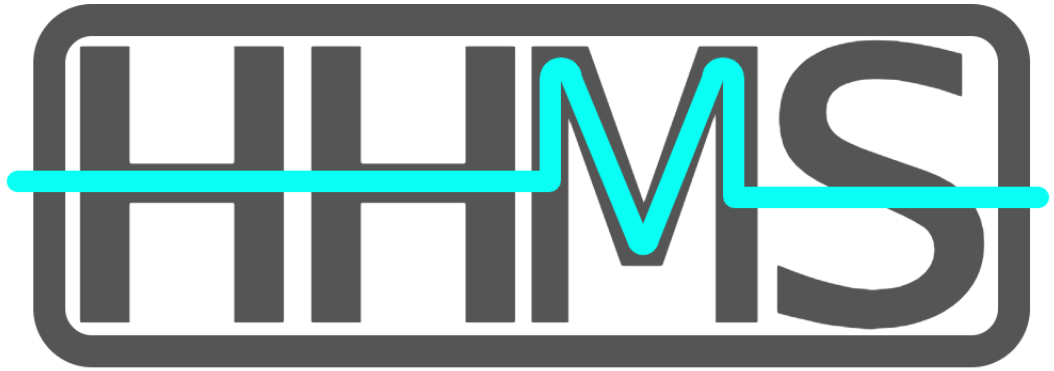
THE UNIVERSITY OF ALABAMA AT BIRMINGHAM



HOME HEALTH MONITORING SYSTEM

Terry Edwards, Ben Whalin, Ziyad Allehaibi, Elijah Rose

Mentor: Gregory Myers

OUTLINE

PROBLEM INTRODUCTION

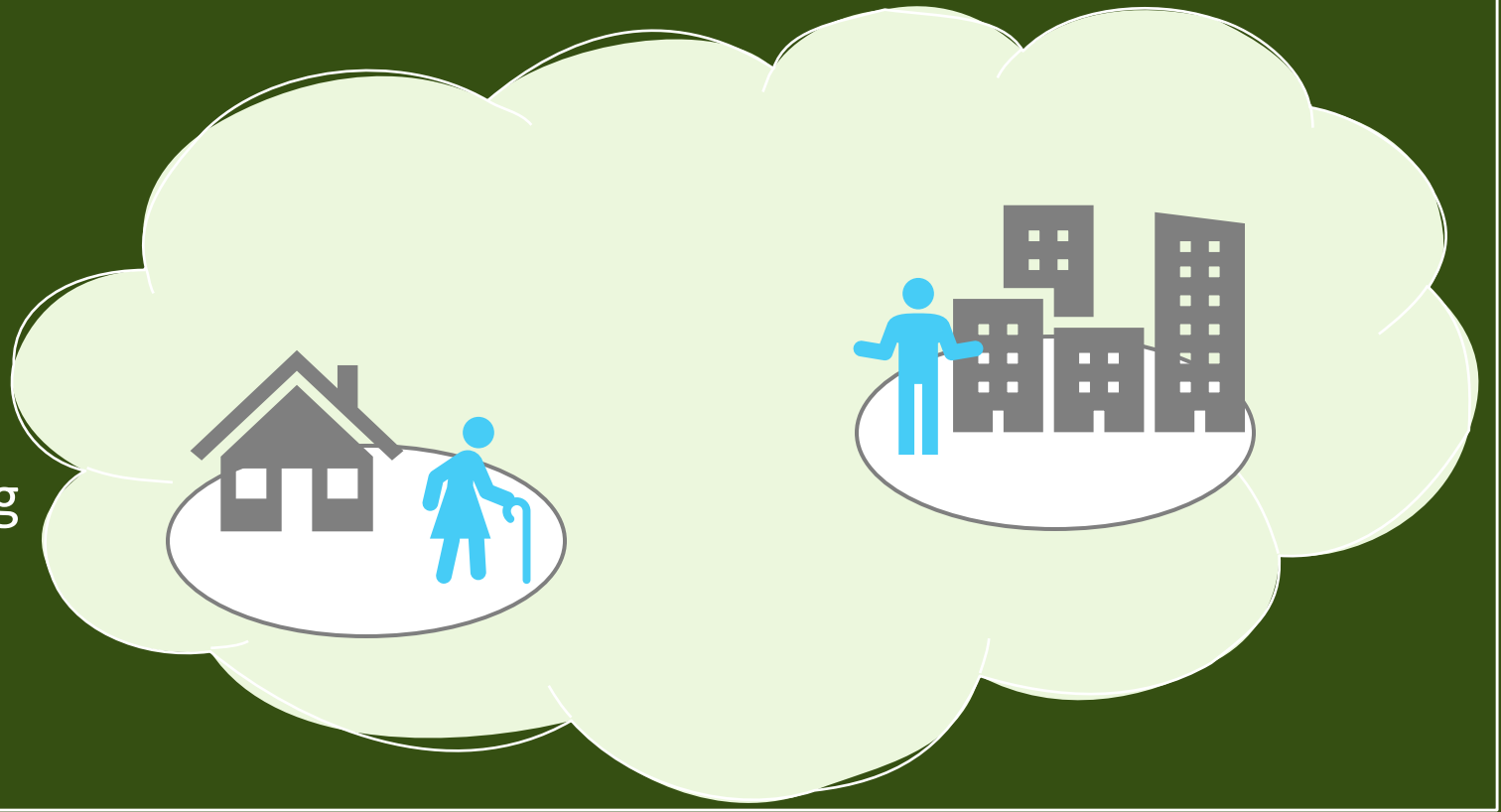
How can one monitor their partially dependent family member while the user is away from their home?

~13% of US Population is 65+.

Average cost of assisted living is $4,000/month.

Some are not comfortable sending family to retirement homes.

