FAMU/FSU College of Engineering

Department of Electrical and Computer Engineering

Final Report

Team 304: FPL ATS Training Application

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Abstract

Florida Power and Light (FPL), a branch of NextEra Energy Inc, has recently introduced a new device into their systems to help reduce the amount of power outages, called the Automatic Transformer Switch (ATS). The ATS makes sure that electrical power is continuously flowing by using a system that can detect faults. When a power outage occurs, the system identifies temporary faults using the ATS and restores them. If it is not a temporary issue, an employee will have to come out and check the ATS. With the recent impact of the COVID-19 pandemic, it's challenging for FPL to offer safe, in-person training to their employees. Instead, they are creating more virtual training opportunities. FPL has tasked us with designing a Virtual Reality (VR) training application that can train their employees on the ATS.

Our remote training solution is an iPad application that will teach the employees about all the aspects of the ATS. The application will contain educational tools including videos and documents on safety procedures. It will teach them how to use the ATS and perform maintenance on it. The application will also allow employees to practice what they have learned by simulating the procedures on a 3D model. It would be very similar to interacting directly with an ATS device. The app will take them through all the information they need to know, and quiz them throughout. It will show them any wrong answers, so they know what areas they need to improve in.

Disclaimer

Unless otherwise indicated, the Application is proprietary property of Florida Power and Light and all source code, databases, functionality, software, website designs, audio, video, text, photographs, and graphics on the Application (collectively, the "Content") and the trademarks contained therein (the "Marks") are owned or controlled by Florida Power and Light or licensed to us, and are protected by copyright and trademark laws and various other intellectual property rights and unfair competition laws of the United States, foreign jurisdictions, and international conventions.

Acknowledgement

A very big thank you goes out to all involved, including but not limited to our Florida Power and Light Liaisons: Genese Augustin, Troy Lewis and Kyle Bush, our faculty advisor: Dr. Reginald Perry, and the Senior Design coordinators: Dr. Chuy and Dr. Hooker. Thank you all for a wonderful year and for all of the insight and help throughout the process.

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Chapter 1: EEL 4911C

Project Scope

Project Description: The scope of this project is to create a user-friendly and intuitive virtual application that correctly trains and tests Florida Power & Light employees on how to perform maintenance on an ATS (Automated Transformer Switch). In the event of ample excess time, a similar application for training on an ALS (Automated Lateral Switch) will be designed.

Stakeholders: The stakeholders for this project are the FPL employees who will be utilizing this training application.

Markets: Students in vocational/technical schools, employees of electric/utility companies that will be professionally utilizing ATS/ALS equipment, manufacturers of the ATS/ALS equipment, and manufacturers of similar equipment.

Assumptions: The team is making the assumption that the user has background knowledge and experience in dealing with electrical components, especially the ATS/ALS.

Customer Needs & Requirements

Table 1: Customer Needs

Identifier	**Need**	**Source**
N1	Train FPL employees on ATS maintenance procedures	Cust.
N2	Conduct training in a virtual manner	Cust.
N3	User-friendly/intuitive	Cust.
N4	Interactive experience	Cust.
N5	Easily distributed among FPL employees	Cust.

Table 2: Requirements

Identifier	Requirement	Need(s) Met
R1	Educate on ATS components and their functions	N1
R2	Educate on ATS maintenance & troubleshooting procedures	N1
R3	Final design is an iPad application	N2, N3, N5
R4	Simulate ATS maintenance & troubleshooting procedures	N1, N2, N3, N4
R5	Assess the users knowledge & provide feedback	N1, N4
R6	Provide feedback during simulations and assessments	N1, N3, N4
R7	Simulation behaves and appears like real life experience	N1, N3, N4
R8	Allow user to freely interact with ATS	N1, N2, N3, N4
R9	Enable user to request information on ATS components	N1, N2, N3, N4
R10	Demonstrate opening and closing of switch procedures	N1, N2, N3, N4

Functional Decomposition

Table 3: Cross-Reference Table

<table>
<tr><td>Level 0</td><td colspan="8">Training</td></tr>
<tr><td>Level 1</td><td colspan="8">Educate the User</td></tr>
<tr><td>Level 2</td><td>Inform user of ATS hazards and warnings</td><td colspan="3">Display Virtual model of ATS</td><td colspan="2">Instruct user of proper maintenance procedures</td><td colspan="2">Instruct user of proper troubleshooting procedures</td></tr>
<tr><td>Level 3</td><td>Display all necessary hazard information</td><td colspan="3">Inform user of ATS functionality and components</td><td>Define situation in which maintenance is required</td><td>Demonstrate proper steps to be taken</td><td>Define situation in which troubleshooting is required</td><td>Demonstrate proper steps to be taken</td></tr>
<tr><td>Level 4</td><td></td><td>Identify ATS components</td><td>Explain functionality of each</td><td>Demonstrate executing various functionalities</td><td></td><td></td><td></td><td></td></tr>
</table>

Table 3 Continued:

Level 0	Training continued								
Level 1	Provide Immersive experience					Assess the user			
Level 2	Allow user to freely interact with ATS	Simulate maintenance procedures		Simulate troubleshooting procedures		Evaluate theoretical knowledge		Evaluate practical knowledge	
Level 3	Enable user to request information on ATS components	Prompt maintenance scenario	Ensure proper steps are taken	Prompt troubleshooting scenario	Ensure proper steps are taken	Prompt user to demonstrate knowledge	Assess user input	Prompt user to demonstrate knowledge	Assess user input
Level 4	Display requested informaton		Provide feedback		Provide feedback		Provide Feedback		Provide Feedback

Table 3 Continued:

Level 0	Manage Information						Virtual Interaction			
Level 1	Store User data	Record user's training process	Grant User access to personal data		Protect internal data values	Allow data modification	Provide virtual environment		Acquire User input	Generate user input
Level 2			Return correct value	Modify Data			Design virtual components		Interpret user input	Receive internal feedback values
Level 3							Design 3D models	Render 3D models	Correctly store internal value	Display feedback to user
Level 4										

