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Scenarios Engineering for Building an Interactive System of Quranic Recitation

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Abstract
The use of the holy Quran is very frequent either for reading, for memorization or for the search of a verse of Quran dealing with a particular subject. Quran memorization and learning are among the best ways of worship that close to Almighty God because of their numerous benefits as stated in the Quran and Sunnah. Today, despite the existence of modern information techniques to memorize, learn and understand we find that Muslims find difficulties in the recite and memorize of this book. For this, and to help Muslims, we focus our work on the problem of building an Interactive System of Quranic Recitation (IS-QR). In this paper we present an approach to use scenarios engineering of UML framework for modeling (IS-QR) that can be used to follow the reader to correct his pronunciation and to measure his memorization. We offer a new methodology for building and developing an interactive system containing two activities: use case and scenarios acquisition and scenarios composition. The system proposed can help in better expressing interaction between use cases, sequence diagrams and messages using one kind of diagram for a computing environment for self-learning of the holy Quran. The research project is at its preliminary stage for the design, architecture and development of a prototype "Interactive System for Automatic Corrector of Quranic Recitation".

Keywords: Interactive system, Quranic recitation, UML Scenarios, Scenarios composition

1. Introduction

The Holy Quran (HQ) is universally accepted by Muslims to be the infallible Word of God as first revealed by the Angel Gabriel more than fourteen hundred years ago. It provides the rules of conduct that remain fundamental to the Muslims. God put in the Quran everything, Provisions and laws, Proverbs and wisdom, Homilies and history, the stories and the system of the universe. There are millions of Muslims all over the world who love to recite and hear the recitation of most recited book of the world, the Holy Quran. In all times, Quran memorization and learning are among the best ways of worship that close to Almighty God because of their numerous benefits as stated in the Quran and Sunnah (Mohamed et al. 2013).

Nowadays we are living the era of information. Thousands of resources are just one mouse-click away, and it is not just written material, but also it is audio and video materials. There is a huge wealth of multimedia resources related to the sciences of the Holy Quran. Some of these resources are for the "Tafseer" of the HQ, some of them are for teaching the provisions

of its recitation, some of them are telling the stories of the HQ, and some are revealing the miracles of HQ (Elhadj et al. 2010, Elhaj et al. 2012, Samir et al. 2007). The main drawback of these approaches is that there is no interactive model for the Quranic recitation. In interactive systems, the user generally launches many tasks concurrently. He or she interacts these tasks alternatively with the user interface. So we need a formal technique that specifies well this conceptual concurrency. The need for formal techniques for analyzing systems is widely acknowledged, a large range of existing formalisms being in use for specifying systems. In modeling interactive systems visual formalisms are needed to reduce the gap between users and analysts.

Nowadays, UML is the most successful model-based approach to the supporting software development, the facto standard for representing different aspects of software structure and behavior, and the model that provides a suitable framework for scenario acquisition using use case diagrams and sequence diagrams for building an interactive system. However, during the evolution of UML (use cases and scenarios engineering) little attention has been paid to supporting user interface design and development interactive systems (Elkoutbi et al. 2006; Paterno, 2001).

Use case (Jacobson. 2004) and sequence diagrams are key UML artifacts for modeling the behavior of software (OMG, 2003; Sharp & Rountev, 2005). The diagrams encode the flow of control during object interactions, for the purposes of software design, documentation, comprehension, and validation (Sharp & Rountev, 2005). UML propose a suitable model for scenarios acquisition using use case diagram for capturing system functionalities and sequence diagrams for describing scenarios. It is an expressive language that can be used for problem conceptualization, software system specification as well as implementation (Jakimi & Elkoutbi, 2009).

In the present study, an effort has been made to find methods to automatically recite the Holy Quran. The main objective of this paper is to use fingerprinting technique to identify the reciter, the Aya and the Soura of the Holy Quran. The rest of this paper is organized as follows: Section 2 of this paper gives a brief overview of the UML scenarios and relevant to our work. In section 3 we discuss the technical details of the approach. Finally, some concluding remarks and indications for further work are presented.