Covid-19: Separation of Family

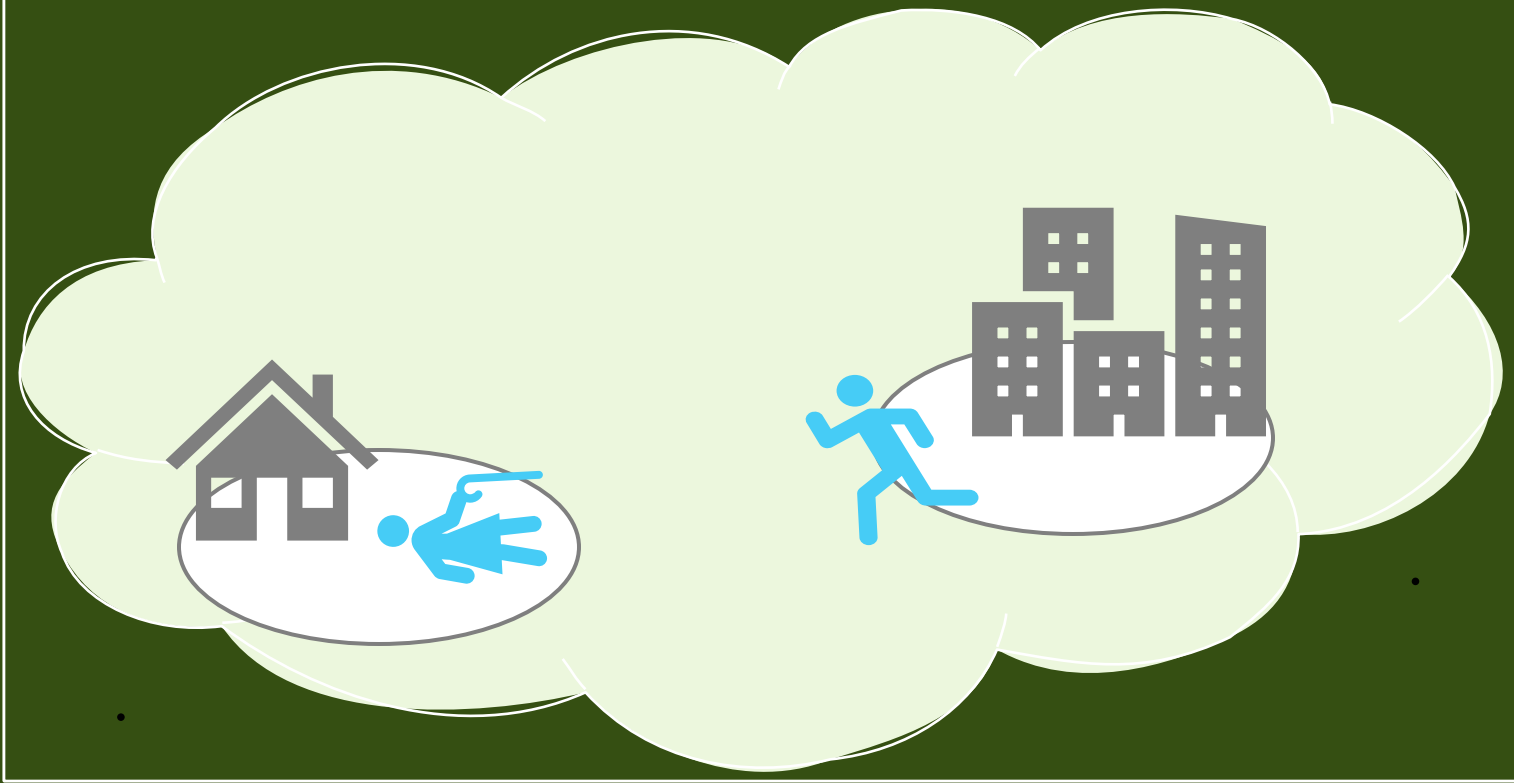


CURRENT COMPETITION

- Assisted Living Facilities:
- Expensive $4,000 per month
- Negates Privacy
- In-Home Assisted Health Care:
- Extremely Expensive:
- Personal Care: $45-$55 per hour
- Health care (Nurse): $70-$90 per hour
- Overnight and long-term daily care in 12- or 24-hour shifts: $660-$915
- Assistance is only for certain hours of the day
- Not covered on healthcare
- Existing Home Health Monitoring Systems:
- Expensive
- Can't be customized by the user

PROPOSED SOLUTION

Open Source **Home Health Monitoring System** with an API to *encourage* extensibility to third-party devices.

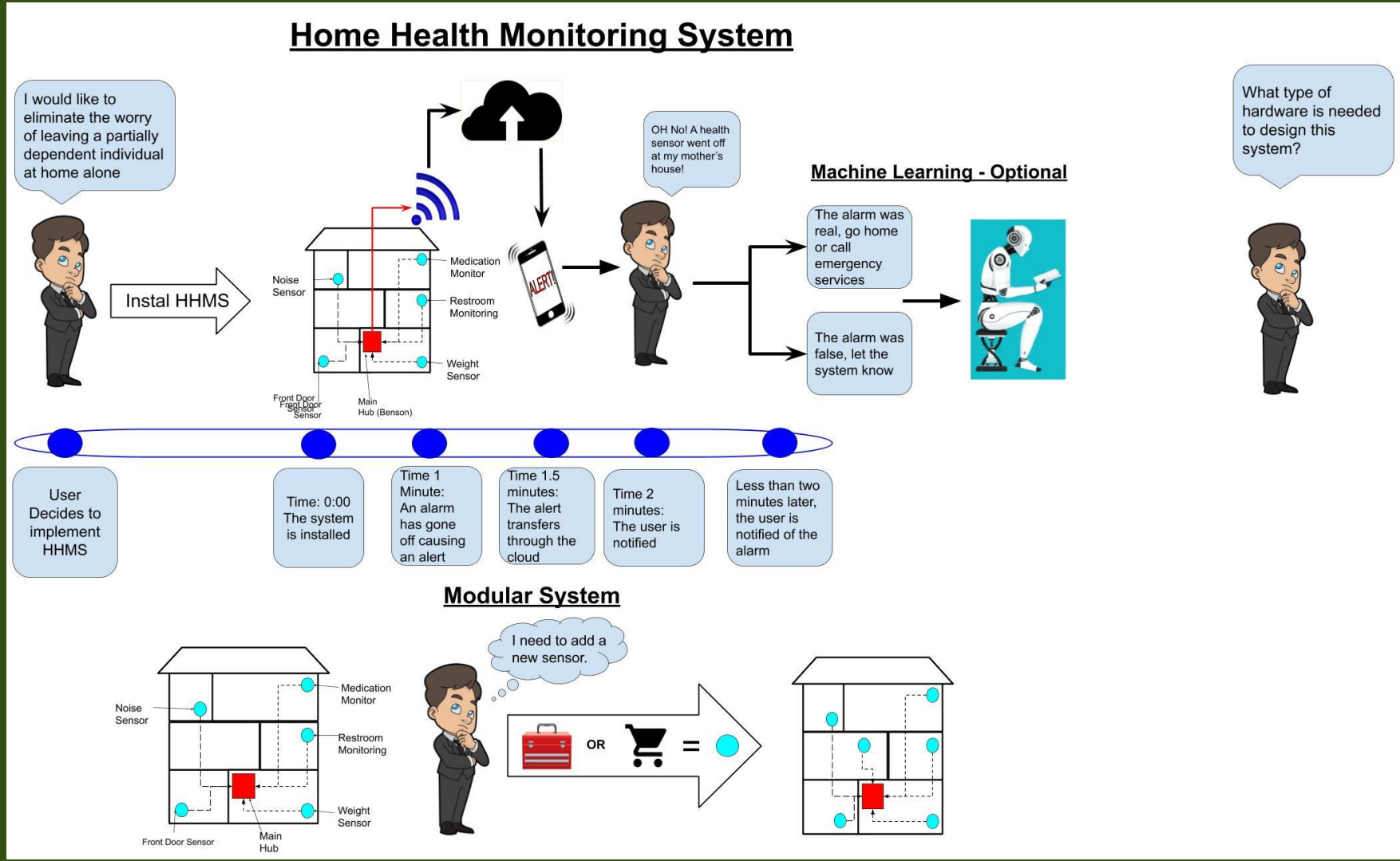


Solution Goals:

- Remove the worry of a loved one's immediate health from the caretaker
- Become a more affordable option
- Be easily expandable to fit costume needs

