

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.

- (a) Draw state-transition diagrams to define graphically the three index cell types. (You may optionally use a tool to draw the state transition diagram.)

1. **Gesture recognition index cell**

From the description we can know that gesture recognition index cell only has one state, each time it detects a gesture of the patient, it will send a message to emergency manager index cell and than remains the same state. So it is stateless.

m1: "I need help"

m2: "Patient Smith needs help"

a1: send m2 to emergency manager index cell

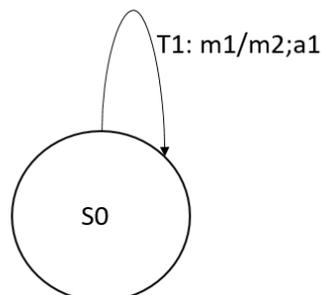


Figure 1. State-transition diagram of gesture recognition index cell

2. Emergency manager index cell

From the description, we can know that the emergency manager index cell can count the number messages that gesture recognition index cell sends. It can send two different messages to homecare staff index cell. So it should have three states.

m0: null message

m2: "Patient Smith needs help"

m3: "Call patient Smith"

m4: "Time out"

m5: "Visit patient Smith"

a0: no action

a2: send m3 to homecare staff index cell

a3: send m5 to homecare staff index cell

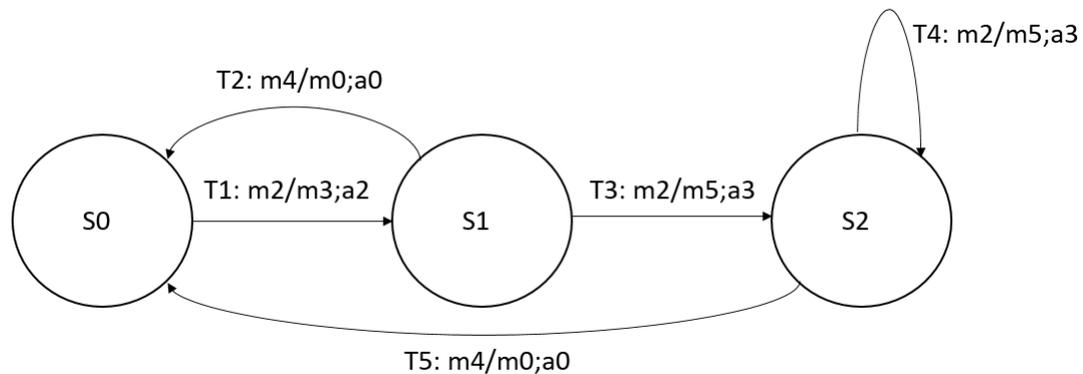


Figure 2. State-transition diagram of emergency manager index cell

3. Homecare staff index cell

From the description, we can know that the homecare staff do two actions. So it should have three states.

m0: null message

m3: "Call patient Smith"

m4: "Time out"

m5: "Visit patient Smith"

m6: "Patient Smith doesn't respond"

a0: no action

a4: call patient Smith

a5: jump into the ambulance and drive to Mr. Smith's home.

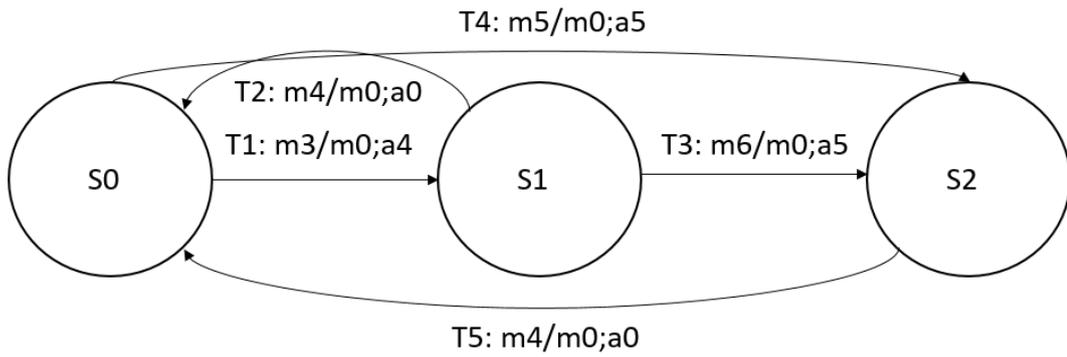


Figure 3. State-transition diagram of homecare staff index cell

(b) Specify the three index cell types formally using mathematical notations $ic = (X, Y, S, s_0, A, t_{max}, f, g)$.