2. UML scenarios

Over the past years, scenarios have received significant attention and have been used for different purposes such as understanding requirements, human computer interaction analysis, specification generation, and object-oriented analysis and design. A typical process for requirements engineering based on scenarios (Hsia et al. 1994) has two main tasks. The first task consists of generating from scenarios specifications that describe system behavior. The second task concerns scenario validation with end users by simulation and prototyping. These tasks remain tedious activities as long as automated tools do not support them. Scenarios have been evolved according to several aspects, and their interpretation seems to depend on the context of use and the way in which they were acquired or generated. In a survey, Rolland (Rolland et al. 1998) proposed a framework for the classification of scenarios according to four aspects: the form, contents, the goal and the cycle of development.

The “form” view deals with the expression mode of a scenario. Are scenarios formally or informally described, in a static, animated or interactive form? The “contents” view concerns the kind of knowledge which is expressed in a scenario. Scenarios can, for instance, focus on

the description of the system functionality or they can describe a broader view in which the functionality is embedded into a larger business process with various stakeholders and resources bound to it. The "purpose" view is used to capture the role that a scenario is aiming to play in the requirements engineering process. Describing the functionality of a system, exploring design alternatives or explaining drawbacks or inefficiencies of a system are examples of roles that can be assigned to a scenario. The "lifecycle" view considers scenarios as artefacts existing and evolving in time through the execution of operations during the requirements engineering process. Creation, refinement or deletion are examples of such operations.

The one reason that scenarios have become so popular in interactive system design is that they enable rapid communication about usage possibilities and concerns among many different stakeholders. Scenarios are used for various purposes in interactive systems design. Scenarios describe partial views of the system (Jakimi et al., 2013; Elkoutbi et al., 2006). To obtain a global view, we need to define an approach to merge or to compose these partial views (Jakimi et al., 2010; Elkoutbi et al., 2006).

Scenarios and use cases have been used interchangeably in several works meaning partial descriptions. UML (OMG, 2003) distinguishes between these terms and gives them a more precise definition. A use case is a generic description of an entire transaction involving several objects of the system. A use case diagram is more concerned with the interaction between the system and actors (objects outside the system that interact directly with it). It presents a collection of use cases and their corresponding external actors. A scenario shows a particular series of interactions among objects in a single execution of a use case of a system (execution instance of a use case). A scenario is defined as an instance of a given use case. Scenarios can be viewed in two different ways through sequence diagrams or communication diagrams.

3. Approach overview

Scenarios are a well-known technique in modeling often used to improve understanding of an interactive application. Furthermore, scenarios engineering are one of techniques mostly used in this approach. They are used in object-oriented methodologies as an approach to requirements engineering. In this section, we give an overview of the iterative process that derives a formal specification for the interactive system from use cases and UML scenarios. Figure 1 presents the sequence of activities involved in the proposed process.

