CS2310: Exercise2

Jeongmin Lee
jel158@pitt.edu

The purpose of this exercise is to enable the students to gain familiarity with the active index approach to active information system design. As discussed in class, the hypermedia model and the active index together can be used to model active distributed multimedia information systems. In this exercise we will first concentrate on the active index component.

Let us consider a Personal Health Care System for a senior citizen living alone at home. The senior citizen may not be computer-literate. Therefore he/she will use gestures to communicate with the system. Let us assume there is a gesture recognition index cell that can recognize user's hand gestures. If the gesture index cell detects a "I need help" gesture then it will send a message, "Patient Smith needs help", to the emergency manager index cell. The emergency manager cell will send a message, "Call patient Smith", to the homecare staff index cell. If the senior citizen makes another "I need help" gesture, which is again sent by gesture index cell to the emergency manager cell, the emergency manager cell will send a message, "Visit patient Smith", to the homecare staff index cell. In other words, multiple "I need help" messages from the gesture index cell will prompt the emergency manager cell to send "Visit patient Smith" to the homecare staff cell. The homecare staff cell will call the patient if he/she receives a message "Call patient Smith" from the emergency manager cell. If the homecare staff cell cannot reach patient Smith by phone, or a message "Visit patient Smith" is received from the emergency manager cell, then the homecare staff will jump into the ambulance and drive to Mr. Smith's home.

(a) Draw state-transition diagrams to define graphically the three index cell types.

Let's define messages as follows
- m1: "I need help" gesture
- m2: "Patient Smith needs help"
- m3: "Call patient Smith"
- m4: "Visit patient Smith"
- m5: "Cannot reach patient Smith by phone"

Gesture Recognition Index Cell
When patient made hand gesture, it send message "Patient Smith needs help" (m2) to the emergency manager index cell. Then, after the message being sent, the status of gesture recognition index cell returns to the s0 state to wait next gesture by the patient Smith.

T1: m1/m2, a1

s0
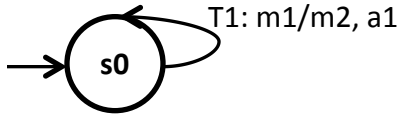
a1: send a message m2 to the emergency manager index cell

Emergency Manager Index Cell

When it receives message "Patient Smith needs help" (m2) from the gesture recognizer, it sends a message "Call patient Smith" (m3) to the homecare staff index cell and the state is on s1 which means it recognizes it already received message m2. Then, additional message m2 is coming from gesture recognition index cell, then it realize that the status of patient is severe and send message "Visit patient Smith" (m4) to homecare staff index cell.

s0 T1: m2/m3, a2 s1 T2: m2/m4, a3 s2 T3: m2/m4, a3
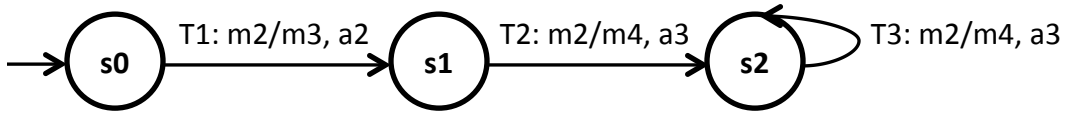
a2: send a message m3 to the homecare staff index cell
a3: send a message m4 to the homecare staff index cell

Homecare Staff Index Cell

In the perspective of homecare staff index cell, when it receives the message of "Call patient Smith" (m3), it takes action of calling patient Smith (a4). If it cannot reach patient Smith by phone, then it takes action of visit Smith (a5). On the other hand, if it directly receives message of visit Smith (m5), then it takes the action of visiting patient Smith (a5) subsequently.

s0 T1: m3/m0, a4 s1
T3: m4/m0, a5
T2: m4/m0, a5
s2 T4: m5/m0, a5
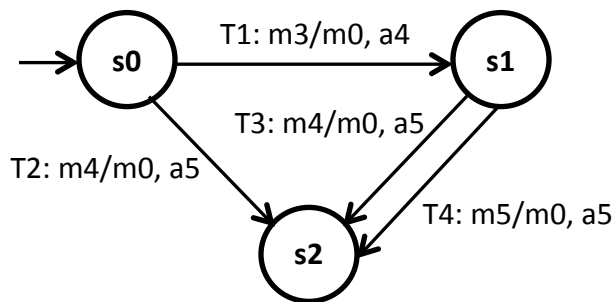
a4: call to patient Smith
a5: visit patient Smith

