+ Cloud

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Abstract

The aim of the project is to ease the working of Doctors and Nurses in the hospital with regard to attending a patient and also making sure that the patient has a comfortable environment. We will be using multiple sensors such as heart rate sensor, blood pressure sensor, temperature sensor, capacitive sense and gesture sensor on a processor to monitor the health condition of the patient and on another processor, we will use temperature sensor, light sensor, liquid level sensor to control the environment of the room in which the patient is admitted. The doctor can view the previous reports of the patient on the Augmented reality(AR) wearable device stored in the cloud, in addition to that the doctor can also view the health condition of the patient such as the heart rate, blood pressure and temperature (data from sensors) on the wearable device. The medical staff can provide a convenient and a comfortable environment for the patient using gesture sensors, which can indicate the staff if the patient needs help and also nurse can control and monitor the room environment by using temperature sensor and light sensor, in addition, a liquid level sensor is used to monitor the IV bag, displayed on the wearable device. The sensor data is stored in the cloud using a Wi-Fi module and then displayed on the wearable device from the cloud which again uses a Wi-Fi module.

1 Solution to present day problems

With millions of patients admitted in hospitals at present day, it drives for a smart application project which can help the doctors and the medical staff to attend all the patients efficiently.

- The doctor usually has to go through all the files to get the information about the previous reports of the patient but with the use of wearable device to display makes it easier for the doctor to view the reports. This reduces human error and saves time.
- The health condition of the patient is also displayed on the wearable device to the doctor, which reduces the man-work of checking the temperature, pulse rate and blood pressure repeatedly.
- The patient can be monitored in a comfortable environment without having to invest much time in it, such as using the liquid level sensors for liquid level of the IV bag, temperature and light of the room.

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- This project also makes it easier for the patient to call for help, when in need. The present day scenario has a button to be pressed if a patient needs help, but there might be a critical situation where the patient may not be able to move to the button and press it, this calls for an idea which can notify the medical staff for help with a simple gesture.

2 Key Components

- Boards

  Leopard Gecko EFM32 Starter Kit 3600

  Thunder Board RD0057

  Atmel Bluetooth ATSAMB11

  Wearable Augmented Reality Device

- Sensors

  Leopard Gecko EFM32 - OnBoard Temperature , Capacitive Sensor

  Thunder Board RD0057 - OnBoard Temperature, Light Sensor

  eTape 8' Liquid Sensor SEN 10221

  Gesture sensor APDS 9960

  AD8232 Single lead Heart Rate monitor(Heart Rate)

3 COMMANDS AND TRIGGER POINTS

- TX power of ATMEL is set to AT_BLE_TX_PWR_LVL_NEG_20_DB
- ad structure of type at_ble_connection_params_t is declared where Conn Interval and Slave Latency is defined.
- When ACMP voltage is above 2 volts which is the reference voltage then a PRS signal is sent from ACMP to PCOUNT to count a heartbeat.
- When a swipe is performed over the gesture sensor, LED is lighted on the atmel and this alerts the doctors and nurses.

4 Difficulties Faced

- In Gesture Sensor the values received in the U,L,D,R registers give out of range values, so decoding them into distinct gestures is hard.

- GFLVL register kept showing 32 datasets in spite of setting 1 dataset in the threshold register.
- Interrupts in the gesture sensor were not getting cleared .
- Gesture sensor was not giving interrupts in sleep.