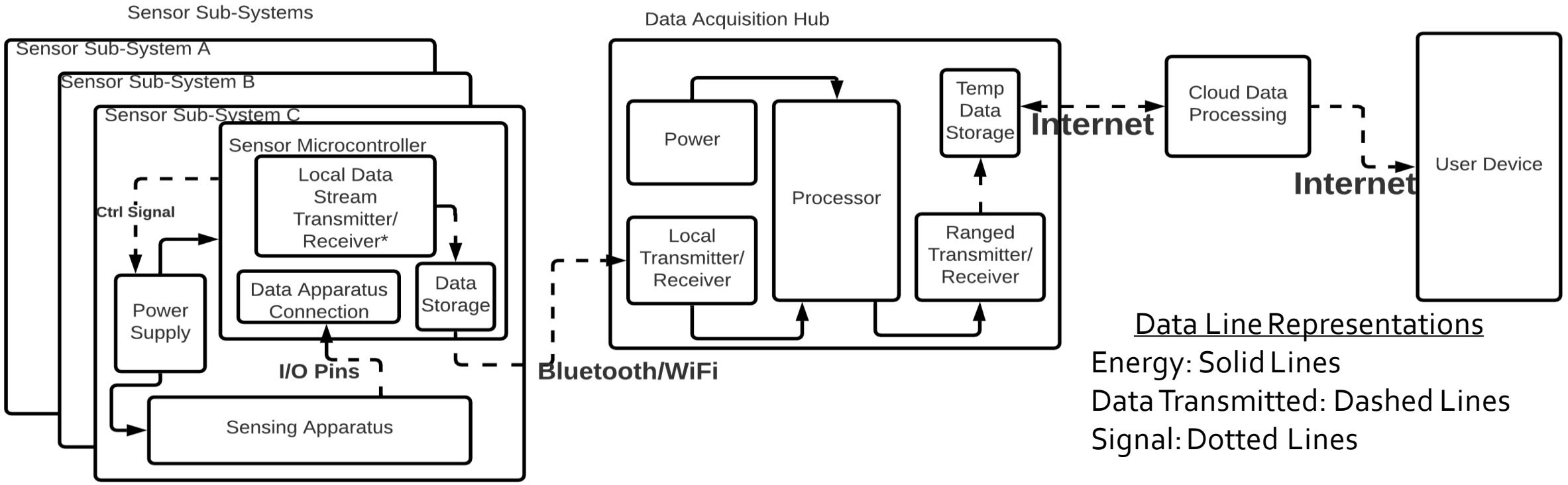
TOP LEVEL DIAGRAM

- Sensors around home
- Alert User quickly in case of emergency
- Modularity
- Machine learning/Pattern Recognition optional



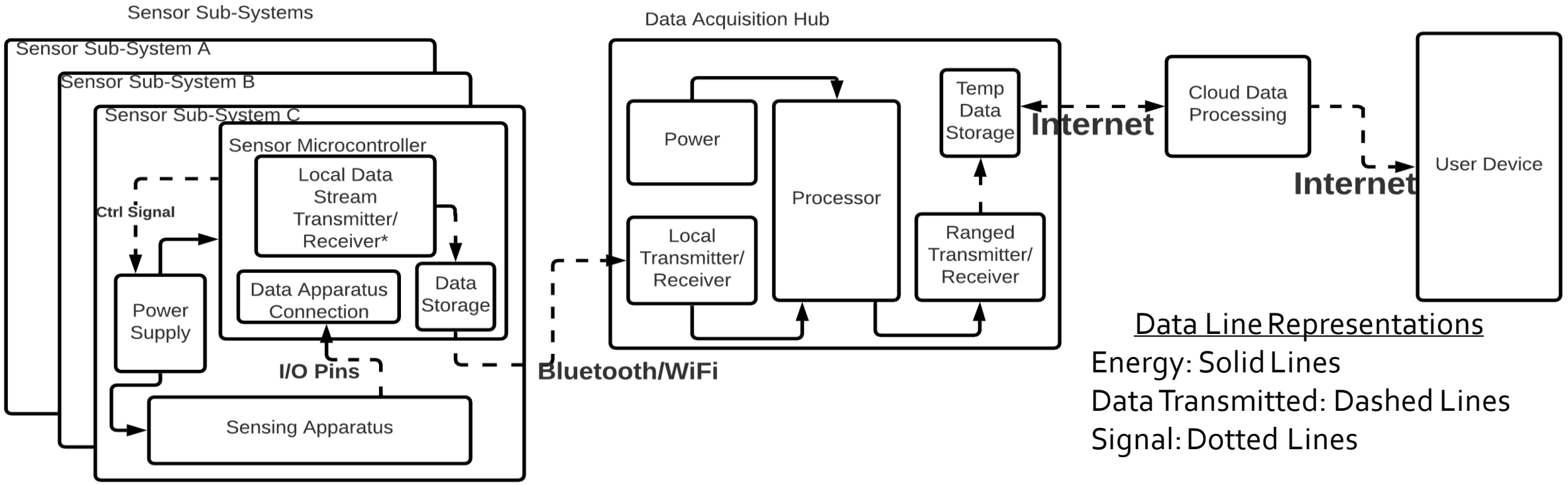
HARDWARE DIAGRAM

- Different sensors around home collect data from the partially dependent person
- Data gathered is transmitted to the Hub via either Bluetooth or Wi-Fi
- Data is then sent to the cloud for processing then the User's device.

