CS2310 Multimedia Software Engineering Final Project Report

Personal Healthcare System

Fall 2015

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Project Brief Description

Personal Healthcare has been and will continue being a popular topic in both academia and industrial community. With the rapid development and flexible deployment of wireless multi-sensor networks, it brings not only the opportunity, but also the challenge of how to benefit human the best, especially for personal medical and health environment.

In this project, I augmented the existed personal healthcare system, the SIS system, by adding three components, including both basic and super components. Additionally, a webcam sensor has also been implemented, which can monitoring the hand gestures.

The overall structure is presented in Figure 1. As illustrated, every component connects via the SIS server. The component of Diagnostic System is the super component that manages all messages sending from basic components and communicates with users. Detailed description for each component is discussed as bellows.

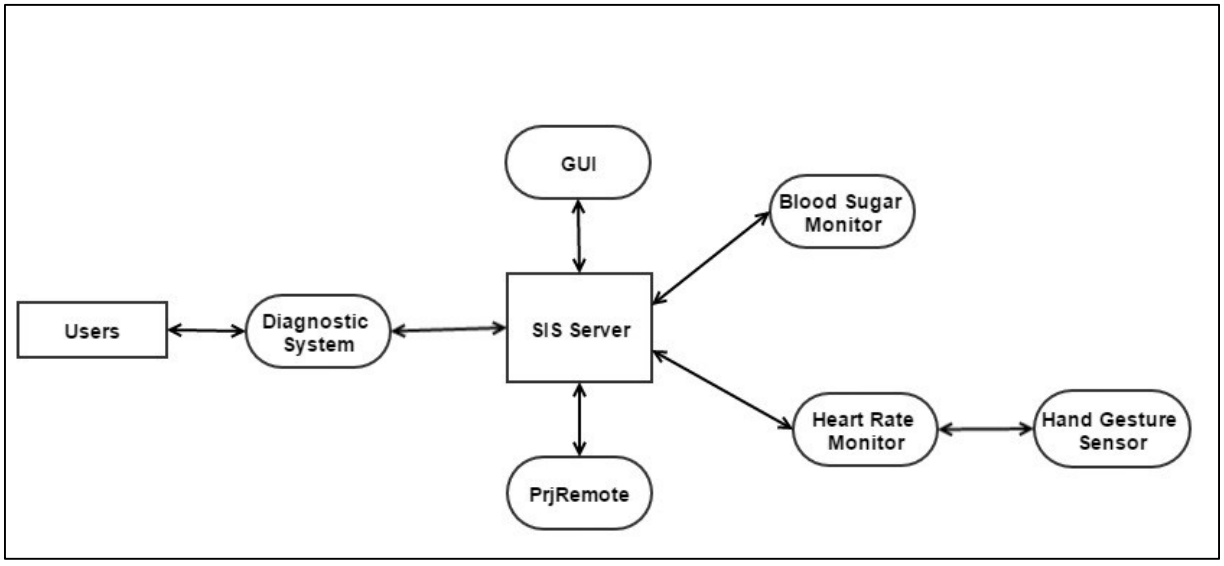

Figure 1. The overall structure of the personal healthcare system.

The detailed description of each component:

1. Blood Sugar basic component

Blood Sugar value is an important factor for personal health status. Monitoring the blood sugar in certain period of the day is crucial and helpful, especially for people who has diabetes. The task of this basic component is very straightforward. It monitors users/patients' blood sugar. When the value is out of the pre-set normal range, it will send out an alert message to the super-component, Diagnostic System.

2. Heart Rate basic component
   Similar with Blood Sugar, the major task of the Heart Rate component is to monitoring users/patients' heart rate. Additionally, it has a real sensor integrated. As long as it detects an abnormal heart rate value, it will invoke the laptop camera and trying to capture users' hand gesture. If it detects the waving or other hand gestures, it will send out an alert message, which is different from usual alert message, to the diagnostic system.

