	
Social	★
Environmental	★
Economic Factors	★
Technical	

7

PROJECT IMPACT – ENVIRONMENTAL

- As indicated by the United States Environmental Protection Agency (EPA), motor vehicles listed from the years 1980- indicating the percentage change in emissions.
- There's a decrease in the percentage our project will be a part of assisting the next generation of percentage drop in emissions from 2021 to 2030.

Percent change in Emissions	1980-2020	1990-2020	2000-2020	2010-2020
Carbon Monoxide	-75%	-70%	-57%	-29%
Lead	-99%	-87%	-76%	-30%
Nitrogen oxide	-70%	-68%	-64%	-46%
Volatile Organic Compounds	-60%	-48%	-29%	-20%
Sulfur Dioxide	-93%	-92%	-89%	-76%

8

PROJECT IMPACT – ECONOMIC FACTORS

- The goal of this project is to decrease the money and time spent on finding parking.
- Inrix is a software Saas and Daas company which provides a variety of internet services and mobile applications pertaining to road, traffic and driver services.

Table 1: INRIX Parking Ranking – Hours Spent Searching for Parking

Rank	U.S. City	Average 2-Hour Parking Cost (One mile of city center)	On-Street Search Time (mins/tnp)	Off-Street Search Time (mins/tnp)	Annual Search Time (hours/driver/year)	Annual Search Cost Per Driver	Annual Search Cost Per City
1	New York	\$33	15	13	107	\$2,243	\$4.3bn
2	Los Angeles	\$14	12	11	85	\$1,785	\$3.7bn
3	San Francisco	\$12	12	11	83	\$1,735	\$655m
4	Washington D.C.	\$18	10	9	65	\$1,367	\$328m
5	Seattle	\$10	9	8	58	\$1,205	\$490m
6	Chicago	\$22	9	8	56	\$1,174	\$1.3bn
7	Boston	\$26	8	8	53	\$1,111	\$262m
8	Atlanta	\$6	8	8	50	\$1,043	\$251m
9	Dallas	\$6	8	8	48	\$995	\$726m
10	Detroit	\$9	6	6	35	\$731	\$209m
	US	\$4	2	2	17	\$345	\$72.7bn

9

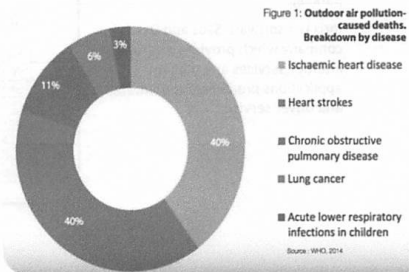
PROJECT IMPACT – SOCIAL (CULTURAL)

- Commuter students and faculty will know how many open spaces are left beforehand instead of driving around to find parking.
 - Helps all students by not wasting time in the lot, which creates time to arrive on time for a class or meeting.
 - Faculty/Employees can avoid being late to work with the time saved.
- The system can be implemented into society through stadiums, large corporations, apartments, etc.
 - Expanding the parking detection system in a global scale can significantly help society.

10

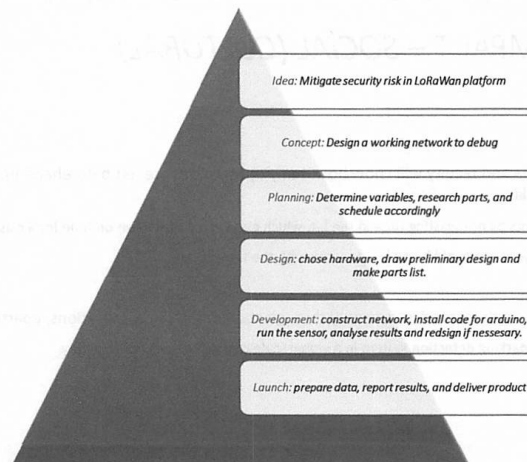
PROJECT IMPACT – *PUBLIC HEALTH, SAFETY, AND WELFARE*

- Implementing a parking space detector can greatly reduce emissions and stress levels for everyday drivers.
- By reducing the driving time of the population, the percentage of carbon monoxide emissions will be reduced. Lowering global greenhouse gas emissions will slow climate change and prevent millions of premature deaths due to air pollution over the next decades.
- People that use parking garages or campus parking lots will benefit from reduced stress levels because they will no longer have to deal with uncertainty and hassle of planning ahead to arrive extra early.

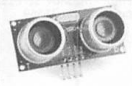


11

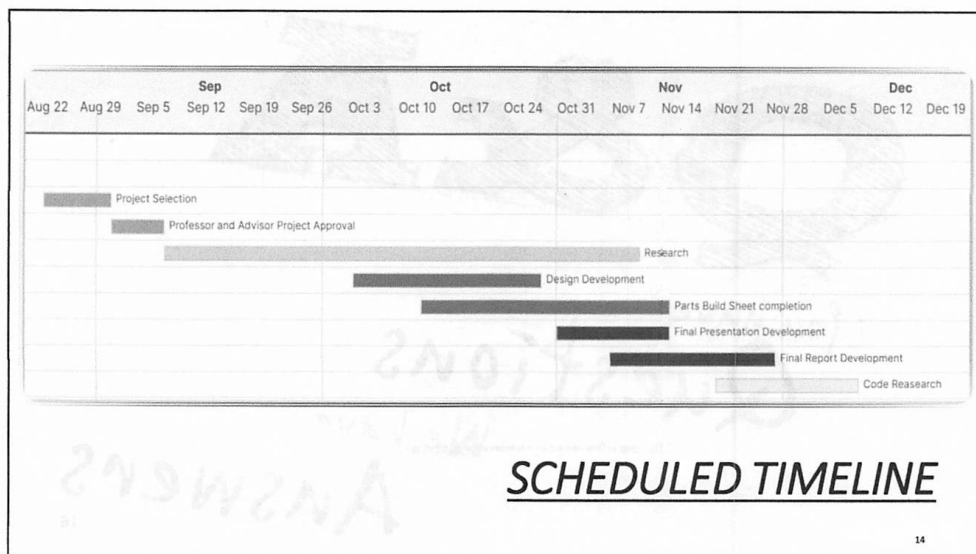
ENGINEERING DESIGN METHODOLOGY



12

PROJECT COMPARISON					
DESIGN OPTIONS	ESTIMATED COST	PROS	CONS	REFERENCE IMAGE	REFERENCE SOURCES
Radar Sensor 	\$8 per sensor	- Detect objects through wood, plastic, or even thin walls - Works in all direction	Work at a distance of at least 4 meters		https://www.amazon.com/HW-M003-Performance-Motion-Microwave-Arduino/dp/B08LMVCH77/ref=mp_s_a_1_4?pd_rd_ggpii=ProductStyle&pf_rd_p=1637012795&pf_rd_r=0224905-2590788&pf_rd_s=merchandise-view_1637012818398
Infrared Sensor 	\$15.99 for a pack of 10	- Works at 2.7 V-12 V - Works in temperatures ranging from -20 to 60 degrees Celsius	Works at a distance of 3-5 m		https://www.amazon.com/Weewood-Pyrotelectric-Infrared-Detection-Temperature/dp/B08PVBVH9Q/ref=mp_s_a_1_4?pf_rd_p=1637012795&pf_rd_r=2590788&pf_rd_s=merchandise-view_1637012818398
Ultrasonic Sensor 	\$3.95 per sensor	- Work at 5V - Range can extend to 2 cm - 4 m	Can not operate 3.3 V		https://www.sparkfun.com/products/15569

13



14

RESOURCES

- [1] Amazon. (n.d.). *Ultrasonic Sensor AM312*. Retrieved November 15, 2021, from https://www.amazon.com/Weewooday-Pyroelectric-Infrared-Detector-Temperature/dp/B08PVB7VHQ/ref=mp_s_a_1_4?keywords=pir+sensor&qid=1637011908&sid=140-0224905-2590768&sr=8-4&sres=B0122Z4LPM%2CB08PVB7VHQ%2CB07K8WVJMP%2CB07KZW86YR%2CB07GZLS9RW%2CB07R5Q2QKN%2CB077Z88M8Y%2CB07NPKMH5%2CB01HTCS920%2CB07CSM3K63%2CB081YQX81P%2CB00JOZTAC6%2CB076273VDM%2CB07GJDIV63&srpt=MOTION_DETECTOR_DEVICE.
- [2] "Dynamic Product Page," *Microchip.com*. [Online]. Available: <https://www.microchip.com/en-us/product/ATECC608A-TNGLORA>. [Accessed: 01-Oct-2021].
- [3] "FAAC B680H Automatic Barrier L Kits," *Allsecurityequipment.com*. [Online]. Available: https://allsecurityequipment.com/products/faac-b680h-automatic-barrier-l-kits?variant=40444798369965¤cy=USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&gclid=CjwKCAjwzQqKBhAWEiwArQGwaLh2tZ_h1TeOES-gGibbRmVBC762lusRHmeuEekZCdh4FoOPEYhoC8J4QAvD_BwE. [Accessed: 01-Oct-2021].
- [4] "Parking Today," *www.parkingtoday.com*. <https://www.parkingtoday.com/blog/2019/03/stress-and-uncertainty-of-finding-parking/>.
- [5] T. of UsePrivacyCopyrightTrademarksNon-DiscriminationAccessibility, "COVID lockdown causes record drop in carbon emissions for 2020," *Stanford Earth*, Dec. 10, 2020. <https://earth.stanford.edu/news/covid-lockdown-causes-record-drop-carbon-emissions-2020#gs.cfr03r> (accessed Oct. 01, 2021).
- [6] *Ultrasonic distance sensor - HC-SR04*. SEN-15569 - SparkFun Electronics. (n.d.). Retrieved November 15, 2021, from <https://www.sparkfun.com/products/15569>.

15



16

11/22/2021

BACK UP SLIDE

17

BELOW AVERAGE



Senior Design ELEG 4247

Outcome 3 – Oral



Below Average Example

Title of Presentation: Team 7 – Home Security Anti Burglar System						
Members Oluwadamilola Osuntuyi, Nolan Coston, Elizabeth Reyna, Teminioluwa Folorunso, Ben Ombusa						
Date of Presentation:						
Name of Evaluator and Affiliation (University or Company name)						
	Excellent 99	VeryGood 89	Average 79	BelowAvg. 69	Poor 54	Comments
Organization						
Objective		✓				Pic slide 2
Introduction of Presentation			✓			
Design Methodology (Design Process)						
Ability to stay within time limit						
Technical						
Technical content and demonstration of understanding of subject		✓				Both Nathan's slides - didn't seem confident Nolan - seemed to not know presented a lot
Quality of design/ Analysis/Construction		✓				
Creativity and originality of design concepts			✓			
Design within constraints	N/A					
Proper use of codes and standards in design	N/A					
Able to demonstrate broader impacts of project (where applicable on society, economics, technical, environmental, safety)						
Quality and functionality of working prototype						A
Delivery						
Use of vocabulary appropriate to technical subject and audience, clarity and confidence			✓			Get content into w/ pointer, slide 12-13 to mean w/d React to the slides
Attire, posture and eye contact			✓			
Efforts of all group members/Group dynamics			✓			
Ability to effectively answer questions						
Quality/Readability of slides			✓			
Relevance of Slides – use of modern techniques i.e. video, animation, sound clips etc.						

Nolan need to have slide/cd

Project Schedule - pedestrian

VST = 62
Must = 76 > 79

Jenni Read the
slide
slide 15

Project Presentation Evaluation Form
ECE Senior Design & Professionalism
Oral Presentation – Outcome 3

Title of Presentation: Team 7 – Home Security Anti Burglar System						
Members Oluwadamilola Osuntuyi, Nolan Coston, Elizabeth Reyna, Teminioluwa Folorunso, Ben Ombusa						
Date of Presentation: 11/18/2021						
Name of Evaluator and Affiliation (University or Company name) Musa						
	Excellent 99	Very Good 89	Average 79	Below Avg. 69	Poor 54	Comments
Organization						
Objective			✓			
Introduction of Presentation				✓		
Design Methodology (Design Process)				✓		
Ability to stay within time limit			✓			
Technical						
Technical content and demonstration of understanding of subject				✓		Too much staving on Board stumbling over messages team no look like rehearsal
Quality of design/Analysis/Construction				✓		
Creativity and originality of design concepts				✓		
Design within constraints						
Proper use of codes and standards in design				✓		
Able to demonstrate broader impacts of project (where applicable on society, economics, technical, environmental, safety)			✓			
Quality and functionality of working prototype				✓		
Delivery						
Use of vocabulary appropriate to technical subject and audience, clarity and confidence			✓			Nolan reads from slides and misstates
Attire, posture and eye contact			✓			
Efforts of all group members/Group dynamics				✓		
Ability to effectively answer questions			✓			
Quality/Readability of slides			✓			
Relevance of Slides – use of modern techniques i.e. video, animation, sound clips etc.			✓			

Lowest team in class.