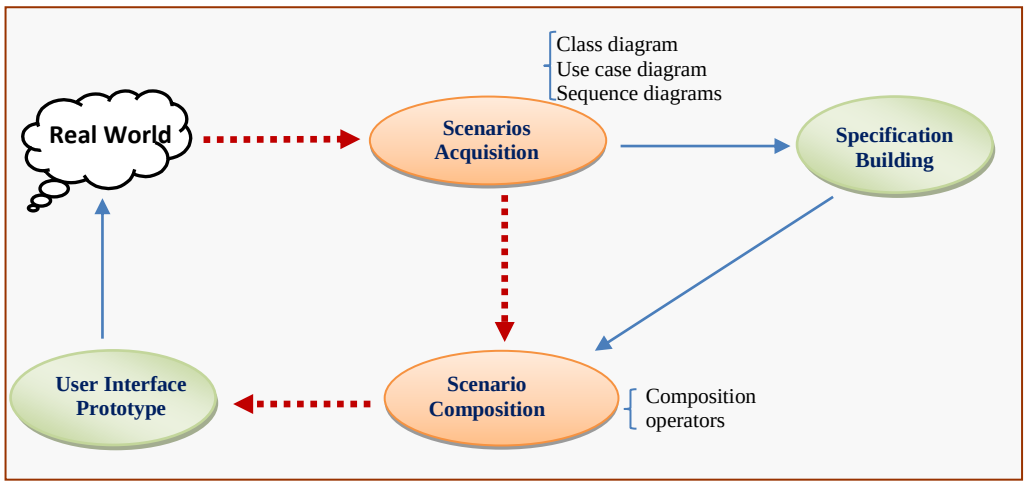

Figure 1: Overview of the approach

In the "Scenario Acquisition" activity, the analyst elaborates the class diagram and use case diagram; for each use case, he or she elaborates several sequence diagrams corresponding to the scenarios of the use case at hand. The "Specification Building" activity consists of deriving Graphs, State charts or Petri Nets (G,S,PN) from the acquired use case diagram and sequence diagrams. During "Scenario composition", we have two steps: the first step is to consider the composition operators (sequential, concurrent, iteration and conditional operator) to compose a set of scenarios that describe a use case of a given system. Our developed algorithms can automatically produce a global sequence diagrams representing any way of composing scenarios. The second step is to build the (G,S,PN) corresponding to the same use case. In this paper, we consider the first step. In the following subsections, we will discuss, for an IS-QR in detail the two activities of the process: scenario acquisition and scenarios composition.

3.1 Scenario acquisition

In this activity, the analyst first elaborates the class diagram of the system and for each class of the class diagram, a detailed analysis is done to identify attributes and methods and to define pre- and post-conditions. The class diagram represents the static structure of the system. It identifies all the classes for a proposed system and specifies for each class its attributes, operations, and relationships to other classes. Relationships include inheritance, association, and aggregation. The class diagram is the central diagram of a UML model. Secondly, the analyst elaborates the use case diagram for the system (see Figure 2). The use case diagram is concerned with the interaction between the system and actors (objects outside the system that interact directly with it). It presents a collection of use cases together with their corresponding actors. A use case is a generic description of an entire transaction involving several objects of the system.

