EEL 4914 - Senior Design I
Divide and Conquer

Home **H**ealthcare **A**ssistant (**HHA**)

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Sponsors: N/A

Objective

In order to alleviate ever-increasing healthcare expenses, the HHA is proposed to assist elderly patients with chronic ailments to perform regular checks of their vital signs and to scout emerging symptoms of patient health deterioration. The amassed data is to be wirelessly transferred to a monitoring station database where the person in charge (ideally, a nurse) is alerted if outlying data is detected. The vital signs' statistical data collected by the HHA aims to allow for quicker diagnoses than an ER visit out of the blue, with the end goal of reducing inpatient overhead experienced by hospitals.

The device is intended to be intuitive to use, compact enough to fit on a nightstand, and an affordable alternative to existing at-home medical monitoring solutions.

Features and requirements

- Device alerts the patient via a speaker when it is time for their daily checkup, then presents various customized questions on a touchscreen display that a doctor would regularly ask to monitor that patient. For a patient with a heart condition, the questions may inquire about current experiences of chest pain, palpitation, light-headedness, swelling of feet, and if the patient had taken their prescribed medication on time. On-screen touchable icons accept responses to these "Yes/No" questions.

- As part of the examination, the HHA prompts the patient to sequentially use various sensors for data collection. Sensors being considered for the project include those that measure body temperature, blood oxygen level, blood pressure, and skin conductance.

- At the end of the questionnaire, the patient is asked to verbally state any new concerns that they might have. If a recorded response to this question exists, the database alerts the nurse to review all data collected from that inspection.

- The data is sent wirelessly to a receiving terminal which alerts nurses immediately if anomalies were detected in the questionnaire or in the statistical data collected. If no anomalies were detected, no urgent alert is issued.

The alert system allows the nurse to take an active role in providing an informed response to the patient's health condition, and to schedule a doctor's appointment for the patient if needed. This alert system is also a part of the monitoring system PC program to be written for this project.

Specifications

- Small built-in speaker alerts user to take health examination.

- GUI prompts user to respond to simple questions. Responses are recorded via touchscreen monitor. Monitor screen should be bright enough to be visible at daytime, and questions should be legible from an arm's length distance (~3-4 ft).

- Sensors, touch screen user input and microphone acquire all data stored by the device. Device holds all data at least until wireless connection to remote PC is established. Data transmission to PC is verified to be error-free.