76

SMART SECURITY SYSTEM

TEAM 7:

NOLAN COSTON
OLUWADAMILOLA OSUNTUYI

TEMINIOLUWA FOLORUNSO

BEN OMBURA

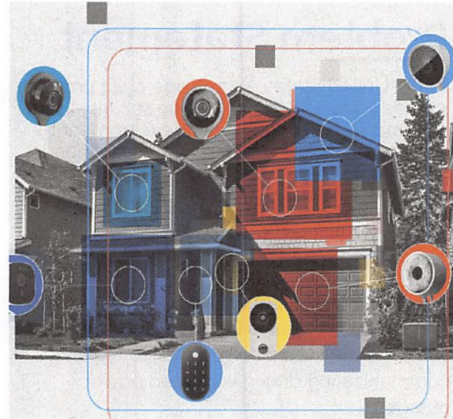
ASHLEY REYNA

INSTRUCTOR:

VEWISER TURNER

TEAM SPONSOR:

CAJETAN M. AKUJUOBI



1

PRAIRIE VIEW A&M UNIVERSITY ROY G. PERRY COLLEGE OF ENGINEERING TEAM 7



NOLAN COSTON
N/A

COMPUTER ENGINEERING

OLUWADAMILOLA OSUNTUYI
Scribe

COMPUTER ENGINEERING

ASHLEY REYNA
Team Lead
Test Lead

ELECTRICAL ENGINEERING

BEN OMBURA
Software Developer
Data Analyst

COMPUTER ENGINEERING



TEMINIOLUWA FOLORUNSO
N/A

ELECTRICAL ENGINEERING

2

Problem Statement

In the United States, an average of 4.1 property crimes occur per second. Many security systems lack cyber security development to increase customer privacy. Home security systems often fail to properly arm and communicate during extended power outages.

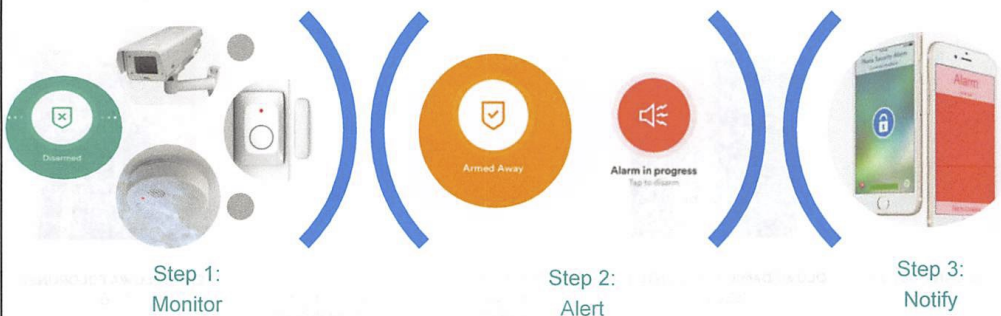
OBJECTIVE:

The goal would be to design a security alarm system that highlights customer privacy and can continue to function by monitoring and communicating during extended power outages.

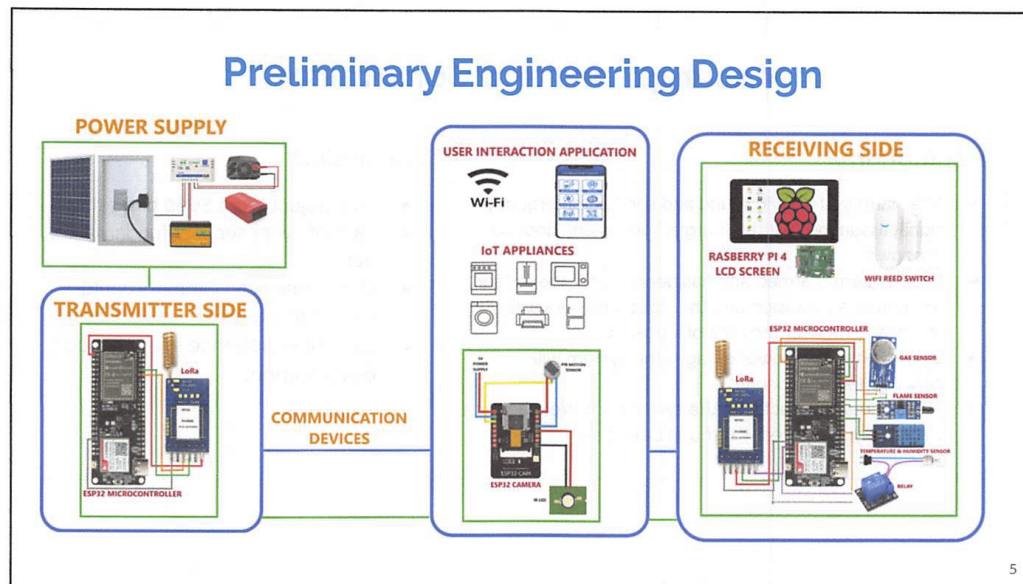


3

Design Methodology



4



MARKETING REQUIREMENTS	ENGINEERING REQUIREMENTS	JUSTIFICATIONS
Integrated communication solution	ESP32 Microcontroller	Low energy system Embedded WiFi, Bluetooth, IoT applications capabilities
Long-range communication	LoRa (Long-Range) module	Sends data and live feed for up to 12 kilometers
Remote monitoring receiver	24/7 emergency and monitoring services. - Self monitoring through APP	24/7 monitoring of property will reassure a customer of investment.
Multi detection sensors	- Smoke/Carbon monoxide sensor - Reed switch sensor - Passive infrared (PIR) motion camera - Temperature and Humidity sensor	Multiple sensors collected readings to alert the customer of a hazard or a security breach.
Off-grid power source	- Solar power - Rechargeable battery source	Providing protection during extended power outages is an additional marketing tool for sales and it increases customer safety.
Customer privacy	- End-to-end encryption - Regular software updates.	Identifying potential vulnerability promotes customer confidence.

6

Assumptions and Constraints

Assumptions

- The alarm system will sound and send an emergency signal assuming that the "burglar" opens any doors or windows.
- If the system is armed and has been set off, the sensor will detect an intrusion and the closest camera will rotate and monitor the area of intrusion
- During extended power outages the system will continue to fully operate.
- The user can interact with the system's control panel via a mobile app or directly through LCD panel.

Constraints

- The project has a \$600 budget.
- Lack of cyber security fundamental training.
- Electromagnetic jammers could disrupt the system.
- Lack of experience in application development.

7

Project Schedule

August – October 2021

- Project selection
- Beginning of project conception
- Agreement with advisor
- Conclusion of conception
- Research
- Start code research

November – December 2021

- Commence designing
- Final presentation
- Order materials
- Finalize design
- Start mobile app development

January – April 2022

- Complete code research
- Build and troubleshoot design
- Completion of building
- Project performance & control
- Project close

8

Project Impact Summary

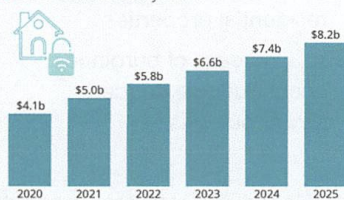
Categories	Applicability
Economic Impact	●
Technological Factors	●
Environmental Factors	
Social Factors	●
Global Impact	●
Safety and Welfare Factors	●

9

Economic Impact

Demand Growing For Smart Home Security Systems

Forecast revenue growth of the U.S. smart home security sector*



* Includes smart locks, cameras, hazard notifications, emergency calls, etc.
Source: Statista Digital Market Outlook



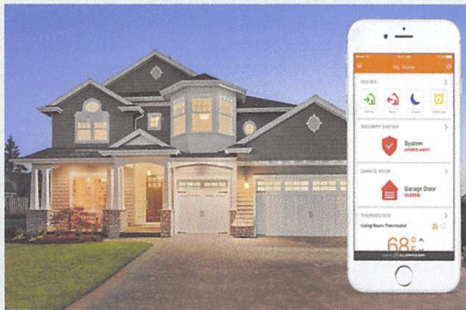
statista

- Most home security providers give discounts on insurance premiums if a home has an installed security system.
- Having a home security system increases the value of the home.

Our project will provide an alarm system that is affordable, reduces expenses for homeowners, and raises the property value of homes for homeowners.

10

Technological Impact

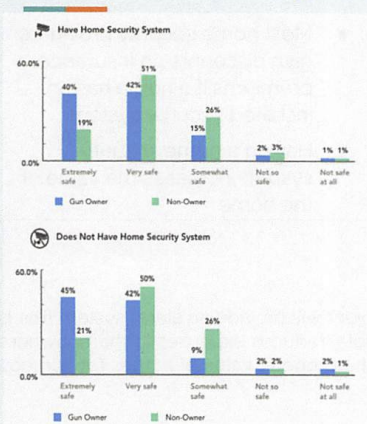


- Modern security systems allow you to remotely monitor what's happening in your home from your phone or device even when you're not there.
- Many alarm systems do not have tight enough security prevention and are easy targets for hackers.

Our project will be using python to provide built-in end to end encryption within our alarm system. This will minimize exposure to potential hackers.

11

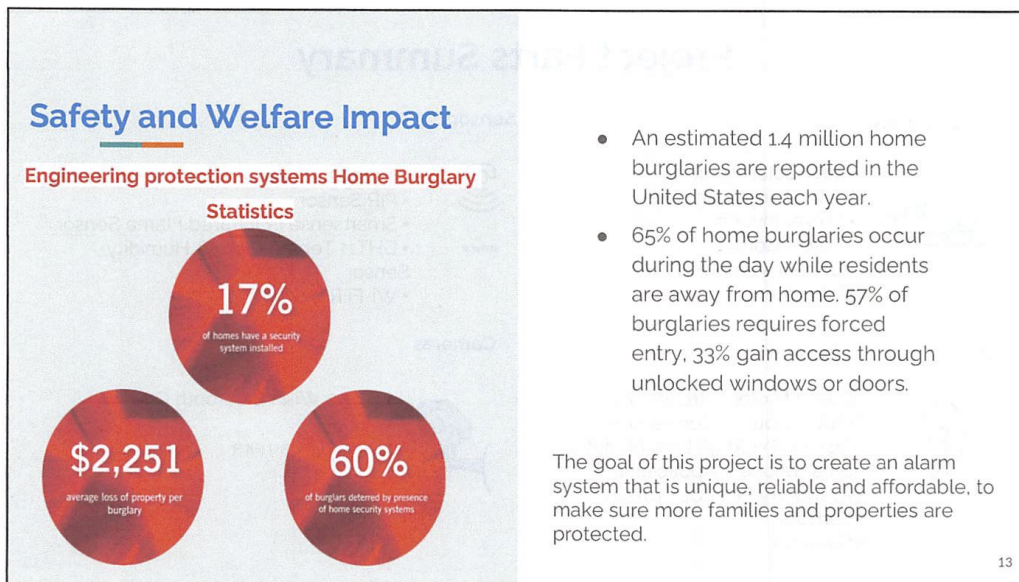
Social & Global Impacts



- Survey suggest security alarms assure peace of mind when the property is empty.
- 66% of burglaries affect residential properties.
- 10% increase of burglaries occur during extended power outages.

The goal of the project is to create an attractive home security system that is versatile in functionality. Furthermore, to provide a security system that is beneficial to society worldwide.

12



Product comparison						
PRODUCT	IMAGE	PROS	CONS	COST	REFERENCE	DECISION
Smart Security system		- Works off-grid - These systems are available in DIY kits - Easy to install and uninstall	Its vulnerable to burglars due to jamming devices	\$600	N/A	
Wired Home Security system		- Extremely reliable - Easy to maintain - Such system are less prone to hacking	- More expensive to install - More vulnerable to burglars - One control location	\$600 to \$2500	https://homeguide.com/costs/security-camera-installation-cost/# https://www.homestratosphere.com/types-home-security-systems/	
Wireless security alarm system		- Easy to install and uninstall - These systems are available in DIY kits - Easy to upgrade	- Its vulnerable to burglars due to jamming devices - Prone to hacking	\$200 to \$2000	2021 Home Security System Cost Monthly Alarm System Prices (homeguide.com)	
Unmonitored security systems		- They provide good level of security - Easy to utilize and operate cheap	- Requires user intervention - Communication with law enforcement is self dependent	\$600	Compare Best Unmonitored Home Security System Features & Costs (myhome-security-pro.com)	
Monitored security system		24/7 professional monitoring services - Systems professionally installed	- You may possibly be charged for a false alarm - This system usually requires a monthly fee or contract	\$280 to \$1092	4 Types of Home Security Systems (Plus Pros and Cons of Each) - Home Stratosphere	

Project Parts Summary

Power Supply



- 10W Solar Panel
- 10A Charge Controller
- Power Inverter
- Power Cords
- Batteries (Triple AAA / 3V Lithium)

Sensors



SENSOR

- MQ2 Gas Sensor
- PIR Sensor
- Smartsense IR Infrared Flame Sensor
- DHT11 Temperature & Humidity Sensor
- Wi-Fi Reed Switch

Communication Systems



- ESP32 Microcontroller (Wi-Fi/Bluetooth Connection)
- REYAX RYL896 Lora Module
- Smartphone / Application
- Raspberry Pi 4 LCD Screen
- Sensors
- Cameras

Cameras



- ESP32 Wi-Fi Bluetooth Camera Module
- Dummy Camera

15

Project Acceptance Criteria

Embedded Communications System



- Low power consumption chip
- Microcontroller with Wi-Fi, Bluetooth and IoT applications
- Available software for application development.

