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| Final Progress Report |
| Intelligent User Interfaces SOEN 7761 |
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# Introduction

The project focuses on adding intelligence to the user interface of a mobile health application called *Personal Health Record,* which aims to measure relevant health statistics based on vital signs of the patient admitted to the hospital. We have limited our context to the hospital to meet the time constraints for this project. Out focus will be to adapt the application to show the increase/decrease in health levels of the patient.

# Motivation

Doctors and nurses are often overwhelmed by ongoing tasks in the workspace. Cognitive overload is also a factor to consider in the context of the application. Therefor, due to these reasons we will focus on adapting the application to infer the “health level” of the patient after entering a new record. This tells the doctors and nurse if the patient’s health is deteriorating or getting better in an adaptive way.

# Project Summary

Our major focus is to add intelligence to an existing mobile health application called *Personal Health Record.* Information about patients will be used to produce a user adaptive system tailored to a particular patient.

# Project Details

## User Interface Adaptation

We have prior knowledge that the patients being treated will most likely have abnormal values for the vital signs (blood pressure, O2 saturation, temperature, blood sugar), therefor if the measurement entered indicates a more healthy/ non-healthy state, and then an alarm will go off indicating this observation. The following table summarizes the abnormal values for each measure; these will be used to compare previous values with current ones.

## High-Level Summarization of Abnormal Vital Sign Values

|  |  |
| --- | --- |
| **Measurement** | **Interpretation** |
| Blood Pressure | * Low Blood Pressure (hypotension): Systolic (top number) <=90, Diastolic (bottom number) <=60.   BPM <60   * Normal Blood Pressure:   Systolic (top number) <=120, Diastolic (bottom number) <=80.  BPM =[60,100]   * High Blood Pressure (hypertension): Systolic (top number) =(140, 190], Diastolic (bottom number) =(90,100].   BPM>100 |
|  | Any reading < 90% leads to life threatening complications. |
| Temperature | * Hypothermia: <= 35.0 °C. * Hyperthermia: >= 40°C. * Normal: = (35,37.2] °C. |
| Blood Sugar | * Excellent: [50,115] mg/dl * Good: (115,180] mg/dl   Poor: (180,380] mg/dl |

## Rules to be Applied

In our initial analysis of the rules we will apply, we’ve included cases where the previous reading and current reading are the same. That is, the health of the patient is stable (regardless of it’s good or bad). We have come to realize that by including such cases, the system would alert the user on every record entry. This in turn is irritating to the user and does not add any “knowledge”. We decided to exclude these cases of “stability”. The following tables show all the rules that we are basing our adaptations on; the interpretation column depicts the state of the patient’s measure.

**Blood Pressure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rule Number** | **Previous Reading** | **Current Reading** | **Interpretation** | **Alert** |
| R-BP1 | Low | Normal | Increase | Healthy |
| R-BP2 | Normal | Low | Decrease | Warning- Bad |
| R-BP3 | Low | High | Increase | Warning-Bad |
| R-BP4 | Normal | High | Increase | Warning-Bad |
| R-BP5 | High | Normal | Decrease | Healthy |
| R-BP6 | High | Low | Decrease | Warning-Bad |

**O2 Saturation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rule Number** | **Previous Reading** | **Current Reading** | **Interpretation** | **Alert** |
| R-O1 | <90 % | >=90 % | Increase | Healthy |
| R-O2 | >=90 % | <90 % | Decrease | Warning- Bad |

**Temperature**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rule Number** | **Previous Reading** | **Current Reading** | **Interpretation** | **Alert** |
| R-T1 | 35.0 °C. | (35,37.2] °C. | Increase | Healthy |
| R-T2 | (35,37.2] °C. | >= 40°C. | Increase | Warning- Bad |
|  |  |  |  |  |
| R-T3 | >= 40°C. | (35,37.2] °C. | Decrease | Healthy |
| R-T4 | (35,37.2] °C. | 35.0 °C. | Decrease | Warning-Bad |

