CS2310 Exercise 2:

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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.
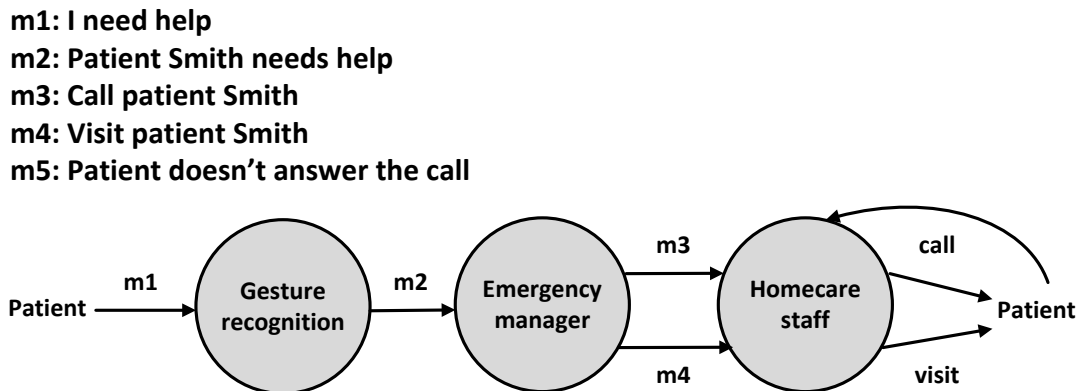
Data flow diagram

m1: I need help
m2: Patient Smith needs help
m3: Call patient Smith
m4: Visit patient Smith
m5: Patient doesn't answer the call

Figure 1. Data flow diagram

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

Gesture recognition index cell

Gesture recognition index cell

m1: "I need help!"
m2: "Patient Smith needs help"
a1: send m2 to the emergency manager cell
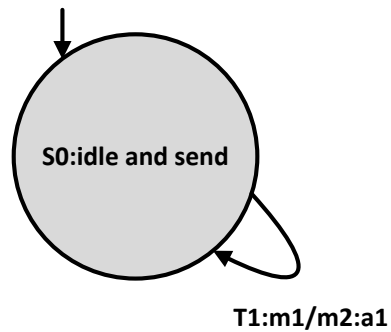
S0:idle and send

T1:m1/m2:a1

Figure 2. Gesture recognition state-transition diagram

Emergency manager index cell

Emergency manager index cell

m2: "Patient Smith needs help"
m3: "Call patient Smith"
m4: "Visit patient Smith"
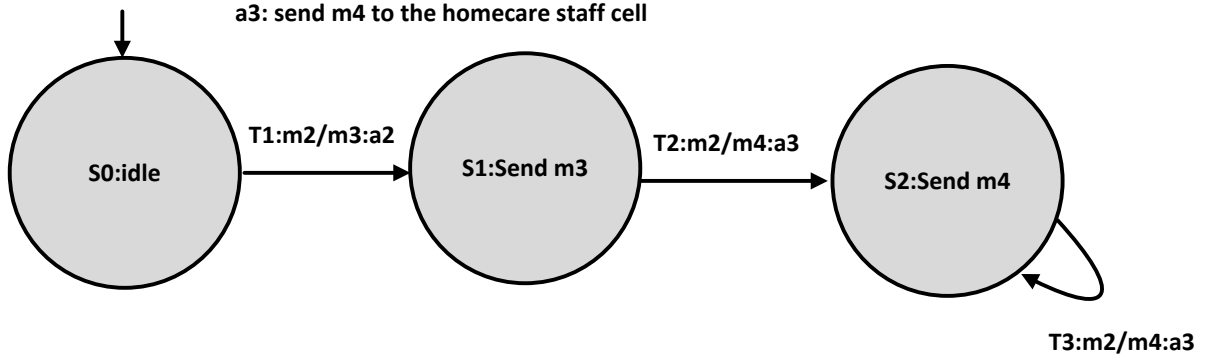**a2: send m3 to the homecare staff cell**
a3: send m4 to the homecare staff cell