Transmitter



- System must be able to transmit long-range communications.
- System must not consume a lot of battery life

Sensors



- Passive infrared (PIR) sensors detect specially designated levels of infrared radiation
- Gas/Flame detectors must detect flames, smoke and carbon monoxide then send notification.
- The temperature/humidity sensor must provide actual conditions at any given point or in any given place

Mobile Application



- Memory is cleared and sensitive data is not stored for long
- Application must be able to keep customers data safe.
- Application must run smoothly.

16

Literature References

- <https://www.csis.org/analysis/cybersecurity-workforce-gap>
- McAfee, B. (2017, July 3). *How to keep your home safe during a power outage: Crime prevention*. CPSS. Retrieved October 5, 2021, from <https://www.cpss.net/about/blog/2015/08/how-to-keep-your-home-safe-during-a-power-outage/>
- Lauren, A. (2021, August 11). *How a power outage puts your home security at risk*. Reader's Digest. Retrieved October 5, 2021, from <https://www.rd.com/article/power-outage-home-security/>
- Home & Business Security Systems in Jacksonville, FL. SafeTouch. (n.d.). Retrieved October 5, 2021, from <https://safetouch.com/security-during-a-power-outage/>
- Carmen. (2019, October 24). *Security system creativity for remote off-the-grid living*. Off The Grid News. Retrieved October 5, 2021, from <https://www.offthegridnews.com/home-defense/off-grid-security-system/>
- Tatro, Kaitlyn. "Light Energy: Our Wasted Resource." *Consilience*, no. 22, Columbia University, 2020, pp. 65-72. <https://www.jstor.org/stable/26924963>
- Newmeyer, N. "Changing the Future of Cyber-Situational Awareness." *Journal of Information Warfare*, vol. 14, no. 2, Peregrine Technical Solutions, 2015, pp. 31-40. <https://www.jstor.org/stable/26487492>
- An Investigative Study for Smart Home Security ... - Scirp.org. https://file.scirp.org/pdf/VWSN_2016042516164326.pdf
- Doleac, Jennifer L., and Nicholas J. Sanders. "UNDER THE COVER OF DARKNESS: HOW AMBIENT LIGHT INFLUENCES CRIMINAL ACTIVITY." *The Review of Economics and Statistics*, vol. 97, no. 5, The MIT Press, 2015, pp. 1093-103. <http://www.jstor.org/stable/43830298>
- Dutta, Pallavi, et al. "5 Major Reasons for 'Why Is Cyber Security Important?'" *Security Boulevard*, 13 Apr. 2021. <https://securityboulevard.com/2021/04/5-major-reasons-for-why-is-cyber-security-important/>
- by, Written, and Katherine Torres. "8 Benefits to Owning a Home Security System." *SafeWise*, 22 Apr. 2021. <https://www.safewise.com/blog/top-8-reasons-get-home-security-system/>
- "Cybersecurity for Physical Security Systems." UL. <https://www.ul.com/services/cybersecurity-physical-security-systems>
- Do I Really Need a Security System? By Celeste Tholen, Managing Editor from (May 27, 2021) <https://www.safewise.com/home-security-faq/do-i-need-a-security-system/>
- [9 important home burglary statistics - EPS Security](#)

QUESTIONS?



ASSIGNMENTS FOR OUTCOME 3

**An ability to communicate effectively with a range of
audiences
(Written Communication)**

Electrical and Computer Engineering
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET
ELEG 4247 Sr Design and Professionalism I
FALL 2021
Instructor: Turner / Musa

Title of Assignment

Final Written Report

Outcome Measured Using this Assignment

Outcome 3

**An ability to communicate effectively with a range of audiences
(Written Communication)**

Check the communication problem characteristics related to this assignment

Ability to prepare an executive summary for the report	
Requires students to:	
	Prepare an executive summary of 5 to 8 pages – this is part of ELEG 4482 deliverable and taught in the Spring Semester
Ability to organize, plan and properly format a written technical report	
Requires students to:	
x	Organize report by chapters, major sections, subsections and paragraphs
x	Provide Title Page, and Table of Contents, list of Figures, and List of Tables properly formatted.
x	Provide figure and table numbers with titles and reference and discuss each table and figure in accord with standard practice.
x	Properly cite references in the report and provide well formatted reference list at the end.
x	Prepare the written report in accord with standard report formatting Manual
Ability to compose original texts and properly apply the conventions of written language.	
Requires students to:	
x	Properly apply capitalization, punctuation, and penmanship, to communicate clearly and spell proficiently,
x	Apply standard grammar and usage to communicate clearly and effectively in writing using complete sentences , good subject-verb agreement, pronoun referents, and parts of speech, properly using adjectives, adverbs, prepositional phrases appropriately, conjunctions to connect ideas to make writing vivid and precise, and use available technology to support aspects of creating, revising, editing, spell checking, and publishing the report.
Ability to provide appropriate discussion, conclusions and recommendations	
Requires students to	
x	summarize the goals, objectives, and indicate whether they were met.
x	summarize the report chapter by chapter
x	summarize constraints and codes and indicate whether they were met for design reports Summarizes how issues relating to public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors were considered/addressed for design reports.
x	Provide logical conclusions Provide logical conclusions and recommendations (including strengths and weaknesses)

Brief justification of the suitability of assignment for the outcome

The written final for ELEG 4247 will require the students to leverage their understanding of the design project and answer questions in written format. There are 10 questions on the assignment ranging from a clear/concise problem statement to project impact on Safety Environment, Society etc. Students also get a detailed

SAMPLE WORK OF STUDENTS

ABOVE AVERAGE

ELEG 4247 Senior Design

Fall 2021

Outcome 3 – Written

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING**



**Senior Design & Professionalism I
ELEG 4247 – P01**

Final Exam Report

Due Date Sunday November 28 by 5:00pm (Central Time)

Upload to Final Exam Written Report Assignment

Due date is firm: early is ok and late is (- 10 points)

Submit to me a word document – do not send me a PDF or PowerPoint

This document will serve as your final exam report

Instructions:

- Avoid unexplained acronyms
- Word Document Only – No PDF or other formats
- Number all pages
- OK to use diagrams or pics but they must be explained clearly

1. What is your team trying to solve/accomplish as part of the Senior Design project? Provide a clear and concise problem statement. [5 points]

2. Why is your project important? Clearly state its broader safety/environmental/technical/societal/economic impacts. [20 points]

Safety – Does the project improve or impact safety in anyway.

Environment – Does the project help the environment in anyway.

Technical – Any new technical or innovation concepts from your project

Society – Does your project help society in anyway (cultural impact)

Economic – Does your project more cost effective, saves money or time

3. What are the major goals or key deliverables of your project? List the marketing and engineering design specifications or 1:1 solution matrix of your proposed solution. What are your design constraints? [10 points]

4. What is your proposed solution? Please provide a detailed explanation of your proposed solution. [5 points]

5. How did your team arrive at your proposed design? You must show any math or engineering analysis used to guide your design proposal. Which courses in your academic program helped you the most in this specific design project? Explain. Were new skills required? If yes, how did your team members acquire them or planning to acquire them? [10 points]

6. What is the competitive advantage of your proposed solution (preliminary design concepts)? Briefly list the advantages and disadvantages of your proposed solution by comparing it with other competing or commercially available solutions/products. Please include your product comparison. [20 points]

7. (a) Provide a brief project status update. What your team has accomplished so far? (b) Include a project timeline showing key milestones for rest of semester and those needed to complete your project my end of April 2021. [10 points]

8. How did you perform your literature review? Provide a list of your pertinent references. Provide in the proper format a list of all references as part of your literature review. [5 points]

9. Do you anticipate any issues in implementing your proposed design solution successfully in a timely manner? If yes, how do you intend to overcome those obstacles? [5 points]

10. Cover Page, Technical Write Up, Grammar, Format, Graphs, Pics, Diagrams, number pages [10 points]

11. **Optional Extra Points:** Define or describe what is a discretionary project and a non-discretionary project [5 points]

➔ **Format – start each section with the question being asked. Double space. Font size 12 or 14. (Must be large enough to read) Please use/include charts and graphs to explain or answer. No page limit.**

1. What is your team trying to solve/accomplish as part of the Senior Design project? Provide a clear and concise problem statement. [5 points]

(Enter your response.....)

Written Communications Evaluation Form
ECE Senior Design & Professionalism
Written Communications-Outcome 3

Title of Presentation: ELEG 4247 Fall Final Written Report						
Team Number and Members: Team 1						
Date of Presentation: 11 - 28 - 21						
Name of Evaluator and Affiliation (University or Company name) UST						
	Excellent 99	Very Good 89	Average 79	Below Avg. 69	Poor 54	Comments
Executive Summary						
Able to prepare an executive summary for the report	N-A					
Format						
Able to organize the report e.g. Title Page, and Table of Contents, list of Figures, and List of Tables properly formatted	N-A					Very good/ Excellent Report
Charts and Graphs in the report are well documented, easily understood and referenced appropriately	✓					
Able to show appropriate discussion, conclusions and recommendation	✓					
Able to cite references in the report and provide well formatted reference list at the end	✓					
Able to prepare the written report in accord with the Senior Projects Report Manual and instructor guidance	N-A					
Written Language						
Able to write the report without grammatical errors	✓					Small adjustments & minor comments to improve
Report includes appropriate level of detail and analysis	✓					
Able to write the report in excellent professional style – no unexplained technical jargon or acronyms	✓					
Apply approved standard method to cite references used and in literature review	✓					
Conclusion and Recommendation						
Able to summarize goal objective and indicate if they are met	N-A					

N/A = Evaluation Spring
Final Report

Score = 99%

PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING



Real-Time Crowd Detection System using Raspberry Pi and Deep Learning

ELEG 4247: Senior Design & Professionalism I

Topic: Final Written Report

Team Number 1

Submitted by:

Deonna London
Jalyn Beaty (Team Lead)
Gabriel Maxwell
Alexis Hunter
Alyssa Reed

Instructor: Professor Turner

Due Date: Sunday, November 28th by 5:00pm

Date of Submission: Sunday, November 28th

*Report
Grade = 100%
Xtra
Credit = 5 pts*

Overall a very good report. Some minor comments included - one thing you might consider is ~~using~~ using a similar style for Project Comparison like you did for Marketing/Matrix section.

What is your team trying to solve/ accomplish as part of the Senior Design project? Provide a clear and concise problem statement. ✓

According to the World Health Organization, the risk of catching COVID-19 is higher in crowded and inadequately ventilated areas. As of September 2021, Harris County is at a level one (severe) threat level. Level one signifies the spread of COVID-19 is uncontrolled; outbreaks are worsening. The 7 day average of new cases is 125.85 per 100,000. Figure 1 shows the sum of new cases reported in the past 7 days based on the population. Where the graph exceeds the 100 threshold, it reflects red severity. Where it exceeds the 50 threshold, it reflects orange severity. Where it exceeds the 10 threshold, it reflects yellow severity. Harris county has been in the red and remained in the red as of the end of July 2021. Without proper social distancing being enforced, COVID-19 and the consequences that come with it will continue to impact the world.

next time define red/orange severity meaning?

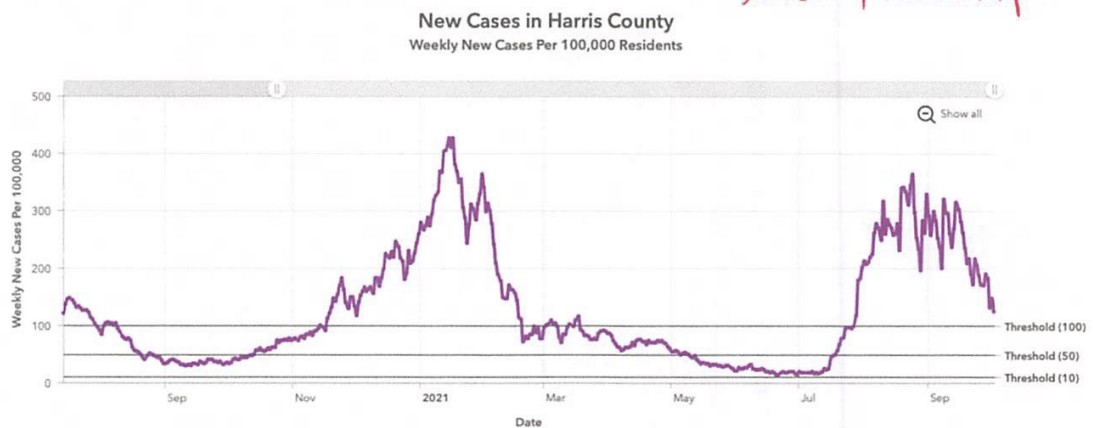


Figure 1

What is your proposed solution? Please provide a detailed explanation of your proposed solution.