Figure 1: Functional Decomposition Function Tree

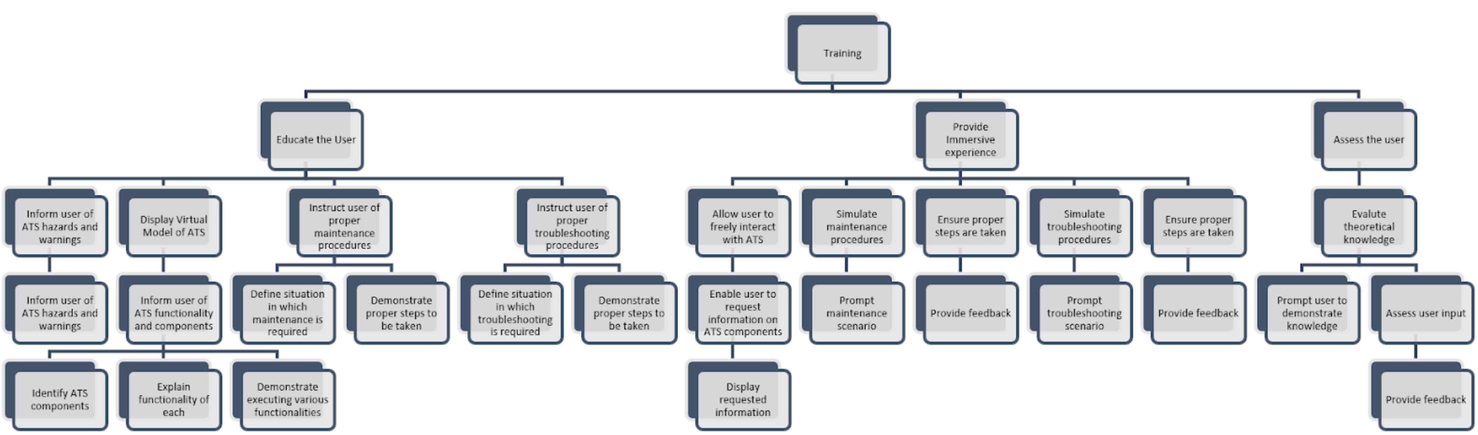
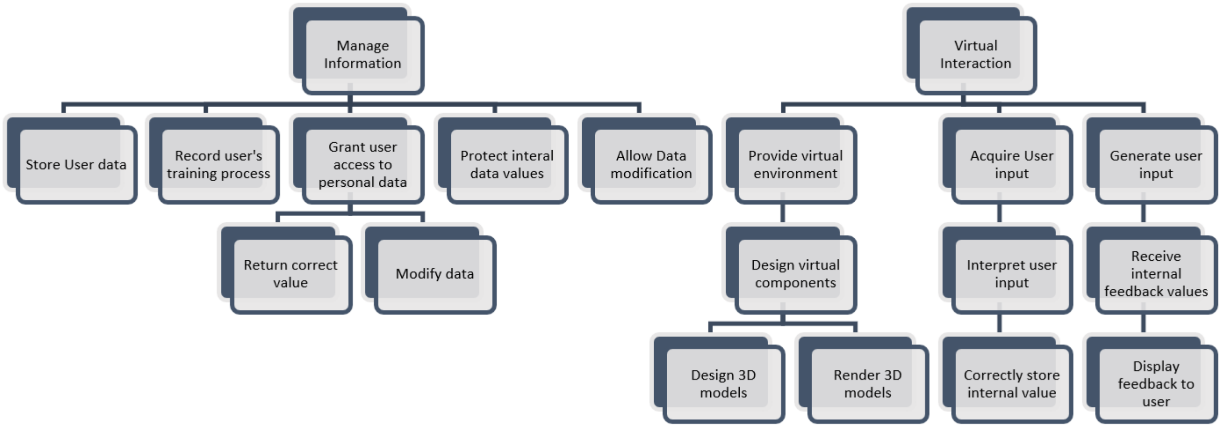


Figure 2: Functional Decomposition Function TreeContinued



Target Summary

The targets and metrics identified were generated to identify the main functions and procedures that the application will contain, as well as a method to verify completion of each target. Many of the targets are direct functions that the application must perform as relayed to the team by Florida Power and Light, with others being inferred or being necessary targets in software development. In a broad sense, the application must educate and simulate various ATS maintenance and troubleshooting procedures. These generalized functions were broken down into the different procedures that must be included within the application and a target was made for each. The outlined targets and metrics will provide the team with various functions that we must include within the final design and also assist in future procedures such as concept generation. The target catalog on the next page includes all of the discussed targets, metrics, importance and method of validation.

Concept Generation

Table 4: Medium Fidelity Concepts

(Highlighted in Yellow)

Production Methold	IDE	3D Modeling Software	Delivery Method	Screen Design	Assessments
Unity	JetBrains Rider	AutoCAD	IPad App	Home/Menu Screen	Multiple Choice
Unreal Engine	Visual Studio	Maya	Android App	Test Statistics Screen	Matching
Google App Engine	Atom	Fusion 360	iPhone App	Splash Screen	Scenario Based
GameMaker	Xcode	Sketch Up		Separate Apps	Fill In the Blank

Table 5: High Fidelity Concepts

(Highlighted in Light-Blue)

Production Methold	IDE	3D Modeling Software	Delivery Method	Screen Design	Assessments
Unity	JetBrains Rider	AutoCAD	IPad App	Home/Menu Screen	Multiple Choice
Unreal Engine	Visual Studio	Maya	Android App	Test Statistics Screen	Matching
Google App Engine	Atom	Fusion 360	iPhone App	Splash Screen	Scenario Based
GameMaker	Xcode	Sketch Up		Separate Apps	Fill In the Blank

Concept Selection

In conclusion based on the charts in conjunction with the customers needs/requirements and from the Pugh, Pairwise Comparison and AHP charts that using Unity and Maya as the design options is the most logical in this case.