(b) Specify the three index cell types formally using mathematical notations ic = (X, Y, S, so, A, tmax, f, g).
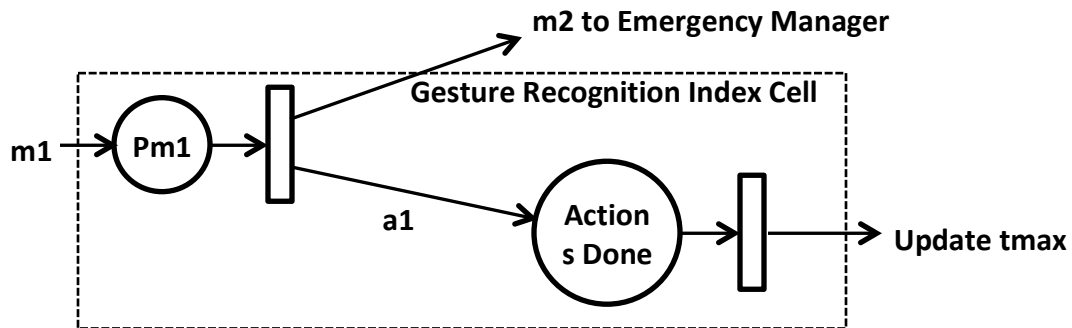

Gesture Recognition Index Cell

X: {m1}
Y: {m2}
S: {s0}, where s0 is status when monitoring patient's gesture. s0 in S is the initial state
A: {a1}