The proposed solution is to design a real-time crowd size detection device with an alarm

components
system using Raspberry Pi 3 B+ and other compatible attachments. The attachments would include a camera for video and image processing, a sound alarm to alert those in the room and include the blind, and a light alarm to include those who are deaf. The Raspberry Pi will serve as the brain of the system as it will be programmed to scan frame-by-frame live video and use TensorFlow and OpenCV to perform object detection. Using deep learning, the system would be able to not only keep track of how many individuals are in a room, but determine how far apart they are as well. If any requirements are not met the system would then send a signal to sound an alarm until the violation is corrected. ✓ good

✓ **Why is your project important? Clearly state its broader safety/ environmental/ technical/ societal/ economic impacts.** Excellent Summary + Reference of Figures -

After researching and truly diving into this project, our team decided that our project is important because it impacts health, culture, society, and the economy. We will first discuss how our project impacted public health, safety and welfare. As of September 2021, there have been about 230 million positive COVID 19 cases around the world. The pandemic has made day to day activities such as class, work, or even the grocery store a real health risk. Figure 2 is a linear representation that shows how the number of positive covid cases have drastically multiplied from Jan 2020 to Sept 2021. Our project will help to reduce the number of positive COVID cases by monitoring spatial issues and preventing gatherings that are too large. It will force users to adhere to CDC guidelines and maintain a minimum of 6 feet apart.

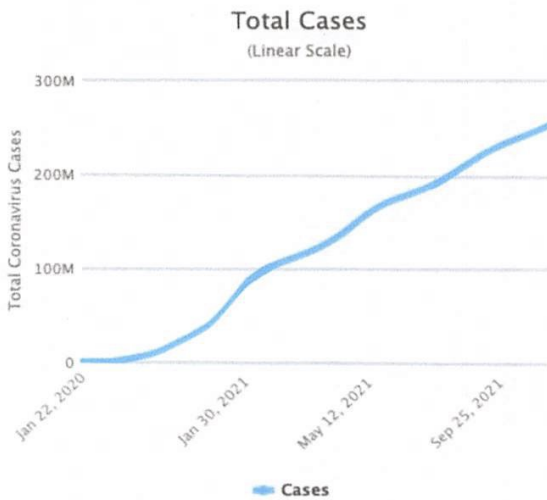


Figure 2: Positive COVID cases

At COVID 19's peak, 90 percent of countries closed their World Heritage site according to a World Bank article. Places such as museums, libraries, churches and art galleries have been closed. Due to these businesses being shut down, they have lost money and now it is no longer an option for them to reopen. COVID has changed the way populations not only go to class, work or the grocery store but the way we go to school, interact with society, entertain ourselves and spread our traditions. * Figure 3 shows the loss of revenue reported by 981 cultural organizations. The higher the loss of revenue, the more likely the business will have to shut down. Our device will help reopen these organizations. Creating and launching this device will reduce the number of COVID cases and make it less likely that businesses have to close.

* = Could consider starting a new paragraph - and putting comments along w/ figure on same page. Nothing wrong how you did it but * might make it more professional looking & easier to read.



Figure 3: Loss of Revenue

The number of adults attempting to get a divorce has risen by 34 percent since 2019. The percentage has risen due to couples being stuffed in the house together which forced them to realize things about one another that they didn't know before. Couples have also disagreed more on parenting decisions. According to the Center for Disease Control and prevention (CDC), “teens and adolescents' social, emotional and mental well-being have been impacted by the pandemic”. Figure 4 displays the results of a survey based on responses from 977 parents with teens aging from 13-18 years old. Anxiety, Depression, Sleep issues, withdrawal, and aggressive behavior are effects brought along by COVID isolation. With the use of our device people will once again be able to meet in group settings. Our device will ensure individuals are able to receive the necessary socialization while not endangering their health or the health of those around them.

*- see comment pg 3

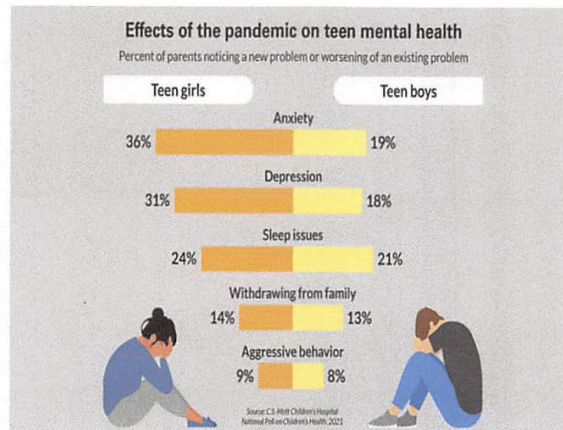


Figure 4: Survey Results

Our economy took a major hit during the pandemic. In 2020, the Gross Domestic Product (GDP) has decreased by 3.5 percent which is the lowest it has been since 1946. The average unemployment rate in 2020 was about 8 percent higher than the annual averages during the Great Recession in 2009. * Figure 5 shows the quarterly unemployment rate from 1968 to 2020. As you can see, in 2020 the unemployment rate reached 13 percent. Our project will mend our economy by reducing the spreading rate of COVID 19. Reducing the number of COVID cases will lead to businesses being able to reopen, thus jobs being available to those in need. After jobs are secured as normal, our unemployment rate and GDP will increase.

* See comment pg 3

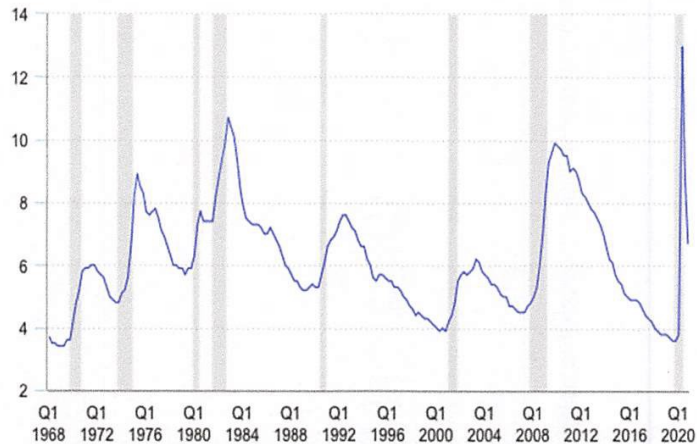


Figure 5: Quarterly Unemployment Rate

What are the major goals or key deliverables of your project? List the marketing and engineering design specifications or 1:1 solution matrix of your proposed solution. What are your designed constraints? [10 points]

Key Deliverables

Very Good - I appreciate how you explained each deliverable!!

Our project has 5 major goals/ key deliverables.

1. We will incorporate object detection. Object detection will allow us to identify and locate objects in each frame.
2. We will incorporate a people counter. Incorporating a people counter will allow us to monitor how many people are located in a room.
3. Perform crowd detection. Crowd detection utilizes object detection and a people counter to monitor the amount of people in a given area and give a notification when capacity has been reached.
4. Our device will incorporate a sound alarm. After utilizing crowd detection, when capacity

has been reached, an alarm will sound.

5. We will incorporate a light alarm. After utilizing crowd detection, when capacity has been reached, along with the alarm being sounded, a light will come on.

Marketing and Engineering Design Specifications

Marketing Requirements	Engineering Requirements	Justification
Fit in the top corner of a room facing the door	Raspberry Pi - 85x56x17mm Camera Board v1.3 - 20x25x9mm sound and light alarms	Device will need to take up minimum space
Facial recognition	Open Source Computer Vision Library (OpenCV)	Misidentified objects could result in inaccurate assumptions; false alarms
Light alarm system	Red light remains on until the spatial issue(s) are resolved Epilepsy Seizure Sensitive	Accessible for deaf while taking in account of other safety risks 5-30 flashes per second may cause seizures
Sound alarm system	Concealed Adjustable volume (40-80 Decibels)	Accessible for blind
Should be able to keep count of people in a given area	Create people tracker using: Python OpenCV Object tracking Algorithms	Count of people in a given area needs to be kept in order for the alarms to sound at the correct times
Distance detection between people in a given area	HC-SR04 Ultrasonic Sensor (2mm - 4m)	Device must be able to detect violation
All added parts and enhancements compatible to computed device	Camera Board v1.3 compatible with Model B	Parts need to be compatible to the Raspberry Pi 3 B+ in order for them to

		be programmed
Reliable and consistent	Test trials and Result Analysis 1080p	Unwarranted alarms can be alerted

Figure Number ?

1. The detection system will be designed to fit in the top corner of a room, facing the door.
The position of the system affects the accuracy of the results. We want to design it to take up as little space as possible and to have easy mobility.
2. Our system will be able to recognize the difference between a human face and an inanimate object. Misidentified objects could result in inaccurate assumptions and false alarms. To achieve this we will use object detection in our software programming.
Object detection is finding out what and where multiple objects are in an image. It is a combination of image processing and computer vision. There are a variety of libraries in deep learning and python to incorporate object detection. We will be using Open Source Computer Vision Library (Open CV) and TensorFlow. OpenCV is a library of functions aimed at real-time computer vision and TensorFlow is a framework for machine learning. Both have their pros and cons like any other technique, but together they align well for our object detection programming.
3. We want our system to be accessible for those who are deaf. We will incorporate a light alarm system; Those that cannot hear the alarm, can see the alarm. The light will be a red light because red is known to be an attention getting color. Our team has researched and learned that those with epilepsy are more likely to have seizures with lights that flash between 5 and 30 times per second. In order to incorporate the safety concerns of all our

users, our light will not flash. The light alarm will come on and remain on until the issues are resolved.

4. Our alarm system will also have an accessibility option for those who are blind. We will incorporate sound so those that cannot see the alarm, can hear it. Our team would like the volume to be adjustable, so that it serves the needs of whoever is using it. We wouldn't want our alarm to be incorporated in a house and sound as a fire alarm. It would be between 40-80 decibels.

5. A main function of our system will be for it to keep count of the amount of people in a room. To do this we will be using OpenCV and Python. We will add object tracking to our already incorporated object detection to create the most efficient people tracker.



Object tracking takes coordinates of where an object is in an image and assigns an ID to that object. It tracks this ID as it moves in a stream predicting the new location it will have in the next frame, based on its previous location. The two together will incorporate two steps to perform the function. First, it will detect what new objects enter. Then, these objects will enter the tracking phase where they are traced throughout various frames. These two phases of detecting and tracking will continue to run, and when going back into the detecting phase some objects that were lost could be found.

6. Our other function of the system is for it to be able to detect distance between objects in a given area. For this we will be using an ultrasonic sensor that is able to detect the proximity between people. This sensor would be able to use object detection and tracking to see where all objects are and then measure the distance between the bounding boxes they create when they are identified.

*Good Explanation of Matrix -
EASY for someone unfamiliar
to understand -*

7. In order for our device to be able to work properly, all of the parts that we attach to the device need to be compatible with the Raspberry Pi 3B+. So far we know we will be using Camera Board v.1.3 which is compatible with Model B of the Raspberry Pi. Any other attachments like the sensors, light and sound alarm will be compatible as well.

Assumptions

1. The area in which our system is located isn't too loud. To be deemed successful, we want to assume that when our system is sounded, the sound of its surroundings is not louder than our alarm system.
2. Those involved are aware of the system and its purpose. What good is a working project if nobody knows its purpose?
3. Participating parties don't enter in groups. For the best results, we want to ensure that our count is accurate. To be as accurate as possible, we would need participants to enter one by one to ensure our system can catch the face and body of each participant.
4. An alert will sound when a violation occurs. We assume our system will do what it was designed to do. When a violation occurs, we want users to be notified by both sound and light.
5. Our system will monitor the amount of people entering the room as well as any spatial issues that occur. This is another main goal for our project. If it does not monitor the amount of people in an area then it cannot be deemed a successful project.

Constraints

1. Our system will require a strong wifi signal to function. Our raspberry pi must be connected to wifi to maintain the proper date and time. We also need wifi to be able to

send out the alerts.