S0:idle → **T1:m2/m3:a2** → **S1:Send m3** → **T2:m2/m4:a3** → **S2:Send m4**

T3:m2/m4:a3

Figure 3. Emergency manager state-transition diagram

Homecare staff index cell

Homecare staff index cell

m3: "Call patient Smith"
m4: "Visit patient Smith"
m0: null
m5: "Patient Smith doesn't answer"
a4: give patient Smith a call
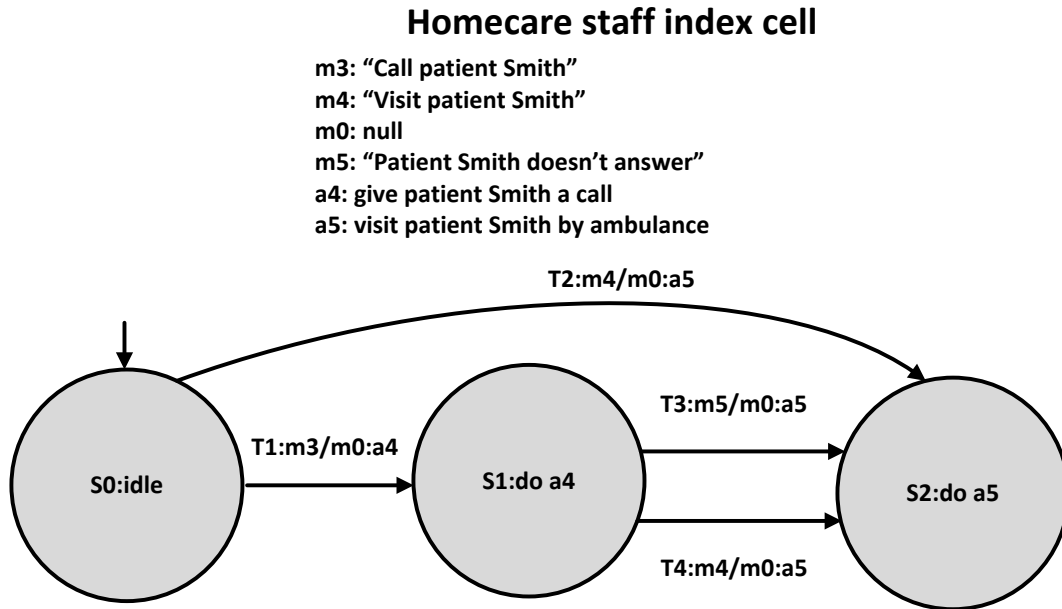a5: visit patient Smith by ambulance

Figure 4. Homecare staff state-transition diagram

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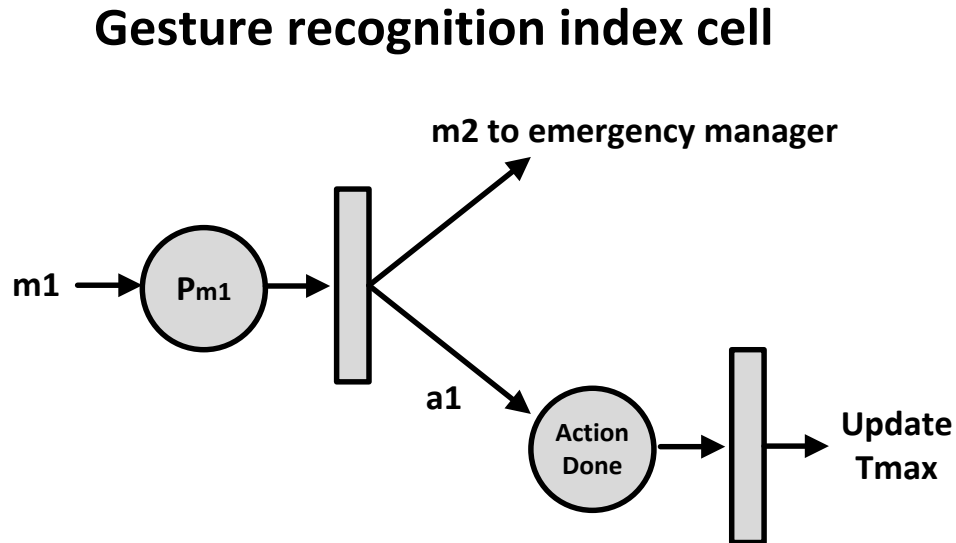
Gesture recognition index cell

Gesture recognition index cell

Figure 5. Gesture recognition petri-net diagram

X = {m1}; Y = {m2}; S = {s0 (see figure 2)}; s0 = s0; A = {a1}; f, g see figure 5