Table 6: Engineering - Customer Tradeoff Matrix

Customer Needs		Engineering Requirements: Educate on Components & Functions	Educate on Maintenance & Troubleshooting	iPad Application	Simulate Maintenance & Troubleshooting	Assess Knowledge & Give Feedback	Simulation is Real Life Experience	Free Interaction w/ ATS	Allow Information Requests	Demonstrate Switch Opening & Closing
		+	+	+	+	+	+	+	+	+
ATS Maintenance Training	+	↑↑	↑↑		↑↑	↑	↑↑	↑	↑	↑↑
Virtual Environment	+			↑↑	↑		↑↑			
User-Friendly/Intuitive	+			↑	↑↑		↑↑	↑	↑↑	
Interactive Experience	+			↑	↑↑	↑	↑↑	↑↑	↑↑	
Easy Distribution	+			↑↑						

Table 7: Engineering - Customer Tradeoff Data

	Unity/Auto-CAD	Unity/Maya	Unreal/Auto-CAD	Unreal/Maya
Cost (1)	-1	1	-1	1
Ease of Use (2)	0	1	-1	0
Implementation (4)	1	0	1	0
Versatility (3)	0	1	0	1
Score	3	6	1	4
Continue	No	Yes	No	Combine

Based on the two charts it supports the decision. Using both Unity and Maya together it meets the customers needs the best because Unity's and Maya's ease of use, cost and versatility outweighs the how well Unreal and Auto-CAD are when it comes to implementing this project. Maya and Auto-CAD are rendering softwares that come from AutoDesk. Both Maya and Auto-CAD can render the ATS in 3D. Auto-CAD will be able to render the ATS with much more detail than Maya but Maya is able to export assets as FBX files that Unity and Unreal can recognize. Auto-CAD can do the same but it will have to be rendered in low resolution and the file will have to be converted for Unity and Unreal to recognize. Unity and Unreal are game design engines both are free to use. Unity is much easier to use and has extensive tutorials to help beginners get into game development while Unreal is the more professional engine that alot of top Game companies used in implementing their game. Unreal will do a better job at implementing the virtual environment and training exercises than Unity but the learning curve on Unreal is so steep that the negatives out way the positives. Unity is a good mix of "Ease of Use" and such a slight drawback when it comes to Implementation that it is the more preferred engine. Plus Unity can develop apps and games for almost any OS that is out there.

Spring Project Plan

1. Review Customer's Needs
    - Review documentation from interview
    - Review all requirements
    - Review official customer documentations of needs and requirements
2. Code Initial Design
    - Design ATS using Maya
    - Animate ATS using Unity
3. Updated Risk Assessment
    - Look over the Risk that are involved in the project
4. Design Review 1
    - Go over where we are at so far in the project
5. Design Training Simulation
    - Animate Simulation based of customers needs
    - Show the important parts of the ATS
6. Design Training Assessment
    - Form Questions based off Customers needs
7. Testing and Validation
    - Test to see if the Simulation is working
    - Test if the Simulation is passable
    - Add a grading module
    - Allow user to review answers after testing
8. Design Review 2
    - Go over where we are at so far in the project
9. Code Menu Functionality
    - Create a menu
    - Divide Program in 3 parts
        i. Training Video
        ii. Simulation
        iii. Assessment

10. Scholarship in Practice
    - Merge the Simulation and Training
    - Test if the program is fully working
    - Remove noticeable bugs from software
    - Improve on design
11. Operation Manual
    - Instructions to accompany project
12. Final Presentation
    - Show all the results from the project
13. Prototype Demonstration
    - Demonstrate how the Simulation works
14. Final Report

Table 8: Work Breakdown Structure:

Ref #	Task Name	Task Description	Deliverables/checkpoints	Duration	People	Resources Needed	Dependencies
1	Review Customer's Needs	Review what the customers wanted in the simulation and form an initial design based off the needs and requirements	Knowledge	1/11 - 1/15	All	PDF given bv the customer	Customer needs and requirements information provided
2	Code Initial Design	Create initial design of the ATS using 3D modeling software i.e Maya, and Code the initial animations of the ATS using a game design engine i.e Unity	3D Model of ATS, Animated ATS	1/18 - 2/15	Chris / Max	Laptop / Computer, Maya, and Unity, JetBrain	On how the ATS looks and how each part of the ATS moves
3	Updated Risk Assessment	Look over the Risk that are involved in the project	PDF	1/25- 1/29	All	Computer, Word Processor	Revised assessment of the risk involved in the project
4	Design Review 1	Go over where we are at so far in the project	Powerpoint	2/1-2 /5	All	Computer / Powerpoint	Information given on where we are in the project
5	Design Training Simulation	Animate the 3D model of the ATS to imitate the moving parts of a real ATS	A simulation that shows how the ATS works	2/15 - 3/1	Chris / Kevin	Unity	Based on the knowledge of what each part of the ATS does and how the ATS will look in different times during maintenance
6	Design Training Assessment	Form Questions that will test the user on how to perform maintain	Training exercise that will test how to perform	3/1 - 3/6	Kaitlyn / Alexis	Pen and Paper	Based on what the customer requires that the users needs to

		on the ATS	maintenance on the ATS				know to perform maintenance
7	Testing and Validation	Test to see that the Simulation is working properly, check to see if the simulation is passable, and remove obvious bugs in software	A more clean and module code for the training Assessment	3/1 - 3/6	All	Laptop / Computer, JetBrain	How well the design of the training assessment was made
8	Design Review 2	Go over where we are at so far in the project	Powerpoint	3/8 - 3/12	All	Computer / Powerpoint	Information given on where we are in the project
9	Code Menu Functionality	Design a menu that will split the program into 3 main parts: Training Video, Simulation, Assessment	A menu that will divide the program into 3 parts	3/8 - 3/22	Kaitlyn / Chris	UI Software	On the size of the Ipad screen
10	Scholarship In Practice	Merge all code together to make the final design, make sure that all parts are working properly. Check that there aren't any bugs in the software, improve design if time allows it	A final Design that starts from the menu and user can move from each section seamlessly	3/22 - 3/26	All	Laptop / Computer, Maya, and Unity, JetBrain	How well the other parts prior were designed
11	Operation Manual	Instructions to accompany project	PDF	3/29 - 4/2	All	Laptop / Computer	A thorough set of instructions on how to use the app
12	Final Presentation	Show all the results from the project	Poster	4/5 - 4/9	All	Computer / Powerpoint	Information given on the final wrap-up of our project.