2. Our camera has to be in a position that can catch people of varying heights. If the camera is too high or too low then we won't be able to catch every user. Missing count decreases our accuracy.
3. A constant power supply is required for our system to function. Our Raspberry Pi must be plugged in at all times to complete the necessary tasks. If there is no power, there is no functionality.
4. The room dimensions must be known and inputted by the user. In our program, we will ask the user to input the dimensions of a room. We ask for this information to help set the capacity of each room. Knowing the dimensions will allow us to have an idea of how many users can fit into that given area while adhering to CDC guidelines.
5. Once the camera is mounted, it cannot be easily moved. Due to the wiring and set up of the device, moving it will not be easy.
6. Raspberry ^{Pi} requires an external monitor. Raspberry ^{Pi} is a computer. It will require a monitor to complete user interfacing and also to display frames and current participant counts. *you should use uppercase P*
Be consistent

How did your team arrive at your proposed design? You must show any math or engineering analysis used to guide your design proposal. Which courses in your academic program helped you the most in this specific design project? Explain. Were new skills required? If yes, how did your team members acquire them or planning to acquire them?

In order to get to the point in our project where we had a proposed design we started by developing a plan for the hardware aspect and the software aspect. For the hardware portion of our project we knew we would have to work with a Raspberry Pi 3 B+. This is the main

↑ correct see comment above

component of the hardware design of our project. Since this is the heart of our project we took our Raspberry Pi and worked from there. We knew that we would need the basic hardware: mouse, keyboard, and a monitor, but we also had to incorporate other hardware components into our device to ensure that we satisfied all of our marketing requirements. These pieces of hardware consisted of a speaker that was able to reach our volume parameters (20-40 decibels) and a light component that was bright enough to catch the attention of our audience. Once we assemble all of our hardware components we are going to 3D print a housing unit that holds all of these pieces together to make our product much more aesthetically pleasing. We needed to incorporate a little bit of old knowledge and a little bit of new knowledge to assist us in our design process. Intro to Electrical Engineering helped us a lot with the hardware piece of our project. We know that we might have to utilize a breadboard in our final product to connect our LED to which we learned how to do in that class but as far as the software is concerned none of our team members knew how to code in Python so we all had to learn lots of new coding techniques to help get us to where we are now. Based on one of our group members previous internship experiences we were able to use her knowledge to navigate through and use the Linux terminal which helped a lot in the installation process and the beginning of our coding process.

To understand the software portion of our project one must understand the basics of identifying objects through computer programming. The base is object localization. This is finding out what and where a single object exists in an image. An advanced version of this is object detection. This is finding out what and where multiple objects are in an image. This combined image processing and computer vision. Object detection is the ground of our project. This is made possible by downloaded libraries called python programming, two of the most important being Open Computer Vision and Tensorflow. In our case, the way it works is by

training the device to distinguish between people and other objects. Figure 6 shows object detection successfully running on our Raspberry Pi device. The next step is to get our device to identify and keep count of the amount of people in a space with specific borders. After this we can implement the distance detection programming onto our device.

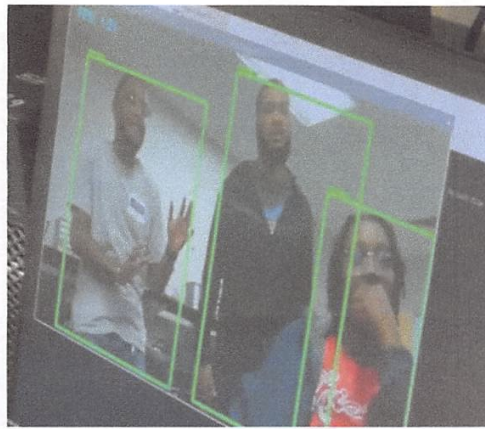


Figure 6: Object detection

*Good
Addition
of work done
so far!!*

What is the competitive advantage of your proposed solution (preliminary design concepts)? Briefly list the advantages and disadvantages of your proposed solution by comparing it with other competing or commercially available solutions/products. Please include your product comparison.

There are other products on the market for enforcing social distancing. Figure 6 shows the comparison of 3 other products in relation to ours. There is a Geovision People Counter device that is used to keep count of how many people are in a given space. Though this meets one of the requirements of our device, it does not meet the distance detection also provided by our device. The Geovision People Counter may be able to count the number of people in a room, but it won't tell you how close those people are. A critical part of social distancing is

staying 6 feet apart. The price of this device is also higher than ours. Another device created for social distancing purposes is the Ultimaxx wristband. This is a watch-like device that will sound off when one user comes within 6 feet of another user. This device relies on battery life and will only work if there are 2 of them active. If an office used these for their employees, they would have to buy one for each participant, which could result in a high cost. This device is also limited to the willingness of a person. If someone chooses not to wear it, much like people choose not to wear a mask, then they are not going to be aware or abide by social distancing rules. Our device will be stationed in a room and anyone who enters will be detected and monitored for violations. The last product found is a tool used in iOS called the Magnifier Tool. This is a software used by apple users that can be programmed by the user to sound or alert when they are within a specific distance of something else. This tool has some of the same constraints as the Ultimaxx Wristband as far as participation. It also has its own con of accessibility as it is only for iOS users and not easily programmable to the average person. Below in Figure, is a chart that depicts these different products in comparison to ours, the Covid-19 Crowd Detector.

Product	Design	Pros	Cons	Cost	Reference	Final Decision
Covid-19 Crowd Detector 	Room camera for social distance	-Counter -Distance detection -Sound alarm -Light alarm	-Require measurement of dimensions beforehand	\$150	https://uk.pi-supply.com/products/raspberrypi-pi-camera-board-v1-3-5mp-1080p	✓
Geovision 84-PC2101T-0010 GV-3D People Counter 	Camera Device used to count and analyze passing people	-Counter -Low power consumption -Lightweight	-Does not have a power adaptor included -Price -No distance detection	\$280	https://www.123securityproducts.com/84-pc2101t-0010.html	✗
Ultimaxx Wristband 	Wristband with 6ft detection	-Size -Portability -App compatible	-Relies on battery life -Only works with 2 -Limited to participation	\$20-40 per unit	https://www.amazon.com/Electronic-Social-Distancing-Wristband-Proximity-IPB088J0XB87Y	✗
Magnifier Tool 	App used to identify objects and their distance	-Price -Audio and visual readout	-No android users -Limited to participation	Free for iOS users	https://www.imore.com/iphone-12-pros-people-detection-accessibility-feature-perfect-social-distancing	✗

Figure 6 Product Comparison

Figure 6: Product Comparison

Would be good
to adjust page
break & so this
is on page
w/figure

(a) Provide a brief project status update. What has your team accomplished so far? (b)

Include a project timeline showing key milestones for the rest of the semester and those needed to complete your project by the end of April 2021.

As of November 19, 2021, We found an open-source code to assist us in coding our machine to run the crowd detection software successfully. The code is successfully running and is used to help our Raspberry pi and camera distinguish between people entering and exiting the camera's view; it also counts the people entering and leaving the room that leaves a timestamp in a separate window. In the upcoming weeks, we will perfect the code by researching different methods for the camera to differentiate between people and non-human objects. We also will be creating an alarm system by using led lights and an audio speaker. We will connect the newly created alarm system to the raspberry pi and incorporate a new code that activates the alarm system when a violation occurs per CDC guidelines. We have spent a total of \$290 of our ~~600~~^{\$600} ~~dollar~~ budget, so we are under budget. We are projected to finish our alarm system a month earlier due to our parts coming faster than expected, and our team plans on working during Christmas break, which can have us finish by the end of March.

Be
consistent

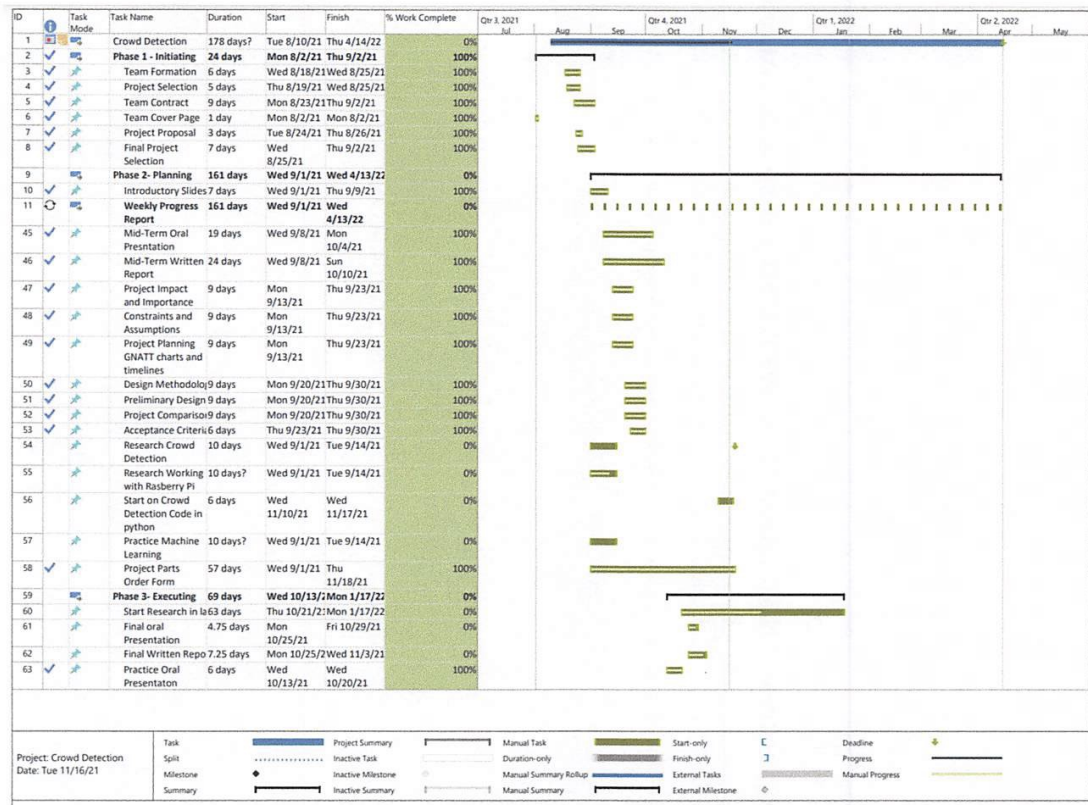


Figure 7 Gantt Chart

Do you anticipate any issues in implementing your proposed design solution successfully in a timely manner? If yes, how do you intend to overcome those obstacles?

We have encountered plenty of issues that could affect our completion of this project by our given deadline but we are working through these issues everyday and coming up with new ways to overcome these obstacles. Some of these obstacles consist of overclocking our CPU, having trouble finding adequate code to satisfy our project requirements, out of date software and many other issues. Even though we keep hitting roadblocks we find a way to push past these

obstacles everytime through thorough research and trial and error. Therefore while yes we might run into some issues we fully intend on working through them and getting our project done in a timely manner.

Optional Extra Points: Define or describe what is a discretionary project and a non-discretionary project.

✓ A discretionary project is a project a company assigns and chooses to implement with choice. A non-discretionary project is a project that is mandatory to complete by the company. They have no choice.

ok
✓ **How did you perform your literature review? Provide a list of your pertinent references.**

✓ **Provide in the proper format a list of all references as part of your literature review.**

Our team performed literature reviews by simply typing what we needed to know in google then by going site to site fact checking all information we discovered.