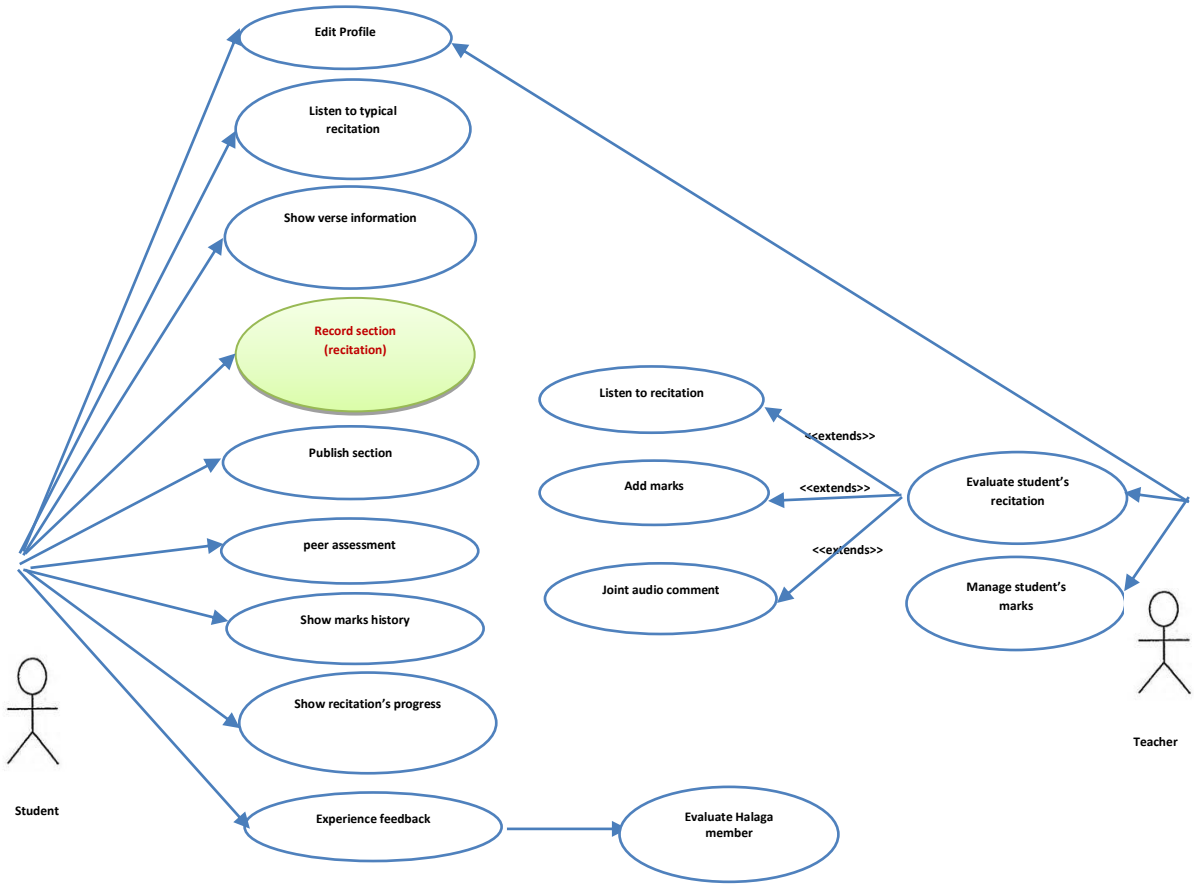

Figure 2: Use case diagram of the IS-QR

There are many interesting use cases that worth to talk about in this paper such as "correct section", "peer assessment" or "listen to typical recitation", but we judged, for the sake of simplicity, that we choose only the most important one, namely "Record Section (Recitation)". This service (use case) enables the student to record his own recitation. Finally, the analyst acquires scenarios as sequence diagrams for each use case in the use case diagram. Scenarios of a given use case are classified by type and ordered by the frequency of use. We have considered two types of scenarios: normal scenarios, which are executed in normal situations, and scenarios of exception executed in case of errors and abnormal situations. To obtain a global description of a given service (use case) of the system or the description of the whole system, an operation of integration or composition between use cases and/or between scenarios is needed. In this part we will present the "Record Section" use case and all its scenarios. Figure 3, shows a sample sequence diagrams (main scenario) corresponding to the use case "Recitation" of the IS-QR system.

