

Location Care

(WORKING TITLE)
DESIGN DOCUMENT

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Executive Summary

Development Standards & Practices Used

List all standard circuits, hardware, software practices used in this project. List all the Engineering standards that apply to this project that were considered.

Summary of Requirements

- Design a dashboard to present a summary of data accumulated.
- Generate a playback feature on the dashboard that would allow us to select a data set and play it back.
- Implement a strategy that will help determine an improved anchor placement to achieve more accurate location information.
- Come up with some potential logic that will help better determine the room a nurse actually went into.

Applicable Courses from Iowa State University Curriculum

- COMS 309
- SE 319
- SE 329
- COMS 363
- CPRE 489
- CPRE 430

New Skills/Knowledge acquired that was not taught in courses

List all new skills/knowledge that your team acquired which was not part of your Iowa State curriculum in order to complete this project.

Table of Contents

1 Introduction	4
1.1 Acknowledgement	4
1.2 Problem and Project Statement	4
1.3 Operational Environment	4
1.4 Requirements	4
1.5 Intended Users and Uses	4
1.6 Assumptions and Limitations	5
1.7 Expected End Product and Deliverables	5
2. Specifications and Analysis	5
2.1 Proposed Design	5
2.2 Design Analysis	6
2.3 Development Process	6
2.4 Design Plan	6
3. Statement of Work	6
3.1 Previous Work And Literature	6
3.2 Technology Considerations	7
3.3 Task Decomposition	7
3.4 Possible Risks And Risk Management	7
3.5 Project Proposed Milestones and Evaluation Criteria	7
3.6 Project Tracking Procedures	7
3.7 Expected Results and Validation	7
4. Project Timeline, Estimated Resources, and Challenges	8
4.1 Project Timeline	8
4.2 Feasibility Assessment	8
4.3 Personnel Effort Requirements	8
4.4 Other Resource Requirements	8
4.5 Financial Requirements	9
5. Testing and Implementation	9
5.1 Interface Specifications	9
5.2 Hardware and software	9

5.3	Functional Testing	9
5.4	Non-Functional Testing	9
5.5	Process	10
5.6	Results	10
6.	Closing Material	10
6.1	Conclusion	10
6.2	References	10
6.3	Appendices	10

List of figures/tables/symbols/definitions (This should be similar to the project plan)

1 Introduction

1.1 ACKNOWLEDGEMENT

We would like to acknowledge the contributions of the following organizations and individuals towards our successes during this senior design project:

In Motion Care, Iowa State University, Green Hills Retirement Community, WISER Systems, and Dr. Daji Qiao.

1.2 PROBLEM AND PROJECT STATEMENT

Currently, healthcare staff at Green Hills Retirement Community receive individual resident care plans, detailed information on individual residents and their needs, through paper packets. These packets are often updated multiple times throughout the day, causing these packets to be reprinted just as often as they were updated. This can cause multiple issues as employees may not be getting the most updated packet, meaning they may not be giving the proper care to a resident.

Each packet also has approximately 27 pages and 75 employees, so printing 75 copies every time an update happens uses quite a bit of paper.

This project sets out to create a system that will track the healthcare staff throughout their facility. Based on their location, the system will give workers real time updates on the requirements of patients' needs as they enter rooms. There are a number of tracking devices called anchors placed around the facility that actively look for another set of passive devices called tags that are carried by the staff and anything else that needs to be tracked throughout the building. The data from the tracking system is displayed to the staff and historical information is stored for later reference and playback

As part of this project, we are planning to have two favorable outcomes. An application with a dashboard view of important information specific to the logged in user and a playback feature to view the position of a tracking tag over a period of time. We will also develop a method of installing anchors with a focus on tracking efficiency.

1.3 OPERATIONAL ENVIRONMENT

Our system will be implemented into Green Hills Retirement Community in Ames, IA. This facility is completely indoors, however hazards to consider are resident and nurse interaction with the hardware.

1.4 REQUIREMENTS

We will design a dashboard that will showcase a map of the facility, a display of nurses time spent in areas and their route within the facility. Going into the features with this concept the user will be able to figure out areas in the room the nurse is located at a given time historically.

When health care staff is in the room of a resident, they get tailored care instructions for the resident. They are sent a series of questions that interact step by step to checkbox all the steps of

care. This helps track the actions of the staff and hold the staff accountable. Our dashboard will supply the historic and real-time data to support staff or hold them accountable.

The dashboard will acquire its data from anchors placed in the facility and tracker tags placed on the asset we will be tracking. The anchors and tags we are dealing with are by a company Wiser Systems. The tags cost \$69 and the anchors cost \$209. Accuracy of the data collected is directly proportional to the number of anchors. Data management systems are maintained on Google Cloud.

The anchors will be strategically placed in locations that will not disturb the patients or the health care staff's daily routine. The anchors require power through wall-outlet or ethernet. Implementing a method for tags to be carried with the least chance of damage while maintaining optimal accuracy.