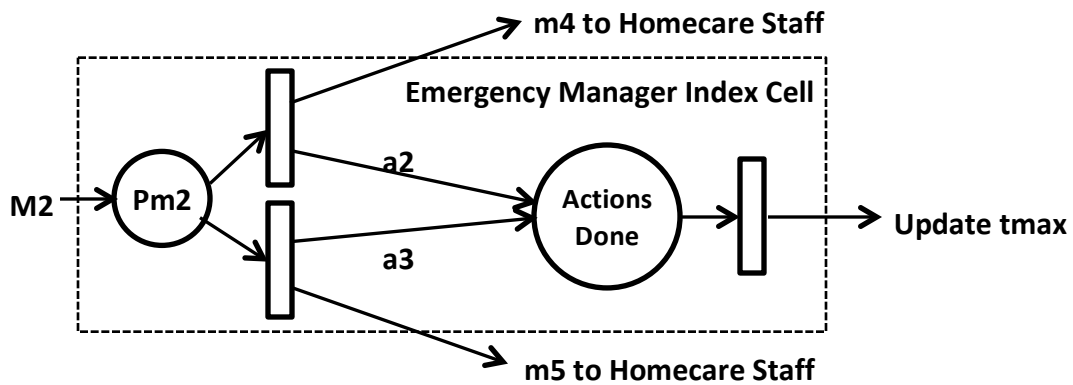The function f and g are such that

m2 to Emergency Manager

Gesture Recognition Index Cell

m1 → Pm1

a1

Action s Done

Update tmax

Emergency Manager Index Cell

X: {m2}
Y: {m3, m4}
S: {s0, s1, s2}
s0 in S is the initial state
A: {a2, a3}

The function f and g are such that

m4 to Homecare Staff

Emergency Manager Index Cell

M2 → Pm2

a2

Actions Done

a3

Update tmax

m5 to Homecare Staff
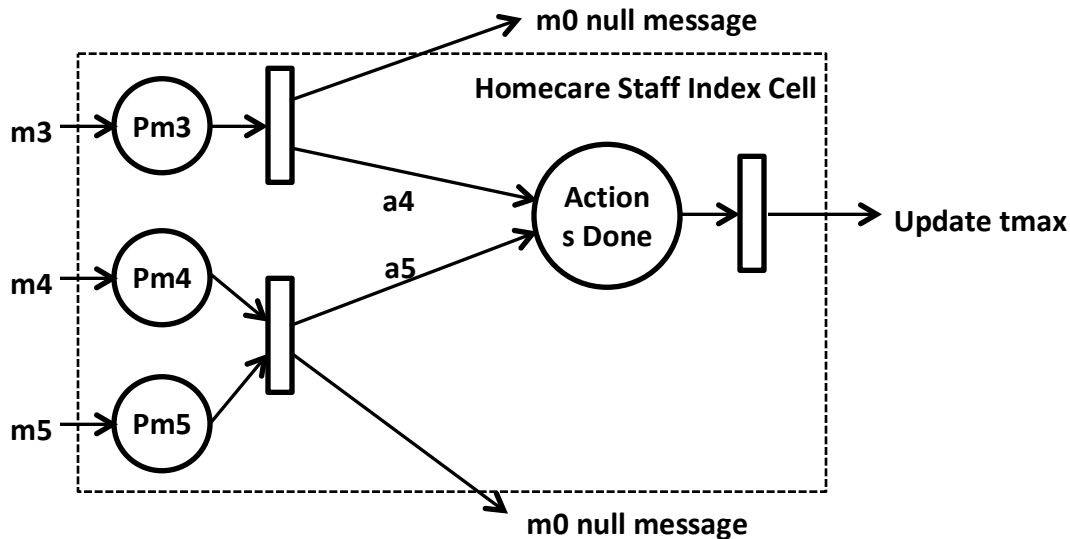
Homecare Staff Index Cell

X: {m3, m4, m5}
Y: {m0}
S: {s0, s1, s2}
s0 in S is the initial state
A: {a4, a5}
The function f and g are such that

**(c) Draw a diagram showing three multimedia interfaces (webpages such as doc-1, ...,
doc-3) enhanced with the index cells to illustrate how these index cells work together
to form an active index system.**

The single active index system consisted of three multimedia interfaces(document 1
through 3). The participants (actors) in this system consisted of patients, emergency
manages, and homecare staffs. The multimedia interfaces (documents) are built to
facilitate control and information dissemination among all participants of the system.
Description of the multimedia interfaces is as following;

- Document1: At this page, information of each patient such as the up-to-date
  electronic medical health record (EMR) from hospitals and contact information
  including patient's home address, phone number and collected and provided.
  When any information about specific patient is needed, emergency manager and
  homecare staff can lookup the information of patient needed.

- Document2: At this page, the current patients' status and emergency situations are collected and monitored. Especially for the gesture recognition, when the sensor gets gesture from the patients, the signal is processed and at this page, message of "patient X needs help" is alerted at this page to the emergency manager.

- Document3: All the information and controls between emergency manager and homecare staff is shown at this page. When it is needed, the messages such as "Call patient X" and "visit patient X" are shown here to homecare staffs.
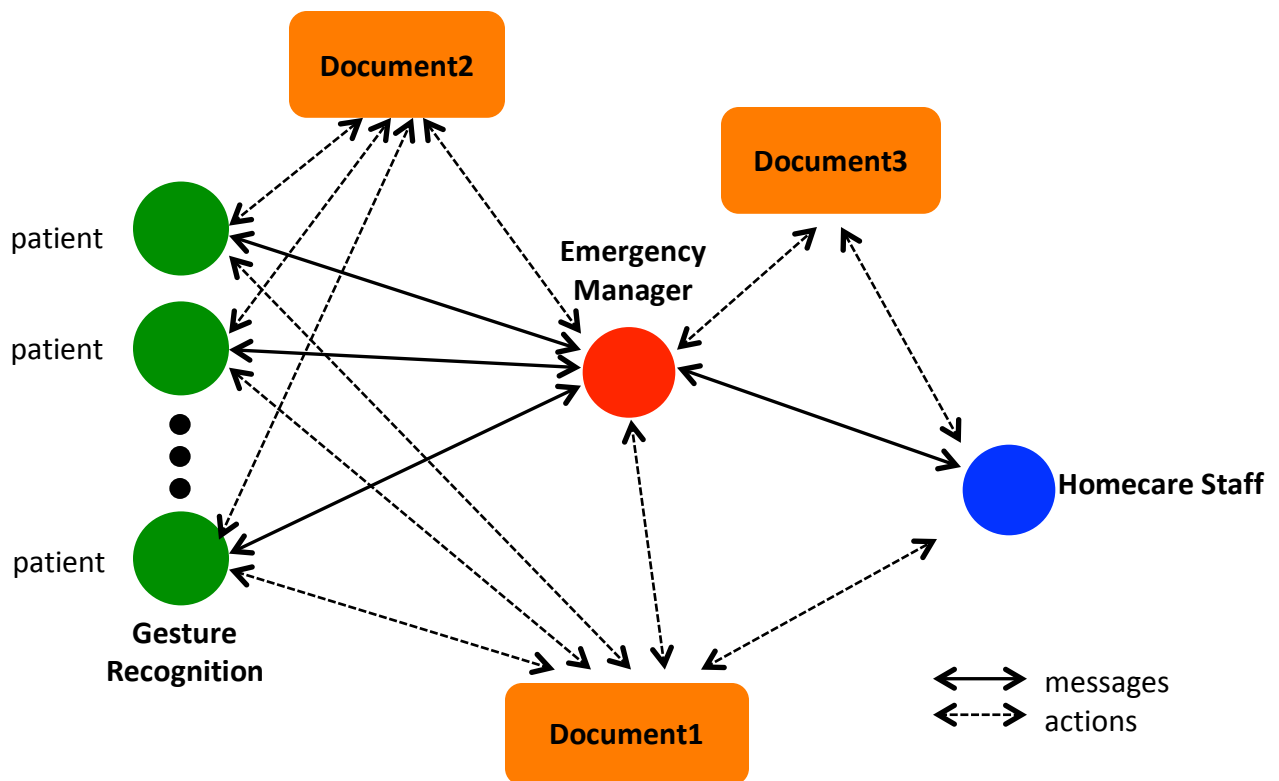
(d) Following the discussion on the concept of patterns, define more clearly the pattern(s) you have identified. If you feel the patterns you have identified are lacking in certain respect, you may replace them by some new patterns.