5 Low Energy design

While calculating the ADC value of the liquid sensor on the slave LG,an RTC clock was used with " wait for event" instruction so that LG can sleep in intervals when ADC is not sampled. The slave gecko sleeps when there is no gesture interrupt and when it is not sampling the ADC. As we are using 4 sensors, we are not continously waiting for the values by polling instead we are using interrupt to obtain values and then use the data obtained. In the case of heart rate sensor, in a traditional way it always used ACMP IRQ handler, to continously count the heart beat for 15 seconds. So, it had about 20 interrupts per 15 seconds. Hence, we used a PRS to send a signal to PCNT whenever the ACMP voltage is above reference volatge , which in-turn counts the heart rate for 15 s. In the temperature sensor, the ADC samples are stored in RAM using DMA instead of ADC interrupt handler. For communication between Leopard Gecko and Thunder Board, Leopard Gecko and ATMEL , between 2 Leopard Geckos, we have used a LEUART which is a low energy peripheral instead of a normal UART. The low power design for ATMEL is implemented by manipulating the slavelatency, connInterval and TX Power. The slavelatency is chosen as 0 - As it is a medical/health related application loosing crucial information like HeartRate-BloodPressure-Gesture. ConnInterval 80 - the maximum interval of a connInterval is 4seconds. We update the client with information every 15 seconds (The heart Rate is calculated for every 15 seconds and extrapolated to BPM). TxPower: The transmit power is dependent on the use of the entire PlusCloud Application. If the application is implemented in spacious hospitals then the power must be more, and counter is as well true. A future scope of low power design for the ATMEL TX power can be to get the RSSI value, thus calculating the range at which the Mobile Phone(Client) is at from the (ATMEL) Peripheral - and updating the TX power accordingly.