1.5 INTENDED USERS AND USES

Our intended users are Green Hills administrative staff, who are looking to introduce an immediate method of delivering updated patient care plans to healthcare staff, alongside a way to track where staff have been within the facility at any given time. The administrative staff would have the ability to view archived data of where the healthcare staff have been in the facility to make sure proper healthcare protocols have been followed during each patient visit.

Should an incident with a patient occur, administrative staff could view the location data of the medical staff and see who was last to work with the patient.

1.6 ASSUMPTIONS AND LIMITATIONS

Assumptions:

- The dashboard will not be used in any facility other than Greenhills Retirement Community.
- Users of the dashboard speak english.
- The facility has a consistent supply of power.

Limitations:

- No tag carrier can accurately be tracked if traveled between more than two rooms in less than .2 seconds.
- For power, anchors need to be placed near a power supply when wireless or be tethered to each other via ethernet cable when not.

1.7 EXPECTED END PRODUCT AND DELIVERABLES

Tracking System User Interface

A React-based web application that acts as a dashboard to present applicable summary statistics to the user. Information to be presented includes an interactive map of the healthcare facility with all currently-in-use tags being monitored. Through the interactable map, a user will be able to access both room and tag specific information. (i.e. what tags have entered and left the room, at what time, what other rooms has a tag accessed, etc.) Deliverable date is to be decided.

Location Playback feature

A playback feature implemented through the web application that accurately displays historical movement of targeted individuals. This feature allows the user to access a particular tag or room within the tracking system. When viewing a tag, the user will be able to track a user across all rooms that they will be moving between. For a given room, the user will be able to see what tags have entered the room, when they left the room, and any movement in the room in the interim.

2. Specifications and Analysis

2.1 PROPOSED DESIGN

Thus far, we have researched the use of the WISER Systems tracking system and its normal use cases. These typical use cases are far different from those that represent the current project. We have discussed with our client their current shortcomings and how they have set up their system.

Our client has had many of the other students working on his project come to our meetings to show what they have been working on and the currently developed systems. Our team has started to learn the currently implemented system's technologies like React JS.

2.2 DESIGN ANALYSIS

We conducted meetings to gain a full understanding of our client's requirements over the course of the first few weeks. We discussed In Motion Care's requirements and what we as a team believe we can deliver. We broke down the system's use cases and specifically tailored questions for our client to get the most details and requirements to properly define our scope. We are drafting our front end screen designs which will be brainstormed with our client and passed on to his partners. Based on the data our client is gathering, we are designing an intuitive database design that we will be able to query from efficiently.

So far, we have been using an iterative design philosophy with our client, going back and forth with different ideas as we come up with and further refine them. This process helps us understand empathy behind each use case to help us ideate and prototype a perfect goal. We identified that our sessions of scoping as a team needed an affirmation or guidance and in this case, our client has been a great mentor. We have seen that our methods help keep us from producing redundant work and that our ideas are in line with our client's vision.

2.3 DEVELOPMENT PROCESS

For this project, an Agile/Scrum development process is to be implemented. This development style was chosen as it allows developers to focus on an iterative approach to development where all requirements, solutions, and goals are decided through collaboration of the entire team. Agile and scrum help to create a strongly structured project management process where issues are handled as they arrive and progress is consistently made. Furthermore, the development process strongly encourages teamwork, self-organization, and accountability.

2.4 DESIGN PLAN

The project will be broken into the following modules:

1. Frontend Design
 - a. UX Design
 - i. Use design software to create mock-ups of application views.

- ii. Look for client approval of designs to move on to implementation.
 - b. Implementation
 - i. Use the React Javascript library to build the graphical user interface for the dashboard.
 - ii. After implementation, check again for client approval and reimplement if needed.
 - c. Testing
 - i. Test application on different screen sizes, devices, and web-browsers.
 - ii. Test all functional flows of application.
- 2. Backend Design
 - a. Database design
 - i. ER Diagram
 - 1. Begin by creating a detailed diagram high-lighting the dependencies between our data. Aim is to create an efficient database.
 - 2. Propose database to client. Add any further dependencies or tables based on feedback.
 - ii. Implementation
 - 1. Create a backend with direct connection to the database.
 - 2. Build in functionality to access multiple sets of data for playback program.
 - 3. Using Ajax, create a connection to the backend to accept requests from the front end to query and process information from the database.
 - iii. Deployment
 - 1. Begin data collection within Green Hills utilizing create backend and database.
 - 2.

3. Statement of Work

3.1 PREVIOUS WORK AND LITERATURE

Include relevant background/literature review for the project

- If similar products exist in the market, describe what has already been done
- If you are following previous work, cite that and discuss the **advantages/shortcomings**
- Note that while you are not expected to “compete” with other existing products / research groups, you should be able to differentiate your project from what is available

Detail any similar products or research done on this topic previously. Please cite your sources and include them in your references. All figures must be captioned and referenced in your text.