1. **Gesture recognition index cell**

$X = \{m1\}$

$Y = \{m2\}$

$S = \{s0\}$

$s0 = s0$

$A = \{a1\}$

$f: f(m1, s0) = 1; \text{ other} = 0$

$g: g(m1, s0) = (\text{emergency manager index cell}, m2, s0, a1)$

2. **Emergency manager index cell**

$X = \{m2, m4\}$

$Y = \{m0, m3, m5\}$

$S = \{s0, s1, s2\}$

$s0 = s0$

$A = \{a0, a2, a3\}$

$f: f(m2, s0) = 1; f(\{m2, m4\}, s1) = 1; f(\{m2, m4\}, s2) = 1; \text{ other} = 0$

$g: g(m2, s0) = (\text{homecare staff index cell}, m3, s1, a2);$

$g(m2, s1) = (\text{homecare staff index cell}, m5, s2, a3);$

$g(m4, s1) = (\text{nil}, m0, s0, a0);$

$g(m2, s2) = (\text{homecare staff index cell}, m5, s2, a3);$

$g(m4, s2) = (\text{nil}, m0, s0, a0);$

3. Homecare staff index cell

$X = \{m3, m4, m5, m6\}$

$Y = \{m0\}$

$S = \{s0, s1, s2\}$

$s0 = s0$

$A = \{a0, a4, a5\}$

$f: f(\{m3, m5\}, s0) = 1; f(\{m4, m6\}, s1) = 1; f(m4, s2) = 1; \text{other} = 0;$

$g: g(m3, s0) = (\text{nil}, m0, s1, a4); g(m5, s0) = (\text{nil}, m0, s2, a5); g(m4, s1) = (\text{nil}, m0, s0, a0);$

$g(m6, s1) = (\text{nil}, m0, s2, a5); g(m4, s2) = (\text{nil}, m0, s0, a0)$

- (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.

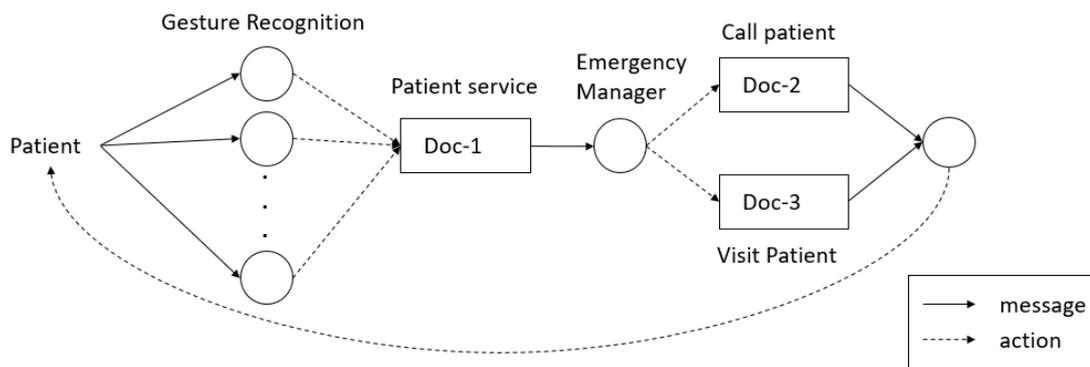


Figure 4. Diagram for active index system

Doc-1: The content should be the patient's name, phone number, address, medical record and so on.

Doc-2: The content should be the patient's name, phone number.

Doc-3: The content should be the patient's name, address.

- (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.