Resources

- "Coronavirus Cases." *Worldometer*,
https://www.worldometers.info/coronavirus/?utm_campaign=homeAdUOA%3FSi.
- Covid-19 parental resources kit – adolescence. (2021, July 27). Retrieved October 04, 2021, from

<https://www.cdc.gov/mentalhealth/stress-coping/parental-resources/adolescence/index.html>

- Culture in the COVID-19 recovery: Good for your wallet, good for resilience, and good for you. (n.d.). Retrieved October 04, 2021, from <https://blogs.worldbank.org/sustainablecities/culture-covid-19-recovery-good-your-wallet-good-resilience-and-good-you>
- "Harris County / City of Houston Covid-19 Data Hub." *Harris County / City of Houston COVID-19 Data Hub*, <https://covid-harriscounty.hub.arcgis.com/>.
- NBC Chicago. (2020, June 23). What are the odds someone at a gathering has covid-19? Chicago health officials break down the math. Retrieved October 04, 2021, from <https://www.nbcchicago.com/news/local/what-are-the-odds-someone-at-a-gathering-has-covid-19-chicago-health-officials-break-down-the-math/2294188/>
- Olson, P. (2020, May 15). Don't stand so close to me: Ai cameras police social distancing at work. Retrieved October 04, 2021, from <https://www.wsj.com/articles/dont-stand-so-close-to-me-ai-cameras-police-social-distancing-at-work-11589452202>
- Rosner, E. (2020, September 02). US divorce rates skyrocket amid covid-19 pandemic. Retrieved October 04, 2021, from <https://nypost.com/2020/09/01/divorce-rates-skyrocket-in-u-s-amid-covid-19/>
- Saladino, V., Algeri, D., & Auriemma, V. (2020, October 2). The psychological and social impact of covid-19: New perspectives of well-being. Retrieved October 04, 2021, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7561673/#!po=12.2642>
- State of the US economy: GDP, unemployment, Jobs & More: 2021 State of the union facts. (2021, April 22). Retrieved October 04, 2021, from https://usafacts.org/state-of-the-union/economy/?gclid=CjwKCAjw4qCKBhAVEiwAkTYsPFMgXd_vhIkdl1arBJjHS5kjdlP5wOZxKfkG5hl4GkeeHabrl9KFGfxoC16cQAvD_BwE
- Jay, et al. "OpenCV People Counter." PyImageSearch, 13 July 2021, <https://www.pyimagesearch.com/2018/08/13/opencv-people-counter/>.
-

AVERAGE

Senior Design ELEG 4247

Outcome 3 – Written

Average Example

Written Communications Evaluation Form
ECE Senior Design & Professionalism
Written Communications-Outcome 3

Title of Presentation: ELE64247 Fall Final Written Report						
Team Number and Members: Team 3						
Date of Presentation: 11-28-2021						
Name of Evaluator and Affiliation (University or Company name) VST						
	Excellent 99	Very Good 89	Average 79	Below Avg. 69	Poor 54	Comments
Executive Summary						
Able to prepare an executive summary for the report	N-A					
Format						
Able to organize the report e.g. Title Page, and Table of Contents, list of Figures, and List of Tables properly formatted	N-A					Need to document + reference Figures/Charts etc
Charts and Graphs in the report are well documented, easily understood and referenced appropriately				✓		
Able to show appropriate discussion, conclusions and recommendation			✓			
Able to cite references in the report and provide well formatted reference list at the end		✓				
Able to prepare the written report in accord with the Senior Projects Report Manual and instructor guidance	N-A					
Written Language						
Able to write the report without grammatical errors			✓			Project Comparison Writeup was weak
Report includes appropriate level of detail and analysis			✓			
Able to write the report in excellent professional style – no unexplained technical jargon or acronyms				✓		
Apply approved standard method to cite references used and in literature review		✓				
Conclusion and Recommendation						
Able to summarize goal objective and indicate if they are met	N-A					

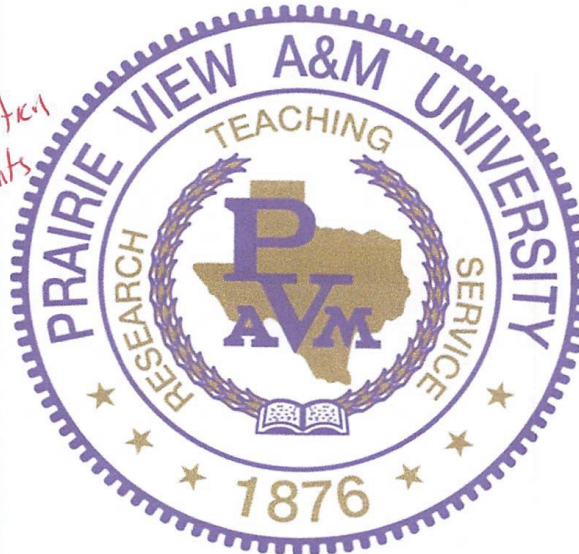
Avg Score = 80%

N/A = Evaluated in Spring Final Report

copy

1

PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING



Dear Team 3
this was far
below my expectations
for Sr level students
if you submit
your final 2022
report like this
you will be here
summer 2022 to
correct.

Senior Design & Professionalism I

ELEG 4247- Fall 2021

Final Written Report

Team 3

Submitted By:

Johnn Owens (Team Lead)

Trevor Johnson

Michael Shepard

Osesiye Ayeni

Adeola Okeowo

Instructor: Professor Turner, Dr. Musa

Date of Submission: November 28, 2021

Score = 82%

this paper was
rushed + little
effort. Not what

this team is
capable of.

please see
me to
discuss

Issues:
① writeups not
detailed
② use of acronyms

③ Did not list
figures correctly

④ Project comp
section is
not Sr level

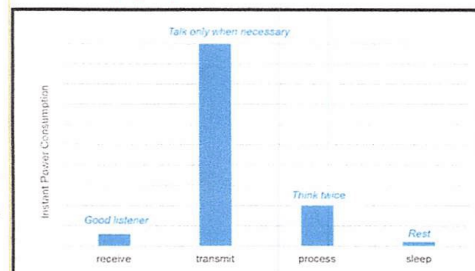
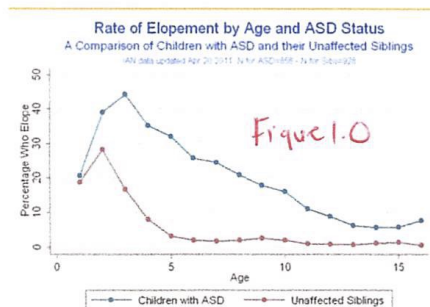
1. What is your team trying to solve/accomplish as part of the Senior Design project?
Provide a clear and concise problem statement. *Very poor + weak*

The main goal of this project is to create an affordable, robust, and effective solution to locate special-needs individuals by investigating viability, performing a feasibility study, and implementing geo-location-based technology in a LoRaWAN (Long Range Wide Area Network) platform. We will be using an android platform that is programmed with Java.

2. Why is your project important? Clearly state its broader safety/environmental/technical/societal/economic impacts. *No mention of purpose or problem you are trying to solve*

Our project is important because it prevents special needs individuals from wandering out of their intended location. This project has a safety, social, economic, and technical Impact.

Social Impact- Our project has a social impact because when special needs children wander frequently, it creates social isolation in autistic youth. According to the Child Mind Institute, various parents stated that wandering is the most stressful autistic behavior. Sixty-two parents of autistic kids stated they kept their kids from participating in any social activities out of fear they would wander off into unsafe environments, increasing social isolation. Forty percent of these already exhausted parents stated that they lost sleep while worrying about a potential escape during the night.



Safety Impact- Our project is a safety impact because it prevents special needs people, especially kids, from wandering into unsafe environments or dangerous situations without knowing where they are located. Statistics show that half of the children with autism between the ages of 4/10 attempt to elope. Out of 808 reported autistics missing person cases of wandering in the United States, seventeen percent ended in death in 2011-2016. The main goal of this project is to reduce these rates using our device.

Economic Impact- Our device is designated to be an affordable method for tracking autistic children. The device uses minimal battery life, and it is made with abundant materials. Our device will also be able to compete with high-tech tracking devices such as Apple or Samsung watches. Our device will be marketed for less than one hundred dollars.

While the write up is good - you did not list your figure (eg Figure 1.0 or Figure 2.0) nor did you reference them in your writeup -3

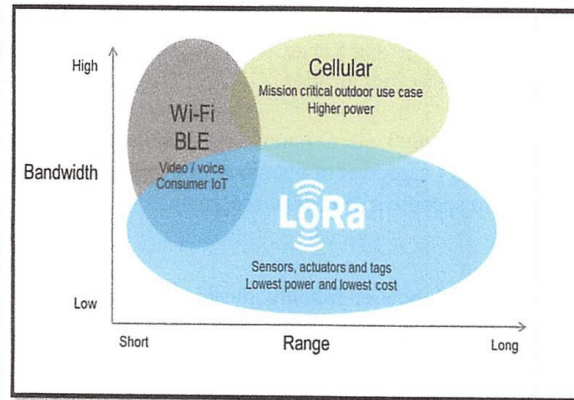


Figure 3.0

Technical Impact- Lorawan is a big part of our project. LoRaWAN creates a broader range of coverage. In an ideal IoT device (Internet of things), data transmission is kept to a minimum to conserve power. LoRa based sensors do not need to pair with a gateway before sending data, limiting energy usage and prolonging battery life.

3. What are the major goals or key deliverables of your project? List the marketing and engineering design specifications or 1:1 solution matrix of your proposed solution. What are your design constraints?

Marketing / Customer requirements, Engineering Solutions, and Justifications

Marketing Requirement	Engineering Requirement	Justification
Reliable and consistent tracking system	Effectively implement LoRaWAN/Cellular technology	Detects individual's location
Alert System through notifications	Implementing geo fencing	Alerts caregiver through a notification once child is out of range
Mobile application interface should be user friendly	Program Android application in Java to have function	Device will be used by multiple individuals simultaneously
Lightweight/Portable	Peripheral Interface Controller (PIC) will fit in case	Device should be small enough to fit on a wristband
Low cost and affordable (No recurring monthly fees)	Internet of Things (IoT) Network System	The device prioritizes safety over profit
Wider coverage than Wi-Fi or Bluetooth	Long range communication coverage up to 10-20 meters implementing geo-fencing	LoRaWAN covers up to 2 miles compared to Wi-Fi (less than 100 meters) or Bluetooth (about 10 meters)
Sufficient battery life will last up to a week on single charge	LoRaWAN platform allows Device to be operated with minimal battery power	The device should be discoverable for enough time to be located
Cyber security considerations for all elements of the system	Secure login to the app or cloud server	Only allow specific network devices (Private Network)

Figure 4.0

What is G3O - Should define Acronym

Whoever wrote this section did a poor job - Little detail, using acronyms - looks rushed

1. The tracking system will be concise and reliable for the most accurate results. By effectively using LoRaWAN (Long Range Wide Area Network) technology, the G3O will pinpoint an individual's exact location.
2. Should the individual wearing the device move outside the desired radius, an alert will be sent directly to the primary caregiver or guardian. The geo-fencing feature in LoRaWAN technology will allow a specific radius to be programmed into the transceiver.
3. The mobile application will be user-friendly, meaning anyone should be able to operate it. It will be programmed in Java to interface with an android device. Multiple individuals will use it, so it should be as simple as possible.
4. The G3O will be lightweight and portable with the idea that a child will wear it. The peripheral interface controller (PIC) should fit in a case about the size of a watch or wristband.
5. The G3O will be marketed at a low cost with no monthly subscription or fees. It will consist of a transceiver and tracker that will connect to a LoRa access point that will communicate with the Internet of Things (IoT) network.
6. The LoRaWAN network has a range of up to two miles outside of its geofence. For this reason, the G3O will not need to use Bluetooth or Wi-Fi that covers up to 10-20 meters.
7. The G3O will use minimal battery power and is functional for up to a week on a single charge. The LoraWAN platform will allow the G3O to be discoverable for enough time to be located.
8. Cyber security measures will be taken to ensure that the G3O is not so easily hackable. The device will require a secure login to the cloud server, and only allowed devices will be admitted to the LoRa private network.

4. What is your proposed solution? Please provide a detailed explanation of your proposed solution.

Deliverables/Objectives / Proposed Solution:

1. Embedded System:

The Steval-STRKT01 microchip will be implemented with geofencing technology to track a specific individual while keeping battery usage at a minimum. The ideal chip will remain in sleep mode for most of its use. The device is designed to wake when it has passed the geofencing threshold. From there, it will transmit a signal to the access point sending its location to the transceiver.

2. Mobile Application:

The application will be designed to function on android devices using Java as the coding language. This is because Java is the most compatible language to collaborate with android devices. The purpose of the code is to establish the desired geofence threshold and interface the android device with the LoRaWAN platform. The LoRa transceiver is what will attach to the android and transmit a signal to the access point. The mobile app will be user-friendly to ensure safety and capable of displaying the latitude and longitude of the individual's location.

3. Access Point:

The LoRa access point will act as a meeting point for the LoRa tracker and transceiver; meanwhile, the access point will serve as a private server linked directly to the IoT cloud. It will also protect the users' personal information from cybercriminals.

5. How did your team arrive at your proposed design? You must show any math or engineering analysis used to guide your design proposal. Which courses in your academic program helped you the most in this specific design project? Explain. Were new skills required? If yes, how did your team members acquire them or planning to acquire them?

Our team arrived at our proposed design after conducting extensive research on our topic and our competitors. We wanted our device to be different from our competitors. That is why we implemented the geofencing feature. Communication theory and Microprocessors and System design were some of the courses that helped with this project. Microprocessors helped us understand the schematics and specific parts we needed and their functions. Communication theory helped us understand how to communicate data over long ranges using low power consumption. Our group had to learn how to use Java for this project. We achieved this by downloading Java and practicing using the sample codes given.