3. Diagnostic system super-component
   Instead of sending emergency alerts simply based on certain values out of the normal range. As a smart system, it should have the capability to do the initial diagnose. Combining messages sent out by basic components of heart rate and blood sugar, the system will give an initial diagnose through the diagnostic system super-component. When it receives the alert message from Blood Sugar, the diagnostic system will check the patient's heart rate records from past 5 minutes. Based on the slope calculated from the records, it decides whether an emergency message needs to send out or not. When it receives the special alert message from the hand gesture capture, it will immediately send out an emergency message of "patient needs help".

The whole project demo can be seen on Youtube with this link: **https://youtu.be/sXJHwHzaCEk.**

Scenarios:

I use Petri Net to describe different scenarios in this project. At the beginning, tokens are placed in each component's idle state, shown in Figure 2. As soon as the sensor/monitor detects the monitoring values, a token is placed and will trigger each component's task.

Due to the space limit, in addition to the initial state, I will illustrate only one scenario using Petri Net. In this case, first, the Heart Rate detects the abnormal heart rate value, and invoked the hand gesture sensor. The hand gesture sensor detects a waving movement from the patient, then token is placed, as shown in Figure 3. Two tokens are ready, which will trigger the Heart Rate component to send out a special alert message to Diagnostic System. After the event is triggered, the tokens' locations are shown in Figure 4. Figure 5 presented the Diagnostic System received the special alert message from Heart Rate and triggered the event, sending out an emergency message "patient needs help". After this event, the system come back to the initial state.

Notice that, after triggering every event, the token is placed to the idle state of each component. Thus, the component is always ready for processing new detections or messages.

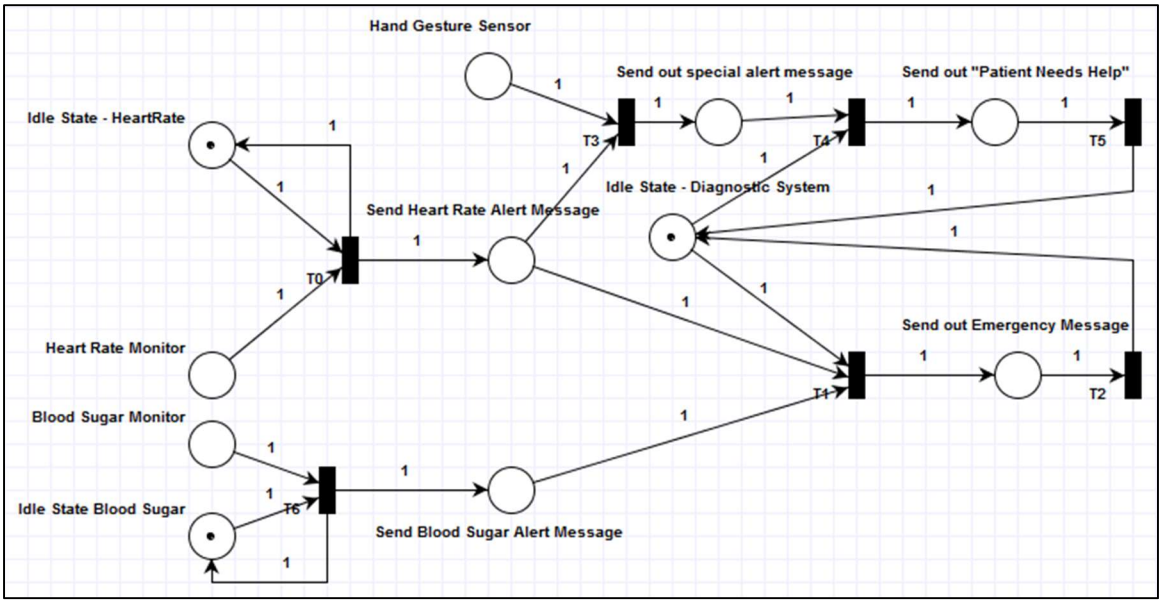

Figure 2. Initial state of the personal healthcare system.