3.2 TECHNOLOGY CONSIDERATIONS

Highlight the strengths, weakness, and trade-offs made in technology available.

Discuss possible solutions and design alternatives

3.3 TASK DECOMPOSITION

In order to solve the problem at hand, it helps to decompose it into multiple tasks and to understand interdependence among tasks.

3.4 POSSIBLE RISKS AND RISK MANAGEMENT

Include any concerns or details that may slow or hinder your plan as it is now. These may include anything to do with costs, materials, equipment, knowledge of area, accuracy issues, etc.

3.5 PROJECT PROPOSED MILESTONES AND EVALUATION CRITERIA

What are some key milestones in your proposed project? Consider developing task-wise milestones. What tests will your group perform to confirm it works?

3.6 PROJECT TRACKING PROCEDURES

What will your group use to track progress throughout the course of this and next semester?

3.7 EXPECTED RESULTS AND VALIDATION

What is the desired outcome?

How will you confirm that your solutions work at a **High level**?

4. Project Timeline, Estimated Resources, and Challenges

4.1 PROJECT TIMELINE

- A realistic, well-planned schedule is an essential component of every well-planned project
- Most scheduling errors occur as the result of either not properly identifying all of the necessary activities (tasks and/or subtasks) or not properly estimating the amount of effort required to correctly complete the activity
- A detailed schedule is needed as a part of the plan:
 - Start with a Gantt chart showing the tasks (that you developed in 3.3) and associated subtasks versus the proposed project calendar. The Gantt chart shall be referenced and summarized in the text.
 - Annotate the Gantt chart with when each project deliverable will be delivered
- Completely compatible with an Agile development cycle if that's your thing

How would you plan for the project to be completed in two semesters? Represent with appropriate charts and tables or other means.

Make sure to include at least a couple paragraphs discussing the timeline and why it is being proposed. Include details that distinguish between design details for present project version and later stages of project.

4.2 FEASIBILITY ASSESSMENT

Realistic projection of what the project will be. State foreseen challenges of the project.

4.3 PERSONNEL EFFORT REQUIREMENTS

Include a detailed estimate in the form of a table accompanied by a textual reference and explanation. This estimate shall be done on a task-by-task basis and should be based on the projected effort required to perform the task correctly and not just "X" hours per week for the number of weeks that the task is active

4.4 OTHER RESOURCE REQUIREMENTS

Identify the other resources aside from financial, such as parts and materials that are required to conduct the project.

4.5 FINANCIAL REQUIREMENTS

If relevant, include the total financial resources required to conduct the project.

5. Testing and Implementation

Testing is an **extremely** important component of most projects, whether it involves a circuit, a process, or a software library

Although the tooling is usually significantly different, the testing process is typically quite similar regardless of CprE, EE, or SE themed project:

1. Define the needed types of tests (unit testing for modules, integrity testing for interfaces, user-study for functional and non-functional requirements)
2. Define the individual items to be tested
3. Define, design, and develop the actual test cases
4. Determine the anticipated test results for each test case
5. Perform the actual tests
6. Evaluate the actual test results
7. Make the necessary changes to the product being tested
8. Perform any necessary retesting
9. Document the entire testing process and its results

Include Functional and Non-Functional Testing, Modeling and Simulations, challenges you've determined.

5.1 INTERFACE SPECIFICATIONS

- Discuss any hardware/software interfacing that you are working on for testing your project

5.2 HARDWARE AND SOFTWARE

- Indicate any hardware and/or software used in the testing phase
- Provide brief, simple introductions for each to explain the usefulness of each

5.3 FUNCTIONAL TESTING

Examples include unit, integration, system, acceptance testing

5.4 NON-FUNCTIONAL TESTING

Testing for performance, security, usability, compatibility

5.5 PROCESS

- Explain how each method indicated in Section 2 was tested
- Flow diagram of the process if applicable (should be for most projects)

5.6 RESULTS

- List and explain any and all results obtained so far during the testing phase
 - - Include failures and successes
 - - Explain what you learned and how you are planning to change it as you progress with your project
 - - If you are including figures, please include captions and cite it in the text
 - This part will likely need to be refined in your 492 semester where the majority of the implementation and testing work will take place
- Modeling and Simulation:** This could be logic analyzation, waveform outputs, block testing. 3D model renders, modeling graphs.
- List the **implementation Issues and Challenges.**

6. Closing Material

6.1 CONCLUSION

Summarize the work you have done so far. Briefly re-iterate your goals. Then, re-iterate the best plan of action (or solution) to achieving your goals and indicate why this surpasses all other possible solutions tested.

6.2 REFERENCES

This will likely be different than in project plan, since these will be technical references versus related work / market survey references. Do professional citation style(ex. IEEE).

6.3 APPENDICES

Any additional information that would be helpful to the evaluation of your design document.

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. This would also be a good area to include hardware/software manuals used. May include CAD files, circuit schematics, layout etc. PCB testing issues etc. Software bugs etc.