6 Hardware Block Diagram

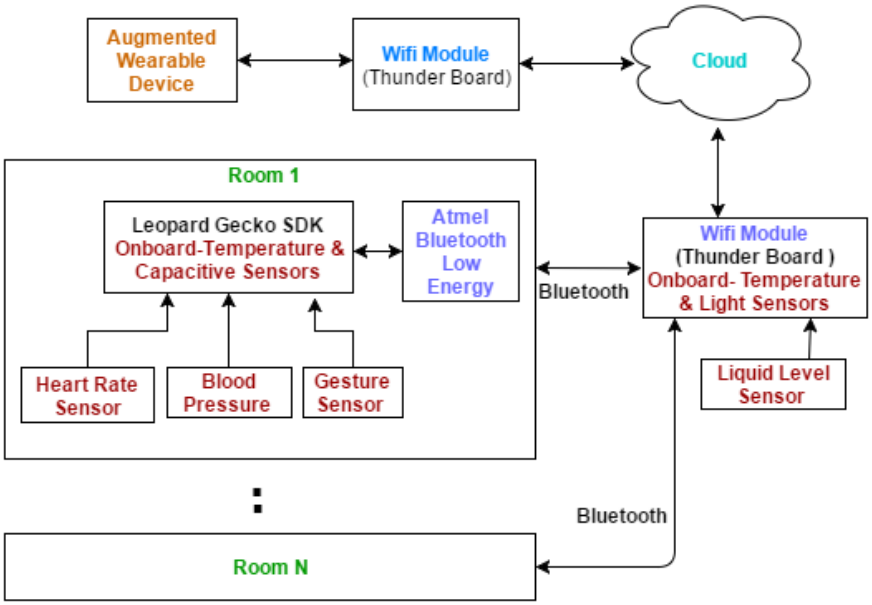

Figure 6.1: Hardware Block Diagram

7 Software Organizational Chart

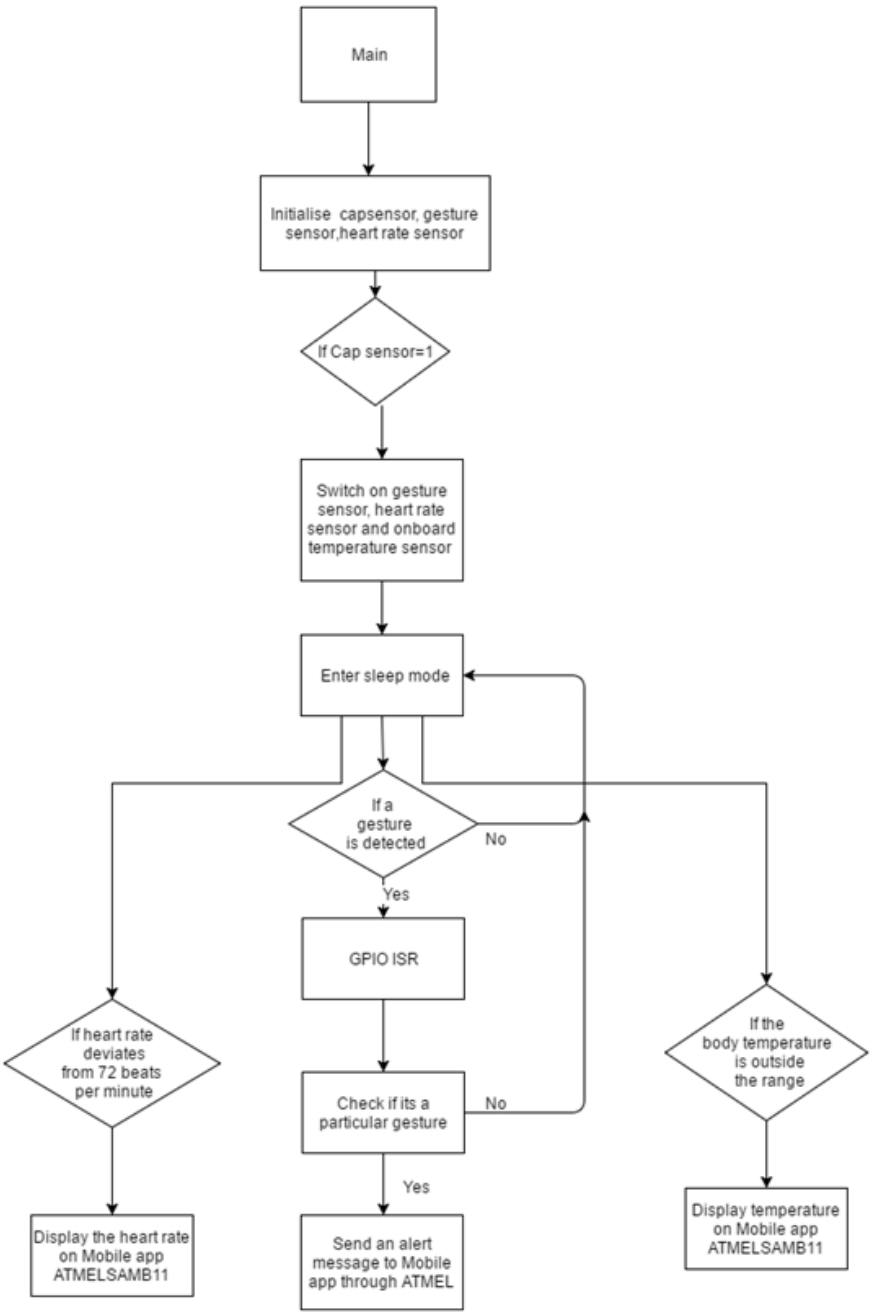

Figure 7.1: Leopard Gecko

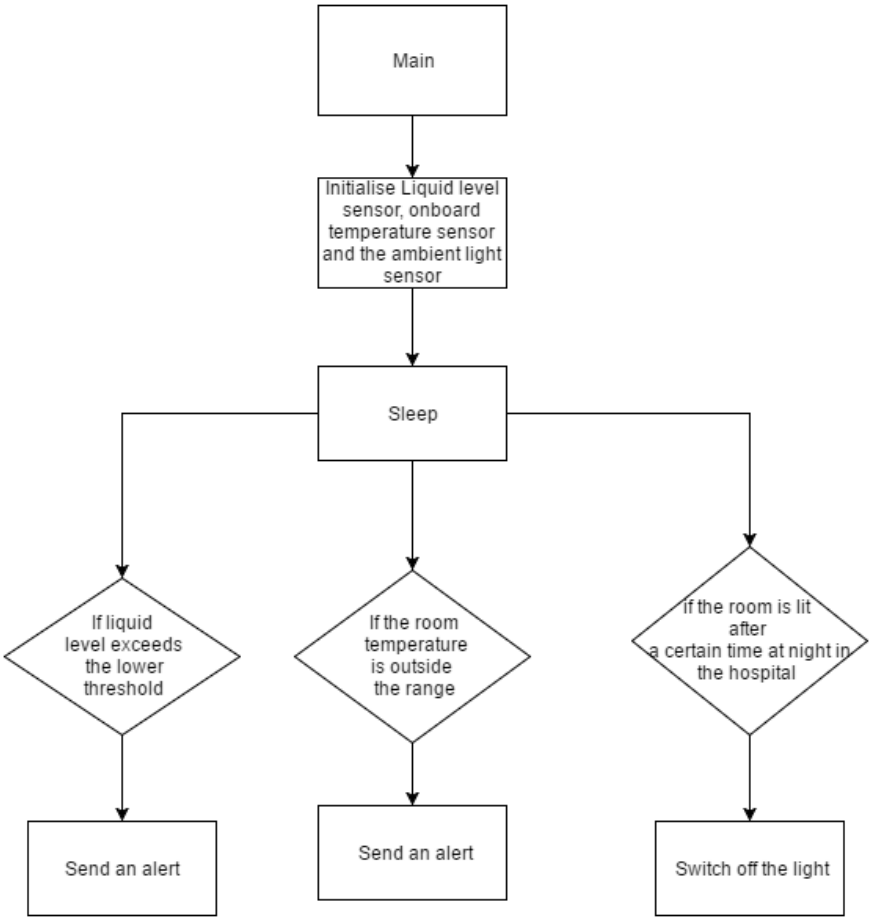

Figure 7.2: Thunderboard

8 Test Methodology

Cap sensor [LESENSE]	Cap sensor acts as a sensor switch	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch on the led? and Does it switch off led when same passcode is touched again	Pass
Cap sensor [LESENSE]	Cap sensor acts as a sensor switch for temperature	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch on temperature sensor and switch off when the same pattern is touched	Pass
Cap sensor [LESENSE]	Cap sensor acts as a sensor switch for Heart rate	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch on Heart rate sensor	Pass

Figure 8.1: Leopard Gecko

Cap sensor [LESENSE]	Cap sensor acts as a sensor switch for Heart rate and Temperature	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch on Heart rate sensor and the Temperature sensor	Pass
Heart rate monitor	To obtain ECG graph	Switch on Heart rate monitor and apply electrodes to the body	Does it give an ECG graph on a oscilloscope	Pass
Heart rate monitor	To get the LED blinking on the sensor according to the Heart rate	Switch on Heart rate monitor and apply electrodes to the body	Does the LED glow according to the Heart rate	Pass
ATSAMB11 Heart rate service from LG LEUART	Receiving Heart rate value on the mobile device application	Send heart rate value through LEUART dynamically	Does it display the same value on the application	Pass

Figure 8.2: Thunderboard

Leopard Gecko Onboard Temperature Sensor	Sending the values from the On Board Temperature sensor to Mobile device	Send Temperature value through LEUART	Does it display a value on the application	Pass
