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CS 2310 Software Engineering

Exercise 2

System Description

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Messages		**Actions**	
m0: I need help		a0: Send message to prompt for help	
m1: Patient Smith needs help		a1: Send message to call patient	
m2: Call Patient Smith		a2: Send message to visit patient	
m3: Visit Patient Smith		a3: Call patient	
m4: No response to phone call		a4: Visit patient by ambulance	

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

Gesture Recognition
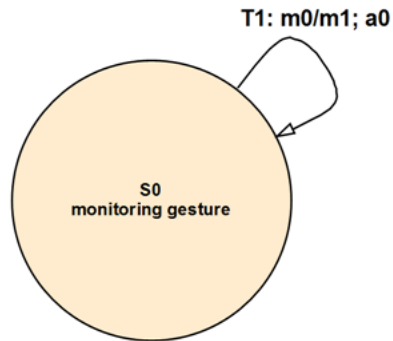
Emergency Manager
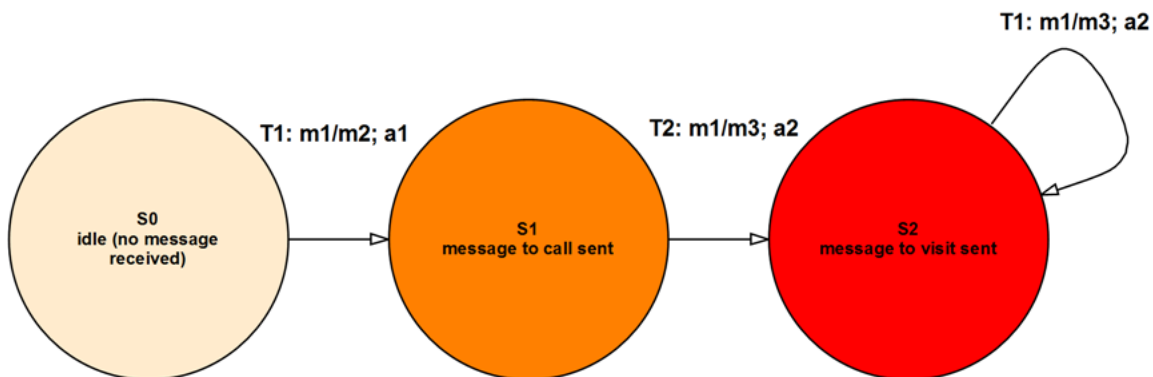
Homecare Staff

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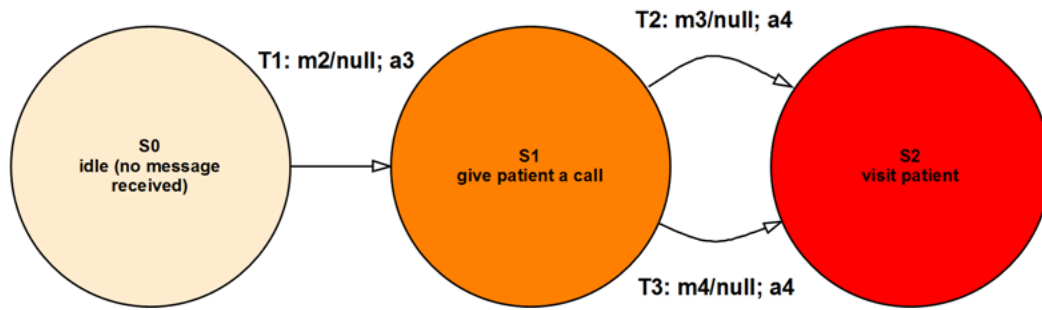
b.) Specify the three index cell types formally using mathematical notations ic = (X, Y, S, s_o, A, t_{max}, f, g).

