Group 9
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Initial Project Document

Project Smart Hospital Watch

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Section 2: Project Narrative

Patients are occasionally misidentified within the hospital. This can result in small inconveniences being placed in the wrong room, to more serious situations where a patient can be given the wrong medication or possibly taken to have major surgeries when not necessary. According to the World Health Organization, the failure to correctly identify patients results in medication errors, transfusion errors, wrong person procedures, and the discharge of infant families [3].

This system will use a programmable RFID or NFC tag to contain the medical and identification information of the patient that will then be scanned to verify the identity of patients in the hospital. This allows for all the information to be contained inside a small chip that can constantly be updated. This also eliminates the small delay that occurs when a traditional barcode is scanned and the information must be retreated from a database. This also allows for improvement in scanning technology.

The main chip, which will contain the RFID/NFC tag, will communicate through the hospital's WIFI network to the main computer network of the hospital. This WIFI network will be used to communicate between the hospital's databases and servers and the patients chip. With the advance of technology, this allows for this communication to be very reliable.

Using the WIFI network of the hospital, the chip will constantly communicate with the servers to track the location of the patient inside the patient. With the accuracy and reliability of WIFI, a virtual fence will be used to know not only where the patient currently is but also where the patient should be. The latter of which will be implemented by communicating with the patient schedule information on the hospital's database.

Another feature included on the chip will be a panic button. This panic button will be activated by the patient when urgent help is needed. The signal will be sent to the hospital network and will alert the staff of the emergency. Of course, safe guards will be put in place to minimize false alarms or accidental button pushes since this can decrease hospital efficiency.

Additional features that will be incorporated into the chip will be medical sensors that can measure heart rate and temperature. This will allow for wireless monitoring of the patient when the patient is not inside the room or if the patient for some other reason is not connected to the already present medical devices.

Since this device will be used within a hospital, cosmetic considerations will be taken into account. The chip will be designed to fit into a housing that will be small as possible, comfortable, hygienic, disposable, and water resistant. Rubber like materials will be considered for attaching the chip to the patient's arm or wrist. It will be disposable so that the same chip can be used after a patient has left. It will be water resistant so that the chip will continue to function even if the patient showers or if bodily fluids come into contact with PCB board. This will allow and increase the reliability of the device.

This device is meant to be a low-cost device as to motivate the consumers (in this case hospitals) to switch over to buy this device. The goal of this device is not to be cheaper than the

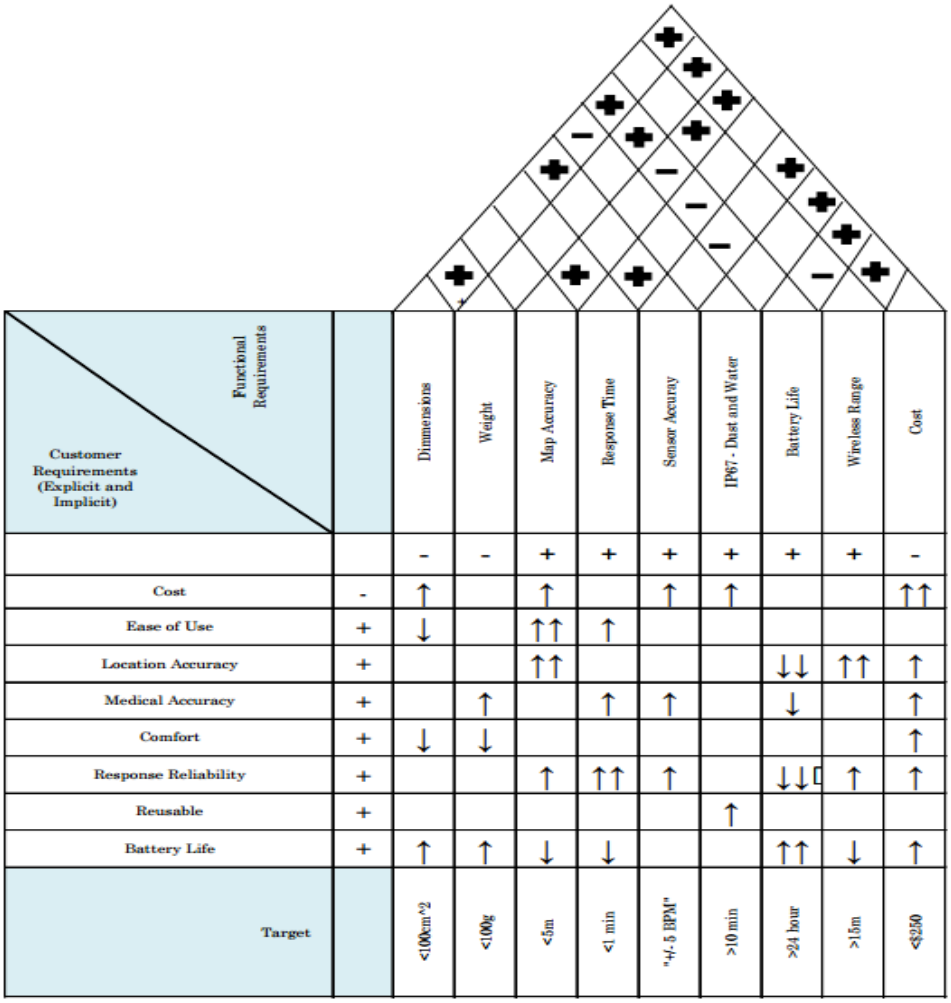
already in use system; it is meant to be more secure and "smarter". The main features of patient tracking/virtual fencing and patient identification will reduce the number of minor and major mistakes and in the long run reduce the number of lawsuits stemming from these mistakes.

