



Greater Accra
Regional Hospital

RIDGE



WPI

WEB APPLICATION PROPOSAL

For the Greater Accra Regional Hospital

Abstract

This proposal is intended to guide the development of a web application to improve the efficacy and efficiency of broken medical device reporting for the Greater Accra Regional Hospital.

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Executive Summary.....	3
Introduction	4
Intentions of Use.....	4
Overall Concept.....	4
General Information	4
Hospital Setup	4
Current System	4
Research Approach	8
Product Specifications.....	8
Client Needs	9
Engineering Department.....	9
Nursing.....	9
Management.....	10
Implementation	10
Overall Implementation Phase	10
Necessary Features	10
Non-necessary Features.....	10
Necessary Considerations.....	11
Login Page	11
Design: Engineering View.....	11
Homepage.....	11
All Work Order Requests.....	12
Work Order Request: Completed	13
Work Order Request: Pending	13
Special Capabilities: Head of Engineering.....	14
Design: Nurses View.....	14
Homepage.....	14
Submit Work Order Request.....	15
Work Order Request Submission.....	15
Progress Updates	16
Equipment Request.....	16
Chat	17
Design: Management View.....	17

Homepage.....	17
All Work Order Requests.....	17
All Data.....	18
Additional Features.....	18
Verification/ Validation.....	19
Conclusion.....	19
Future Recommendations	19

Executive Summary

This proposal is intended to guide the creation of a web application to improve the efficiency and efficacy of medical device reporting in the Greater Accra Regional Hospital. It compiles the research, product specifications, and client needs, and describes the implementation and concept design of this application in detail.

The hospital's current system for reporting broken medical devices relies on engineers to check in with each of the 50+ hospital units who then report if a device is broken. This process is time consuming and lacks a reliable system of communication between the nurses and the engineering department after a device has been taken to be fixed. The process was observed through shadowing of the engineering department. Product specifications were made based on these observations and background research. It was determined that the new system would need to improve communication and be user friendly, secure, time efficient, accurate, accessible, and affordable. Client needs were then divided into three categories: engineering department, nursing, and management. The engineering department's primary needs are improving communication and efficiency. The nurses' needs are improving communication, creating a way for nurses to receive updates on devices, and having a better way to request new equipment. The management needs to be able to see long-term data on commonly broken devices to make decisions on future investments.

Because of the complexity of the system, a phased approach for implementation is suggested. The features of the system were divided into necessary and non-necessary features, with the latter being less important, but still beneficial to the users. Additionally, the necessary conditions to adhere to the requirements of the Ghana Health Service and the Greater Accra Regional Hospital were considered.

The general concept is described in detail, starting with the login page, then splitting into the different views for the engineering department, nurses, and management. The engineering department has a homepage, a page for all work order requests, and individual pages for each work order. Special capabilities for the head of the engineering department are also detailed. The nurses' view has a homepage, a page to submit work order requests, a submission confirmation page, and a progress updates page. Additional pages with the non-necessary features of requesting equipment and messaging the engineers are also described. The management view has a homepage, a page with all work order requests like the engineers, and a page to see long-term trends in the data. Additional features that are not specific to a certain page are also listed.

This design should be validated through an iterative process in collaboration with the head nurses of a designated unit before being implemented throughout the hospital. If this is successfully implemented at the Greater Accra Regional Hospital and proven to be beneficial, it has the potential to be implemented elsewhere in Ghana. The flexibility of the program would allow it to be modified as necessary for other hospitals or healthcare centers. This application can be designed to suit the needs of the users through continuous input and collaboration.

Introduction

Intentions of Use

This proposal is meant to improve the system for medical device reporting at the Greater Accra Regional Hospital, formerly known as Ridge Hospital. This document was created following the research on medical reporting systems completed at the hospital from January 2023 to March 2023. This research was completed with the goal of understanding the current device reporting system and its key players' concerns, and needs. The belief that the most successful products arise from communication with client needs was the main force that drove the ethnographic research approach. This document is meant to present research findings and a cohesive proposal of the ideal medical device reporting system suited to the hospital. The intention is that information presented in this proposal will guide an information technology/computer science team in the future and provide all necessary information to implement a successful medical device reporting system within the hospital. We hope that with this proposal, the medical device reporting system created can not only have the necessary features for efficient reporting but also have the ability to adapt to future needs and open to continuous improvements.