13	Prototype Demonstration	Demonstrate how the app and simulation works	Presentation	4/19 - 4/23	All	Computer / Powerpoint	Demonstration that shows all the functions of the app
14	Final Report	Report on the project	PDF	4/19 - 4/23	All	Laptop / Computer	Final report including all the details of the project

Chapter 2: EEL 4914C

Restated Project Definition and Scope

Project Scope

Project Description: The scope of this project is to create a user-friendly and intuitive virtual application that correctly trains and tests Florida Power & Light employees on how to perform maintenance on an ATS (Automated Transformer Switch).

Stakeholders: The stakeholders for this project are the FPL employees who will be utilizing this training application.

Markets: Students in vocational/technical schools, employees of electric/utility companies that will be professionally utilizing ATS equipment, manufacturers of the ATS equipment, and manufacturers of similar equipment.

Assumptions: The team is making the assumption that the user has background knowledge and experience in dealing with electrical components, especially the ATS. Furthermore, it is assumed that the user will know how to install the ATS, as the application will only cover maintenance and troubleshooting procedures.

Results

User Interface

The user interface consists of a menu based scheme that is responsive through the user via buttons. The primary menus included are the main menu, the menu for each module, the documentation menu, the videos menu, and the playground menu. Each menu offers the ability for the user to progress within the application or return to the main menu. The buttons are each labeled with their functionality to provide clear instructions to the user on how to progress through the application.

Documentation Menu

The documentation menu contains five buttons that each link to a different informative document provided by FPL about the ATS. When you click on a button, it will open the document as a PDF in the web browser on the iPad. The five documents contain in depth information about the ATS description, operation, and troubleshooting procedures.

Animations

Creating a 3D model of the ATS was one of the most important parts of this app. Having a 3D model that can move will help the user understand more about the ATS and how it works. For the 3D model, simple shapes were chosen to represent each part of the ATS. A large rectangular block was used to show the made part of the ATS, a smaller green rectangular block to represent the switch, a yellow square to represent the valve and two small spheres that were turned into a green and red LED to represent the light that shows if the ATS valve is open or closed. To get these blocks to move, a script of code was made to control each animation. When the ATS is stationary a RED LED will shine at the bottom to indicate that it is in the off state, the valve will be parallel with the red block to show that the valve is close and the switch will be in a -45 degree angle. When ATS switch is which clicked on will rotate in a 90 degree angle to enter into the "OPEN" state, while the switch is rotating the valve will also rotate so that it is perpendicular to the red block, the RED LED shuts off and the Green LED flashes to show that it is open.

Video Players

The video players that the team chose to include in the application are very simplistic. The team chose to implement only a few options within the modules. Those being a play , stop, and exit button. However, we felt these functions were all that was necessary for what we needed to do within the application in regards to the videos. The video players run in 2 different fashions for each of the desired modules containing the video players. The video menu runs the videos at run time but lets the user be flexible since they are not assessed in this part of the application. Here the user may freely scroll through the menu by clicking on the progress bar at the button which lets them skip or rewind at their leisure. They are also able to access any video at any time and watch only the content the user chooses to.

The storyboard implementation of the video player works a bit differently. Though the video player works and runs in the same fashion. The user is only able to pause and play the video at run time but cannot rewind or scroll through the video like the menu implementation. Once the video is completely watched, only then will the quiz for the module be unlocked.

Discussion

Going into the project the sponsor gave a list of specific things that the app had to have and what they were expecting from the app. The results in the end fulfills the customer's needs and requirements.

Creating an user interface so that the app can be easily navigated was a great choice in the end because it allowed all the other parts of the projects to be added seamlessly, one of the parts was the documentation, the customer requested that important documents explaining health and safety of the ATS should be added into the app. Adding a document reading into Unity is very complicated, but with the implementation of the UI the documents can be viewed by clicking on a button that will send the user to a link that will display all the documentation needed.

One of the functionalities that FPL will most likely need is how to interchange some of the linking between the modules and their specified documents/videos as well as adding to them. For the linking of all of our images, documentation, and videos we used a class called “ResourceClass”. This object oriented style type of script easily creates objects by linking the pathing information to the specific target. In order to alter the videos and/or documents that are opened, the programmer will simply need to change out the mp4 file or URL link that is attached to the object and change out the string to make a new title for the module. For our canvas images, which we used to improve the UI, we used different sprites. These different sprites can be found in the “Resources/Sprites” folder and more sprites can be easily added to this folder. Changing the png file linked to the object will also change the sprite image attached to that functionality(ex. A button).

The Animations on the other hand were done separately, a 3D model was required to show what an ATS looks like and give users an opportunity to interact with the ATS, the results didn’t exactly meet the expectation but they delivered on all of the needs and requirements.

Testing the user on their knowledge on the ATS is difficult if documents are only provided, so having a visual medium to allow users to watch videos about different safety protocols about the ATS is helpful. This is why adding a video player to the app was important and the results were better than expected, each video works perfectly and can be controlled with a scroller.

Conclusion

Overall, the project was a success. The main objective of this project was to develop a proof of concept for Florida Power and Light. This proof of concept provides a new application idea on how FPL can train its employees in a virtual manner. The main targets of including documentation, videos, an interactive component and an assessment module were all completed and the user is able to obtain a lot of information about the Automatic Transformer Switch through use of the application. The project was completed using all the various steps in the engineering design process. Starting from a customer statement, the needs and requirements were derived and served as the starting point. A roadmap that first laid out how the project would be constructed was first conducted followed by the technical implementation. There is future work that could be done in order to make the application more robust in training FPL employees, but as it stands, the application successfully implements the customer needs and requirements.