Section 3: Project Requirements and Specifications

- Continuously monitor patient location in hospital to main computer program
    - Using Wi-Fi positioning system (WPS) IEEE 802.11.n
    - Provide XYZ axis
- Device will contain patient info necessary for medical staff (e.g. name, condition, medication, medication allergies, vital signs)
    - Transmit this data using Wi-Fi to a tablet device or computer used by medical staff
- Ability to transmit an alert activated by patient if there is an emergency regardless of location
- Device will be low power
- Low heat generation
- Battery powered (LI-ION) with a goal of at least 24 hours of continuous use out of a single charge
    - Charging ability via USB to AC
- Compact and able to fit on the wrist of a patient without impacting movement of wrist or comfort
- Wi-Fi and NFC ability
    - RFID tag assigned to room and device
- Meet HIPAA requirements
- Implement as many medical sensors as possible
- Plastic case which encloses hardware that can be cleaned easily
- Disposable wrist strap
- Device shall not cost more than $250

Section 4: House of Quality Diagram

The house of quality diagram is a conceptual map developed in Japan that provides interfunctional planning and communications [2]. Yoji Akao, the original developer, described the House of Quality as a "method to transform qualitative user demands into quantitative parameters, to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elments of the manufacturing process." [1].



Customer Requirements (Explicit and Implicit) \ Functional Requirements		Dimensions	Weight	Map Accuracy	Response Time	Sensor Accuray	IP67 - Dust and Water	Battery Life	Wireless Range	Cost
		-	-	+	+	+	+	+	+	-
Cost	-	↑		↑		↑	↑			↑↑
Ease of Use	+	↓		↑↑	↑					
Location Accuracy	+			↑↑				↓↓	↑↑	↑
Medical Accuracy	+		↑		↑	↑		↓		↑
Comfort	+	↓	↓							↑
Response Reliability	+			↑	↑↑	↑		↓↓□	↑	↑
Reusable	+						↑			
Battery Life	+	↑	↑	↓	↓			↑↑	↓	↑
Target		<100cm^2	<100g	<5m	<1 min	"+/- 5 BPM"	>10 min	>24 hour	>15m	<$250

Correlation	
↑	Positive
↓	Negative
↑↑	Stong Positive
↓↓□	Stong Negative

Figure 1 – House of Quality

Section 5:

Block Diagram and Software flowchart

The purpose of the block diagram is to divide the project into smaller sections and then assigning each subtask individually. Since we are still very into the planning and research stages of the project, the roles of each person were assigned in a way that each person would be partnered with every other teammate on a task. The intended result would be to not load any one person up while still allowing each person to be directly helped and held accountable. This system might change as the project goals come nearer.