Integration of Cap Sense, Heart rate sensor and Temperature sensor	LED1 turning on when the temperature is within the range and obtaining Heart rate in the ACMP_count variable.	Set Cap Sense as 1 and run the code	Does LED1 turn on when the temperature is within the range and do we obtain Heart rate in the ACMP_count variable	Pass
ATSAMB11 Heart Rate service and Temperature service from LG LEUART	Receiving Heart rate (dynamic value) and Temperature (dynamic value)	Send Heart rate sensor and Temperature sensor through LEUART	Does it display the same value sent through LEUART on Heart rate service and	Pass

Figure 8.3: Leopard Gecko

Cap sensor [LESENSE]	Cap sensor acts as a sensor switch for Heart rate and Temperature	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch off Heart rate sensor and the Temperature sensor	Pass
Heart rate monitor using PRS and PCNT instead of ACMP Handler	It should stay in EM2 while counting the number of heart beats instead of waking up every time with ACMP handler	Cap Sense =1 and run the code	Does it consume less current	Pass
Obtaining gesture and liquid level values from one LG to another	The values of sensors should be obtained via LEUART on the receiver LG.	Execute both the codes simultaneously	Do we receive values in receiver LEUART	Pass

Figure 8.4: Thunderboard

Integration of two LGs and ATMEL to obtain data on Mobile application	The values should be obtained on the mobile application	Execute all the codes, set capsense=1.	Do we receive the values on the app	Pass
Communication between Leopard Gecko and Thunder Board for sending Heart rate, Temperature and Liquid level values	The sensor values sent from LG to Thunder Board using UART	Configure UART for LG and Thunder Board	Do we receive the sensor values in the UART of Thunder Board	Pass