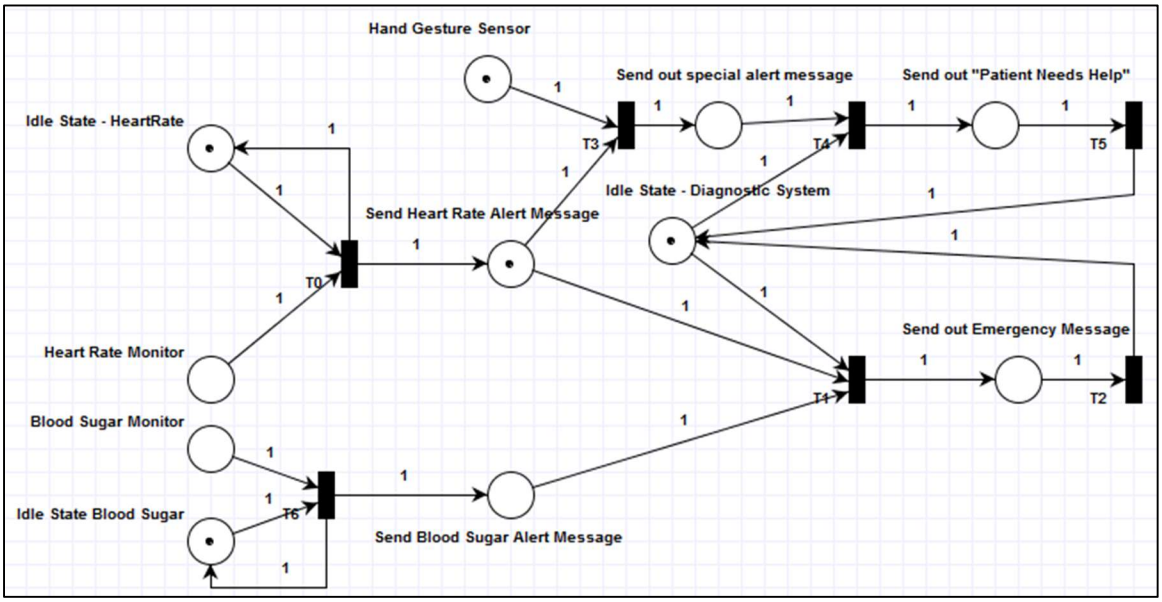

Figure 3. When Heart Rate is abnormal, and Hand Gesture Sensor detects the waving movement from the patient.