Note : Refer to messages and actions under System Description. Dummy values are only being taken into account when set is empty

Notation: $P(A)$ *= power set of A; $A - B$ = relative complement of sets;   d = dummy value*

Gesture Recognition Index Cell (ic $_{gesture}$)

- X = {m0}
- Y = {m1}
- S = {s0}
- s0 = {s0}
- A = {a0}
- tmax = infinity
- f:
    - f({m0},s0) = 1
    - f(P{m0,m1,m2,m3,m4} – {m0}, s0) = 0
- g:
    - g(m0,s0) = (**ic $_{emergency}$** , m1, s0, a0)

Emergency Manager Index Cell (ic $_{emergency}$)

- X = {m1}
- Y = {m2,m3}
- S = {s0,s1,s2}
- s0 = {s0}
- A = {a1,a2}
- tmax = infinity
- f:
    - f({m1},s0) = 1

- o f({m1},s1) = 1
- o f({m1},s2) = 1
- o f(P{m0,m1,m2,m3,m4} – {m1}, s0) = 0
- o f(P{m0,m1,m2,m3,m4} – {m1}, s1) = 0
- o f(P{m0,m1,m2,m3,m4} – {m1}, s2) = 0
  - g:
    - o g(m1,s0) = (**ic** homecare , m2, s1, a1)
    - o g(m1,s1) = (**ic** homecare , m3, s2, a2)
    - o g(m1,s2) = (**ic** homecare , m3, s2, a2)

Homecare Staff Index Cell (ic homecare)

- X = {m2,m3,m4}
- Y = {d} , where d = dummy value
- S = {s0,s1,s2}
- s0 = {s0}
- a = {a3,a4}
- tmax = infinity
- f :
  - o f({m2},s0) = 1
  - o f({m3},s1) = 1
  - o f({m4},s1) = 1
  - o f(P{m0,m1,m2,m3,m4} – {{m2},{m3},{m4}}, s0) = 0
  - o f(P{m0,m1,m2,m3,m4} – {{m2},{m3},{m4}}, s1) = 0
  - o f(P{m0,m1,m2,m3,m4} – {{m2},{m3},{m4}}, s2) = 0
- g :
  - o g(m2,s0) = (null , null , s1, a3)
  - o g(m3,s1) = (null , null , s2, a4)
  - o g(m4,s1) = (null , null , s2, a4)

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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.

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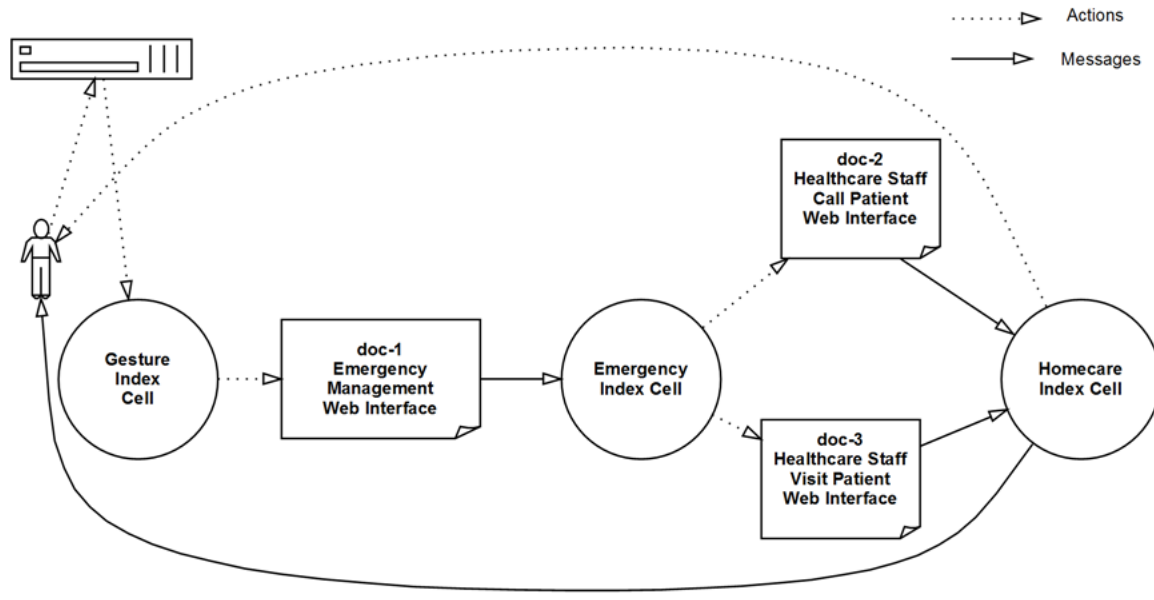
d.) Following the discussion on the concept of patterns, define more clearly the pattern(s) you have identified. If you feel the patterns you have identified are lacking in certain respect, you may replace them by some new patterns.