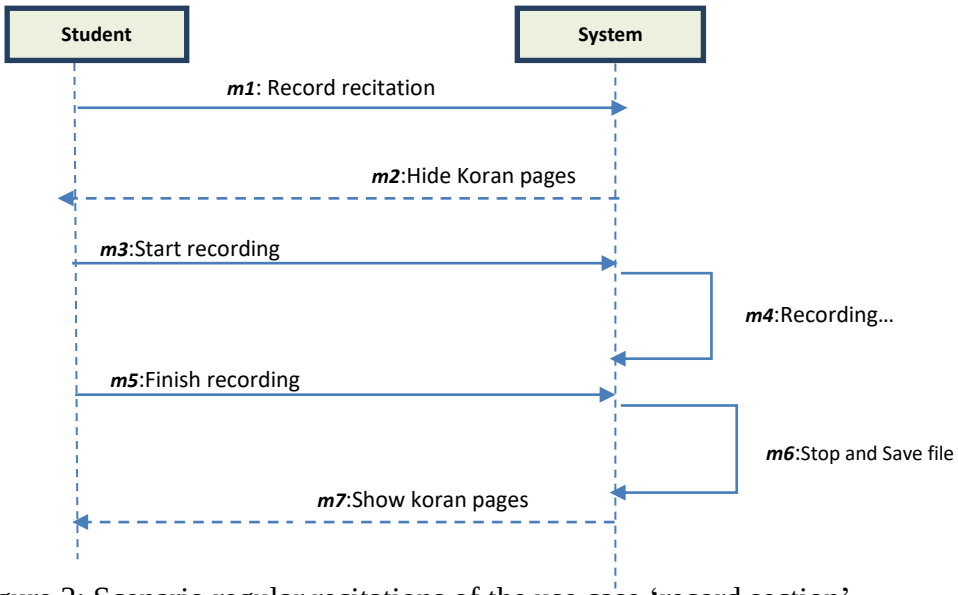

Figure 3: Scenario regular recitations of the use case 'record section'

But, for this recitation we have the possibility of six scenarios (those various scenarios will be also depicted in a sequence diagram):

- *Scenario 1*: Student didn't press finish while programmed section have been finished;
- *Scenario 2*: Student stopped reciting while system still recording (stop timeout);
- *Scenario 3*: A pause recording while reciting;
- *Scenario 4*: Student didn't repeat the last three verses;
- *Scenario 5* Student cancels recording;
- *Scenario 6*: Student's device doesn't have enough space.

3.2 Scenario composition

UML scenarios are considered as partial descriptions. To obtain a global description of a given service of the system or the description of the whole system, an operation of integration or composition is needed. The difficulty of scenarios composition comes in the fact that the scenarios are being described independently one to another. Figure 4 gives an overview of the merging algorithm based on scenarios represented in the form of sequence diagrams. In this paper, we consider composition operators (sequential, concurrent, iteration and alternative operators) to compose a set of scenarios that describe a use case of a given system.

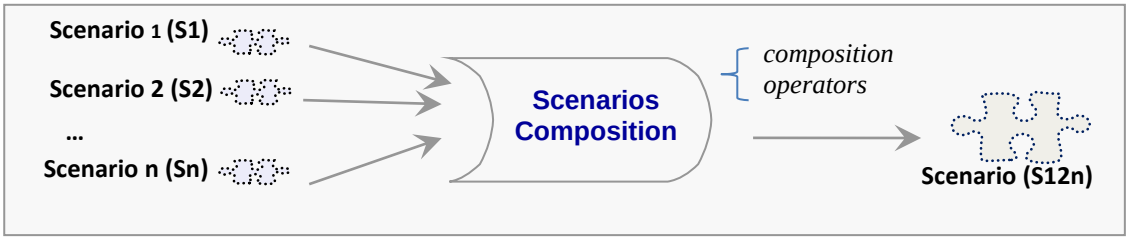

Figure 4: Composing UML Scenarios

Our developed algorithms can automatically produce a global sequence diagram representing any way of composing scenarios. Given a set of scenarios, our processes can produce any composing form of the given scenarios. Finally, Figure 5 shows a global sequence diagram for "recitation (record section)" that present a service of our interactive system of Quranic recitation.