**Blood Sugar**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rule Number** | **Previous Reading** | **Current Reading** | **Interpretation** | **Alert** |
| R-BS1 | (180,380] Mg/dl | (115,180] Mg/dl | Decrease | Healthy-Better |
| R-BS2 | (115,180] Mg/dl | [50,115] Mg/dl | Decrease | Healthy-Best |
|  |  |  |  |  |
| R-BS3 | [50,115] Mg/dl | (115,180] Mg/dl | Increase | Healthy |
| R-BS4 | (115,180] Mg/dl | (180,380] Mg/dl | Increase | Warning-Bad |

## DECISION TABLES

**Blood Pressure**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Conditions** | **Rules** | | | | | |
|  |  | 1 | 2 | 3 | 4 | 5 | 6 |
| C1 | Previous Reading = Low | Y |  | Y |  |  |  |
| C2 | Previous Reading = Normal |  | Y |  | Y |  |  |
| C3 | Previous Reading = High |  |  |  |  | Y | Y |
| C4 | Current Reading = Low |  | Y |  |  |  | Y |
| C5 | Current Reading = Normal | Y |  |  |  | Y |  |
| C6 | Current Reading = High |  |  | Y | Y |  |  |
|  | **Actions** |  |  |  |  |  |  |
| A1 | Alert: Healthy | X |  |  |  | X |  |
| A2 | Alert: Warning Bad |  | X | X | X |  | X |

**O2 Saturation**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Conditions | Rules |  |
|  |  | **1** | **2** |
| C1 | Previous<90 % | Y |  |
| C2 | Previous >= 90% |  | Y |
| C3 | Current <90 % |  | Y |
| C4 | Current >= 90% | Y |  |
|  | **Actions** |  |  |
| A1 | Healthy | X |  |
| A2 | Warning-Bad |  | X |

**Temperature**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Conditions | Rules | | | |
|  |  | **1** | **2** | **3** | **4** |
| C1 | Previous = 35.0 °C. | Y |  |  |  |
| C2 | Previous =(35,37.2] °C. |  | Y |  | Y |
| C3 | Previous >= 40°C. |  |  | Y |  |
| C4 | Current = 35.0 °C. |  |  |  | Y |
| C5 | Current=(35,37.2] °C. | Y |  | Y |  |
| C6 | Current >= 40°C. |  | Y |  |  |
|  | **Actions** |  |  |  |  |
| A1 | Healthy | X |  | X |  |
| A2 | Warning-Bad |  | X |  | X |

**Blood Sugar**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Conditions | Rules | | | |
|  |  | **1** | **2** | **3** | **4** |
| C1 | Previous= (180,380] mg/dl | Y |  |  |  |
| C2 | Previous= (115,180] mg/dl |  | Y |  | Y |
| C3 | Previous= [50,115] mg/dl |  |  | Y |  |
| C4 | Current=(180,380] mg/dl |  |  |  | Y |
| C5 | Current= (115,180] mg/dl | Y |  | Y |  |
| C6 | Current= [50,115] mg/dl |  | Y |  |  |
|  | **Actions** |  |  |  |  |
| A1 | Healthy-Better | X |  |  |  |
| A2 | Healthy-Best |  | X |  |  |
| A3 | Healthy |  |  | X |  |
| A4 | Warning-Bad |  |  |  | X |

# Implementation

Hardware: Google Nexus 4 (Cell Phone), Laptop

Software: Java Eclipse, ADT (Android Development Tool), Android Emulator

Classes of Interest: ***BloodPressureActivity, BloodSugarActivity, O2Activity, TemperatureActivity***

Functions of Interest: submit (View iView, Date timeOfReading) in each ***BloodPressureActivity, BloodSugarActivity, O2Activity, TemperatureActivity***

Class. The ValueComparer () method is implemented.