Overall Concept

The overall concept is a web application that improves ease of communication between the clinical engineering department, the head nurses of each department, and hospital management. The application will allow the head nurse of each department to report any broken medical equipment to the engineering department, the engineering department to respond with progress updates on the reported device, and the management to track data that will guide the hospital in worthwhile future investments.

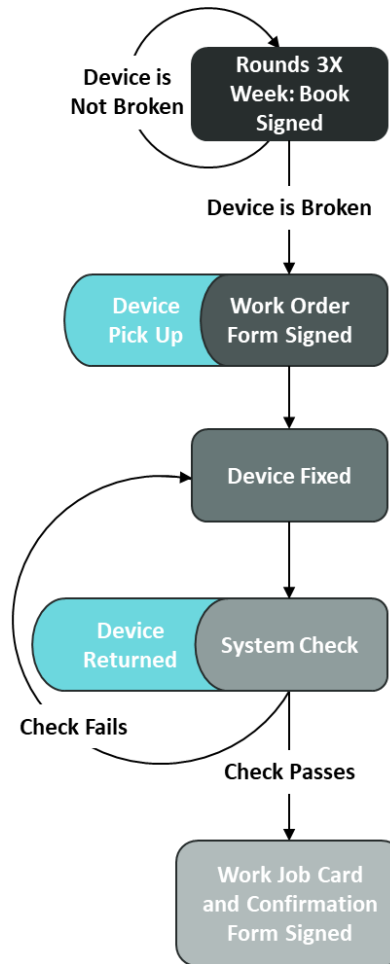
General Information

Hospital Setup

The Greater Accra Regional Hospital consists of two buildings: the original building where the engineering department lies, and the new building connected to the old with a skywalk. The engineering department is responsible for one level in the old building and five levels (0 through 4) in the new building. Within these levels there are over 50 units that the engineering department is responsible for checking in on during rounds.

Current System

At the Greater Accra Regional Hospital, broken biomedical devices are reported through a system of paperwork and personal communication. An overview of the entire system is shown below.



Three times a week, rounds are completed to check in with each department and determine if there are issues with any devices. The engineering department has a record book for each level of the Greater Accra Regional Hospital. The team will divide into groups assigned to cover one or two levels for the day. The group will go to the head nurse of each department on that level to ask if there is any broken equipment. Regardless of whether there is an issue or not, each head nurse must sign the book confirming that the round was completed. If there is an issue, the engineers will do a preliminary scan on the device with some basic troubleshooting, complete the rounds in the remaining departments, then return with a Work Order/Request form. The device is not taken from the unit to the engineering workshop until the Work Order/Request form is completed.

This form is one of the three forms that are filled out by the clinical engineering department: the Work Order/Request form, the Work Report/Job Card, and the Certification of Work. The Work Order form is the form that officially opens a complaint with the clinical engineering department. This form takes note of the problem the user is facing, as well as information on the equipment, the requesting entity, request type, and level of service interruption, as seen below. It requires a signature from the person requesting the work. After these forms are completed and signed, they are photocopied and saved in an online record.



THE GREATER ACCRA REGIONAL HOSPITAL
CLINICAL ENGINEERING UNIT

WORK ORDER/REQUEST

REQUESTING ENTITY	
DEPARTMENT REQUESTING:	PERSON REQUESTING:
SIGNATURE:	DATE OF REQUEST:
EQUIPMENT DATA	
TYPE OF EQUIPMENT:	SERIAL NUMBER:
MANUFACTURER:	MODEL:
INVENTORY NUMBER:	LOCATION OF EQUIPMENT:
TYPE OF REQUEST	LEVEL OF SERVICE INTERRUPTION
<input type="radio"/> CM – Corrective maintenance <input type="radio"/> PM – Preventive maintenance <input type="radio"/> TR – Training <input type="radio"/> CS – Consulting <input type="radio"/> INS – Installation <input type="radio"/> RL – Relocation <input type="radio"/> DC – Decommissioning	<input type="radio"/> High <input type="radio"/> Medium <input type="radio"/> Low
DESCRIPTION OF PROBLEM	

NB: All machines/equipment should be cleaned and emptied of all contents by USER, before technicians can accept for servicing

The Work Report/Job Card form serves as a record of the issue and the maintenance performed on the device and notes any replacement parts used. It requires a signature from both the technician who worked on the device and the head of the clinical engineering department.