Future Work

The main shortcoming of the application is the 3D model of the Automatic Transformer Switch. In the future, it would be desirable to construct a "real-life" model of the ATS for better training of the product. This is an obstacle as S&C (the manufacturer of the ATS) will not provide technical drawing or an already defined 3D model due to intellectual property concerns. The suite of animations provided in the applications can also be extended to include more of the training procedures required of lineman.

Appendix

Code of Conduct

Mission Statement

Team 304 is committed to ensuring a positive work environment that supports professionalism, integrity, respect, and trust. Every member of this team will contribute a full effort to the creation and maintenance of such an environment in order to bring out the best in all of us as well as this project.

Roles

Each team member is delegated a specific role based on their experience and skill sets and is responsible for all here-within:

Team Leader - Kaitlyn Gurtner

Delegates tasks among group members according to their skill sets. The team leader is responsible for promoting synergy and increased teamwork. If a problem arises, the team leader will act in the best interest of the project. The team leader takes the lead in organizing, planning, and setting up of meetings. In addition, they are responsible for keeping a record of all correspondence between the group and 'minutes' for the meetings. Finally they give or facilitate presentations by individual team members and is responsible for overall project plans and progress

Lead Programmer - Christopher Sopeju

Most responsible for the programming aspect of the project. The team decided to use a combination of C(#/++) and Unity for the virtual implementation of the application. Coordinates with other team members to create cohesive code that

Lead Designer - Kevin Rodriguez

Responsible for organizing the complete design of the virtual representation of the ATS (Automated Transformer Switch) in the training application. Coordinates with other team members to create smaller design items and incorporate them into the full design.

Technical Specialist - Alexis Cross

Researches the ATS (Automated Transformer Switch) and is most knowledgeable about the technical details of it. Communicates with other team members about the technical workings of the ATS and how to accurately represent it in the training application. Responsible for maintaining the accuracy of the representation of the ATS throughout the training application.

Test Engineer - Max Urscheler

In charge of testing the product periodically and relaying information back to the other team members if there an issue was to arise with the application when it was tested.

All Team Members:

- Work on certain tasks of the project
- Buys into the project goals and success
- Delivers on commitments
- Adopt team spirit
- Listen and contribute constructively (feedback)
- Be effective in trying to get message across
- Be open minded to others ideas
- Respect others roles and ideas
- Be ambassador to the outside world in own tasks

Communication

The main form of communication will be over via Zoom Meetings and text-messaging among the group. Email will be a secondary form of communication for issues not being time-sensitive. For the passing of information, i.e. files and presentations, email and Google Drive will be the main form of file transfer and proliferation. There will also be a google drive folder shared between all team members with important files stored pertaining to the project inside.

Each group member must have a working email for the purposes of communication and file transference. Members must check their emails at least twice a day to check for important information and updates from the group. Although members will be initially informed via a text message, meeting dates and pertinent information from the sponsor will additionally be sent over email so it is very important that each group member checks their email frequently.

If a meeting must be canceled, an email must be sent to the group at least 24 hours in advance.

Any team member that cannot attend a meeting must give advance notice of 24 hours informing the group of his absence. Reason for absence will be appreciated but not required if personal. Repeated absences in violation with this agreement will not be tolerated.

Team Dynamics

The students will work as a team while allowing one another to feel free to make any suggestions or constructive criticisms without fear of being ridiculed and/or embarrassed. If any member on this team finds a task to be too difficult it is expected that the member should ask for help from the other teammates. If any member of the team feels they are not being respected or taken seriously, that member must bring it to the attention of the team in order for the issue to be resolved. We shall NOT let emotions dictate our actions. Everything done is for the benefit of the project and together everyone achieves more.

Ethics

Team members are required to be familiar with the NSPE Engineering Code of ethics and the IEEE Code of Ethics, as they are responsible for their obligations to the public, the client, the employer, and the profession. There will be stringent following of the NSPE Engineering Code of Ethics and the IEEE Code of Ethics.

Dress Code

Team meetings will be held in casual attire. Sponsor meetings and group presentations will be business casual to formal as decided by the team per the event.

Weekly and biweekly Tasks

Team members will participate in all meetings with the sponsor, adviser and instructor. During said times ideas, project progress, budget, conflicts, timelines and due dates will be discussed. In addition, tasks will be delegated to team members during these meetings. Repeat absences will not be tolerated.

Decision Making

It is conducted by consensus and majority of the team members. Should ethical/moral reasons be cited for dissenting reason, then the ethics/morals shall be evaluated as a group and the majority will decide on the plan of action. Individuals with conflicts of interest should not participate in decision-making processes but do not need to announce said conflict. It is up to each individual to act ethically and for the interests of the group and the goals of the project. Achieving the goal of the project will be the top priority for each group member. Below are the steps to be followed for each decision-making process:

- Problem Definition – Define the problem and understand it. Discuss among the group.
- Tentative Solutions – Brainstorms possible solutions. Discuss among the group for plausible solutions.
- Data/History Gathering and Analyses – Gather necessary data required for implementing Tentative Solution. Re-evaluate Tentative Solution for plausibility and effectiveness.
- Design – Design the Tentative Solution product and construct it. Re-evaluate for plausibility and effectiveness.
- Test and Simulation/Observation – Test design for Tentative Solution and gather data. Re-evaluate for plausibility and effectiveness.
- Final Evaluation – Evaluate the testing phase and determine its level of success. Decide if design can be improved and if time/budget allows for it.

Conflict Resolution

In the event of discord amongst team members the following steps shall be respectfully employed:

- Communication of points of interest from both parties which may include demonstration of active listening by both parties through paraphrasing or other tool acknowledging clear understanding.
- Administration of a vote, if needed, favoring majority rule.
- Team Leader intervention.
- Instructors will facilitate the resolution of conflicts.

Statement of Understanding

By signing this document the members of Team 304 agree to all of the above and will abide by the code of conduct set forth by the group.