6. What is the competitive advantage of your proposed solution (preliminary design concepts)? Briefly list the advantages and disadvantages of your proposed solution by comparing it with other competing or commercially available solutions/products. Please include your product comparison.

this section was worth 20 pat
+ you put in no effort to
explain the other options

					Service Fee	
G30		1. LoRaWAN Cloud 2. Geofencing 3. Cost-Effective 4. Power- Conservative 5. Range is 2 miles	1. Decreased performance at a remote location	TBD	No Monthly/Yearly Fee	https://www.hackster.io/pulsartronic/diy-smartphone-lora-connection-bde258
AngelSense		1. Two-way communication 2. Only parent can remove it. 3. Wi-Fi tracking	1. Bulky 2. Expensive subscription 3. Battery life lasts less than 24 hours	\$59	\$52.99 Monthly	https://gadgets-reviews.com/review/154-best-tracking-devices-for-kids-watching-your-children-with-the-help-of-gadgets.html
Apple AirTag		1. No monthly Fee	1. Only works on iPhone 2. Uses Bluetooth (30-foot range)	\$30	No Monthly/Yearly Fee	https://ifixscreens.com/apples-airtag-review-pros-and-cons/
Tile Mate		1. Battery life of one year. 2. User-friendly App	1. Doesn't include Geofencing 2. Range is 400 feet	\$30	\$30 yearly	https://www.popularmechanics.com/technology/gadgets/a37245328/best-bluetooth-trackers/

6

Figure 4

10

The advantages of our G30 are that it is lightweight and power-conservative. It offers a geofencing feature that its alternatives do not. Our only disadvantage is that our device requires a cellular signal to transmit its location. The project comparison table above lists the advantages and disadvantages of each competing device. It concludes our product is the best option because of no monthly fee, its extended range accessibility, and the implementation of geofencing.

Poor - very weak should explain each alternative

7. (a) Provide a brief project status update. What has your team accomplished so far? (b) Include a project timeline showing key milestones for the rest of the semester and those needed to complete your project by end of April 2021.

Team 3's project is on track. As far as accomplishments are concerned, we have successfully created an account with the Internet of Things. This will allow us to configure our LoRa gateway to complete the tasks required. We have also undergone extensive research on the code or programming languages necessary to make our project function. On our project timeline shown below, we are currently entering phase 3. This consists of adapting our code to the parts that we receive to begin testing.

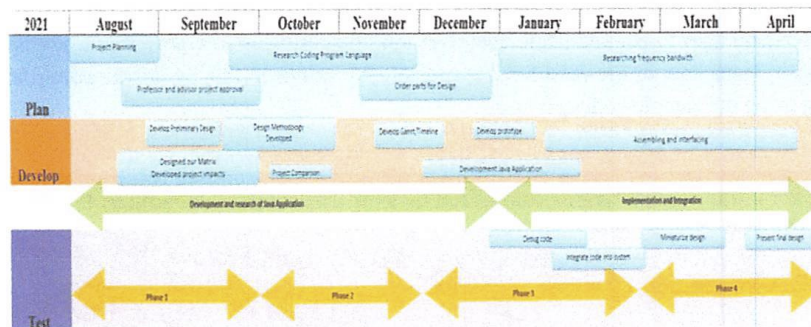


Figure 4

8. How did you perform your literature review? Provide a list of your pertinent references. Provide in the proper format a list of all references as part of your literature review.

We performed our literature review by looking up different websites with as much information as possible about LoRaWAN and the other parts we needed to complete our projects, including the endnote and the gateway. We also received various articles from our advisor that aided us with our project parts and gave us a better understanding of LoRaWAN and IoT networks.

Building a private Lora Network. Building a private LoRa network - API references and tutorials | Mbed OS 6 Documentation. (n.d.). Retrieved November 23, 2021, from <https://os.mbed.com/docs/mbed-os/v6.15/apis/LoRa-tutorial.html>.

What are Lora and Lorawan? The Things Network. (2021, April 29). Retrieved November 23, 2021, from <https://www.thethingsnetwork.org/docs/lorawan/what-is-lorawan/>.

Mortality & Risk in ASD wandering/elopement 2011-2016. (n.d.). Retrieved October 3, 2021, from <https://nationalautismassociation.org/wp-content/uploads/2017/04/NAAMortalityRiskASDElopement.pdf>

Autism plus wandering. Child Mind Institute. (2021, September 26). Retrieved October 3, 2021, from <https://childmind.org/article/autism-plus-wandering/>

Law, P. (2011, April 20). *Ian Research Report: Elopement and wandering.* IAN Research Report: Elopement and Wandering | Interactive Autism Network. Retrieved October 3, 2021, from https://iancommunity.org/cs/ian_research_reports/ian_research_report_elopement

SX1272. Semtech. (n.d.). Retrieved October 3, 2021, from <https://www.semtech.com/products/wireless-rf/lorawan-core/sx1272>

Griffey-Hill, L. (2020, June 2). *ChirpStack - A LoRawan network server to make you sing.* Pycom. Retrieved October 3, 2021, from <https://pycom.io/chirpstack-a-lorawan-network-server-to-make-you-sing/>

9 Do you anticipate any issues in implementing your proposed design solution successfully in a timely manner? If yes, how do you intend to overcome those obstacles?

The main concern we have that could prevent us from completing our design solution is the requisition of our parts promptly. We intend to overcome this by conducting as much research as possible to prepare for any potential setbacks.

Extra Points:

1. Define or describe what is a discretionary project and a non-discretionary project?

Discretionary projects are projects where the management has a choice in implementing clients. A discretionary project does not involve the client actively, and the investment manager takes all the decisions on his behalf. In contrast, a non-discretionary project consists of the client at every step of the project.

No - Discretionary = management has a choice

Non Discretionary = management has no choice must implement

BELOW AVERAGE

Senior Design ELEG 4247

Outcome 3 – Written

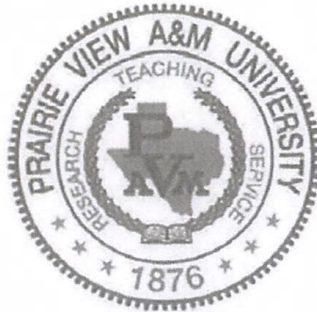
Below Average Example

Written Communications Evaluation Form
ECE Senior Design & Professionalism
Written Communications-Outcome 3

Title of Presentation: Final Written Report ELEG4247						
Team Number and Members: Team 6						
Date of Presentation: 11/28/21						
Name of Evaluator and Affiliation (University or Company name) USF						
	Excellent 99	Very Good 89	Average 79	Below Avg. 69	Poor 54	Comments
Executive Summary						
Able to prepare an executive summary for the report	N-A					
Format						
Able to organize the report e.g. Title Page, and Table of Contents, list of Figures, and List of Tables properly formatted	N-A					Team did not follow direction Combined Question,
Charts and Graphs in the report are well documented, easily understood and referenced appropriately				✓		
Able to show appropriate discussion, conclusions and recommendation			✓			
Able to cite references in the report and provide well formatted reference list at the end				✓		
Able to prepare the written report in accord with the Senior Projects Report Manual and instructor guidance	N-A					
Written Language						
Able to write the report without grammatical errors			✓			TABLE looks poor
Report includes appropriate level of detail and analysis			✓	✗		
Able to write the report in excellent professional style – no unexplained technical jargon or acronyms				✓		
Apply approved standard method to cite references used and in literature review				✓		
Conclusion and Recommendation						
Able to summarize goal objective and indicate if they are met	N-A					Answered bonus question correctly

74

PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING



**iMasons Project: Site Selection and Comparative Analysis for the
Design of a Data Center to Meet Demand**

ELEG 4472: Senior Design & Professionalism I

Written Report

Submitted By:(Group 6)

Isaiah Allen (Team lead) (CE)

Ahmad Yakuba (EE)

John Barrett (EE)

Riley Mallett (EE)

Instructor: Dr. Vewiser Turner

Date of Submission: 11/28/2021

*Score
80
(includes bonus)
See Comments
Attached*

Dear Team 6

My comments

1. This paper is difficult to read – I spent excessively too much time trying to find answers to my questions. NOWHERE in the instructions did I say you can combine questions – I could not interpret with comment was meant for which question.
2. Its very aggravating to hunt for which comments was intended to answer which question / you did not answer in the sequence of the questions plus you combined questions. \
3. Your formatting and writing style is poor, and basis. Take for example page 10 looks like a high school person wrote that page.
4. Your paper lacks pictures, slides, tables and diagrams. You miss opportunities to make it easier on the reader – for example, pic of a server rack or adding in your matrix slide from oral presentation would be an upgrade.
5. In your opening section – you use the word app over and over and over.... No imagination – it should be application / you could also say software, computer program etc to make it more creative and professional.
6. The state scoring table looks horrible.
7. Need to explain the table more and weighting factors
8. Why didn't you include a literature listing?

If you don't follow instructions, make your report more readable, and put in the effort for your Sr Final Paper in the Spring then you will probably get a very low score which might put you below threshold to satisfactorily complete the course.

1. What is your team trying to solve/accomplish as part of the Senior Design project? Provide a clear and concise problem statement. [5 points] -2
2. Why is your project important? Clearly state its broader safety/environmental/technical/societal/economic impacts. [20 points]

Safety – Does the project improve or impact safety in anyway.

Environment – Does the project help the environment in anyway.

Technical – Any new technical or innovation concepts from your project

Society – Does your project help society in anyway (cultural impact)

Economic – Does your project more cost effective, saves money or time

3. What are the major goals or key deliverables of your project? List the marketing and engineering design specifications or 1:1 solution matrix of your proposed solution. What are your design constraints? [10 points]
4. What is your proposed solution? Please provide a detailed explanation of your proposed solution. [5 points]
5. How did your team arrive at your proposed design? You must show any math or engineering analysis used to guide your design proposal. Which courses in your academic program helped you the most in this specific design project? Explain. Were new skills required? If yes, how did your team members acquire them or planning to acquire them? [10 points] -8
6. What is the competitive advantage of your proposed solution (preliminary design concepts)? Briefly list the advantages and disadvantages of your proposed solution by comparing it with other competing or commercially available solutions/products. Please include your product comparison. [20 points]
7. (a) Provide a brief project status update. What your team has accomplished so far? (b) Include a project timeline showing key milestones for rest of semester and those needed to complete your project my end of April 2021. [10 points] -5 Missing status update
8. How did you perform your literature review? Provide a list of your pertinent references. Provide in the proper format a list of all references as part of your literature review. [5 points] -5 no list
9. Do you anticipate any issues in implementing your proposed design solution successfully in a timely manner? If yes, how do you intend to overcome those obstacles? [5 points]
10. Cover Page, Technical Write Up, Grammar, Format, Graphs, Pics, Diagrams, number pages [10 points] -5 - Format Poor, Paper had to read, Table 1 looks high school
11. **Optional Extra Points:** Define or describe what is a discretionary project and a non-discretionary project [5 points] +5 Yes correct but I had to search for it

➔ **Format – start each section with the question being asked. Double space. Font size 12 or 14. (Must be large enough to read) Please use/include charts and graphs to explain or answer. No page limit.**

1. What is your team trying to solve/accomplish as part of the Senior Design project? Provide a clear and concise problem statement. [5 points]

(Enter your response.....)

Terms:

Sims Extra Credit

✓ Discretionary Project: A project where the company has a choice whether or not to undertake the project.

Non-discretionary Project: A project where the company does not have a choice whether to undertake the project.

Chief Financial Officer (CFO): The senior executive of a company who is responsible for managing the financial actions of the company.

Co-location/multi-tenant (colo): A data center space that houses servers and equipment from many different companies.

Point of Presence (PoP): A physical location where two or more networks share a connection.

Uninterruptible Power Supply (UPS): An electronic device that uses an internal battery to store power and then in times of need can use the battery to power the electronic devices connected to it.

Infrastructure as a Service (IaaS): A type of service that provides networking, storage, and compute resources as needed.

Bandwidth: The rate of information transfer that can be carried by a communication channel.

Thank you for the glossary of words -
Best practice would be to also spell it
out in the writeup once so reader
will understand how it applies & not have
to go back n forth

1. What is your team trying to solve/accomplish as part of the Senior Design project? Provide a clear and concise problem statement.

Project Problem Statement

ACME Paint is a large, well-financed paint manufacturer serving a global market. In 2017 ACME launched a new, free mobile app in the United States market to help building owners choose paint colors. The user can take a photo of their building or room and digitally try different paint schemes, estimate the amount of paint needed, and order the paint online. The app was initially hosted on a major IaaS public cloud platform. The app caught on, and the user base grew. In 2019 ACME began augmenting the cloud-hosting by leasing space in colo data centers housing ACME-owned servers. And, use of the app has continued to grow in the U.S. and globally. At this point, almost 50% of the company's paint sales come through the app. ACME's CFO has recently been questioning the expense of the cloud and colo services, especially with the forecast of user growth. The CFO has asked our team to develop a comprehensive proposal to build and operate their own data center(s) to host the growing demand in the United States, to use as a cost comparison to the continued and growing expense of the cloud and colo services.

This was written by a "techie" - used to many shortcuts & acronyms. Used to much technical lingo not professional.