THE GREATER ACCRA REGIONAL HOSPITAL
CLINICAL ENGINEERING UNIT

CERTIFICATION OF WORK		
REQUESTING ENTITY DEPARTMENT NAME		DEPARTMENT CODE
REQUESTING PERSON NAME CONTACT EMAIL		
REQUISITION INFORMATION REQUISITION DATE ROOM NAME & NUMBER LEVEL		
EQUIPMENT INFORMATION TYPE SERIAL NUMBER MANUFACTURER MODEL INVENTORY NUMBER		
DESCRIPTION OF REQUEST ISSUE(S)		SOLUTION(S)
JOB COMPLETION DATE RECOMMENDATION(S) \ REMARK(S)		
NAME:		SIGN:
CLINICAL ENGINEER'S COLUMN WORK DONE <input type="checkbox"/> GOOD <input type="checkbox"/> FAIR <input type="checkbox"/> POOR USER'S RESPONSE TO <input type="checkbox"/> GOOD <input type="checkbox"/> FAIR <input type="checkbox"/> POOR RECOMMENDATION(S) REMARK(S)		
DEPARTMENT RESPONSIBLE(NAME, SIGNATURE)		CLINICAL ENGINEERING MANAGER(NAME, SIGNATURE)

According to the Ghana Health Service, it is the responsibility of the hospital staff to report any issues or malfunctioning of equipment. However, the current system relies on the clinical engineering department seeking out any issues.

Research Approach

The goal of the research project was to better understand the innerworkings of how broken medical devices go through the process of being fixed to provide recommendations of an improved system. This was achieved by doing preliminary research on medical device reporting policies provided by Ghana Health Services, understand the current system of reporting through shadowing the engineering department, and speaking with various stakeholders at the hospital. This was done to identify common issues and areas for improvement within the system.

Product Specifications

Based on the research conducted, the following product specifications were developed to guide the design of a new system.

1. **Proper Communication:** The system should improve communication between the head nurses and the engineering department.

2. **User Friendly:** The system needs to be simple to navigate and easy for all users to learn. Otherwise, no one will have a desire to pick up the new system, causing more complaints than the current system.
3. **Security:** The system should be secure in the sense that only those who need to use the system have access to it. The data collected on the devices and their issues should be safely stored and given to the engineering department head and hospital management.
4. **Time Efficiency:** The system must achieve time efficiency in multiple aspects. Decreases should be seen in the time between each device being broken and fully operating in the unit again, the time for rounds to occur, and the time that the engineers are receiving calls about issues. This specification allows the engineers to have more time to focus on getting the device functioning as soon as possible
5. **Accuracy:** The system should allow for data on devices and issues to be accurate.
6. **Accessibility:** The application and all components of the system must be easy to find.
7. **Affordability:** The system must be affordable for the hospital. The system should be designed to be aware of any costs related to service and maintenance.

Client Needs

The system for medical device reporting is held together by the relationship between three categories of clients: the clinical engineers, the head nurses of each unit, and the management of the hospital. Based on our research, the following needs were discovered.

Engineering Department

Currently, after a device has been reported as broken, there is no consistent method of communication between the nurses and the clinical engineering department for updates on the device. There is a need for a system that allows the nurses to receive progress updates from the engineers to increase communication between the two departments. Another major concern to be addressed is efficiency. The current system requires a significant amount of time for the engineers to complete rounds, which is time that could be used for more relevant work. An ideal system would eliminate the time it takes to complete rounds altogether, as well as minimizing the time it takes for a broken device to be seen by the engineering department, as the reports can come in real time.

Secondary needs that the system would have to address include minimizing the number of complaints the head of the engineering department receives via phone call and allowing the reports to be sorted by importance.

Nursing

As previously stated, the lack of communication between the nurses and clinical engineering department is an area for improvement. It is common for nurses to ask for updates on reported devices during rounds, but because the engineers' floor for rounds does not necessarily correspond to the devices they work on, the nurses questions often go unanswered. Additionally, nurses will often request new equipment either on rounds or via phone call to the head of the engineering department, so incorporating that functionality into a new system would be beneficial both to the nurses and the engineers.

Management

The medical reporting process produces a lot of data that could be valuable to management. This data could be better utilized to identify common issues with device categories, companies, and models, that could guide the hospital's purchases. Data around the cause of device malfunctions can result in new training to guide users.

Implementation

Overall Implementation Phase

In order to implement the system effectively, it is recommended that the system is developed to adhere to the needs and wants of the clients as listed in this document. Once the application is developed the system should be first implemented in one or two units in order to gain feedback and improve upon the system before integrating it into all units.



Considering the time that it may take for the application to be developed, it may be best to add features to the system according to their importance. These features can be divided into necessary and non-necessary features.

