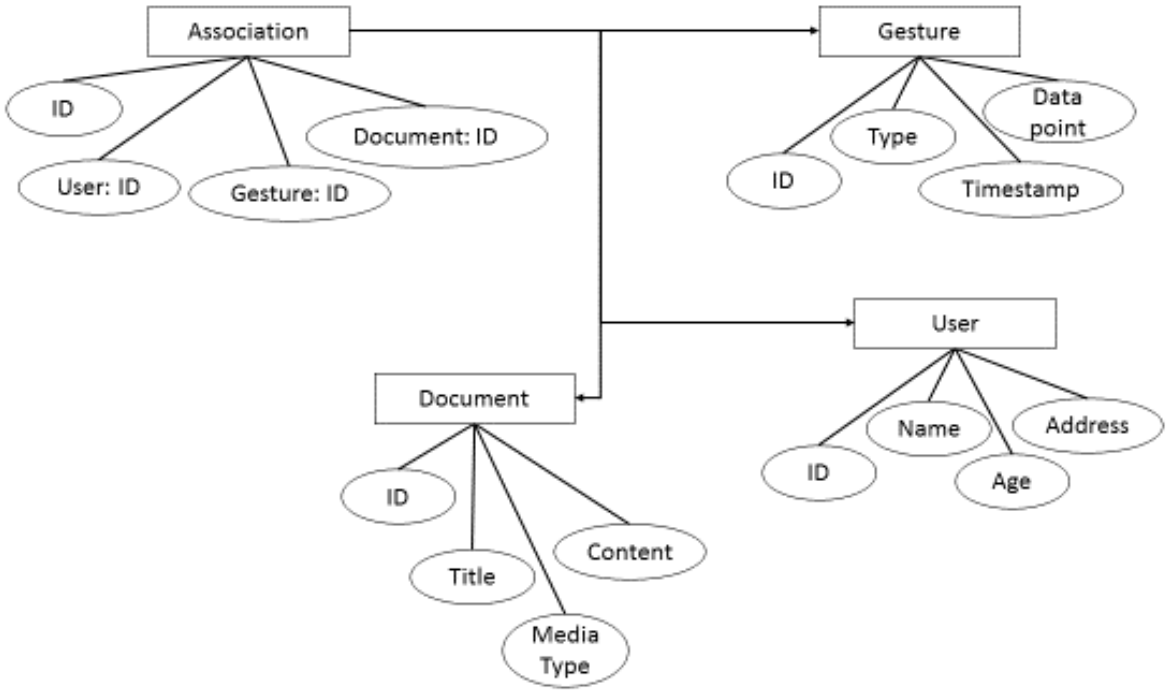
CS2310 – Exercise 4 (Fall 2014)

Name: Nikolaos Romanos Katsipoulakis

Exercise Description:

The purpose of this exercise is to apply multimedia functional dependency to multimedia applications design. Given an application (its requirements), design the multimedia database using multimedia functional dependency theory. Then specify the patterns (IC cards) associated with the multimedia database. The application is the personal health care system that allows the user (a senior citizen) to access related multimedia documents using gestures. A new classification scheme based upon the gestures associated with the multimedia documents is to be introduced. This would allow users to search for multimedia documents similar to a known audio search key (such as the voice of a certain author). Your task is to design the multimedia database and associate patterns (IC cards), which can in turn be transformed into IC index and finally an implementation.

Exercise Solution:



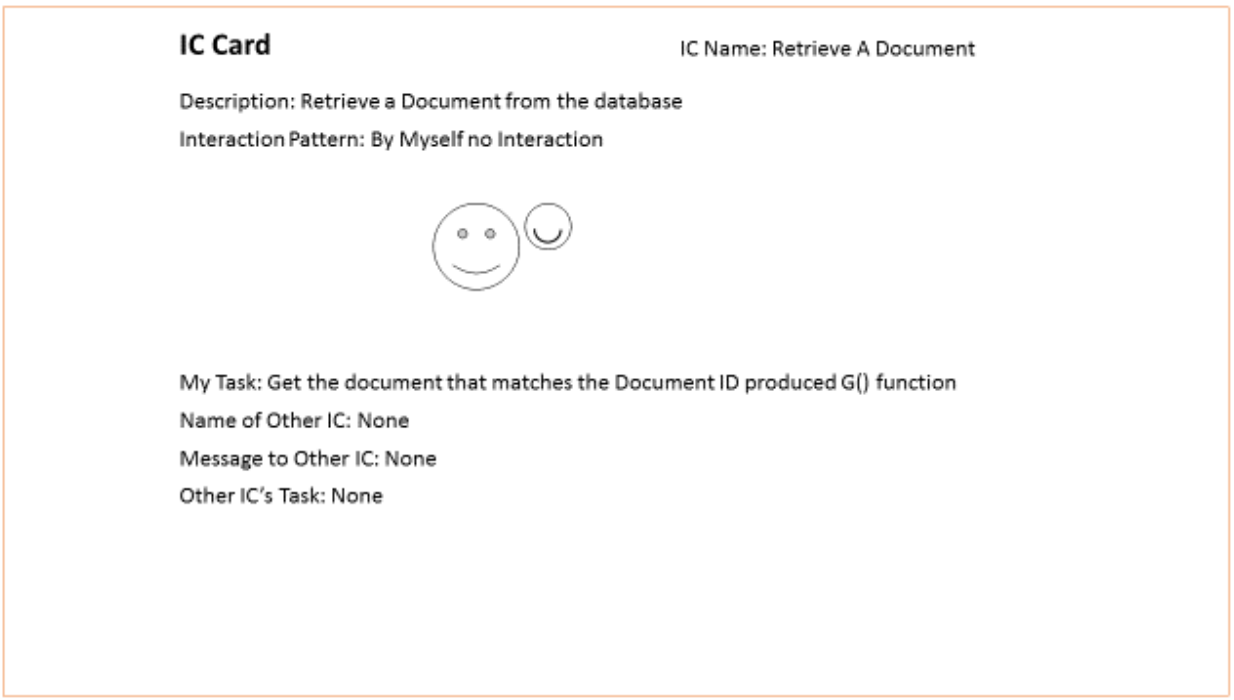
As can be seen from the above diagram, the Association relation works as a connection between the other three relations. In more detail, the relation User keeps track of the users of the Healthcare Center, which have access to the multimedia database. The Document relation maintains the multimedia content of the documents available in the database. Each document has an id (primary key), a title, for summarizing contents of a multimedia file, the document media type (i.e. jpeg, mp3, avi, etc), and the content stored in a binary form. Finally, the Gesture relation keeps track of the users' gestures. Each gesture belongs to a specific category and is related with a timestamp and a data point which is a vector representing the hand movement of the user. All of the aforementioned data types come in agreement with SQL:11 standards and can be supported by many Database Management Systems.

The functional dependency among these tables can be modeled with the use of two functions:

- F(Gesture.Datapoint, User.ID) -> Gesture.Type
- G(Gesture.type) -> Document.ID

The F function associates a user's id and gesture to a specific gesture type. It has a dual role: check the credentials of the user, and perform a similarity metric in order to translate a gesture to a type. This functionality is handled by software that supports gesture recognition (with visual sensors), and a Pattern Recognition library for calculating similarity metrics. In addition, the G function will receive a Gesture Type and will return a Document ID. The G function can be implemented with many ways and an efficient way would be through a DBMS's PL/SQL interface (as a UDF for instance). All of the previously mentioned information is guarded by the Association relation. Now, I am going to present the IC Cards related to the multimedia functional dependencies stated above.

IC Cards:



The first card represents the Retrieval of a document action. It is the top-level IC card that pictures the interaction of a user with the system.

IC Card IC Name: Add user to datatabase

Description: Add a new user to the Healthcare System database

Interaction Pattern: By Myself no Interaction

My Task: Create a new record for the new user and populate the Gesture relation with the user gestures

Name of Other IC: None

Message to Other IC: None

Other IC's Task: None

The card "Add user to database" deals with the registration of each user to the system. Each user needs to perform this interaction at most once and before populating the database with his/her information.

IC Card IC Name: Update a gesture

Description: Update a user's gesture

Interaction Pattern: By Myself no Interaction

My Task: Update a user's gesture in the Gesture relation

Name of Other IC: None

Message to Other IC: None

Other IC's Task: None

After a user has created a user record with his/her data, he/she has to perform some sample gestures to populate the system. This way, the database will keep records of the users actions and whenever a "retrieval" is initiated, functions F and G will be able to compare the parsed gesture with the stored gestures to determine the document ID.

IC Card IC Name: Recognize gesture

Description: Associate a gesture with a document and a user

Interaction Pattern: By Myself with Interaction

My Task: Associate a document ID with a user ID and a gesture ID using the functions F and G

Name of Other IC: Retrieve a Document

Message to Other IC: Retrieve Document with the provided Document ID

Other IC's Task: Retrieve Document

The "Recognize gesture card is essential for representing the execution of the F function, which determines the gesture performed by the user. We can see that there is an interaction with the "Retrieve a Document" IC card, since the execution of the gesture recognition will trigger a document retrieval.