CS2310 Project Report

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Introduction

In this project, I basically expanded the Exercise 4 to implement the 3 components of Homecare System, which are "*Gesture Recognition"*, "*Emergency Manager"*, "*Homecare Staff"*.

I specially implemented "*Gesture Recognition"* component with the help of Arduino board. This component is flexible and programmable, as it allows users to add new functionalities with new sensors. "*Emergency Manager"* is the super component of this system. "*Homecare Staff"* has graphic interface for homecare staff to operate on.

This system is implemented based on the theory of Slow Intelligence System. Special thanks to the SIS testbed provided by instructor.

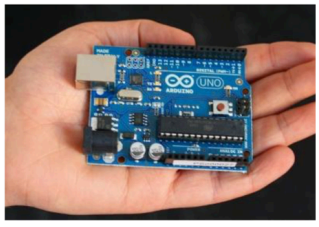
Background

- SIS (Slow Intelligence System)

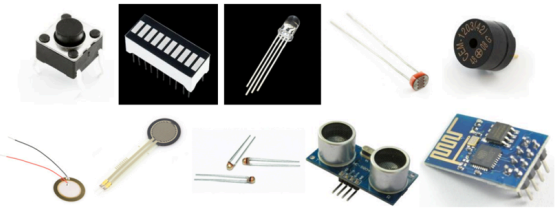
A slow intelligence system is a system that (i) solves problems by trying different solutions, (ii) is context-aware to adapt to different situations and to propagate knowledge, and (iii) may not perform well in the short run but continuously learns to improve its performance over time.

- Arduino Board

Arduino is an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. (possible gem here)



Arduino Uno board



A set of sensors

System Structure

Gesture Recognition

This component will monitor user's gesture input and send corresponding request to Emergency Manager. I used the Arduino Uno board and some recognition sensors implement the recognition part. And I implemented certain interfaces to interact with the sensors in Java program inside this component. Socket based communication were used in it.

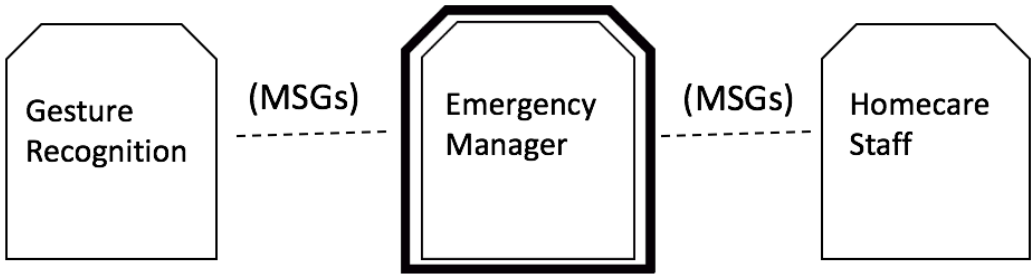
Emergency Manager

This is the super component of the system. All other components register themselves to the super component when initialized. EM super component implements more complex functionalities than normal ones. The EM sets counter for the messages sent by one specific patient and determine different strategies for different situations. This component was implemented as a Java program. Messages were sent via socket communication

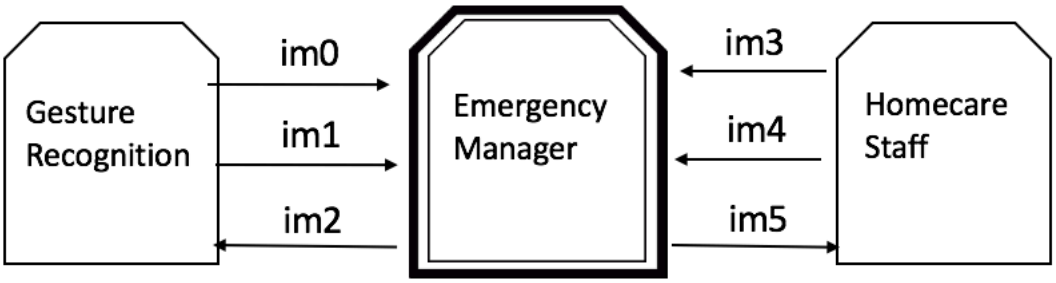
Homecare Staff

This is the component for homecare staff members. It has a GUI window for the ease of usage. It is connected to the EM super component. Home care staff members listen to the messages from Emergency Manager and complete certain tasks required in the messages.