Necessary Features

The following features have been deemed necessary to the system's success.

- Login
- Account capabilities vary based on the following user types: nurse, engineer, and management
- Work Order/ Request Form
- Work Request/Job Card
- Confirmation of Work Form
- Progress updates
- Phone and computer application

Non-necessary Features

The following features have been deemed non-necessary to the system as a whole, but very beneficial to the users involved. These features are ranked at a lower priority than those deemed necessary.

- Surgery Calendar for engineers who need to sit in on operations

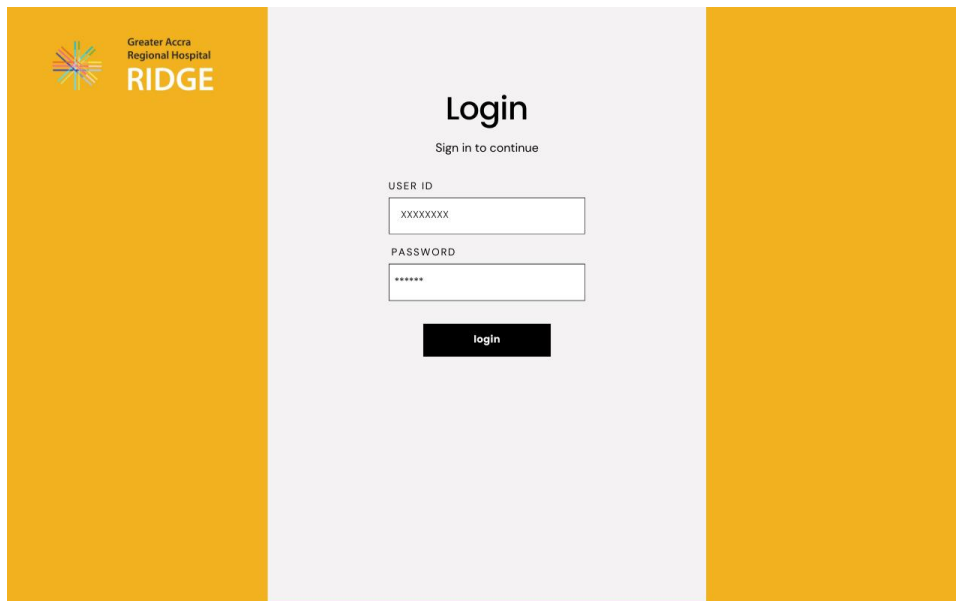
- Database of Manuals for devices
- Way to request new equipment
- Training videos
- Ability for head engineer to assign jobs
- Troubleshooting tips and flowcharts
- Chat

Necessary Considerations

Beyond the features necessary to meet the client needs, conditions need to be met to uphold the standards set by the Ghana Health Service and the Greater Accra Regional Hospital. The primary requirement is the logging of user information for any request or updates submitted. Anything submitted should record the user ID of the person, as well as the date and time. This is in place of a signature that is required on physical documents. The user IDs should be the same as the ID numbers used by the hospital management system and will be inputted into the login page at the launch of the application.

Login Page

This is the first page that all users see. They can log into their accounts using the same user ID they are assigned to for the hospital. Depending on the user's ID (nurse, engineer, or management), they see a different interface once they log in.



The image shows a login page for the RIDGE system. The page has a yellow header on the left with the Greater Accra Regional Hospital logo and the word 'RIDGE'. The main content area is white and contains the following elements:

- Login** (Section Header)
- Sign in to continue
- USER ID (Label)
- XXXXXXXX (Text input field)
- PASSWORD (Label)
- ***** (Text input field)
- login (Button)

Design: Engineering View

Homepage

This is the homepage for the engineering department. This page consists of four sections: new requests, pending requests, request summary, and calendar of events. These sections allow the engineers to have a clear understanding of what requests still need to be completed and what new issues have occurred. A new request is moved to a pending request once it is seen and electronically signed by the engineer to confirm that the work order is in place. The request summary shows how

many devices are in each stage of the repair process. This graph feature is clickable, taking the user to the work order requests page, with a filter based on the status they clicked on. The calendar feature tracks when surgeries occur that need an engineer to assist.

