Homework 2

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In this exercise we have to use an active index approach to active information system design. The hypermedia model and the active index together can be used to model active distributed multimedia information systems. The assumptions of this exercise are given below –

- 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 "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.

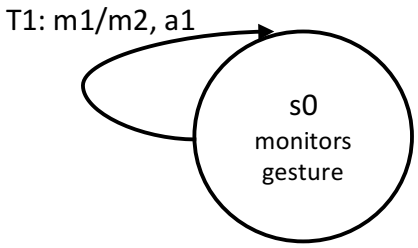
(a) Draw state-transition diagrams to define graphically the three index cell types.

To draw the state-transition diagram we need to define the messages sent and received by each cell and the actions performed.

Messages	**Actions performed**
m1: “I need help”	a1: Send m2 to Emergency Manager Index Cell to prompt help
m2: “Patient Smith needs help”	a2: Send m3 to Homecare Staff Cell to call patient
m3: “Call patient Smith”	a3: Call patient from Homecare Staff Cell
m4: “Visit patient Smith”	a4: Send m4 to Homecare Staff Cell to visit patient
m5: No response to call	a5: The homecare staff will drive ambulance to Mr. Smith’s home to visit him.

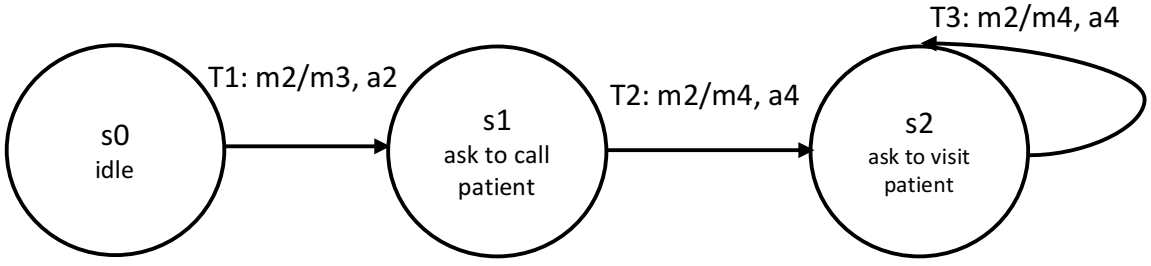
Gesture Recognition Index Cell

A gesture recognition index cell always monitors to recognize user's hand gestures. If it detects ***m1****: "I need help"* gesture then it will send a message, ***m2****:"Patient Smith needs help"*, to the emergency manager index cell which is action **a1**. It has only one state **s0**.



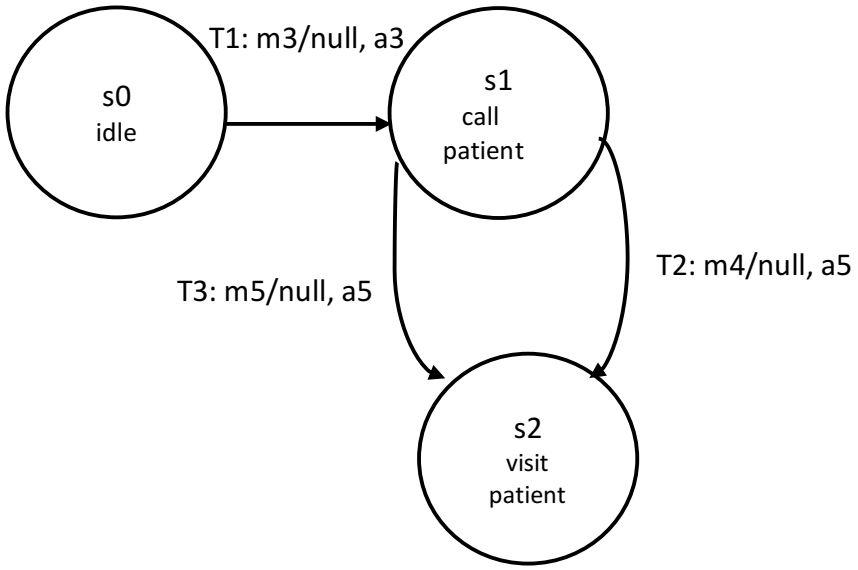
Emergency Manager Index Cell

At first the emergency manager index cell can be idle, which is state **s0**. When it receives a message **m2**: *“Patient Smith needs help”*, it sends **m3**: *“Call patient Smith”* to homecare staff index cell and performs action **a2** and goes to state **s1**. Then if receives the same message **m2** again, it sends another message **m4**: *“Visit patient Smith”* to the homecare staff index cell performing action **a4** and goes to state **s2**. While in state **s2**, if it receives **m2** multiple times, then it sends **m4** multiple time.