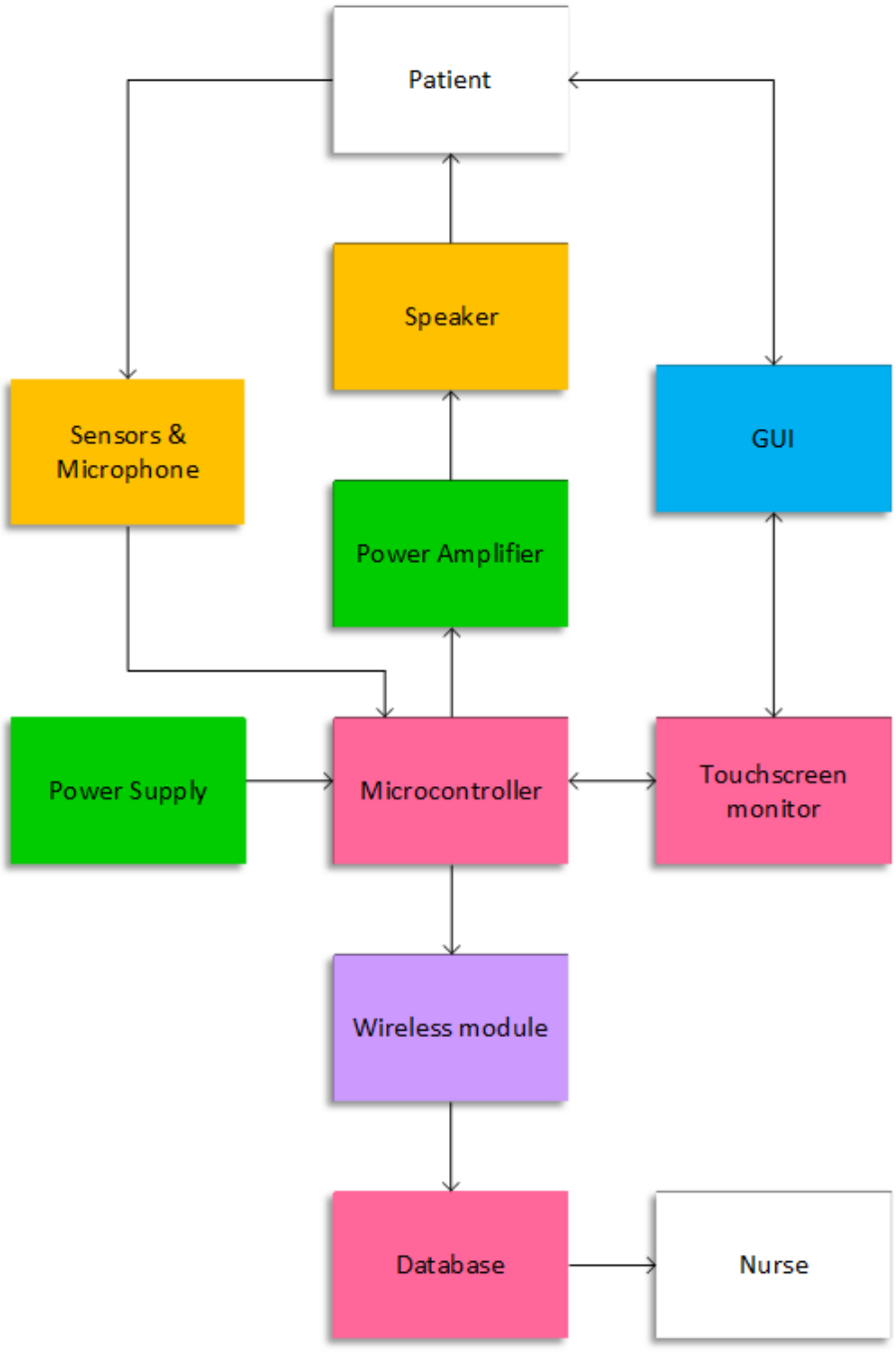
- To aid with the low-cost objective of the device, the body temperature sensor shall be built by the team.

- A single microcontroller will handle the readings, graphical display, and database management aspects of this project. If more inputs are needed than are available on the microcontroller, a second microcontroller can be used to accommodate the extra inputs into the main microcontroller. Wireless data transfer to a PC terminal will have to be researched for suitable implementation techniques.