Pattern 1 : Waiting for Signal

Context = Health care system for a senior citizen who is not computer-literate

Problem = System needs to be actively monitoring at all times to detect and recognize the signal

Solution = Continuously monitor and wait for a signal. System should be alive at all times.

A common pattern observed in all index cell is that each index cell is waiting for a signal or message to act. For a home health care system, it is crucial for the index cells to be alive and waiting at all times, as message can be received at any time so the system needs to be available. In this case, emergency manager and homecare staff are passively waiting for a signal but the gesture index cell is actively waiting for a signal. The gesture index cell must detect every movement and process it to recognize if it is a movement for help in order to take the required action.

Pattern 2 : Centralized Manager Between Agents

Context = Communication between patient and homecare staff occurs through emergency manager

Problem = Communication between the agents is stateful and actions depend on the state

Solution = Have a distributed system with a centralized manager between agents to maintain states and takes actions accordingly

In this paradigm, it is seen that the state of emergency and gesture index cells changes as repeated messages are received from the gesture index cell. In order to keep track of the state change based on message frequency, the system uses a centralized emergency manager that takes the messages from the gesture index cell and determines the urgency of the situation based on the number of times the message has been received in the past in order to prompt the homecare staff accordingly. Having a centralized manager also allows communication between multiple instances of gesture index cells and multiple instances of homecare staff index cell.

Pattern 3 : Time Critical Execution

Context = Health care system for senior citizen should provide timely care

Problem = Delay in execution of action can be life threatening for the patient

Solution = Stateful architecture that transitions to a high priority state upon receiving repeated messages and ensures that execution of action is timely

Another pattern observed is how the emergency index and the homecare index cells transition to a high priority state when the message for help is received repeatedly. This is done in order to prompt the homecare index cell that the situation of patient is critical and the patient must be attended immediately.
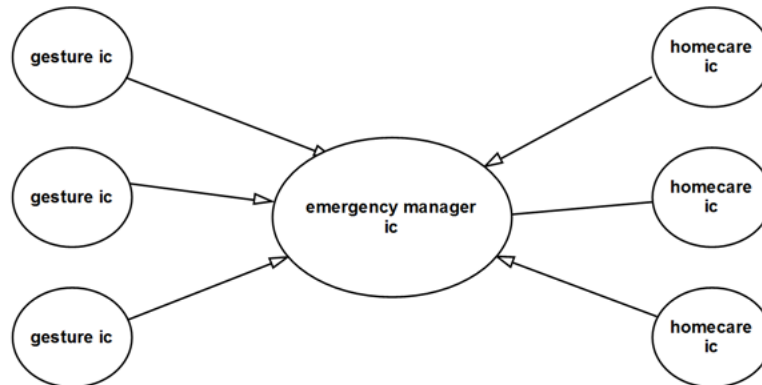
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e.) A visual specification of the identified pattern(s) should be included, using for example visual grammar rules. Remember Alexander's dictum: "If you can't draw a picture of it, it isn't a pattern.")

Pattern 1: Waiting for Signal
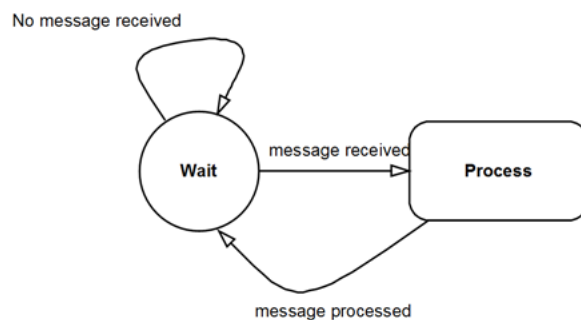
Pattern 2 : Centralized Manager Between Agents

Pattern 3 : Time Critical Execution