1. Gesture recognition

Sometime some information is needed, but it cannot be directly gotten. It has to converted to another type of message first.

Problem: The patient can't use computer, but hospital need information from him.

Context: The patient can gesture to show what he want

Solution: Use gesture recognition machine to convert gesture to literal message.

2. Recognize the level of help is needed 1

The input from gesture recognition machine is simple, but different information is needed to identify the level of help is needed by the patient. So, the amount of input will be used to differ the different level.

Problem: Different level of help should be differ.

Context: The emergency manager can count the number of message from gesture recognition machine.

Solution: Define one message stands for low level help is needed. Two or more continuous messages stands for high level help is needed.

3. Recognize the level of help is needed 2

The condition of patient may change when time goes by. The homecare staff cannot get a up-to-date message in time. He needs a way to double check the condition the patient.

Problem: The homecare staff needs a way to double check the condition the patient.

Context: The homecare staff will call the patient.

Solution: If the patient doesn't answer the call, the emergency level will change from low to high.

(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 is what a compiler uses to generate sentences: ^[1]

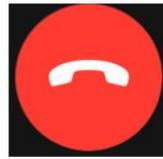
$G = (N, X, OP, s, R)$ where N is the set of nonterminals, X is the set of terminals (icons), OP is the set of spatial relational operators, s is the start symbol, and R is the set of production rules whose right side must be an expression involving relational operators.

Nonterminals is listed as following: ^[2]

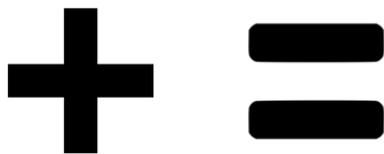


From left to right, they are Help the patient, Visit the patient, Call the patient, Communicate with patient.

The followings terminals will be described in the production rule R: ^[2]



Relational operators will include '+' plus and '=' equal to represent combination of icons and result of combination. The way to represent them is listed as follow:^[2]



Visual specification of the identified patterns

1. Gesture recognition



It means the if a gesture is detected by the camera, it will be converted to a help message.

2. Recognize the level of help is needed 1

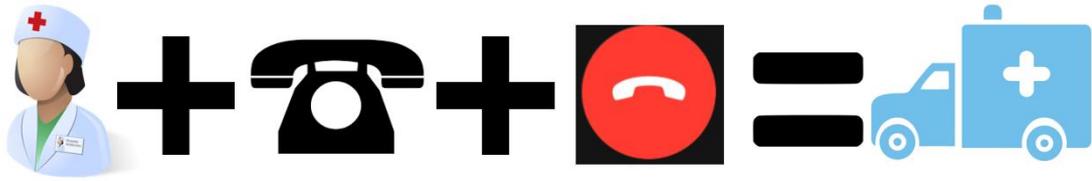


It means if a help message is detected by the emergency manager, he will send a 'call the patient' message.

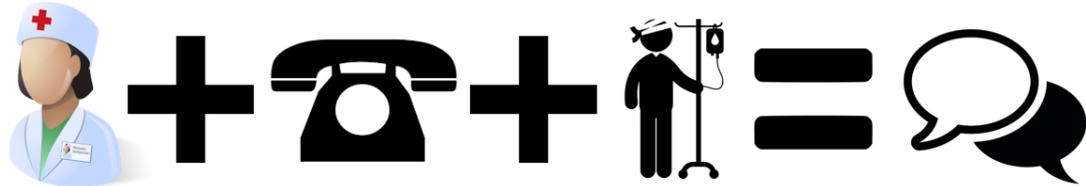


It means if two help message is detected by the emergency manager, he will send a 'visit the patient' message.

3. Recognize the level of help is needed 2



It means if the patient doesn't reply to the phone which is called by the homecare staff, the homecare staff will visit the patient.



It means if the patient reply to the phone which called by the homecare staff, the homecare staff will communicate with the patient and ask him about his health condition.

Reference:

[1] Shi-Kuo Chang, Multimedia software engineering: 39

[2] <http://image.baidu.com/>.