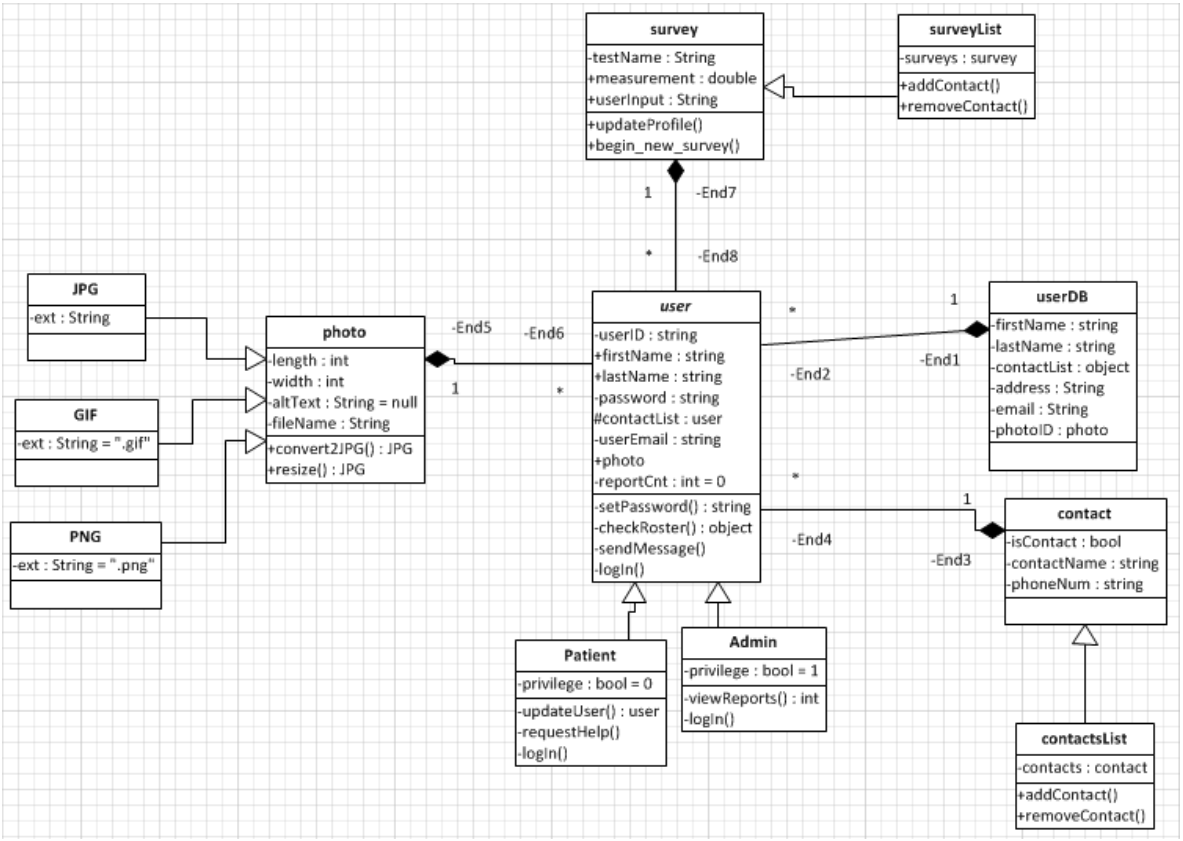
- At the monitoring PC station, patient data received is chronologically sorted in a database to be written by the team, and the numerical sensor data received throughout the patient's history can be plotted to show outliers.

The HHA aims to assist hospitals in reducing elderly inpatient costs via periodic remote monitoring of patient vital signs, and to inform nurses of patient condition deterioration so that medical intervention may convene before life-threatening issues manifest within the patient.