NEW REQUESTS

Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX
Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX
Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX
Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX

PENDING REQUESTS

Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX
Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX
Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX
Equipment:	Issue Description:	Reported:
Equipment Name	Description of the issue would go here	XXXXXXXX

CALENDAR OF EVENTS

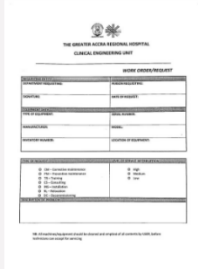
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10 Cancer surgery	11	12	13	14
15	16	17	18	19 Neuro surgery	20	21
22	23	24	25 Ortho surgery	26	27	28
29	30	31				

All Work Order Requests

All the work order requests that nurses have reported go to the “All Work Order Requests” page on the application. A sample of what the display looks like is shown below. Requests have the option of being sorted by date of report, date of completion, or level of service interruption. The default display shows the most recent reports. The reports can also be filtered to show specific floors, units, levels of service interruption, and statuses. Engineers can select multiple filters at once. There is also a search feature. Each request is clickable, and links to a page with the full details of the request. Additionally, the engineers can designate unit names if the hospital expands or goes through changes. These changes are also reflected in the nurse’s interface.

WORK ORDER REQUEST

WORK ORDER #XXXXXX

Status: Awaiting Parts	Equipment: Equipment Name	Serial Number: XXXXXXXX	Physical Document Scans: 
Level: Level X	Model: Model Name	Inventory Number: XXXXXXXX	
Unit: Unit Name	Manufacturer: Manufacturer Name	Logged On: XX/XX/XXXX XX:XX	
Location: Location/Room Name	Maintenance Type: CM/PM	Logged By: Requestor Name	
Issue Description Long-form issue description from the nurses goes here			

1 of 1

Special Capabilities: Head of Engineering

The head of the engineering department has the capabilities of both the clinical engineers and the management. The homepage is identical to the clinical engineering homepage, but the management view home page is also included in a separate summary tab, as well as a tab for the long-term data that the management can access.

Another capability to be explored is the ability to assign jobs to people as requests come in. This allows the head of the engineering department to better delegate tasks and increase accountability.

The head of engineering is also able to edit the drop-down sections of the work order request form to be able to add/edit the units of the hospital. Hospitals are always changing and expanding so this is a necessary capability for the department head to have.

Design: Nurses View

Homepage



This is the homepage for the head nurses of each unit. The requests show up for the specific unit that the nurse works in, depending on the login information. The progress updates section of this interface shows any devices that have an updated status from the last time that the nurse has logged in. The submitted requests section contains all requests that have been submitted in order of the date they were reported.

SUBMITTED REQUESTS		
Equipment: Equipment Name	Issue Description: Description of the issue would go here	Reported: XX/XX/XX
Equipment: Equipment Name	Issue Description: Description of the issue would go here	Reported: XX/XX/XX
Equipment: Equipment Name	Issue Description: Description of the issue would go here	Reported: XX/XX/XX

PROGRESS UPDATES			
Equipment: Equipment Name	Status: Report Seen	Notes: Notes for nurses from technicians	Reported: XX/XX/XX
Equipment: Equipment Name	Status: Device Picked Up	Notes: Notes for nurses from technicians	Reported: XX/XX/XX
Equipment: Equipment Name	Status: Awaiting Parts	Notes: Notes for nurses from technicians	Reported: XX/XX/XX

Submit Work Order Request

The submit work order request section allows the head nurse to report an issue to the engineering department. This form contains all necessary information for the Work Order/Request form. Any changes made by the engineers in terms of departments/units are reflected here in the nurse's request form as well.


[HOME](#)
[SUBMIT WORK ORDER REQUEST](#)
[WORK ORDER PROGRESS UPDATES](#)
[EQUIPMENT REQUEST](#)
[CHAT](#)


WORK ORDER REQUEST

Name: <input type="text" value="Name"/>	Department Requesting: <input type="text" value="Select Department"/>	Type of Request: <input type="text" value="Select Type"/>	Level of Service Interruption: <input type="text" value="Select Level"/>
Equipment Type: <input type="text" value="Select Equipment"/>	Manufacturer: <input type="text" value="Select Manufacturer"/>	Model: <input type="text" value="Select Model"/>	Serial Number: <input type="text" value="Input Serial Number"/>
Inventory Number: <input type="text" value="Input Inventory Number"/>	Location of Equipment: <input type="text" value="Select Location"/>		

Description of Problem:
Input a description of the problem

Work Order Request Submission

Once the work order request is submitted, the nurse is led to this page, confirming that the request has been received. This page also links back to submit another request, if necessary.

WORK ORDER REQUEST SUBMISSION CONFIRMATION

Thank you, your work order request has been submitted. If you would like to submit another request, please click [here](#).