Gesture Recognition Index Cell
Problem: Recognize patient hand gesture
Context: 1) Patient needs help 2) He is unable to use digital devices
Solution: The gesture recognition index cell senses hand gesture of patient and send message to the emergency manager

Emergency Manager Index Cell
Problem: Emergency manager should detect patient's urgent situation and manage the situation
Context: The emergency manager index cell is connected to the gesture recognition index cell through means of wide area network. Also the emergency manager index cell is connected to the home care staff index cell through network.
Solution: When the gesture recognition index cell sent message of 'Patient X is in need', the message will be instantly received by the emergency manager cell and based on the message, the emergency manager index cell can acknowledge the situation and generate proper subsequent message such as 'call patient X' or 'visit patient X' to the homecare staff index cell.

Homecare Staff Index Cell
Problem: Look after old-aged patients at home.
Context: The homecare staff should constantly monitor condition of patients and give proper intervention when there is emergency situation.
Solution: When homecare staff index cell receives message from emergency manager index cell over network, it makes call to patient or visit the patient when it is necessary and mandated by the procedure.

Besides those three patterns of each of actor in our case, we can additionally detect some thoughts about more abstract patterns as follows.

The Less Should Take Care of The More
The given situation of this exercise implies that there exist multiple (probably we can assume 100~500) patients that the homecare staff should manage. With traditional approach that does not involve any intelligence system, managing a number of patients with limited number of staff causes decreasing of quality of service which means some patients in emergency situation cannot get proper care on time. To solve the problem, the multi-tiered information and control scheme and the intelligence system are introduced and those greatly helped the homecare staffs to cover the patients who are in need and care. We will discuss the multi-tiered information and control scheme flowingly.

Multi-tiered Information and Control Scheme
The single active index system consisted of three documents presented in previous question (c) reveals the pattern of multiple layers (tiers) of information collection, propagation, decision making and dissemination. Those patterns allowed effectiveness and efficiency of the single active index system that enables managing many patients with (limited) homecare staff.

(e) A visual specification of the identified pattern(s) should be included, using for example visual grammar rules. Remember Alexander's dictum: "If you can't draw a picture of it, it isn't a pattern.")

Gesture Recognition Index Cell

   Recognize a gesture → create a message of "I need help" → send the message to the emergency manager index cell

Emergency Manager Index Cell

   Receive the message → determine the order (call or visit) → send the message to the homecare staff index cell

Homecare Staff Index Cell

   Receive the message → Make a call or visit the patient