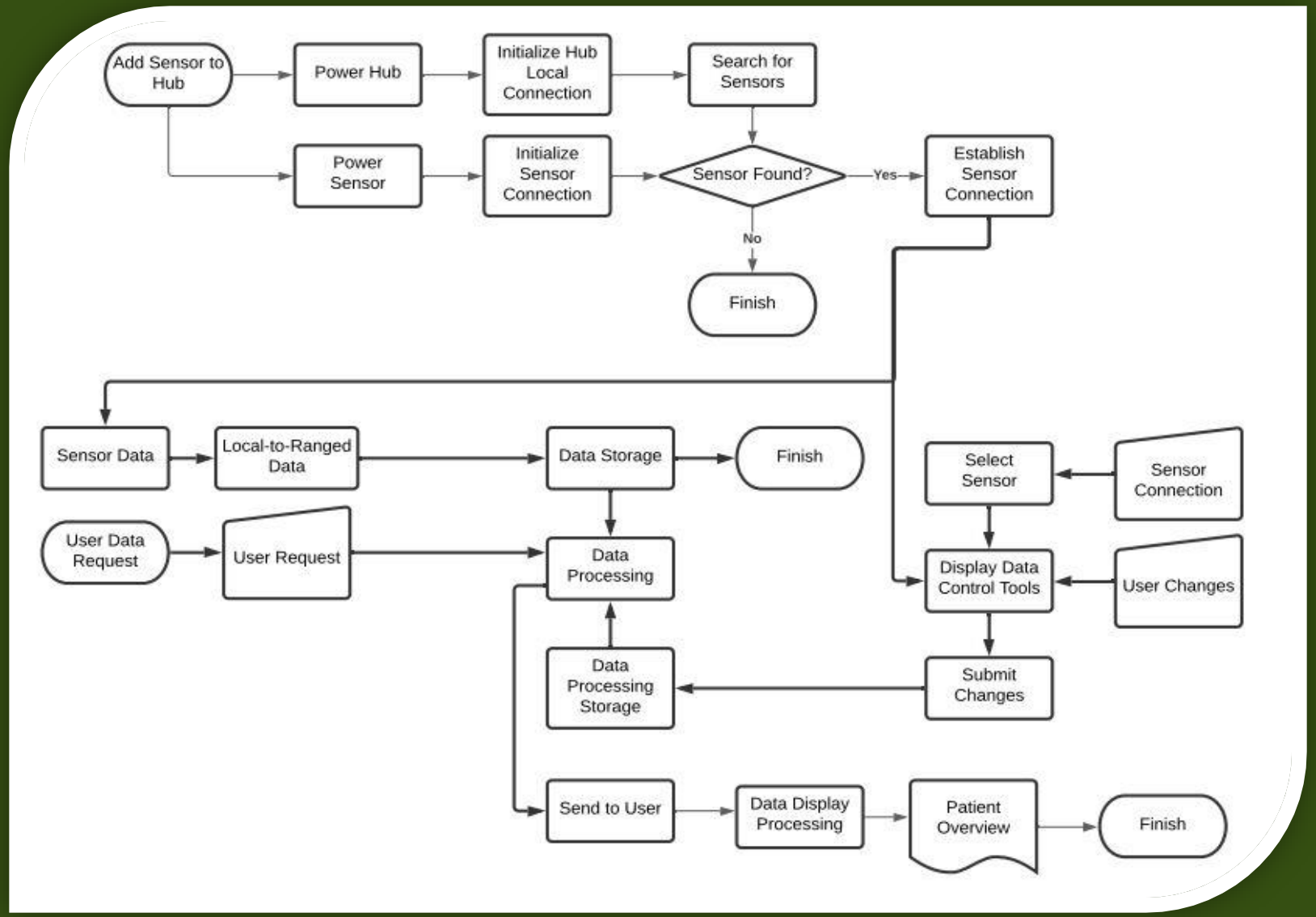


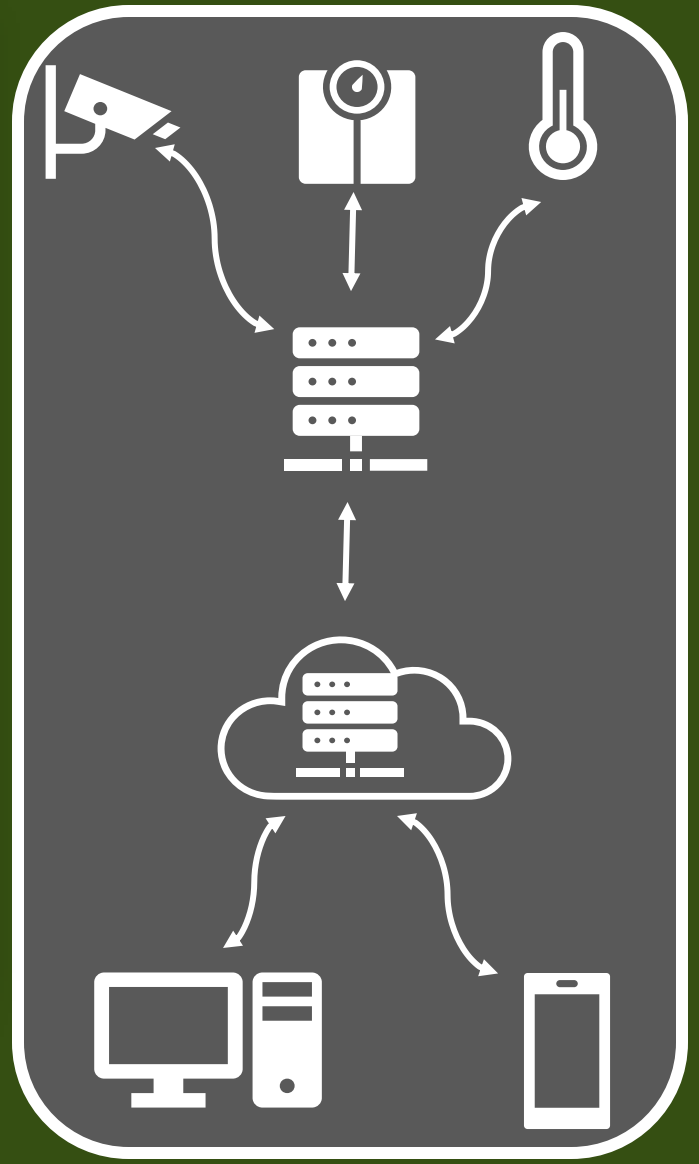
HARDWARE DIAGRAM

- If a sensor detects an emergency, alert is quickly sent to the User.
- User verifies if the alert was genuine or a false alarm, reacts accordingly



SOFTWARE DIAGRAM





DESIGN TABLE

- In order to ease with future design, a design table was created to help visualize the needed pieces for the product.
- Parts of the design:
  - The controller/Hub
  - Subsystems
  - Client Interface

HUB DESIGN TABLE

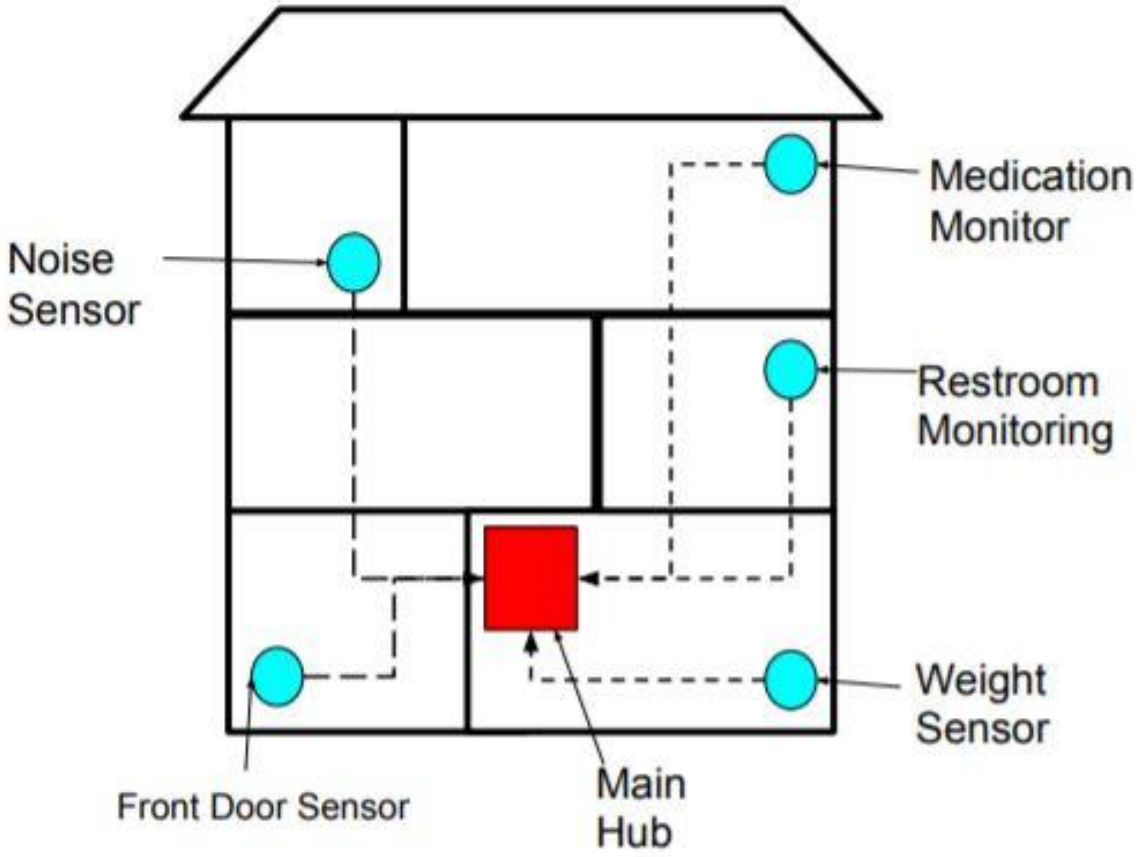
Problem Statement	Approach	Solution	Features	Approach	Hardware Needed	Price (USD)	Link
How can one monitor their partially dependant family member while the user is away from their home?	Develop a home health monitoring system hub that has the ability to connect multiple subsystems to approach different aspects of a client's needs	Hub(Benson)	Data Processing	Use the hub as a transport to relay the data to an offsite software to process the data			
			Computer/Controller	Raspberry PI 4B 8GB	Rasberry Pi 4B 8Gb	75	https://www.pishop.us/product/raspberry-pi-4-model-b-8gb/?src=raspberrypi
			Input	WiFi			
				Bluetooth			
				USB 2.0			
				USB 3.0			
				USB C			
				HDMI Type D - Micro			
				Ethernet			
			Output	Wifi			
			Hub Case Material	Store Bought Case	Raspberry Pi 4 Case, Red/White	5	https://www.pishop.us/product/raspberry-pi-4-case-red-white/
			Case Cooling Fan/Heatsink	Store Bought Fan for Case	Case Fan & Heatsink For Raspberry Pi 4 Case	5	https://www.pishop.us/product/case-fan-heatsink-for-raspberry-pi-4-case/?src=raspberrypi
			Temporary Data Storage (Hub)	64GB Storage	Class 10 microSD card - 64GB	14	https://www.amazon.com/SanDisk-Extreme-microSD-UHS-I-Adapter/dp/B07FCMBLV6/ref=sr
			Temporary Data Storage (SubSystems)	32GB Storage	Class 10 microSD card - 32GB	7	https://www.amazon.com/SanDisk-Ultra-microSDXC-Memory-Adapter/dp/B073JWXGNT/ref=sr_1_3?dchild=1&keywords=micro+sd+card+32gb+class+10&qid=1603739324&sr=8-3
			Power Supply	Wired	USB-C Power Supply	8	https://www.pishop.us/product/usb-c-power-supply-5-1v-3-0a-black-ul-listed/