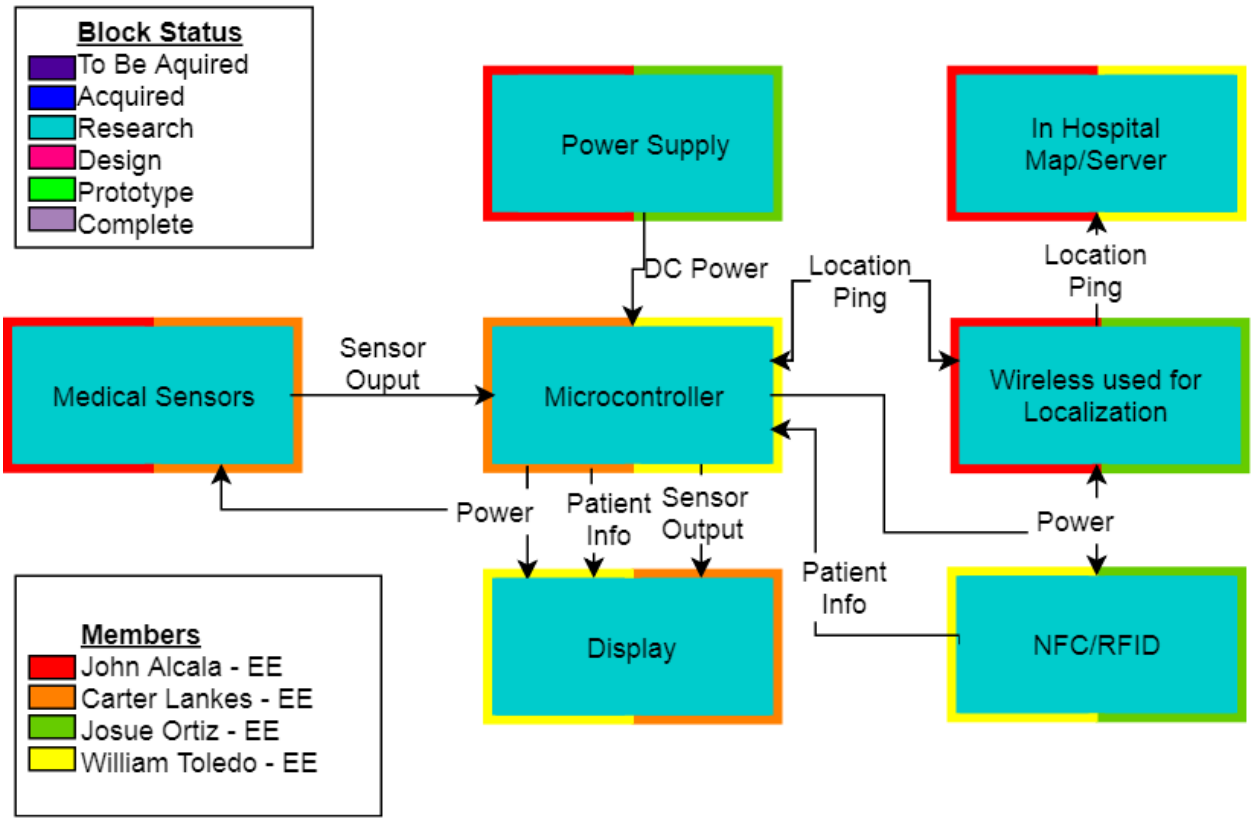


Figure 2 – Block Diagram

The software flowchart demonstrates the rough idea of what the watch will do. The watch will be programed to hold the patient's information like name, sex, allergens, condition, etc. This data will be displayed on the watch for quick glimpses but will ultimately be scanned with an RFID/NFC device like a tablet or phone. This app will also have to be designed to be easily used and to connect with the hospital's servers.

The watch will also use WIFI protocol to help triangulate the position of the patient. This raw data with the strengths of the WIFI signals would be transferred to the server and then a probability will appear on the map. As long as the patient remains inside the expected areas, the band will not signal anything.

The heart rate monitors would monitor the pulse of the patient and then display the data on the watch. An oximeter might also be added which would provide data on the effeciency of the patients respiration and blood pressure.