Emergency manager index cell

Emergency manager index cell

m3 to homecare staff

m2 → P_{m2} a2   **Action Done**   **Update Tmax**

a3

m4 to homecare staff

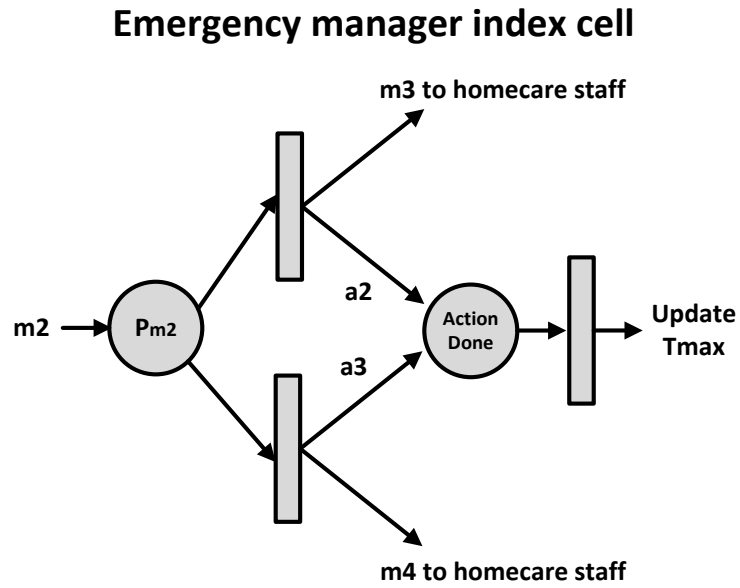**Figure 6. Emergency manager petri-net diagram**

X = {m2}; Y = {m3, m4}; S = {s0, s1, s2 (see figure 3)}; s0 = s0; A = {a2, a3}; f, g see figure 6

Homecare staff index cell

Emergency manager index cell

m0

m3 → P_{m3}

a4   **Action Done**   **Update Tmax**

m4 → P_{m4} a5

m5 → P_{m5}

m0

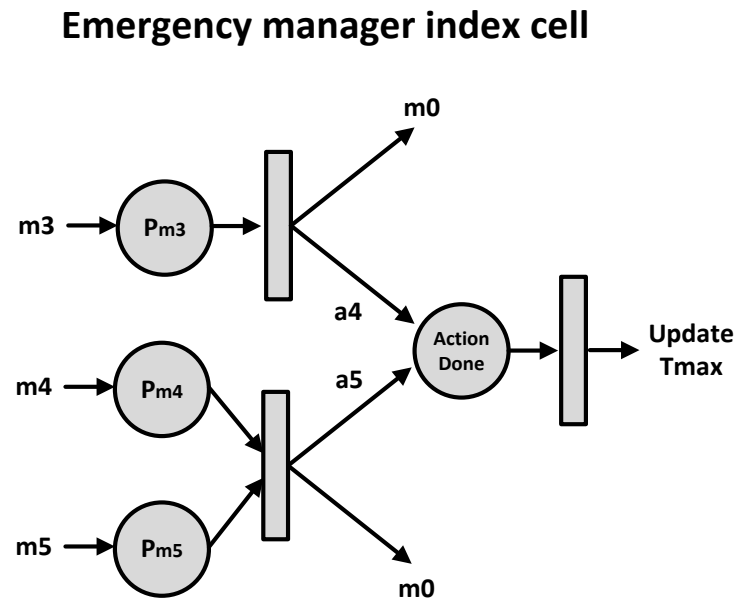**Figure 7. Homecare staff petri-net diagram**

X = {m3, m4, m5}; Y = {m0}; S = {s0, s1, s2 (see figure 4)}; s0 = s0; A = {a4, a5}; f, g see figure 7

(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.
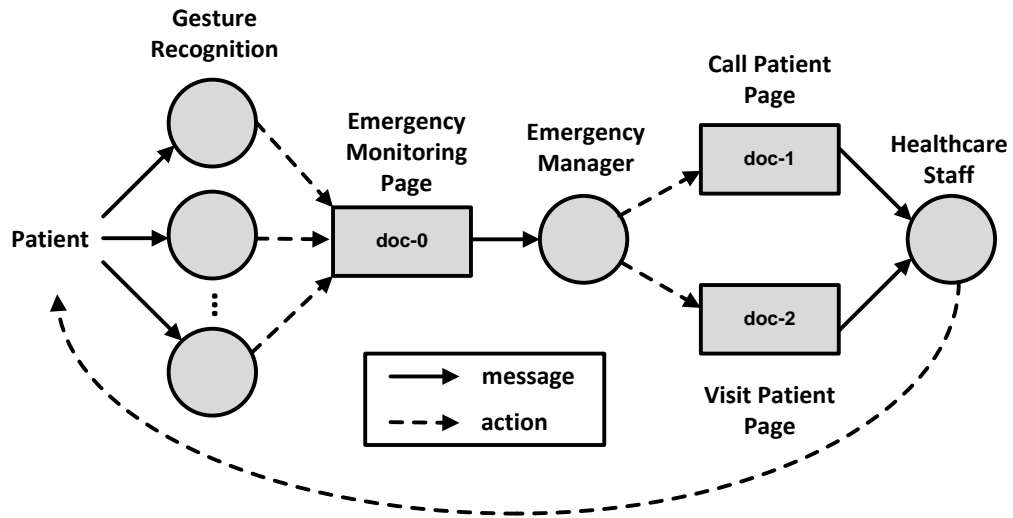