Design Table for the system's Hub.

SUBSYSTEM DESIGN TABLE

Problem Statement	Approach	Solution	Features	Approach	Hardware Needed	Price (USD)	Link
How can one monitor their partially dependant family member while the user is away from their home?	Develop a home health monitoring system hub that has the ability to connect multiple subsystems to approach different aspects of a client's needs	Subsystems	Magnetic Contact Switch Sensor	Monitor movement in the house	Magnetic Alarm Contact Switch	$27	https://www.amazon.com/Gikfun-S
				Monitor if a person has gone to the restroom			https://www.amazon.com/MELIFE-
				Monitor exterior doors			
			Button For User Input	Has the person taken their medication?	Small Static Button	$33	https://www.newark.com/alc
				Did the person take a shower or bath?			hvdev=c&hvdvcmdl=&hvlocint=&hvl
				Has the person had a meal?			
			Light Level Sensor	Insure that lights have not been left one throughout the home	Photoresistor Photo Light Sensitive Resistor Light Dependent Resistor	$38	obotics.com/shop/tmp36-temperat
				Make sure the user is moving throughout the day (lights turning off and on)			https://www.amazon.com/MELIFE-
			Temperature Sensor	Monitor the temperature throughout the house	TMP36 Temperature Sensor	$29	https://www.amazon.com/gp/prod

Design Table for the system's sensors.



SUBSYSTEM TABLE

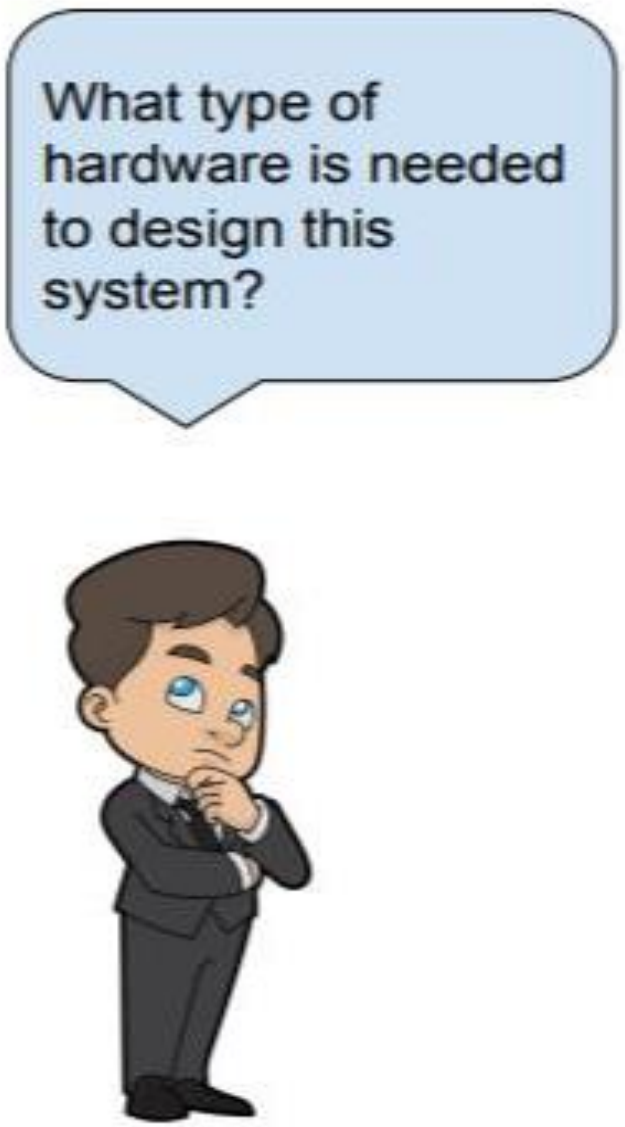
- Used to brainstorm possible subsystems.
- Divided into sensor categories.
- A weighted table was then used to find the most viable choice.

SUBSYSTEM TABLE

Sensor Types	Uses	Hardware Options	Web Link	Price	Total cost	In Scope (0-1)	Intrusiveness (Input)	Intrusiveness (Input Freq)	Intrusveness (Wearable)	Intrusiveness (Security/Privacy)		Results
						Weight:	Weight:	Weight:	Weight:	Weight:		
						100	1	1	1	1		
						Value: 0 = No, 1 = Yes	Value: 0 = No, 1 = Yes	Value: 0 = No, 1 = Yes	Value: 0 = No, 1 = Yes	Value: 0 = No, 1 = Yes		
Magnetic alarm contact switch	Monitor movement in the house	Sensor (two pack)	https://www.amazon.com/Gikfu	$8	$27 for two sets	1	0	0	0	0		1
	Monitor if a person has gone to the restroom	ESP32 (two pack) (option micro usb power supply)	https://www.amazon.com/MELI	$15		1	0	0	0	0		1
	Monitor exterior doors	Power supply	https://www.adafruit.com/produ	$2		1	0	0	0	0		1
	Monitor if a window is open or closed	Sensor (two pack)	https://www.amazon.com/Gikfun-Sens			0	0	0	0	0		0
	Monitor if a lever has been pushed on a toilet	ESP32 (two pack) (o	https://www.amazon.com/MELIFE-Dev			0	0	0	0	0		0
	Monitor the door on the refridgerator	Power supply	https://www.adafruit.com/product/3858			0	0	0	0	0		0

- Decision table for the magnetic contact sensors.
- Shows individual hardware price as well as the total costs.
- Calculates intrusiveness for the specific sensor.

- Other sensors:
  - Buttons for user input
  - Pressure
  - Temperature
  - Light level
  - Sound level
  - Weight Scale
  - Wearable Watch



HHMS PRODUCT DECISION TABLES

- Used as support tables for the hardware chosen in the design table.
- Contains each design option from the different component on the design table.
- Shows the applicable engineering characteristic for all design options.
- Equations are used to calculate the results for each decision table.