Figure 8.5: Leopard Gecko

Function	**Feature to be tested**	**Plan test**	**Definition of pass or fail**	**Pass or fail**
Cap sensor	Cap sensor acts as a sensor switch	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch on the led? and Does it switch off led when same passcode is touched again	Pass
Cap sensor	Cap sensor acts as a sensor switch	When Cap Sensor 1, Touch the cap sense pad in a specific pattern	Does it switch on all the sensors and send data to ATSAMB11	Pass
ATSAMB11 Heart rate service from LG LEUART	Receiving Heart rate value on the mobile device application	Send heart rate (hard coded) value through LEUART	Does it display the same value on the application	Pass
ATSAMB11 Alert message service from LG LEUART	Receiving Alert message on the mobile device application	Open the alert message service	Gives an alert in the form of red coloured vibration	Pass
ATSAMB11 Temperature service from LG LEUART	Receiving Temperature on the mobile device application	Send temperature value through LEUART	Does it display the same value on the application	Pass
ATSAMB11 Blood pressure service from LG LEUART	Receiving Blood pressure value on the mobile device application	Send Blood pressure value (hard coded) through LEUART	Does it display a value on the application	Pass

Figure 8.6: Thunderboard

Leopard Gecko Onboard Temperature Sensor	Sending the values from the On Board Temperature sensor to Mobile device	Send Temperature value through LEUART	Does it display a value on the application	Pass
Firebase Cloud Website	Dynamical Updating the sensor values in the Website	Send the Values of sensor values from Android Application to the Firebase Cloud	Display the sensor values in the website dynamically	**Pass**
Firebase Cloud Realtime Database	Dynamical Updating the sensor values in the Realtime Database	Send the Values of sensor values from Android Application to the Firebase Realtime database Cloud	Update the sensor values in the Realtime Database dynamically	**Pass**
Configuring Augmented Reality	Check if Augmented reality works for the QR Code	Display the Image/ UI/UX of the in the Augmented Reality.	See in Realtime if the Augmented Reality works	**Pass**
Augmented Reality	Display the sensor value in the augmented reality Application	Send the Values of sensor from Firebase dynamic Website to the Augmented reality Application	Display the sensor values in the Augmented Reality Application dynamically	**Pass**

Figure 8.7: Thunderboard

Android PlusCloud Application to display the sensor values	Dynamical Updating the sensor values in the Android Application	Send the Values of sensor values from thunder Board to the Android Application	Display the sensor values in the Application	**Pass**
Android PlusCloud Application to display the sensor values-using BLE services	Use the BLE services to send the values of sensor values from the thunder board to the android application (using common UUIDs)	Send the values of sensors using the BLE services from the thunder board to the Android Application.	Display the sensor values in the android Application	**Pass**
Augmented Reality – displaying the realtime values	Display the sensor values in realtime on to the Augmented reality Application	Retrieve the uploaded realtime sensor values from the Firebase cloud and Display it on the Augmented Reality Application	Depending on the QRCode/respective value it has to display the augmented reality Canvas on which it displays the sensor values	**Pass**

Figure 8.8: Thunderboard

Gesture Sensor	Sensor is in sleep throughout the time when no gesture is shown	Observing currents in the energy profiler	It stays in the sleep modes	Pass
Gesture Sensor	Receives an interrupt and wakes from sleep when gesture is shown	Breakpoint in the GPIO IRQ handler	It reaches the breakpoint on receiving a gesture	- Pass
ATSAMB11 Battery monitor service from LG LEUART	Receiving liquid level value on the mobile device application	Send value (hard coded) through LEUART	Does it display a value on the application	Pass
Liquid Level Sensor	Send liquid level to Thunderboard	Send value to master LG, which sends to TB. Test through reading of second Gecko RX	Does it display the same value that was sent	Pass
Cloud	Send and receive the liquid level	Configure the thunder board to send and receive the data using wifi Module	Does it display the data sent or received in the Mobile App	- Pass

Figure 8.9: Thunderboard