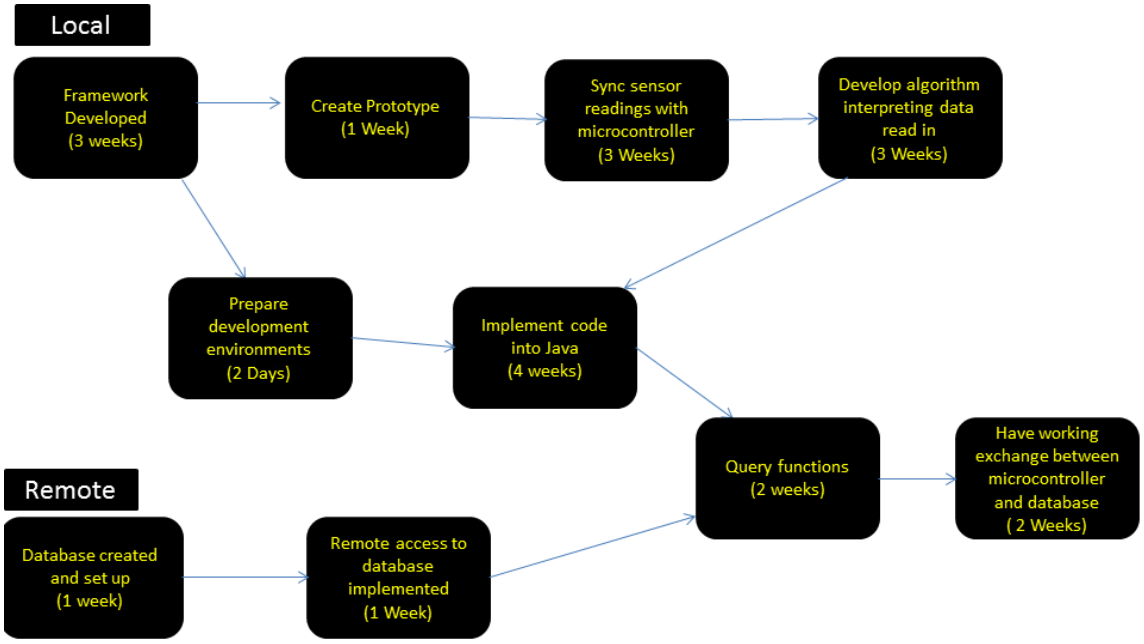
HHA Hardware Block Diagram



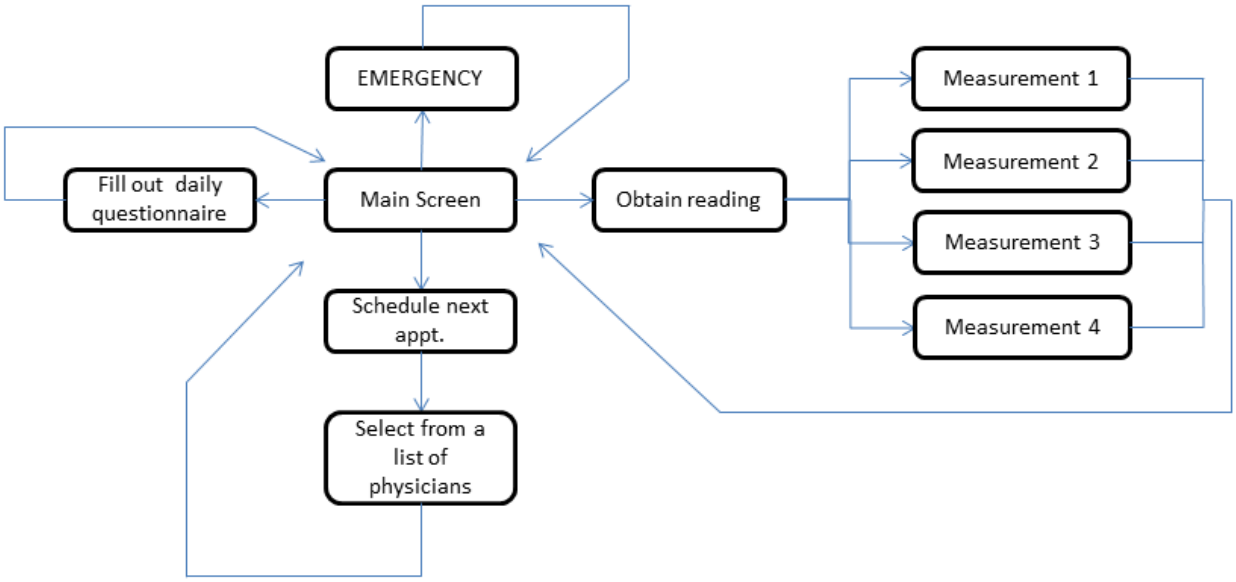
Class Diagram:



Software PRT Chart:



Proposed GUI navigation path:



Project Budget

List of Devices	Importance	Estimated Cost
Body Temperature Sensor	Related to most diseases such as fevers, heart problems, and hypothermia. A close look at the changes in body temperatures will show if the patient's condition is deteriorating or not.	$15.00
Pulse Oximeter (SpO2) Sensor	Increase in heart rate could lead to heart problems and is a decent measure of stress levels. The pulse sensor also comes with a sensor to measure oxygen saturation in case the patient has COPD or any disease involving the hemoglobin.	$60.00
Airflow Sensor	Airflow measurement has a strong relationship with complications in the lungs or any of the breathing passageways such as allergies and bronchitis. It will check many of the unforeseen complications the oximeter will not be able to detect.	$30.00
Skin Conductance (GSR) Sensor	Increase in sweating has a direct correlation with skin conductance. An increase in skin conductance would mean the person has higher than normal stress levels. Sweating is also a symptom of multiple diseases which can be prevented.	$35.00
Electrocardiogram (ECG) Sensor	ECG is a measure of electrical activity in the heart. It will identify if there is a problem with the heart's orientation, muscles, damage, blood flow, and/or abnormalities (heart murmur).	$40.00
Blood Pressure Sensor	Monitoring blood pressure can prevent an incoming stroke, heart attack, and diabetes complications.	$135.00