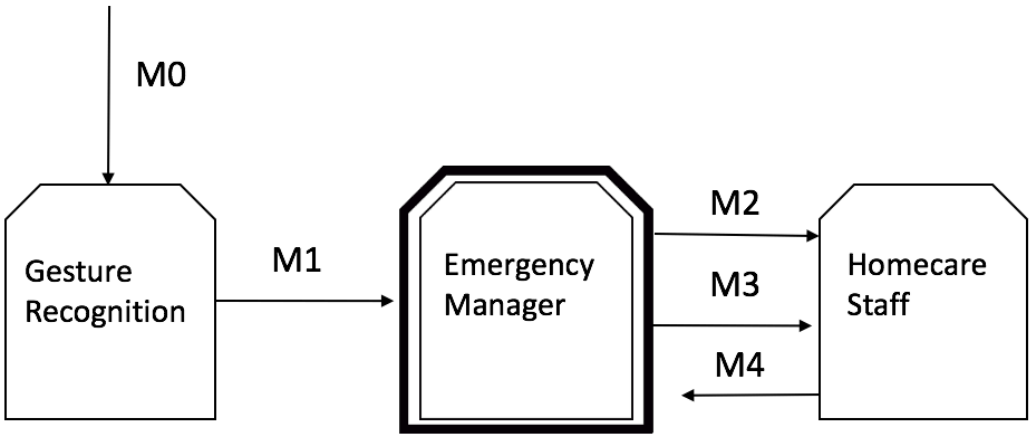
The relations between components are displayed here:



Below are the messages during the System Initialization Phase,



Below are the messages during the System Runtime Phase



In the initialization phase, all basic components will register themselves to the super component (which acts as a server). Then all basic components will try to connect to super component, and the super component will send confirm messages back to the basic components.

So im0, im3 are register messages; im1,im4 are connect messages; im2, im5 are confirm messages. M0 is reading message from the sensors. M1 is alert message sent from Gesture Recognition. M2, M3 are the alert and emergency messages sent to Homecare Staff. M4 is alert message sent from HS to EM to notify that patient didn't respond.

Working Scenarios

In addition to message definitions, I will describe a step-by-step detailed scenario showing what messages are exchanged and what are the expected effects. Screenshots are pasted here for better illustration.

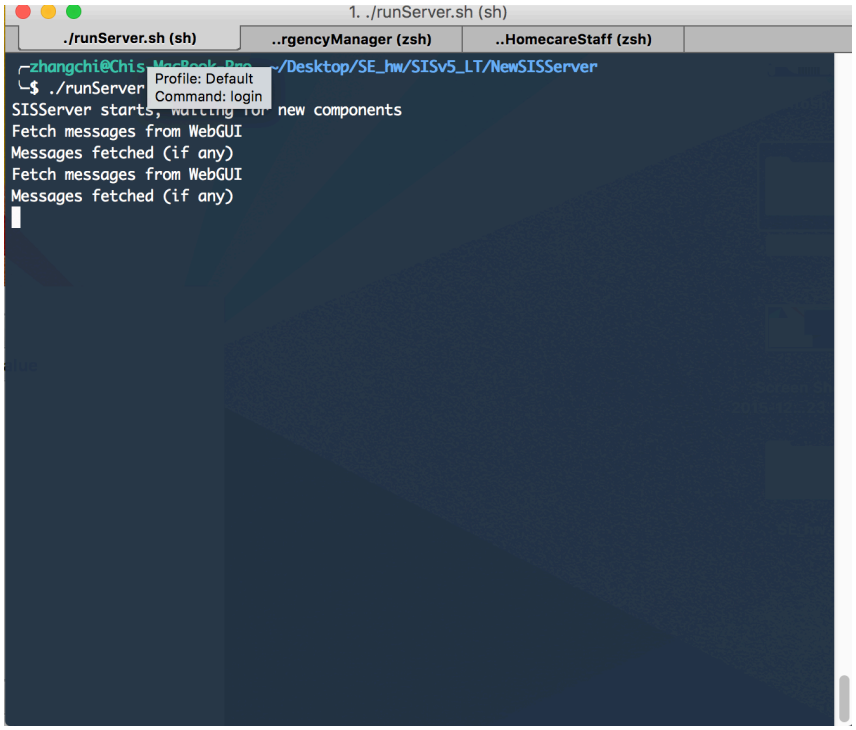
Links to the YouTube videos demoing those two scenarios are listed below:

- https://youtu.be/doc9v-RRnKE (First Scenario)
- https://youtu.be/RAJOupYDEp4 (Second Scenario)

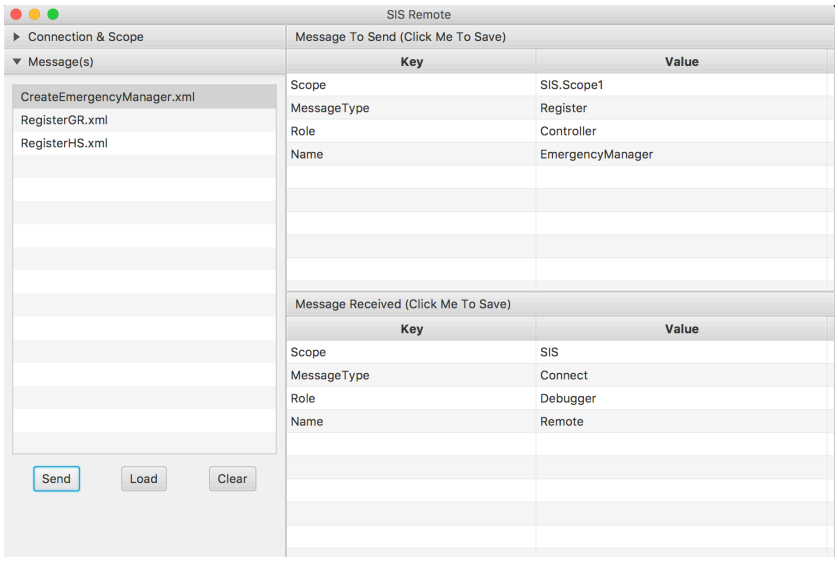
(possible gem here)