Homecare Staff Index Cell

At first the homecare staff index cell can be idle. When it receives the message **m3**: *"Call patient Smith"*, it calls the patient performing action **a3**. If it receives message **m4**: *"Visit patient Smith"*, the homecare staff goes to visit Mr. Smith by ambulance, which is action **a5**. The homecare staff will also do **a5** if the patient does not pick up the phone. This index cell has 3 states too.



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

The mathematical notations for the three index cells are given below –

Gesture Recognition Index Cell

Set of input messages, X = {m1}
Set of output messages, Y = {m2}
Set of states, S = {s0}
Initial state, s0 = {s0}
Set of action sequences, A = {a1}
Maximum time, tmax = infinity
f function :

$f(\{m1\}, s0) = 1$
$f(P\{m1, m2, m3, m4, m5\} - \{m1\}, s0) = 0$,

g function :

$g(m1, s0) = (ic_{emergency\_manager}, m2, s0, a1)$

Emergency Manager Index Cell

Set of input messages, X = {m2}
Set of output messages, Y = {m3,m4}
Set of states, S = {s0, s1, s2}
Initial state, s0 = {s0}
Set of action sequences, A = {a2, a4}
Maximum time, tmax = infinity
f function :

$f(\{m2\}, s0) = 1$
$f(P\{m1, m2, m3, m4, m5\} - \{m2\}, s0) = 0$
$f(\{m2\}, s1) = 1$
$f(P\{m1, m2, m3, m4, m5\} - \{m2\}, s1) = 0$
$f(\{m2\}, s2) = 1$
$f(P\{m1, m2, m3, m4, m5\} - \{m2\}, s2) = 0$

g function :

$g(m2, s0) = (ic_{homecare\_staff}, m3, s1, a2)$
$g(m2, s1) = (ic_{homecare\_staff}, m4, s2, a4)$
$g(m2, s2) = (ic_{homecare\_staff}, m4, s2, a4)$

Homecare Staff Index Cell

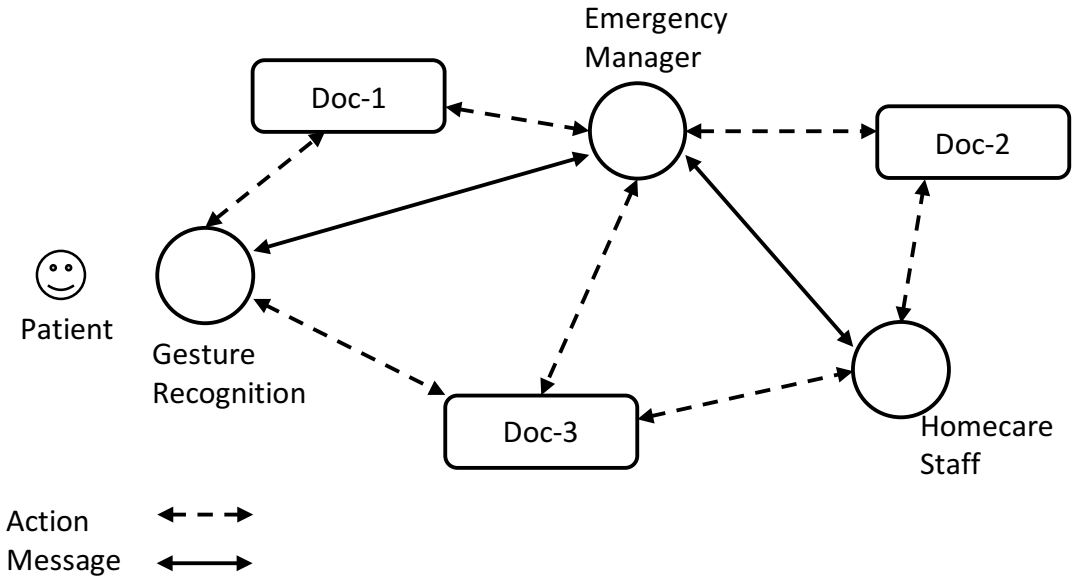
Set of input messages, X = {m3, m4, m5}
Set of output messages, Y = {dummy}
Set of states, S = {s0, s1, s2}
Initial state, s0 = {s0}
Set of action sequences, A = {a3, a5}
Maximum time, tmax = infinity
f function :

$f(\{m3\}, s0) = 1$
$f(P\{m1, m2, m3, m4, m5\} - \{m3, m4, m5\}, s0) = 0$
$f(\{m4\}, s1) = 1$
$f(P\{m1, m2, m3, m4, m5\} - \{m3, m4, m5\}, s1) = 0$
$f(\{m5\}, s1) = 1$

g function :

$g(m3, s0) = (null, null, s1, a3)$
$g(m4, s1) = (null, null, s2, a5)$
$g(m5, s1) = (null, null, s2, a5)$

(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 above diagram shows an active index system for the personal healthcare system. The three index cells are gesture recognition, emergency manager and homecare staff. Three interfaces are doc-1, doc-2 and doc-3. The dotted lines means actions and the straight line shows the message passing.