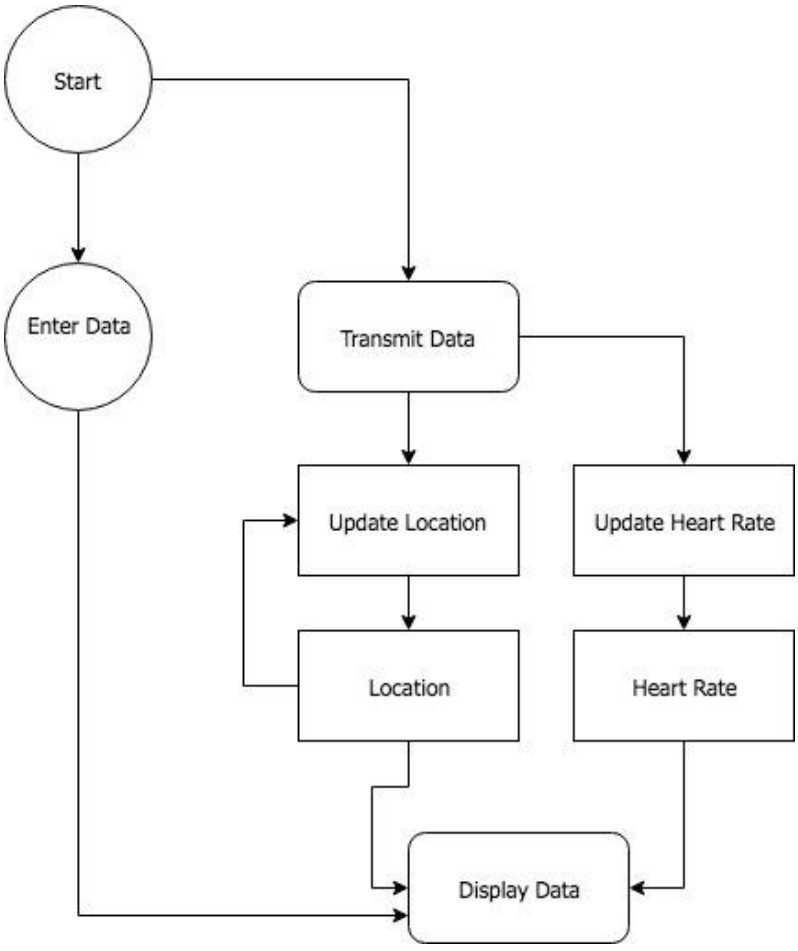


Figure 3 – Software Flowchart

Section 6: Schedule and Project Budget

This is a very rough schedule of the dates and budget we will use. We will expand this section more after the review with the professors. Many more subtasks will be stated.

Senior Design I

Task	Duration	Date
Project Ideas	2 weeks	May 14-21
Project Selection	1 week	May 21-28
Divide and Conquer	1.5 weeks	June 8
Research and Documentation	7 weeks	June 8–July 31
60 Page Draft	4 weeks	June 8–July 6
Prototype	7 weeks	June 8–July 31
Final Document	7 weeks	June 8–July 31

Senior Design II

Task	Duration	Date
Construct prototype design	4-5 weeks	Aug 20 – Sept 17
Test and redesign	2 weeks	Sept 17- Oct 1
Finalize Prototype	2 weeks	Oct 1- Oct 15
Peer Presentation		TBA
Final Report		TBA
Final Presentation		TBA

Cost Analysis:

The prices listed are subject to change during research period. The group is unsponsored as of now and the group will cover the costs with each group member providing $100 resulting in an estimated excess project budget.

Item	Quantity	Price per Unit
PCB	1	~$80
Microcontroller	**1**	**~$10**
Sensors	**2**	**~$40**
LCD Screen	**1**	**~$10**
NFC Tags	**1**	**$0.10**
Enclosure	**1**	**~$20**
Wireless chip	**1**	**~$20**
LI-ION Battery	**1**	**~$10**
Disposal Strap	**1**	**~$3**
Total Cost		**$195**

Figure 4 – Cost Analysis table

Section 7: Project Goals

Project Smart Hospital Watch will be used to assist in the hospital setting by monitoring, locating, and accessing the data of patients easier, faster, and more precise than it is today. Our team will design a device for accuracy, being user-friendly, and to meet the standards of the medical industry. Our vision is that the Smart Hospital Watch will contribute and make an impact in progressing hospital settings to provide the best and most accurate care for patients.

Section 8: Sources

[1] Y. Akao, *The Customer Driven Approach to Quality Planning and Deployment.* Minato, Tokyo: Asian Productivity Organization, 1994.

[2] https://hbr.org/1988/05/the-house-of-quality

[3] http://www.who.int/patientsafety/solutions/patientsafety/PS-Solution2.pdf