Scope Purpose

This project is to create a detailed budget report to build and maintain the digital infrastructure required to support the operation of a business' mission-critical mobile app. The primary location will be on the east coast to reach the most users, with a secondary site placed nearer to the west coast that will help keep the whole United States within a 50-millisecond latency tolerance. The data center facility will store user data, such as payment information, photos, and user-generated paint color schemes that users have saved to the app. The data center will also provide graphical

processing power for the app when the users apply new paint color schemes to their photos.
Therefore the data center resources will have to be designed with this specialty workload in mind.

4. What is your proposed solution? Please provide a detailed explanation of your proposed solution.

3. What are the major goals or key deliverables of your project? List the marketing and engineering design specifications or the 1:1 solution matrix of your proposed solution. What are your design constraints?

(3 & 4 are answered below)

No where in the instruction did I say you can combine question - I cannot grade & search for your answer

Deliverables/Objectives/Proposed Solution

1. Location

We will focus on a location on the east coast that can accommodate what we are looking for in the following areas. (We will place another site near the west coast to allow for full United States coverage, but it is not the focus of the project)

I don't understand - under Scope p92 you claim to do this for latency

- Power

The company wants its data center to run on 100% renewable energy by the year 2025. Therefore we will only consider locations with sources of renewable energy. We will need to install enough battery storage to supply the data center with power during grid outages or when the grid does not provide enough renewable energy. We will give preference to any location with access to multiple grids that can supply renewable energy as the two independent grids will increase the ruggedness of the

overall design of the data center to sudden grid outages. Generators will be needed for unexpectedly long power outages.

- Bandwidth

Enough bandwidth needs to be sourced from the ISP so that the expected concurrent users will not experience large queuing times, which would lead to higher ping times.

*not in your glossary +
? why you should
spell it out
once*

2. Cabinet Design

Server/Equipment

Our design will be modular with a set number of servers in the initial startup of the data center that will accommodate the initial user base; this includes the secondary location. Still, the project will focus on the primary site. Then using the modularity of the design, we will roll out new servers to accommodate the user growth as needed. Initially, in 2022 when the data center goes live, the primary and secondary locations will have to supply service to an estimated five million users. Then in 2023, that will grow to twenty million users. Then finally, to sixty million users in 2024.

3. Price

We will be giving the price the highest priority. Since this project has no upper bound on the design cost, we will minimize the costs as much as possible. This objective is because the goal is to show whether it is economical to build and operate a private data center versus renting space in a colo data center.

Constraints

1. We will not be able to build and test this design physically. (Not enough time or budget).
2. We have to take a good portion of our sources at their word (i.e., energy costs, cutbacks, power efficiency).
3. There is no software available to simulate a data center workload, and therefore we cannot run any software simulations to test the design of computational and bandwidth resources.

why didn't you include your picture of MATRIS?

Marketing / Customer Requirements, Engineering Solutions, and Justifications

1. This data center will provide low latency connection to the whole of the United States (< 50-milliseconds). To accomplish this, we will place the data center in a zone that offers latency under the 50-millisecond threshold for as much of the user base as possible. Doing so will also allow us to utilize the full functionality of the already available fiber framework. This site should be near a highly-populated area.
2. This data center should be able to receive and transmit about 3 Megabytes of data per interaction. To do this, the data center will source enough local fiber bandwidth to supply the concurrent users with interruption-free usage. Interruption-free usage is needed as this is the background for an application with which customers will be directly interacting. Any downtime or lag gives for a bad user experience which would, in turn, reflect poorly upon the company.
3. User data is vital to this business ranging from user payment information to the various photos stored on the platform for later use. To prepare for this data, we will build storage

infrastructure into the design. Providing this storage will allow the users not to store their data on their phones but instead on our servers. Doing so will provide a better user experience as the user's local storage space is not consumed by using the app.

4. Our Data Center must be able to grow for an estimated 60 million users by 2024. To not waste resources at any point in the project, the design of the Data Center will be modular, allowing for additional resources to be rolled out at a later date. Doing so allows the data center to support any current user base and gives the ability to expand quickly and efficiently to meet future growth goals.
5. The total capital and operational expenses should show that it is more economical in the long term to build, operate, and maintain a separate private data center. We plan to do this by taking advantage of the modularity of resources and the user growth by performing a systematic rollout of resources. The initial capital and short-term operational expenses can be kept low by rolling out resources only when needed. Doing so allows for the long-term monetary benefits of ownership to dominate. Emphasizing the economic benefits of ownership should show that it is more economical to build and own a data center than rent space in a colo data center.
6. This data center must be cheaper than the existing colo solution and have a 99.999% uptime. To achieve this, we are opting to build two Tier III Data Centers and connect them to a PoP with fiber optic cable to share data between them, allowing for seamless

operation. This solution gives us an uptime within our acceptable range, and it should be cheaper than running a massive tier IV Data Center.

7. The last requirement we have is that our Data Center must reach 100% renewable energy by 2025. We are looking for sites with existing renewable energy programs and incentives; this makes it easier and cheaper to reach our green energy goals by working with the already existing electric grids.

Acceptance Criteria

1. **Location**

- a) Power: 100% renewable energy by 2025. Tolerant of grid outages and brownouts.
- b) Fiber: Must be able to meet the concurrent user demand while remaining within the latency tolerance.

2. **Design**

- a) Storage: 500 megabytes of storage for each user to store their photos and color schemes. (About enough for 200 photos, with each photo being about 2.5 MB in size)
- b) Computing Power: Enough graphical processing power to keep up with the concurrent user demand; this means that the images will need to be processed quickly enough so that on the return trip to the user, it does not break the 50-millisecond latency threshold.
- c) Power: Each cabinet will need to have UPS's so that any power flickers or brownouts will not interrupt the server function.

- d) Uptime: The system should maintain a 99.999% uptime.

Assumptions

1. User Growth Data is constant and accurate.
2. Environmental cooling will have a real tangible positive impact on data center performance.
3. The users are within the United States.
4. The users are not on unreliable wifi or cellular data networks, which could cause poor latency performance.

2. Why is your project important? Clearly state its broader environmental/economic impacts. *Why is Question #2 behind Question 3-4?*

Impacts

- Environmental - Data centers are responsible for a large percentage of the global energy demand, and this percentage is growing as more data centers are being built. Therefore it is important to keep the environment in mind when designing one. If a data center is going to use a large amount of energy it would be best for the environment if it was renewable energy and not energy made by fossil fuels.
- Economic - This project has a large impact on the financial future of the ACME paint company. Data centers are very expensive to build and are expensive to upkeep and operate. However, they also have the potential to bring in large profits.

6. What is the competitive advantage of your proposed solution (preliminary design concepts)? Briefly list the advantages and disadvantages of your proposed solution by comparing it with other competing or commercially available solutions/products.

Please include your product comparison.

Project Comparison

*This section worth 20 points +
was horrible to follow !!*

This Project is in the Data Center realm and within that realm, the main method of comparison is amongst the various tiers of Data Center. These tiers go from least fault-tolerant to most fault-tolerant with a Tier-4 Data Center having maximum redundancy. Colocation Data Centers will also be included here so as to fully describe the whole of options that are available for those who need data storage services.

1. Colocation

This Data Storage Method is not fully privately owned and involves paying for rack-space in a location owned by a separate owner of the data center who then charges according to various factors.

Advantage

This Option has a low upfront cost and does not require any sort of buildup to get storage capability.

This Option also has no maintenance cost which is a requirement for any Tier of physical Data Center.

*? Very Hard
to Read*

Disadvantages

This Option has a wide variety of costs that are uncontrollable for those seeking this option. This rent or subscription-based system has people buy in and continue paying these users are subject to price fluctuations not under their control.

Security is another problem as with your information being among others it can easily be accessed by malevolent people as compared to a privately owned Data Center.

2. Tier-1 Data Center

This is the lowest Tier of Data Center and has minimal redundancy and is a physical location.

Advantage

Cheapest data center design.

Disadvantages

No redundancy. Uptime will not meet project requirements. Requires maintenance for the physical location

3. Tier-2 Data Center

Second Tier of Data Center and has some redundancy factors that help with uptime

Advantage

Cheap in comparison to the higher-tier data centers.

Disadvantages

Not much redundancy. Will not meet the uptime requirements required for the project.

Maintenance costs.

4. Tier-3 Data Center

3rd Data Center Tier and is ultimately the option that will be implemented amongst the other factors that will enable this Data Center to meet our uptime requirements.

Advantage

Has a fair amount of redundancy. Cheaper than a tier-4 data center

Disadvantages

Costs more than lower-tier data centers. Does not have as much uptime as a tier-4 data center. Maintenance costs.

5. Tier-4 Data Center

Best quality official tier of data center; only outclassed by the unofficial tier-5 data center that the company Switch invented and builds.

Advantage

Lots of redundancy. The most reliable single data center.

Disadvantages

Very expensive. Typically needs to be very large to fit all the redundant hardware. Maintenance costs.

5. **How did your team arrive at your proposed design? You must show any math or engineering analysis used to guide your design proposal. Which courses in your academic program helped you the most in this specific design project? Explain. Were new skills required? If yes, how did your team members acquire them or are planning to acquire them? [10 points]**

I did not say you can combine topics?
7. (a) Provide a brief project status update. What your team has accomplished so far?

(b) Include a project timeline showing key milestones for the rest of the semester and those needed to complete your project by end of April 2021. [10 points]

(5 & 7 are answered below)

Status Update

Digital Analysis
After considering several states that looked promising, we have decided on placing the data center in Minneapolis Minnesota. We have come to this conclusion by weighing the incentives that the state/city has as well as the resources that are available in that location. The higher the final score from Table 1 the better.

Table 1: State Scoring Matrix

State	Fiber Availability	Power Availability	Power Price	Renewable Energy	Latency	Land	Labor	Natural Disasters	Tax Incentives	Climate	Score
Michigan	30	40.75	70	8	75	24	95	60	0	16	33
Texas	44	25	75	22	62.5	54	76	70	50	2	43
Minnesota	53	81.5	70	26	50	52	78	60	100	16	56
Calif	36	50	60	32	25	16	72	40	0	15	32

This Table is Horrible

this is not senior level work

ornia											
Washington	59	75	80	9	12.5	36	50	40	50	21	45
Virginia	52	31.25	70	5	100	28	70	40	50	9	43
Nevada	25	48.75	75	24	37.6	92	76	70	50	10	42
Massachusetts	44	50	60	15	87.5	8	74	60	0	17	35
Category Weight	0.2	0.05	0.15	0.15	0.05	0.025	0.05	0.025	0.15	0.15	

A map of the service area for the planned data center is currently being created so that the service plan can be finished.

Frustrated! You did not explain the categories + how they are weighted or why some category was weighted differently -

13

Future Timeline

? Where is the status report?

Task	Start	End
Service Plan	11/28/2021	01/18/2022
Hardware Design	12/12/2021	02/01/2022
Power Design	01/18/2022	02/15/2022
Networking Design	01/18/2022	02/15/2022
Cooling Solution Design	01/18/2022	02/15/2022
Detailed Budget	02/15/2022	04/30/2022

8. How did you perform your literature review? Provide a list of your pertinent references. Provide in the proper format a list of all references as part of your literature review. [5 points]

Literature Review

A large part of our literature review has been in the form of lectures. These lectures are performed by various industry mentors, sometimes panels of industry mentors. The lectures are generally about a topic that is pertinent to the area of the design that the group is currently undertaking, and time is left at the end so that any questions that the group needs to be answered can be asked. Outside of the lectures, the industry mentors have also included a library of papers

and PowerPoint presentations that are useful to the project. The industry mentors have also been very helpful when asked, outside of the lectures, for information; being able to provide resources and answer complex questions. Literature outside of the aforementioned sources have been mostly from governmental websites and national agencies. Examples of this would be data pertaining to the availability of tax breaks given to data centers in different states, or the availability of renewable energy in different states.

Where is your list of references?

9. Do you anticipate any issues in implementing your proposed design solution successfully in a timely manner? If yes, how do you intend to overcome those obstacles?

[5 points]

Concerns

There are a couple of concerns with completing the project on time. We have received feedback from the industry mentors (iMasons team) that we are behind schedule. They expected the service map to be completed and a plan of service distribution. The service area for the planned data center is currently being created and should be finished right after final examinations are finished. From the service area map, a service distribution plan can be made. This plan would take the form of any tertiary data centers that need to be placed, or if a colo solution for those would be sufficient so that the whole of the United States can receive timely service. This should be sorted out by the end of the winter holiday. Another concern is that the original plan for the project includes the physical design of the building, which should be taken care of by the architecture students who were supposed to also be on the team. As it stands this part will most likely not be completed as none of the members of the team are trained in building design. The

industry mentors seem to understand this and are trying to get architecture students on the team, but have currently been unsuccessful. This might affect what can be shown at the end of the project, if a building is not designed for the project there won't be anything to display for it and the pricing of the construction would not be as accurate