Doc-1 : This is an interface between the gesture recognition and the emergency manager. The previous data of patient initiating of need for help is recorded and stored here. This is regularly monitored. Based on this information emergency manager sends different kinds of message to the homecare staff.

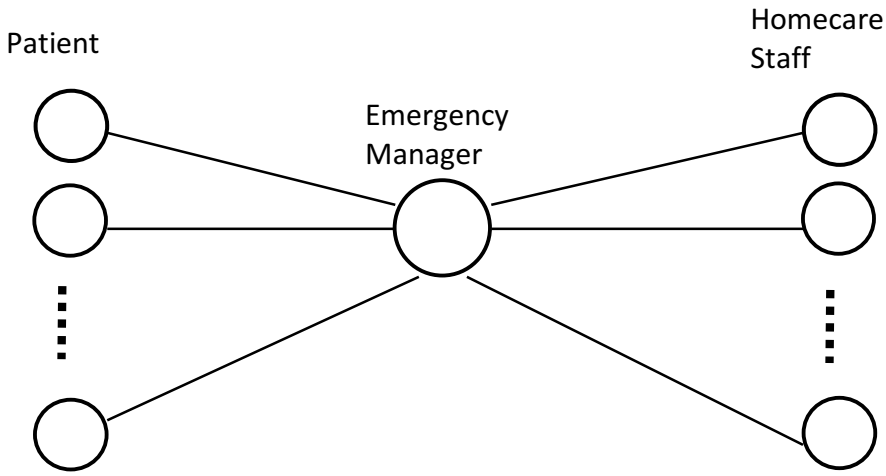
Doc-2 : This is an interface between the emergency manager and the homecare staff. The information for the homecare staff if he needs to call the patient or visit the patient is stored here and retrieved when needed.

Doc-3 : This interface connects the patient and gesture recognition index cell, the emergency manager index cell and the homecare staff index cell. The patient information is stored here. Any cell can retrieve this information when needed.

(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.

Centralized Manager :

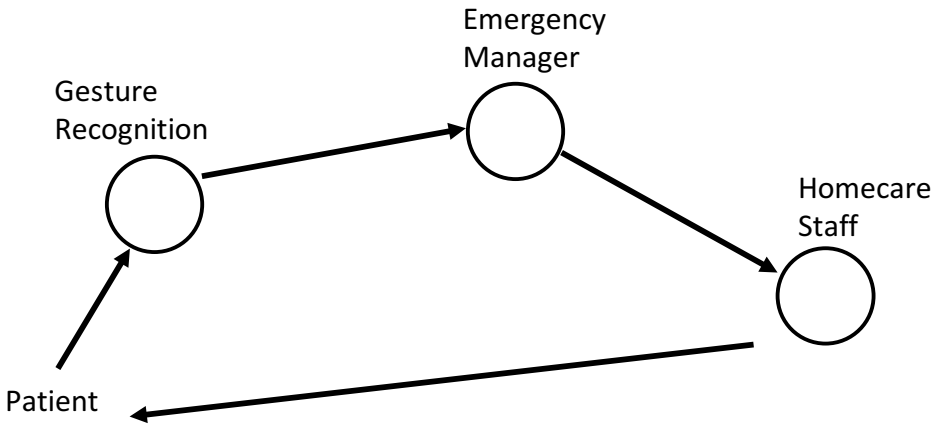
We can assume that the homecare staff not only takes care of Mr. Smith but also other patients. So there should be multiple homecare staffs too. So that in critical condition when multiple patient may need to be visited, there should be enough homecare staff to provide the service. And all these things are managed by a central emergency manager who passes the messages from the patient to homecare staff.



Context : Communication between multiple patients and homecare staffs
Problem : Multiple patient needs to be called or visited at the same time
Solution : Central Emergency manager for the patients and homecare staffs

Circular Information flow:

When a gesture recognition detects that a patient needs help, it sends message to emergency manager. Then emergency manager sends message to the homecare staff and then homecare staff gets back to the patient by calling the patient or visiting the patient. Thus there is a circular information flow in this system.



Context : Information flow between the index cells
Problem : Patient requesting personal care successfully and getting back the care
Solution : Circular data flow starting from the patient to homecare staff back to patient