Figure 8. Overview of communication between Gesture Recognition, Emergency Manager and Healthcare Staff
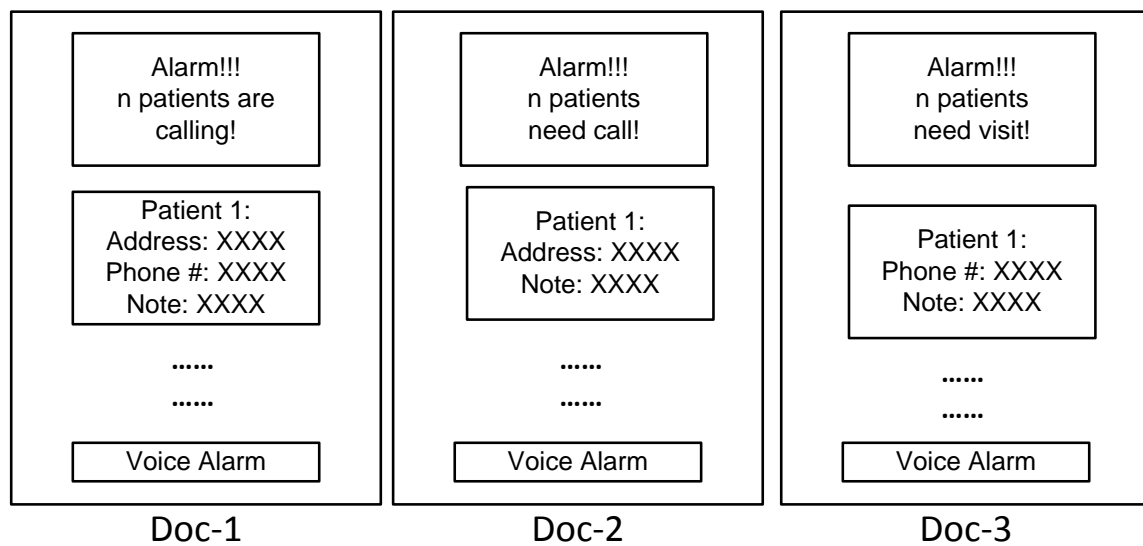

Figure 8. Details of 3 docs

(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

GestureRecogniton(P, X, S)
Problem: recognize a gesture
Context: recognizing a gesture is for patient to send a message to emergency manager
Solution: recognize a gesture and send "I need help" to emergency manager

Emergency Monitoring

EmergencyMonitoring(P, X, S)
Problem: monitor emergency situations
Context: monitoring emergency is for sending visit or call patients message to homecare staff
Solution: receive "I need help" and send "visit or call patients" to homecare staff based on the number of "I need help"

Homecare processing

HomecareProcessing(P, X, S)
Problem: conduct a homecare to a patient
Context: homecare processing is for rescuing patients' life
Solution: receive "visit or call patients" and visit or call patients

(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.")

G=(N,X,OP,s,R)
where N is the set of nonterminals, X is the set of terminals (icons), OP is the set of spatial relational operators, s is the start symbol, and R is the set of production rules whose right side must be an expression involving relational operators.
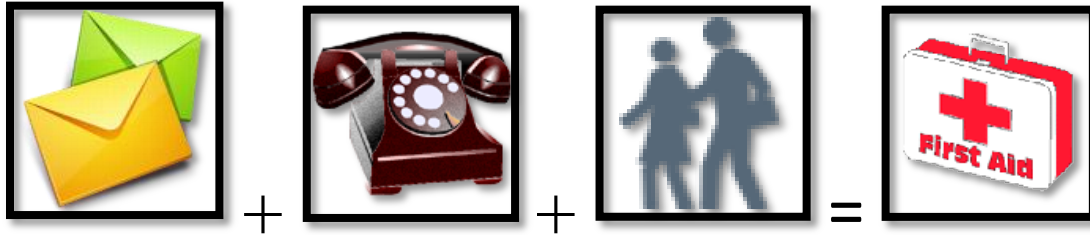
Gesture recognition

Recognizing gestures + Sending help = Gesture recognition

N is all circles and bars in the figure 5. X is the bar after Action done circle. Op is all connections in the figure 5. S is Pm1. R can be derived in the figure 5.

Emergency Monitoring

Receiving help message + Sending call message + Sending visit message = Emergency monitoring

N is all circles and bars in the figure 6. X is the bar after Action done circle. Op is all connections in the figure 6. S is Pm2. R can be derived in the figure 6.

Homecare processing

Calling patients+ Visiting patients = Homecare processing

N is all circles and bars in the figure 7. X is the bar after Action done circle. Op is all connections in the figure 7. S is Pm3. R can be derived in the figure 7.