First scenario using PrjRemote

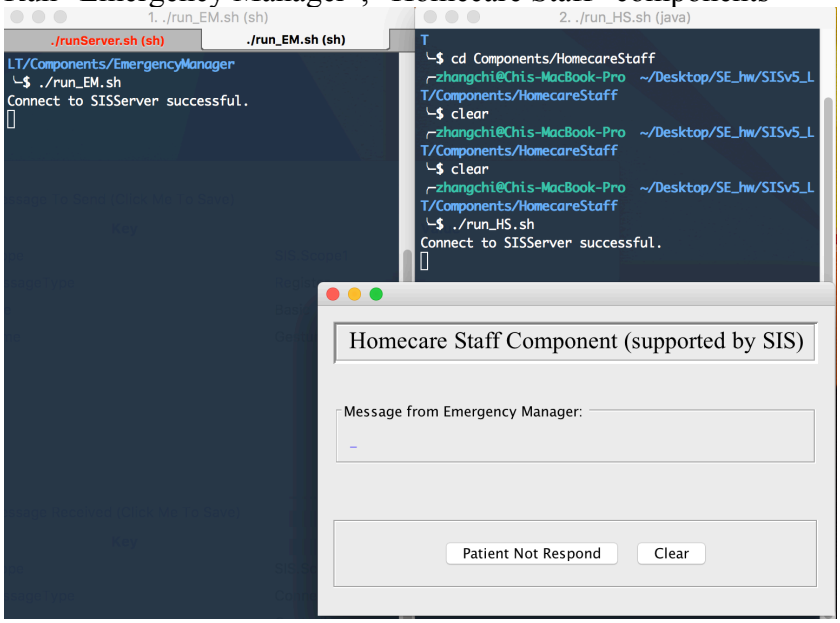
- Run the server



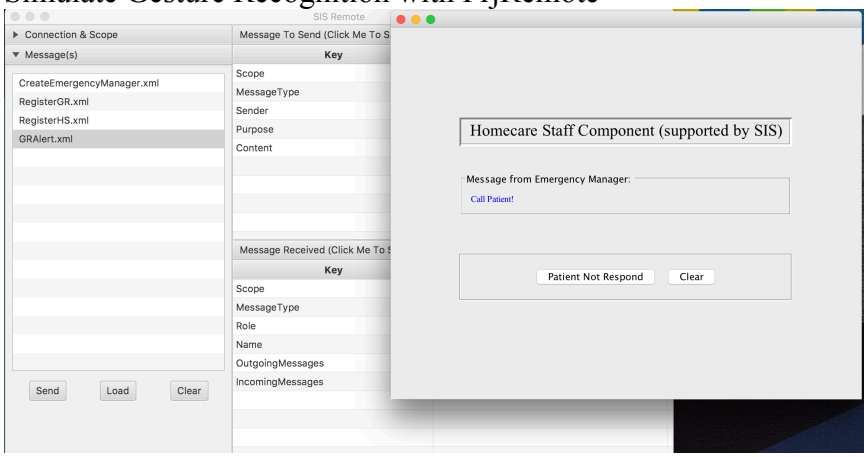
- Register “Emergency Manager”, “Gesture Recognition”, “Homecare Staff” through PrjRemote



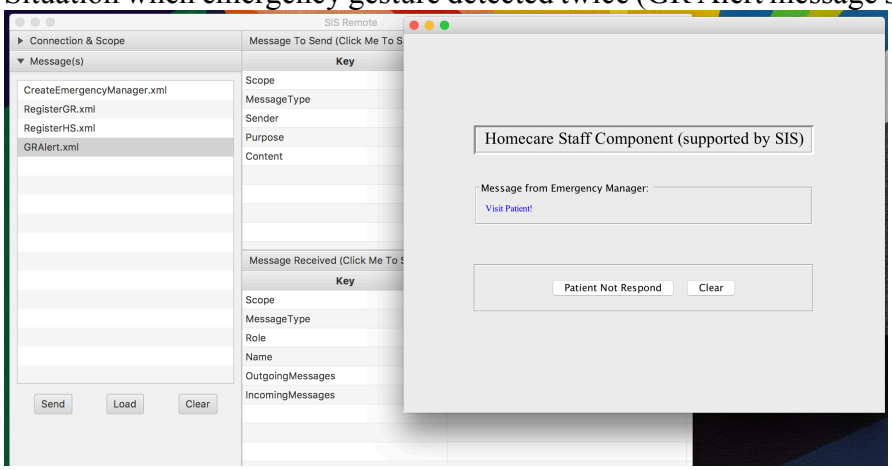
- Run “Emergency Manager”, “Homecare Staff” components