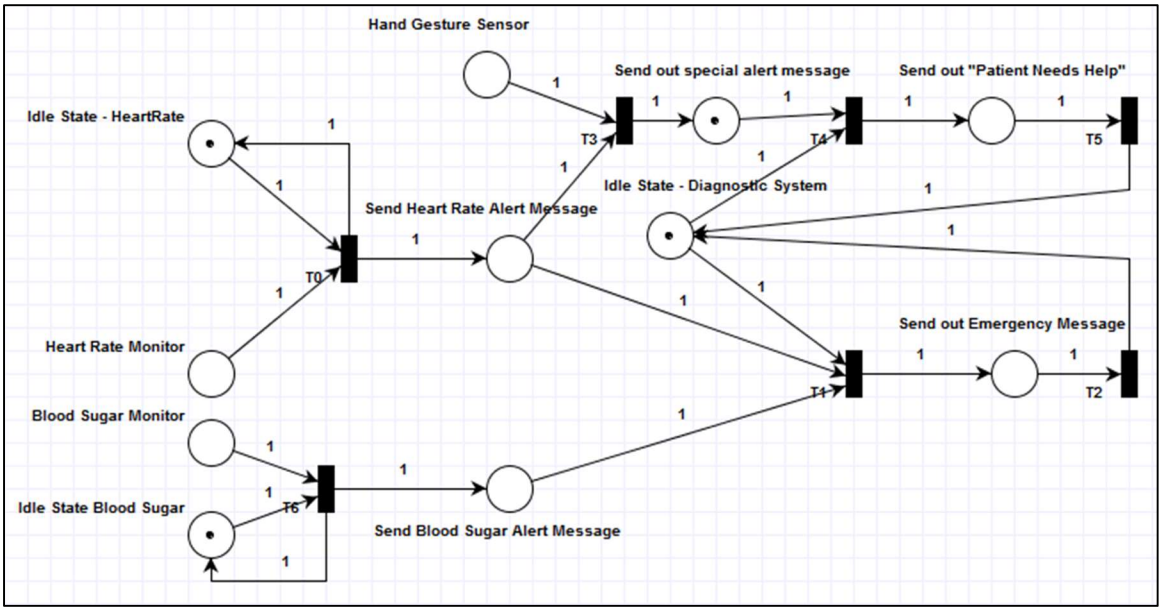

Figure 4. Heart Rate is sending out a special alert message to Diagnostic System.

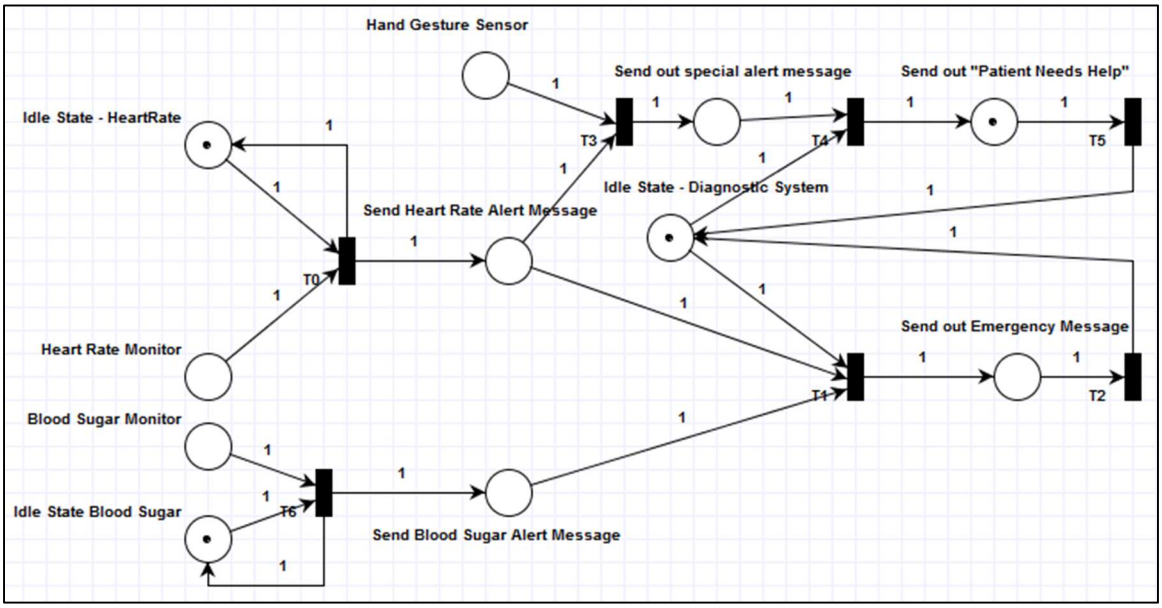

Figure 5. Diagnostic System is sending out the emergency alert message “patient needs help”.

Possible Future Works:

Currently, the Diagnostic System is doing a simple job of checking the historical recorded values and making a decision of whether sending out an emergency message. Ideally, it should perform as an intelligent system that can do the initial diagnose by integrating machine learning classification models. I think this could be an interesting topic to combine different research field and benefits the whole community.

Possible Gems:

The following bullets are gems I think I may be deserved:

- Uploaded Youtube video link **https://youtu.be/sXJHwHzaCEk**
- The real sensor I implemented.
- I implemented total 3 components, which is more than required. Although Blood Sugar is very similar to what existed in the SIS system, the other two involves with lots of work.
- The possible future work I think can be this project's extension.
- Using Petri Net to describe scenarios.