HUB DECISION TABLE 1/2

Microprocessors					
Microprocessors	Processor Name	Processor Speed	Number of Cores	Onboard Ram	Integrated GPU
		Weight:	Weight:	Weight:	Weight:
		10	7	7	3
		Value in GHz:	Value:	Value in GB:	Value: 1: yes 0:no
Raspberry PI 4B 4GB	Cortex-A72	1.5	4	4	1
Raspberry PI 4B 8GB	Cortex-A72	1.5	4	8	1
Arduino NANO 33 IOT	SAMD21 Cortex®-M0+	0.048	1	0.000032	0
Banana Pi M3	Allwinner A83T ARM Cortex-A7	1.8	8	2	
Odroid XU4	Samsung Exynos5422 Cortex-A15 and Cortex-A7 Octa core	2/1.4	8	2	0
NanoPi NEO4	Rockchip RK3399 64-bit Dual Core Cortex-A72 + Quad Core Cortex-A53	2/1.5	2/4	1	1
UDOO BOLT V8	AMD Ryzen™ Embedded V1605B Quad Core	2.0/3.6	4	up to 32	1
UDOO X86 II ULTRA	Intel Pentium N3710	2.56	4	8	1
ASUS Tinker Board	Rockchip Quad-Core RK3288	1.8	4	2	1
Onion Omega2+	MT7688 SoC	0.58	1	0.128	0
Orange Pi 4B	Rockchip RK3399	2	6	4	1
NanoPC-T3 Plus	Samsung S5P6818	1.4	8	2	0
Le Potato - AML-S905X-CC	ARM Cortex-A53	1.512	4	2	1
Orange Pi Zero Plus2	Cortex-A53	1.2	4	0.512	1
Raspberry Pi Zero W	BCM 2835 SOC	1	1	0.512	0
Intel® NUC Board NUC7i3DNBE	Intel® Core™ i3-7100U	2.4	2	up to 32	1

- The decision table for the possible microprocessors used in the Hub.

HUB DECISION TABLE 2/2

	Output Types								
Microprocessors	Bluetooth	Wifi	USB 1.1	USB 2.0	USB 3.0	USB C	HDMI Type A - Standard	HDMI Type C - Mini	HDMI Type D - Micro
Weight: 0-10	10	10	1	5	5	2	1	2	3
Values: Boolean									
Raspberry PI 4B 4GB	1	1	0	1	1	1	0	0	0
Raspberry PI 4B 8GB	1	1	0	1	1	1	0	0	0
Arduino NANO 33 IOT	1	1	0	1	0	0	0	0	0
Banana Pi M3	1	1	0	1	0	0	0	1	0
Odroid XU4	0	0	0	1	1	0	0	1	0
NanoPi NEO4	1	1	0	1	1	1	0	1	0
UDOO BOLT V8	1	1	0	0	1	1	0	1	0
UDOO X86 II ULTRA	1	1	0	0	1	0	0	1	0
ASUS Tinker Board	1	1	0	1	0	0	0	1	0
Onion Omega2+	0	1	0	1	0	0	0	0	0
Orange Pi 4B	1	1	0	1	1	0	0	1	0
NanoPC-T3 Plus	1	1	0	1	0	0	0	1	0
Le Potato - AML-S905X-CC	0	0	0	1	0	0	0	1	0
Orange Pi Zero Plus2	1	1	0	0	0	0	0	1	0
Raspberry Pi Zero	1	1	0	1	0	0	0	1	0
Intel® NUC Board NUC7i3DNBE	1	1	0	1	1	0	1	0	0

- The decision table for the output types on each microprocessor.

SUBSYSTEM DECISION TABLE

Microcontrollers								
Microcontrollers	Cost	Physical Size	Bluetooth	Wifi	Clock Speed	Flash Memory	Digital I/O Pins	Analog I/O Pins
	in USD	in mm	Weight:	Weight:	Weight:	Weight:	Weight:	Weight:
			10	7	7	10	10	10
			Value (0=no, 1=yes):	Value (0=no, 1=yes):	Value in MHz:	Value in KB:	Value:	Value:
Arduino UNO WiFi Rev 2	35.84	53.4 x 68.6	1	1	16	48	14	6
Arduino YÚN Rev 2	46.90		0	1	16	32	20	12
Canaduino WEMOS D1 R32	7.66		1	1	240	4	20	6
Teensy 4.0	29.17	17.78 x 35.56	0	0	600	2048	40	14
DigiStump Oak	10.95	23.4 x 30	0	1	80	4096	11	1
SparkFun RedBoard Artemis Nano	14.95	23.14 x 50.04	1	0	48	1024	17	8
Raspberry Pi Zero	5.00	30 x 65	0	0	1000	0	40	0
ESP-12E NODEMCU	4 for 16.99	25.6 x 48.55	0	1	80	4096	11	1
HiLetgo ESP-WROOM-32	10.99	25.4 x 48.26	1	1	240	4096	32	0
MSP-EXP430FR2355	15.59		0	0	24		44	12

- The decision table for the possible microcontrollers used in the Subsystems.
- Displays each possible option and calculates the best choice.

SENSORS SUB TABLE

- Multi different sensors
- Purpose: provide more information and definition for each type of sensors that could help to select the right sensor that matches our need

Sensors sub table				
Sensors	**Description**	**Use**	**Example**	**Links/References**
Step counters/pedometer	A device, usually portable and electronic or electromechanical, that counts each step a person takes by detecting the motion of the person's hands or hips.	designed to detect vertical movement at the hip and so measure the number of steps and provide an estimate of distance walked.	After a patient is discharged from the hospital, they will typically be given a list of what to do and what not to do. Often times, these instructions will include getting a certain amount of exercise every day. When their care providers are able to monitor their activity through a step counting device, care givers can ensure that the patient is getting the correct amount of physical activity.	https://aetonix.com/chronic-disease-management/monitoring-chronic-conditions-home-health-monitoring-devices/
Fall detection & Wandering	smartphone-based system monitoring people with dementia for both indoor and outdoor. The whole system comprises wandering path tracking and fall detection, safety-zone monitoring, communication services, alert notifications, and emergency medical services.	smartphone camera to take real-time pictures along the user's path as he or she moves about. Those photos, along with time and GPS signals, are delivered to and stored on the Cloud system. When there is a need, family caregivers can download those data to quickly find a way to help the elderly individual.	When a fall incident is detected, the alarm system issues notification messages to all emergency contact person in sequence until one responds to the system. If no one responds within a pre-determined time period, then the system immediately calls emergency medical services to procure timely help for that elderly individual.	https://ieeexplore.ieee.org/document/7016086
Pulse oximeter	a small device usually worn on the patients' finger, that can measure how much oxygen is in the patient's blood along with measuring their heart rate	This type of device is typically used by those with illnesses that compromise the body's ability to take in and circulate oxygen – like COPD, congestive heart failure, and asthma	a sleep specialist might recommend a pulse oximeter to monitor the nighttime oxygen saturation level of someone with suspected sleep apnea or severe snoring.	https://www.medicalnewstoday.com/articles/318469#Who-can-benefit-from-pulse-oximetry
Weight scale	Medical scales are scales used to describe or assess medical conditions or in another word it is a measuring instrument for determining the weight or mass of an object.	a device used to measure the weight of person and it is among the common used device by doctors	Medical quality weight scales can always be found in any hospital or doctor's office. When the patient's health is at risk, their care provider might suggest they lose weight. Patients with COPD or heart failure can benefit greatly from weight loss.	https://www.definitions.net/definition/weighing+scale
Blood pressure (sphygmomanometer)	a device used to measure blood pressure, composed of an inflatable cuff to collapse and then release the artery under the cuff in a controlled manner, and a mercury or aneroid manometer to measure the pressure.	Monitoring blood pressure changes at home can help you and your doctor make decisions about your treatment, such as adjusting dosages or changing medications.	people have normal blood pressure at a clinic but elevated pressure elsewhere (masked hypertension). Monitoring blood pressure at home can help determine if you have true high blood pressure.	https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/in-depth/high-blood-pressure/art-20047889