Glucometer Sensor	Measures the blood sugar levels. The glucometer will be focused on the diabetic community to closely monitor any changes in glucose and prevent the problems associated with it.	$45.00
e-Health Platform	Platform to communicate data obtained from the sensor to the Raspberry-pi 2	$80.00
Raspberry-pi 2	Microcontroller acting on all central functions of the device.	$35.00
LCD touchscreen monitor	Handles all input which requires text entry.	$25.00
Wifi Module	For data transmission from the microcontroller to the remote database	$15.00
Soldering kit	To facilitate construction of the body temperature sensor	$35.00
Micro SD card	For non-volatile storage of acquired data prior to transmission to remote PC	$25.00
Microphone + Speaker	Speaker will be used to alert the patient when it is time to get evaluated. Microphone will function as a recorder of any addition complaints the patient might have.	$20.00
	Total	**$595.00**

Project Milestones

Home Healthcare Assistant (HHA)			Start Date: January 27, 2015
MILESTONES			
Task	**Start Date**	**End Date**	**Duration (days)**
1.0 Planning [Senior Design 1]	**01-27-2015**	**03-19-2015**	**56**
1.1 Generate and submit Project Proposal	**01-27-2015**	**02-04-2015**	**9**
1.2 Research sensors	**02-05-2015**	**02-11-2015**	**7**
1.3 Research wireless communication	**02-11-2015**	**02-20-2015**	**10**
1.4 Research GUI development	**02-20-2015**	**03-01-2015**	**10**
1.5 Research database software development	**03-01-2015**	**03-10-2015**	**10**
1.6 Research PSU and speaker amplifier	**03-10-2015**	**03-19-2015**	**10**
2.0 Design [Senior Design 1]	**03-19-2015**	**04-27-2015**	**45**
2.1 Implement sensors	**03-19-2015**	**03-21-2015**	**3**
2.2 Design wireless communication system	**03-21-2015**	**03-30-2015**	**10**
2.3 Design GUI	**03-30-2015**	**04-08-2015**	**10**
2.4 Design power system	**04-08-2015**	**04-17-2015**	**10**
2.5 Design database	**04-17-2015**	**04-26-2015**	**10**
2.6 Finalize Senior Design Paper	**04-26-2015**	**04-27-2015**	**2**
3.0 Implementation [Senior Design 2]	**05-18-2015**	**06-23-2015**	**40**
3.1 Implement power system and amplifier	**05-18-2015**	**05-27-2015**	**10**
3.2 Integrate wireless communication system	**05-27-2015**	**06-05-2015**	**10**
3.3 Implement GUI	**06-05-2015**	**06-14-2015**	**10**
3.4 Implement database	**06-14-2015**	**06-23-2015**	**10**
4.0 Testing [Senior Design 2]	**06-11-2015**	**07-05-2015**	**28**
4.1 Test power system and amplifier	**06-11-2015**	**06-17-2015**	**7**
4.2 Test wireless communication system	**06-17-2015**	**06-23-2015**	**7**
4.3 Test GUI	**06-23-2015**	**06-29-2015**	**7**
4.4 Test database	**06-29-2015**	**07-05-2015**	**7**
5.0 Deployment [Senior Design 2]	**07-05-2015**	**2015-07-31**	**37**
5.1 Integrate all subsystems	**07-05-2015**	**07-18-2015**	**14**
5.2 Verify design functionality	**07-18-2015**	**07-31-2015**	**14**
5.3 Finalize design and documentation	**07-31-2015**	**08-03-2015**	**4**
5.4 Prepare for and present final design	**08-03-2015**	**08-07-2015**	**5**

Questions for Richie:

Can we just buy all these sensors?

Examples:

http://www.eecs.ucf.edu/seniordesign/projects.php

http://www.eecs.ucf.edu/seniordesign/sp2012su2012/g10/documents/Initial%20Project%20and%20Group%20Identification%20Document.pdf

http://www.eecs.ucf.edu/seniordesign/su2012fa2012/g16/docs/Initial%20Project%20Description.pdf

discuss/research:
http://www.alliedelec.com/lp/150201/dlp-design/
http://www.raspberrypi.org/learning/web-server-wordpress/

http://www.freepascal.org/download.var
http://www.raspberrypi.org/raspberry-pi-2-on-sale/

Rpi used as authentication measure for signing in to doctors.
Have Rpi submit to master database or store the database on built-in storage.
External method for RFID authentication (ie. NFC card).
Database has a field for profile picture.