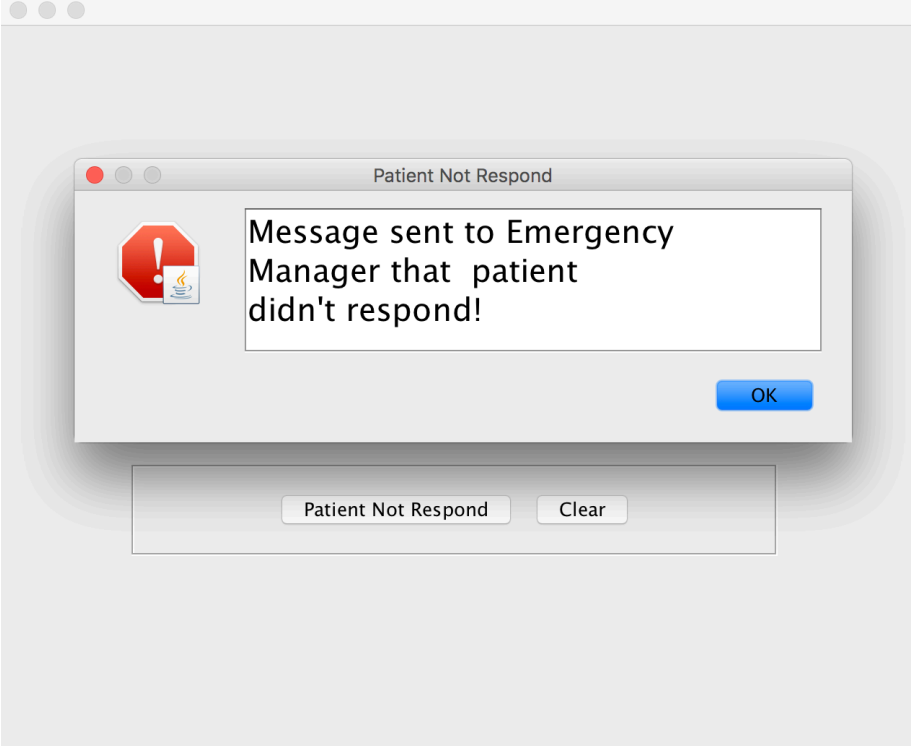
- Simulate Gesture Recognition with PrjRemote



- Situation when emergency gesture detected twice (GR Alert message sent twice by PrjRemote)



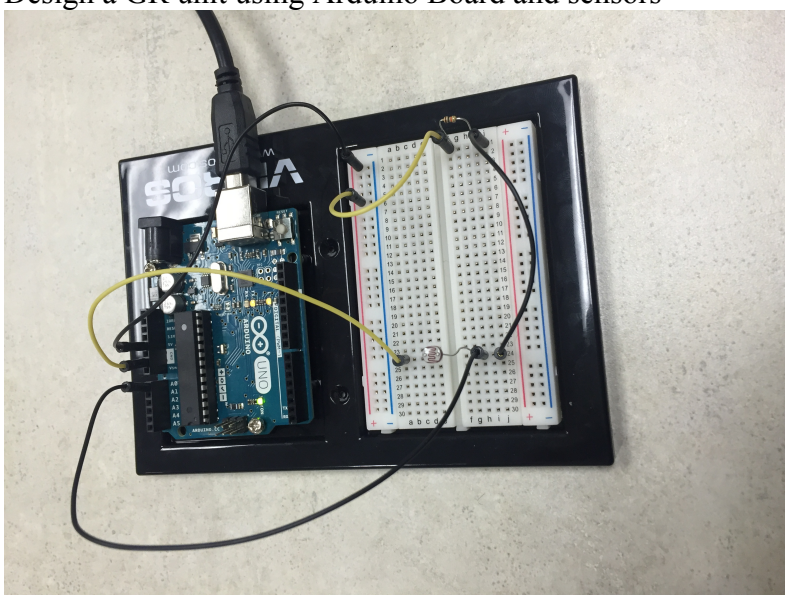
- Situation when patient didn't respond. (Staff pressed the "Patient Not Respond" button)



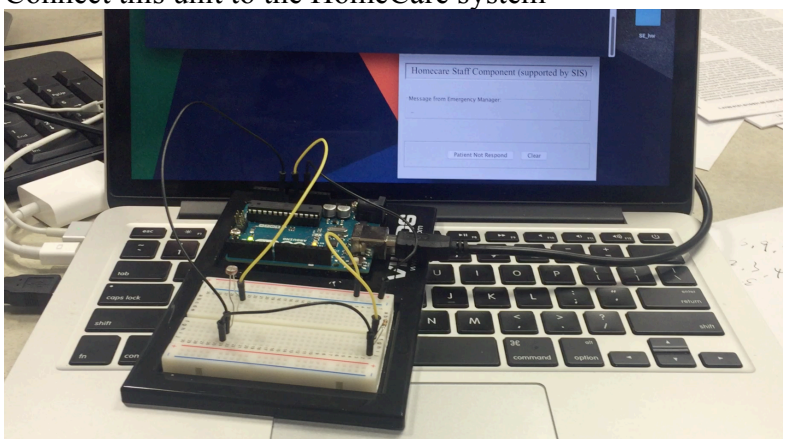
Second scenario using Arduino-based Gesture Recognition Component