Name	Signature	Date
Alexis Cross	*Alexis Cross*	09/12/2020
Kaitlyn Gurnter	*Kaitlyn Gurnter*	09/12/2020
Kevin Rodriguez	*Kevin Rodriguez*	09/12/2020
Chris Sopeju	*Chris Sopeju*	09/12/2020
Max Urscheler	*Max Urscheler*	09/12/2020

Functional Decomposition Charts

Level 0:

Table 9: Training Module

Module	Training
Input	Information: Information about the ATS that can be viewed by the user.
Output	Display: Show all relevant information about the ATS, display instructions
Functionality	Design a training application that will train workers in how to perform maintenance on the ATS

Table 10: Manage Information Module

Module	Manage Information
Input	Store: answers given during the training simulation.
Output	Display: display the information and answers the user had during the simulation and display the overall score
Functionality	To store and display the information that is given during the training simulation to allow the company Florida Power to know which user passed the training simulation.

Table 11: Virtual Interaction Module

Module	Virtual Interaction
Input	Design: Design of ATS, store user input
Output	Display: Render of the ATS, and displays Information about the ATS
Functionality	Design a virtual ATS that can be interacted with the user and can show all the relevant information that all the users will need .

Integration

Table 12: Integration Modules

Integration	Description
Training-Virtual Interaction	Virtual Interaction and Training integrate through how the user interacts with the ATS. Virtual Interaction will display information that is needed in the training section
Manage Information-Training	Through the training section the information that is needed will be recorded that is important for the manage information section

Target Catalog

Table 13: Target Catalog

Metric No.	Need	Metric	Imp.	Units	Marginal Value	Ideal Value
1	Inform User of ATS Hazards and Warnings	Binary	Moderate	N/A	N/A	N/A
2	Inform User on ATS Functionality & Components	Binary	High	N/A	N/A	N/A
3	Conduct training in a virtual manner	Binary	High	N/A	N/A	N/A
	Assess the user’s knowledge		High	N/A	N/A	N/A
4	Provide feedback during simulations and assessments	Binary	Moderate	N/A	N/A	N/A
5	Display Virtual model of ATS and allow user to interact with model	Binary	Critical	N/A	N/A	N/A
6	Educate and demonstrate Normal In-Service Operation	Binary	High	N/A	N/A	N/A
7	Simulate Normal In-Service Operation	Binary	High	N/A	N/A	N/A
8	Educate and demonstrate ATS Operation during Permanent Fault	Binary	Critical	N/A	N/A	N/A

9	Simulate ATS Operation during Permanent Fault	Binary	Critical	N/A	N/A	N/A
10	Educate and demonstrate ATS Operation during Temporary Fault	Binary	Critical	N/A	N/A	N/A
11	Simulate ATS Operation during Temporary Fault	Binary	Critical	N/A	N/A	N/A
12	Educate and demonstrate Non-Reclose Lever Operation	Binary	Critical	N/A	N/A	N/A
13	Simulate Non-Reclose Lever Operation	Binary	Critical	N/A	N/A	N/A
14	Educate and demonstrate Manual Open Procedure	Binary	Critical	N/A	N/A	N/A
15	Simulate Manual Open Procedure	Binary	Critical	N/A	N/A	N/A
16	Educate and demonstrate Visual Open using Operating Ring	Binary	Critical	N/A	N/A	N/A
17	Simulate Visual Open using Operating Ring	Binary	Critical	N/A	N/A	N/A
18	Educate and demonstrate Manual Close	Binary	Critical	N/A	N/A	N/A
19	Simulate Manual Close	Binary	Critical	N/A	N/A	N/A
20	Educate and demonstrate user of proper troubleshooting procedures	Binary	Critical	N/A	N/A	N/A
21	Simulate troubleshooting procedures	Binary	Critical	N/A	N/A	N/A
22	Manage Information	Binary	Critical	N/A	N/A	N/A

Risk Assessment

Project Hazard Assessment- Project Narrative

Name of Project: AR Training Application		**Date of submission:** 11/18/2020
Team member	**Phone number**	**e-mail**
Alexis Cross	(727) 542-2668	aac16g@my.fsu.edu
Kaitlyn Gurtner	(407) 371-9736	kmg16e@my.fsu.edu
Kevin Rodriguez	(305) 803-3724	kar16m@my.fsu.edu
Christopher Sopeju	(850) 591-0762	christopher1.sopeju@famu.edu
Max Urscheler	(201) 470-7918	mju16@my.fsu.edu
Faculty mentor	**Phone number**	**e-mail**
Reginald Perry	(850) 410-6465	perry@eng.fsu.edu

Rewrite the project steps to include all safety measures taken for each step or combination of steps. Be specific (don't just state "be careful").

- Each teammate will follow university guidelines for Social Distancing & wear a face mask
- iPad will be handled by one teammate at a time
- iPad will be thoroughly disinfected when it is shared amongst team members
- Software will not be developed continuously for long periods of time

Thinking about the accidents that have occurred or that you have identified as a risk, describe emergency response procedures to use.

Passing along the iPad can cause problems with the spread of germs and virus cells. An accident can occur when a team member who has come in contact with someone that has the virus and does not perform the proper safety and cleaning guidelines of handling the Ipad. If this issue is to arise, the affected team member is to socially distance from the team until further COVID-19 testing is performed and a negative test result is obtained. After this process, the team member must do everything to abide by the university guidelines for Social Distancing.

List emergency response contact information:

- Call 911 for injuries, fires or other emergency situations
- Call your department representative to report a facility concern

Name	Phone number	Faculty or other COE emergency contact	Phone number
Emergencies	911	Donte Ford	(850) 410-6472
Tallahassee Police Dept.	(850) 891-4200	Reginald Perry	(850) 410-6465
		Sastry Pamidi	(850) 410-6283

Safety review signatures

Team member	Date	Faculty mentor	Date
Alexis Cross	04/01/2021		
Kevin Rodriguez	04/01/2021		
Christopher O Sopeju	04/01/2021		
Max Urscheler	04/01/2021		
Kaitlyn Gurtner	04/01/2021		

Report all accidents and near misses to the faculty mentor.