PARTS LIST

Part Name	Status	Supplier	Part Number	Description	Price	Quantity	Subtotal
Amazon							
SanDisk 64GB microSD Memory Card	Need to Order	Amazon	SDSQXA2-064G-GN6MA	Memory Card for Rasberry Pi	$13.99	3	$41.97
4PCS Breadboards Kit	Need to Order	Amazon	RQ-BK-002	Two large breadboards and two small	$9.99	3	$29.97
HiLetgo 200pcs/5x40pcs Breadboard Jumper Wires	Need to Order	Amazon	3-02-1141	Assortment of Wires	$6.99	1	$6.99
61 Values (Pack of 1095) 1% 0.25w Resistor Book kit	Need to Order	Amazon	EE902	Assortment of Resistors	$14.99	2	$29.98
Virtuabotix SD Card Reader/Writer for Arduino and other Microcontrollers	Need to Order	Amazon	SDREADWRITE_BO	SD Card Reader for ESP32 Board	$4.99	15	$74.85
SanDisk 32GB Ultra microSDHC	Need to Order	Amazon	SDSQUAR-032G-GN6MA	Micro SD Memory Card	$6.99	15	$104.85
MELIFE 2 Pack ESP32 ESP-32S Development Board	Need to Order	Amazon	B07Q576VWZ	with 3 Breadboards	$20.22	4	$80.88
MELIFE 2 Pack ESP32 ESP-32S Development Board	Need to Order	Amazon	B07Q576VWZ	Pack of 2 ESP32 Development Boards	$14.99	4	$59.96
Gikfun MC-38 Wired Door Sensor Magnetic Switch	Need to Order	Amazon	3652995690	Two pack of door sensor	$7.29	3	$21.87
Cylewet 70Pcs Momentary Tactile Push Button	Need to Order	Amazon	CYT1115	35 Momentary Push Buttons	$8.99	1	$8.99
Eiechip 10Pcs 18B20 DS18B20 TO-92 3 Pins Wire Digital Thermometer Temperature IC Sensor	Need to Order	Amazon	1	Pack of 10 Temperature sensors	$9.99	1	$9.99
eBoot 30 Pieces Photoresistor Photo Light Sensitive	Need to Order	Amazon	EBOOT-RESISTOR-05	Pack of 30 Light Level Sensors	$4.95	1	$4.95
MakerFocus WiFi Test Tool ESP8266 WiFi Deauther Watch DSTIKE NodeMCU ESP8266 Programmable Development Board Built in 500mAh Battery with OLED Dispaly, Wristband and 3D Printing Case	Need to Order	Amazon	ZWQW16U53EUI2GO383O44	Wearable Watch from ESP32 board	$42.99	1	$42.99
PiShopUS							
Rasberry Pi 4B 8Gb	Need to Order	PiShopUS	8GB-9006	Raspberry Pi Development Board	$75.00	3	$225.00
Raspberry Pi 4 Case, Red/White	Need to Order	PiShopUS	644824914916	Raspberry Pi Case	$5.00	3	$15.00
Case Fan & Heatsink for Raspberry Pi 4 Case	Need to Order	PiShopUS	1411	Raspberry Pi Case Fan	$5.00	3	$15.00
USB-C Power Supply, 5.1V 3.0A	Need to Order	PiShopUS	1203	Raspberry Pi Power Supply	$7.95	3	$23.85
							$797.09

Total cost of Hub materials: $106.94
Total cost of one Subsystem package with six assorted sensors systems: $253.24

Actual cost of System: $360.18

EE 498-TIME LINE

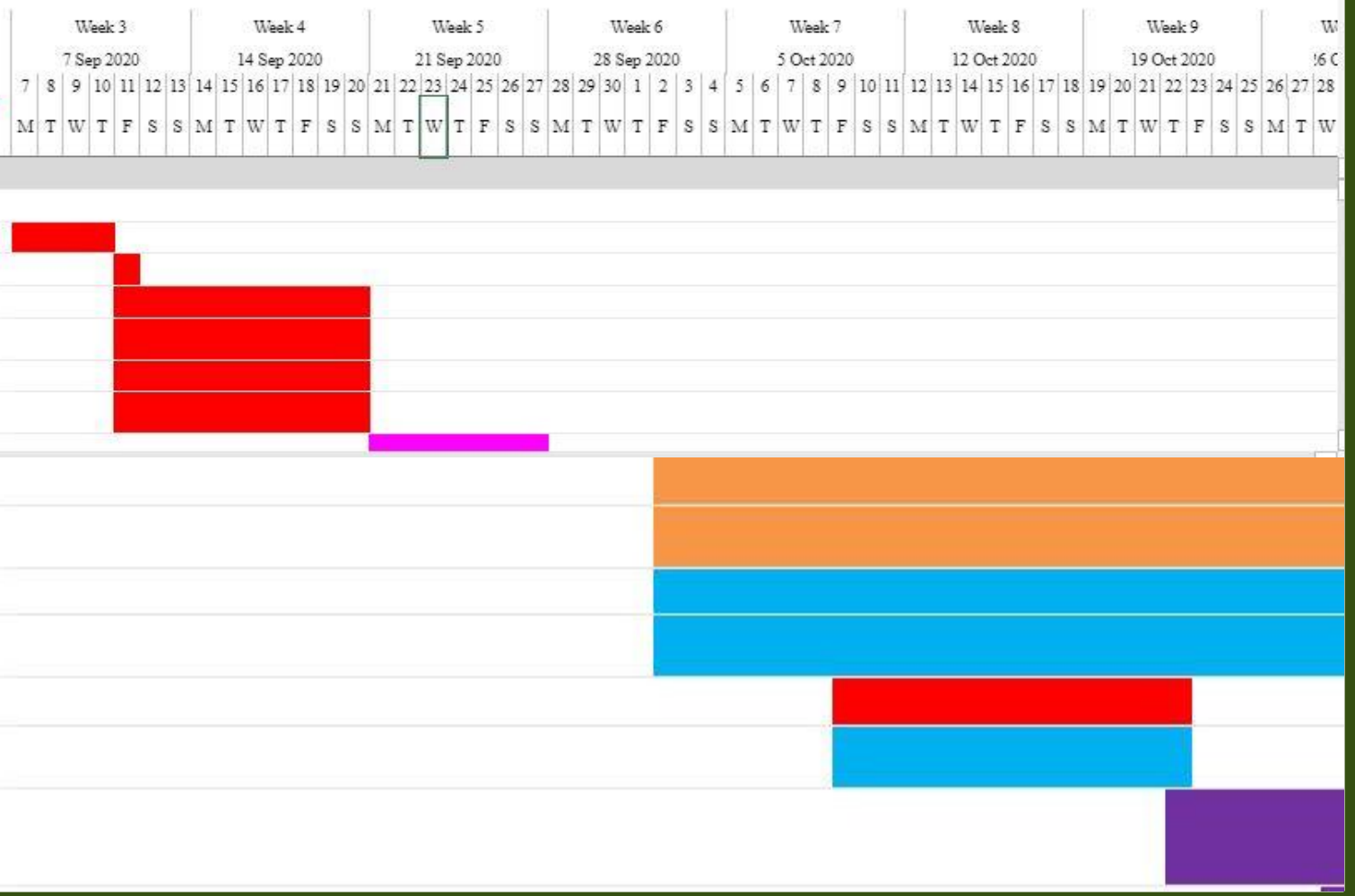
Home Health Monitoring System

Gantt Chart Template © 2006-2018 by Vertex42.com.