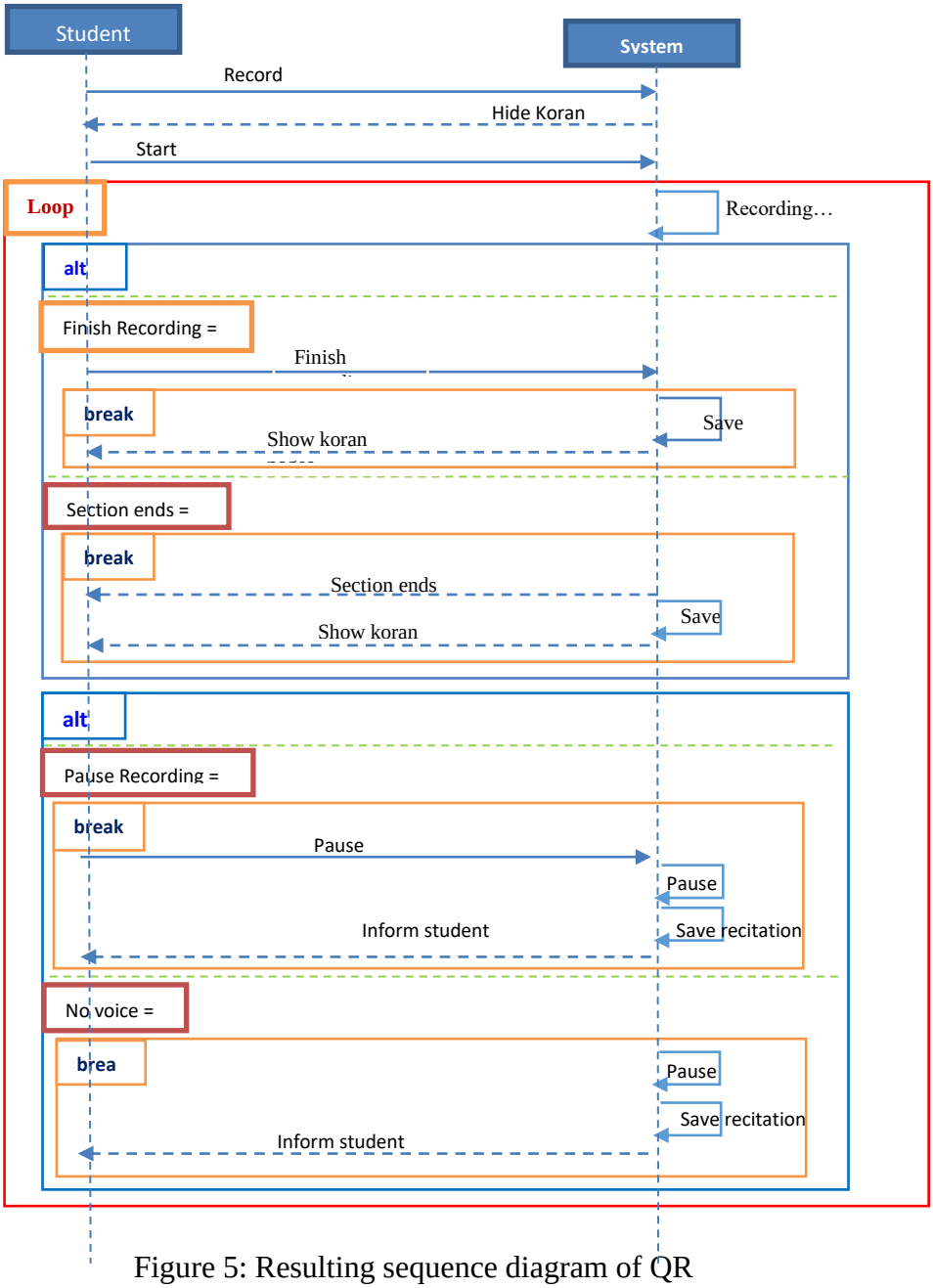

Figure 5: Resulting sequence diagram of QR

4. Conclusions

In this work, we have presented a new approach that produces automatically a global description or specification of a given service of the interactive system for Quranic recitation using scenarios engineering. This methodology proposed we permit to derive the behavior of a use case (recitation (record section)) by simply composing the scenarios describing it. The developed method permits to derive the behavior for our interactive model (IS-QR) of use case "recitation" by simply composing the scenarios describing it using composition operators (alt, loop...). As for future work, we prospect to study the possibility of producing and creating an interactive model for Tajweed rules, listening to typical recitation and automatic corrector of Quranic recitation.

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