Progress Updates

The work order progress updates provide detailed information on what stage of repair the device is currently under. This allows the nurses to have more communication with the engineering department while their device is being received.

WORK ORDER REQUEST

PROGRESS UPDATES		
Equipment: Equipment Name	Issue Description: Description of the issue would go here	Reported: XX/XX/XX
Status: Report Seen	Notes: Notes for nurses from technicians	Updated: XX/XX/XX
Equipment: Equipment Name	Issue Description: Description of the issue would go here	Reported: XX/XX/XX
Status: Report Seen	Notes: Notes for nurses from technicians	Updated: XX/XX/XX
Equipment: Equipment Name	Issue Description: Description of the issue would go here	Reported: XX/XX/XX
Status: Report Seen	Notes: Notes for nurses from technicians	Updated: XX/XX/XX

Equipment Request

The equipment request page is meant for nurses to submit a request for any new equipment they may need that the engineering department may have or be able to order. This form does not currently exist, as requests are usually made over the phone to the head of the engineering department or during rounds.

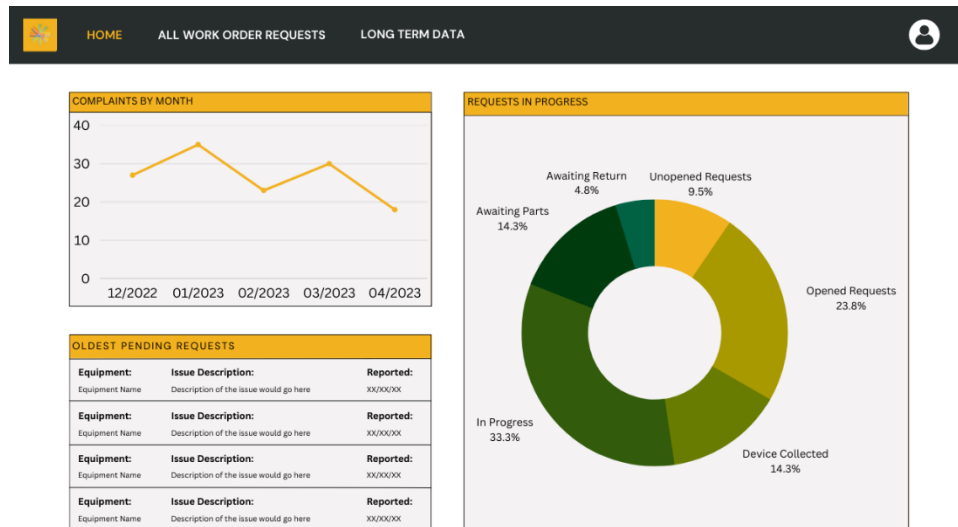
Chat

The chat page is meant for nurses to further communicate with the engineering department. It also functions as live support for any troubleshooting issues.

Design: Management View

Homepage

The homepage for the managers serves as an overview of the complaints/requests to the engineering department. It displays the number of complaints in the last several months, the oldest pending requests to see if any have been going on for an extended period of time, and a chart with the statuses of the requests in progress.



All Work Order Requests

This page is identical to the engineer's page and displays all the work order requests for the management to see.

Verification/ Validation

We recommend that once the system is created, it is first integrated into a single unit to undergo testing. As with the creation of the system, collaboration with the clients is crucial to the success of the system. At this stage, once the system has been designed, the client focus would shift from the nurses to the engineers. Any head nurses that are willing to participate would provide feedback on the ease of use of the system. With this feedback in mind, the system would be modified as needed then retested. This process would continue until the nurses are satisfied with the interface. The system would then be implemented throughout the hospital in phases to ensure that there are no further issues.

Conclusion

Future Recommendations

If this application is proven to be successful and beneficial at the Greater Accra Regional Hospital, it could be implemented in other hospitals around the region. This application should have the ability to be modified as needed to suit the needs of the users. Should more needs come up, the application would serve as a platform to address them. Because of this flexibility, it could be adapted to serve hospitals or health care centers beyond just the Greater Accra Regional Hospital. Should the application expand its reach, an additional feature for managers to customize the interfaces that nurses and engineers see could also be beneficial to better suit their specific needs.

Successful implementation of this application hinges on the continuous input from the clinical engineering team. With this type of collaboration, the project can be successfully designed to suit their needs. We hope that WPI continues its relationship with the Greater Accra Regional Hospital and that together, we can create something that provides value for the hospital.