In order to implement this Intelligence changes at code level were done mainly in Two Packages i.e. **myphr.presentation.vitalsigns** and **myphr.domain.** A Function called ValueComparer() of return type string is implemented in all the four activities *(****BloodPressureActivity, BloodSugarActivity, O2Activity, TemperatureActivity)****.*

Each function returns a string message on satisfying the condition which is passed to VitalSignComponent Class, where it is displayed as a pop up.

Moreover, some snapshots of how the PHR app behaves intelligent now has been shown below:

# Testing

For testing the system’s output to inputs, we came up with values for each metric that cover all the rules previously mentioned. Initially, some tests failed that revealed bugs in our implementation related to array boundaries and inclusive/ exclusive values in ranges. These issues were important as they improved the accuracy and reliability of the adaptation. After fixing these issues, we ran the same tests again and obtained a 100% success rate.

**Blood Pressure**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | **BPM** | **Systolic** | **Diastolic** | **Interpretation** | **Status** |
| Test Case 1 | Prev | 30 | 60 | 30 | Increase | Pass |
| Current | 60 | 105 | 50 |
| Test Case 2 | Prev | 100 | 120 | 80 | Decrease | Pass |
| Current | 50 | 90 | 60 |
| Test Case 3 | Prev | 50 | 80 | 50 | Increase | Pass |
| Current | 110 | 150 | 91 |
| Test Case 4 | Prev | 100 | 120 | 80 | Increase | Pass |
| Current | 119 | 180 | 99 |
| Test Case 5 | Prev | 119 | 180 | 99 | Decrease | Pass |
| Current | 100 | 120 | 80 |
| Test Case 6 | Prev | 119 | 180 | 99 | Decrease | Pass |
| Current | 50 | 80 | 50 |

**Blood Sugar**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Mg/dl** | **Interpretation** | **Status** |
| Test Case 1 | Prev | 185 | Increase | Pass |
| Current | 120 |
| Test Case 2 | Prev | 140 | Increase | Pass |
| Current | 70 |
| Test Case 3 | Prev | 210 | Increase | Pass |
| Current | 110 |
| Test Case 4 | Prev | 115 | Decrease | Pass |
| Current | 165 |
| Test Case 5 | Prev | 120 | Decrease | Pass |
| Current | 380 |
| Test Case 6 | Prev | 90 | Decrease | Pass |
| Current | 370 |

**Temperature**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **°C.** | **Interpretation** | **Status** |
| Test Case 1 | Prev | 30 | Increase | Pass |
| Current | 36 |
| Test Case 2 | Prev | 36.5 | Increase | Pass |
| Current | 40 |
| Test Case 3 | Prev | 45 | Decrease | Pass |
| Current | 37 |
| Test Case 4 | Prev | 37 | Decrease | Pass |
| Current | 34 |
| Test Case 5 | Prev | 30 | Increase | Pass |
| Current | 40 |
| Test Case 6 | Prev | 45 | Decrease | Pass |
| Current | 30 |

**O2 Saturation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **%** | **Interpretation** | **Status** |
| Test Case 1 | Prev | 80 | Increase | Pass |
| Current | 95 |
| Test Case 2 | Prev | 98 | Decrease | Pass |
| Current | 60 |

# Limitations/ Issues

Initially, we included the weight to be part of the adaptations we will implement. However, after researching on how weight is calculated for individuals, different factors play a role. These factors include the gender and height of the patient. After assessing the stored values in the app, it has become evident that these factors are not being saved. This in terms hinders our approach of including the weight in our adaptation. Due to time limitations of the project, we have agreed to exclude the weight from our current implementation.

# Conclusion

By determining the context and environment of the hospital workplace, we have pinpointed certain areas that can affect the usage of the PHR application. These areas include a highly overwhelming workplace. Therefor, in order to decrease the cognitive overload of doctors and nurses, we have implemented intelligent adaptations that will aid the users in their tasks.