Engies Members: Ziyad Allehaibi, Terry Edwards, Elijah Rose, Ben Whalin

Project Start Date: 8/28/2020 (Friday) | Display Week: 3 | Project Lead:

WBS	TASK	LEAD	START	END	DAYS	% DONE	WORK DAYS
1	Project Start			-			-
1.1	Decide Group Members	Group	Fri 8/28/20	Thu 9/03/20	7	100%	5
1.2	Decide Project	Group	Fri 8/28/20	Thu 9/10/20	14	100%	10
1.3	Meet with mentor	Group	Fri 9/11/20	Fri 9/11/20	1	100%	1
1.4	Debate scope of project	Group	Fri 9/11/20	Sun 9/20/20	10	100%	6
1.5	Decide on management software	Group	Fri 9/11/20	Sun 9/20/20	10	100%	6
1.6	Decide Team Leader	Group	Fri 9/11/20	Sun 9/20/20	10	100%	6
1.7	Decide on management software	Group	Fri 9/11/20	Sun 9/20/20	10	100%	6
1.7.1	Create trello Board	Elijah	Mon 9/21/20	Sun 9/27/20	7	100%	5
2.2	support tables for the decision tables	Ziyad	Fri 10/02/20	Thu 10/29/20	28	100%	20
2.3	support tables for the subystem sensors	Ziyad	Fri 10/02/20	Thu 10/29/20	28	100%	20
2.4	Create the group Poster	Group	Fri 10/02/20	Fri 11/20/20	50	100%	36
2.4.1	Create the images for theTop Level Diagram	Group	Fri 10/02/20	Tue 11/10/20	40	100%	28
2.4.1.1	Create individual TLD	Group	Fri 10/09/20	Thu 10/22/20	14	100%	10
2.4.1.2	Create the image depicting the problem	Terry	Fri 10/09/20	Thu 10/22/20	14	100%	10
2.4.1.3	Create the image showing the possibility of machine learning	Ben	Thu 10/22/20	Wed 10/28/20	7	100%	5



OUTPUT TABLE

Output Table		
Parameters	**Expected Results**	**Measured Results**
Data Rates		TBD
Bluetooth	3 MB/s	
Wi-Fi	25 MB/s	
USB	18 MB/s	
Cloud upload	20 MB/s	
Battery Life		
Subsystems - Door Sensor	400 Hours	
Subsystems - Weight Scale	400 Hours	
Subsystems - Light Sensor	200 Hours	
Subsystems - Temperature Sensor	100 Hours	
Hub	0 Hours (Wired)	
Software		
Expected file size of the string sent from the subsystems to the hub - Door Sensor	Format of String: Opened - Date - Time - Sensor ID 40 KB	
Expected file size sent from the subsystems to the hub - Button sensor. Sending a 1 when it's been pressed, storing for a week	20 KB	
Expected file size sent from the subsystems to the hub - Temperature Sensor. Potential hourly log of room temp.	100 KB	
Expected file size sent from the subsystems to the hub - Light Sensor. Potential hourly log to check if a light is on, sending 1 if on, 0 if off	20 KB	

Home Health Monitoring System

Team Advisor: Gregory Myers (ECE)
Terry Edwards, Ben Whalin, Elijah Rose, Ziyad Allehaibi

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Goals

When someone oversees the care of their loved one for any number of reasons, be the person ill or elderly, the caretaker of the partially dependent person cannot always be home with their loved one at all points of a day. With this in mind, a system that can monitor the person in the home and send alerts when certain subsystems are triggered to the caretaker, with the system learning about different scenario's such as what patterns of behavior are acceptable and will no longer trigger alerts is a benefit to society at large. The system developed will be a modular system with a central hub unit that will communicate with the caretaker and learn based on the caretaker's responses to the alert. It will be a modular system so that many different subsystems can be easily added to the overall system.

Methods and Technologies

Modular Sensor Microcontrollers, Local-to-Ranged Communication Hub, API, Custom Sensor Integration Interfacing, Data Manipulation Interface/Commands, Possible Machine Learning and Behavioral Anomaly Recognition

Research Issues

With advances in medicine, developed countries have an increasing population of elderly and partially-dependent individuals. The choice between retirement homes and personal caregiving is increasingly relevant. Due to the price involved with retirement homes, a real-time monitoring solution can offer greater tools to caregivers for increased safety of the partially-dependent individual as well as convenience and peace of mind for the caregiver.

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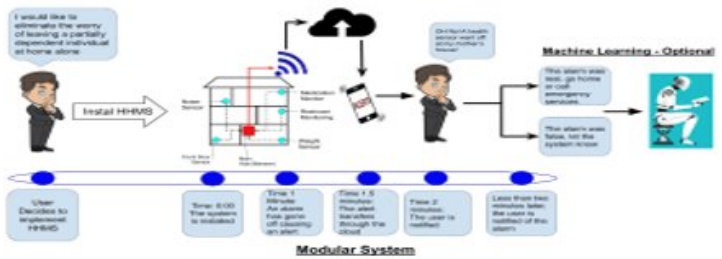
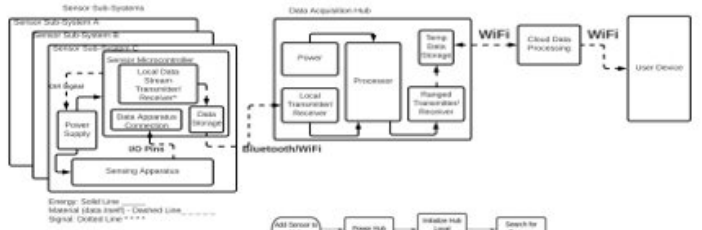
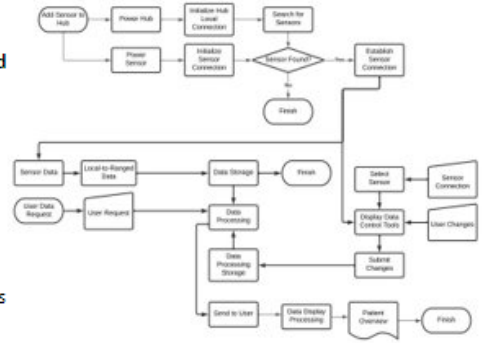
Project Top-Level Diagrams

Home Health Monitoring System







Project Specification and Features

- Modular System: Add third-party sensors
- Data Acquisition Hub in Home to Connect Sensors
- Data Logging for Health Pattern Checks
- Modify Data Stream Display and Analysis
- Constant Feedback to Caretaker

Software & Learning Materials

- API Documentation
- Machine Learning (Pattern Break Recognition)
- Dotnet Core
- Windows IoT Core OS
- Arduino/Sketch/Launchpad
- GitHub

Required Hardware & Price

- Raspberry Pi Microprocessor ($75)
- HiLetgo ESP32 Microcontroller w/ Breadboards ($35)
- Raspberry Pi Case w/ Heatsink and Fan ($10)
- 64GB MicroSD card ($14)
- Sensors: Temperature, Light, Door ($22)
- Momentary Pushbutton ($9)
- Wires and Resistors ($22)

Preparation and Plan

1. Create Data Acquisition Component; Integrate with Processing Hub
2. Design Demo Sensor Microcontroller
3. Send Data from Sensor to Data Acquisition
4. Create Processing Software
5. Send Data from Data Acquisition Hub to Processing
6. Create Data Controller Interface; create Data View/Monitor Interface. Implement on local monitor.
7. Demonstrate connection of Processor to Control Interfaces.
8. Implement Remote Communication of Hub-to-Processor and Processor-to-Controller
9. Implement Local Communication of Sensor Microcontroller-to-Hub
10. Demonstrate feedback capability from processing to hub to sensor.

Instructor Information

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THANK YOU!

ANY QUESTIONS?