In this scenario, I integrate the Arduino-based GR into the whole system. I use photocell sensor to achieve coarse gesture detection. In the future, with more powerful sensors, there could be better and more stable gesture recognition functionalities.

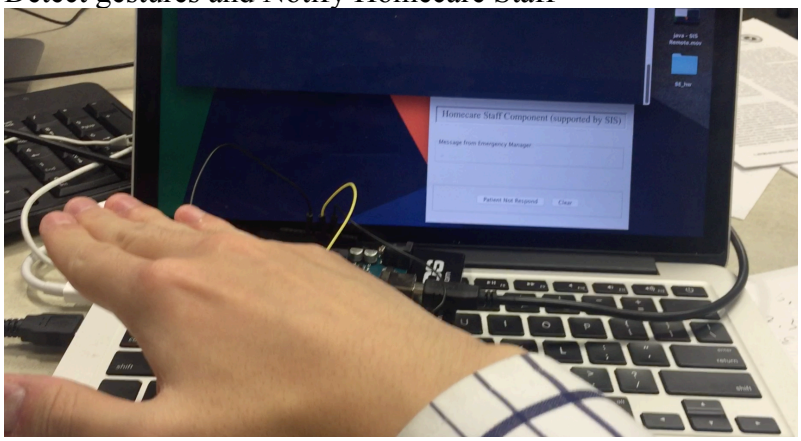
- Design a GR unit using Arduino Board and sensors

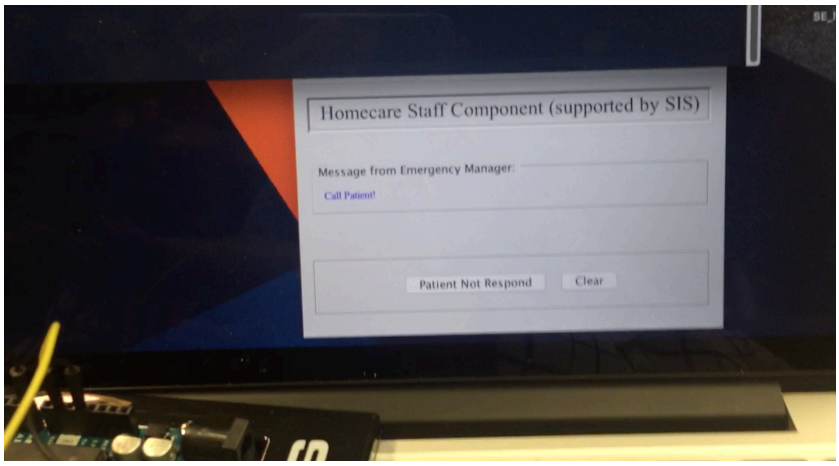


- Connect this unit to the HomeCare system



- Detect gestures and Notify Homecare Staff





Conclusion

In this project, I implemented SIS-assisted HomeCare system. Designed a programmable GR component, with the help of Arduino board and sensors. Users could communicate with this system using gestures. According to the detected gesture, emergency management cell of this system would decide certain tasks so that homecare staff members can help the patient. Developers could add more semantics to Gesture Recognition to detect more gestures and help this system work more efficiently.

Special thanks to the instructor for providing SIS testbed and the inspiration of this project. By completing this project, I gained better and deeper understanding of mechanism of Slow Intelligence System.

Possible Gems:

- Using Arduino to implement the Gesture recognition
- Upload demo videos to YouTube.
- Detailed Scenario descriptions