FAMU-FSU College of Engineering
Project Hazard Assessment Policy and Procedures

INTRODUCTION

University laboratories are not without safety hazards. Those circumstances or conditions that might go wrong must be predicted and reasonable control methods must be determined to prevent incident and injury. The FAMU-FSU College of Engineering is committed to achieving and maintaining safety in all levels of work activities.

PROJECT HAZARD ASSESSMENT POLICY

Prior to starting an experiment, laboratory workers must conduct a project hazard assessment (PHA) to identify health, environmental and property hazards and the proper control methods to eliminate, reduce or control those hazards. PI/instructor must review, approve, and sign the written PHA and provide the identified hazard control measures. PI/instructor continually monitor projects to ensure proper controls and safety measures are available, implemented, and followed. PI/instructor are required to reevaluate a project anytime there is a change in scope or scale of a project and at least annually after the initial review.

PROJECT HAZARD ASSESSMENT PROCEDURES

It is FAMU-FSU College of Engineering policy to implement followings:

1. Laboratory workers (i.e. graduate students, undergraduate students, postdoctoral, volunteers, etc.) performing a research in FAMU-FSU College of Engineering are required to conduct PHA prior to commencement of an experiment or any project change in order to identify existing or potential hazards and to determine proper measures to control those hazards.
2. PI/instructor must review, approve and sign the written PHA.
3. PI/instructor must ensure all the control methods identified in PHA are available and implemented in the laboratory.
4. In the event laboratory personnel are not following the safety precautions, PI/instructor must take firm actions (e.g. stop the work, set a meeting to discuss potential hazards and consequences, ask personnel to review the safety rules, etc.) to clarify the safety expectations.
5. PI/instructor must document all the incidents/accidents happened in the laboratory along with the PHA document to ensure that PHA is reviewed/modified to prevent reoccurrence. In the event of PHA modification a revision number should be given to the PHA, so project members know the latest PHA revision they should follow.
6. PI/instructor must ensure that those findings in PHA are communicated with other students working in the same laboratory (affected users).
7. PI/instructor must ensure that approved methods and precautions are being followed by :
    a. Performing periodic laboratory visits to prevent the development of unsafe practice.
    b. Quick reviewing of the safety rules and precautions in the laboratory members meetings.
    c. Assigning a safety representative to assist in implementing the expectations.

    d. Etc.
8. A copy of this PHA must be kept in a binder inside the laboratory or PI/instructor's office (if experiment steps are confidential).

Project Hazard Assessment Worksheet				
PI/instructor:	Phone #:	Dept.:	Start Date:	Revision number: 1
Project: AR Training Application			Location(s):	
Team member(s): Alexis Cross, Kaitlyn Gurtner, Kevin Rodriguez, Christopher Sopeju, Max Urscheler			Phone #: (727) 542-2668	Email:aac16g@my.fsu.edu

Experiment Steps	**Location**	**Person assigned**	**Identify hazards or potential failure points**	**Control method**	**PPE**	**List proper method of hazardous waste disposal, if any.**	**Residual Risk**	**Specific rules based on the residual risk**
Transfer of iPad between team members	N/A	All	COVID-19	Masks worn & iPad sanitized before and after exchange	Masks, Disinfectant wipes	Wipes placed in receptacle after use	HAZARD: CONSEQ: Severe Residual: Medium	Written safety plan required, limited amount of people in area
Software Development	N/A	All	Poor posture leads to muscular pain and deterioration	Ergonomic chairs & limit on continuous time spent coding	N/A	N/A	HAZARD: CONSEQ: Significant Residual: Low Med	Controls planned prior to start

Principal investigator(s) PHA certification: I certify that I have reviewed and approved the PHA worksheet and will ensure the control measures are available and implemented in the laboratory.

Name	**Signature**	**Date**	**Name**	**Signature**	**Date**

Team members' certification: I certify that I have reviewed the PHA worksheet, am aware of the hazards, and will ensure the control measures are followed.

Name	**Signature**	**Date**	**Name**	**Signature**	**Date**
Alexis Cross	Alexis Cross	04/01/2021	Kaitlyn Gurtner	Kaitlyn Gurtner	04/01/2021
Kevin Rodriguez	Kevin Rodriguez	04/01/2021	Christopher Sopeju	Christopher O Sopeju	04/01/2021
Max Urscheler	Max Urscheler	04/01/2021			

DEFINITIONS:

Hazard: Any situation, object, or behavior that exists, or that can potentially cause ill health, injury, loss or property damage e.g. electricity, chemicals, biohazard materials, sharp objects, noise, wet floor, etc. OSHA defines hazards as "*any source of potential damage, harm or adverse health effects on something or someone"*. A list of hazard types and examples are provided in appendix A.

Hazard control: Hazard control refers to workplace measures to eliminate/minimize adverse health effects, injury, loss, and property damage. Hazard control practices are often categorized into following three groups (priority as listed):

1. **Engineering control:** physical modifications to a process, equipment, or installation of a barrier into a system to minimize worker exposure to a hazard. Examples are ventilation (fume hood, biological safety cabinet), containment (glove box, sealed containers, barriers), substitution/elimination (consider less hazardous alternative materials), process controls (safety valves, gauges, temperature sensor, regulators, alarms, monitors, electrical grounding and bonding), etc.
2. **Administrative control:** changes in work procedures to reduce exposure and mitigate hazards. Examples are reducing scale of process (micro-scale experiments), reducing time of personal exposure to process, providing training on proper techniques, writing safety policies, supervision, requesting experts to perform the task, etc.
3. **Personal protective equipment (PPE):** equipment worn to minimize exposure to hazards. Examples are gloves, safety glasses, goggles, steel toe shoes, earplugs or muffs, hard hats, respirators, vests, full body suits, laboratory coats, etc.

Team member(s): Everyone who works on the project (i.e. grads, undergrads, postdocs, etc.). The primary contact must be listed first and provide phone number and email for contact.

Safety representative: Each laboratory is encouraged to have a safety representative, preferably a graduate student, in order to facilitate the implementation of the safety expectations in the laboratory. Duties include (but are not limited to):

- Act as a point of contact between the laboratory members and the college safety committee members.
- Ensure laboratory members are following the safety rules.
- Conduct periodic safety inspection of the laboratory.
- Schedule laboratory clean up dates with the laboratory members.
- Request for hazardous waste pick up.

Residual risk: Residual Risk Assessment Matrix are used to determine project's risk level. The hazard assessment matrix (table 1) and the residual risk assessment matrix (table2) are used to identify the residual risk category.

The instructions to use hazard assessment matrix (table 1) are listed below:

1. Define the workers familiarity level to perform the task and the complexity of the task.
2. Find the value associated with familiarity/complexity (1 – 5) and enter value next to: HAZARD on the PHA worksheet.

Table 14: Hazard assessment matrix.

		Complexity		
		Simple	Moderate	Difficult
Familiarity Level	Very Familiar	1	2	3
	Somewhat Familiar	2	3	4
	Unfamiliar	3	4	5

The instructions to use residual risk assessment matrix (table 2) are listed below:

1. Identify the row associated with the familiarity/complexity value (1 – 5).
2. Identify the consequences and enter value next to: CONSEQ on the PHA worksheet. Consequences are determined by defining what would happen in a worst case scenario if controls fail.
    a. Negligible: minor injury resulting in basic first aid treatment that can be provided on site.
    b. Minor: minor injury resulting in advanced first aid treatment administered by a physician.
    c. Moderate: injuries that require treatment above first aid but do not require hospitalization.
    d. Significant: severe injuries requiring hospitalization.
    e. Severe: death or permanent disability.
3. Find the residual risk value associated with assessed hazard/consequences: Low –Low Med – Med– Med High – High.
4. Enter value next to: RESIDUAL on the PHA worksheet.

Table 15: Residual risk assessment matrix.

Assessed Hazard Level	**Consequences**				
	Negligible	Minor	Moderate	Significant	Severe
5	Low Med	Medium	Med High	High	High
4	Low	Low Med	Medium	Med High	High
3	Low	Low Med	Medium	Med High	Med High
2	Low	Low Med	Low Med	Medium	Medium
1	Low	Low	Low Med	Low Med	Medium

Specific rules for each category of the residual risk:

Low:
- Safety controls are planned by both the worker and supervisor.
- Proceed with supervisor authorization.

Low Med:
- Safety controls are planned by both the worker and supervisor.
- A second worker knowledgeable of the task and hazards is in the vicinity (buddy system).
- Proceed with supervisor authorization.

Med:
- After approval by the PI, the Safety Committee and/or EHS must review and approve the completed PHA.
- A written safety plan is required and must be approved by the PI before proceeding. A copy must be sent to the Safety Committee.
- A second worker must be in place before work can proceed (buddy system).
- Limit the number of authorized workers in the hazard area.

Med High:
- After approval by the PI, the Safety Committee and/or EHS must review and approve the completed PHA.
- A written safety plan is required and must be approved by the PI and the Safety Committee before proceeding.
- Two qualified workers must be in place before work can proceed.
- Limit the number of authorized workers in the hazard area.

High:

The activity will not be performed. The activity must be redesigned to fall in a lower hazard category.

Table 16: Hazard Types and Examples

Types of Hazard	**Example**
Physical hazards	Wet floors, loose electrical cables objects protruding in walkways or doorways
Ergonomic hazards	Lifting heavy objects Stretching the body Twisting the body Poor desk seating
Psychological hazards	Heights, loud sounds, tunnels, bright lights
Environmental hazards	Room temperature, ventilation contaminated air, photocopiers, some office plants acids
Hazardous substances	Alkalis solvents
Biological hazards	Hepatitis B, new strain influenza
Radiation hazards	Electric welding flashes Sunburn
Chemical hazards	Effects on central nervous system, lungs, digestive system, circulatory system, skin, reproductive system. Short term (acute) effects such as burns, rashes, irritation, feeling unwell, coma and death. Long term (chronic) effects such as mutagenic (affects cell structure), carcinogenic (cancer), teratogenic (reproductive effect), dermatitis of the skin, and occupational asthma and lung damage.
Noise	High levels of industrial noise will cause irritation in the short term, and industrial deafness in the long term.
Temperature	Personal comfort is best between temperatures of 16°C and 30°C, better between 21°C and 26°C. Working outside these temperature ranges: may lead to becoming chilled, even hypothermia (deep body cooling) in the colder temperatures, and may lead to dehydration, cramps, heat exhaustion, and hyperthermia (heat stroke) in the warmer temperatures.
Being struck by	This hazard could be a projectile, moving object or material. The health effect could be lacerations, bruising, breaks, eye injuries, and possibly death.
Crushed by	A typical example of this hazard is tractor rollover. Death is usually the result
Entangled by	Becoming entangled in machinery. Effects could be crushing, lacerations, bruising, breaks, amputation and death.
High energy sources	Explosions, high pressure gases, liquids and dusts, fires, electricity and sources such as lasers can all have serious effects on the body, even death.
Vibration	Vibration can affect the human body in the hand arm with `white-finger' or Raynaud's Syndrome, and the whole body with motion sickness, giddiness, damage to bones and audits, blood pressure and nervous system problems.
Slips, trips and falls	A very common workplace hazard from tripping on floors, falling off structures or down stairs, and slipping on spills.
Radiation	Radiation can have serious health effects. Skin cancer, other cancers, sterility, birth deformities, blood changes, skin burns and eye damage are examples.
Physical	Excessive effort, poor posture and repetition can all lead to muscular pain, tendon damage and deterioration to bones and related structures

Psychological	Stress, anxiety, tiredness, poor concentration, headaches, back pain and heart disease can be the health effects
Biological	More common in the health, food and agricultural industries. Effects such as infectious disease, rashes and allergic response.