Comparative Analysis of GUI Development for Android application by utilizing MDA Approach

Mohsin Javaid Siddiqui[1], Xintao Li[2], Isma Farah Siddiqui[3], Asad Abbas[4] and Scott Uk-Jin Lee[5*]

[1][2][3][4][5]*Department of Computer Science and Engineering, Hanyang University ERICA, Ansan, South Korea*

E-mail : [mohsinjavaid] [scottlee] @hanyang.ac.kr

*Corresponding author: Scott Uk-Jin Lee

Abstract

Mobile application development platform is playing a key role in software engineering field to enhance the potential of development by utilizing minimum resources. It is mandatory to design application within the shortest possible time by utilizing domain-specific concepts. Model-driven methods with lack of portability and low reusability were ignored. Previously used approaches utilized domain specific language concepts mostly done by domain experts, UML provides a feasible method. In this paper, we provide a comparative analysis of UML based methodologies for development of mobile application's GUI by utilizing MDA as a fundamental approach.

Keywords: Model Driven Architecture, UML, Mobile GUI

1. Introduction

The Mobile application development appears to be the most developing area in the field of Software Engineering as the number of mobile devices increases. The Model Driven Architecture (MDA) approach for developing user interface of mobile applications is fulfilling this demand to some extent [1]. This approach is challenging because it is replacing the methodologies of code-centric development and provides an efficient way to develop applications by utilizing only model-driven approach [2]. Core concepts of MDA are based upon the different levels of abstractions such as Computation Independent Model (CIM) that represents working of a system to be developed and represents business layer view of a software due to which it is sometimes referred as domain model. Platform Independent Models (PIM) have a self-sufficient ability to specify a system in general terms, mostly Unified Modeling Language (UML) models are utilized for this purpose. Platform Specific Model (PSM) is used to apply more focused approach by making the model close to exact for each platform. Transformation rules are applied to get the target model that conforms to the target metamodel from source model, also conforming to the source metamodel by applying a well-defined set of rules[3, 4]. In this paper, we have developed models for a graphical user interface for a healthcare android application and applied two different approaches to identify the better development methodology and presented their comparative analysis. In the first approach, the window navigation diagram method is adopted. This diagram is also known as interface flow diagram as it represents the transitions during interaction with the mobile screen. In the second approach, UML class and object diagrams are adopted for the development of GUI.

2. Related Work

Lachgar et. al. [5] have proposed an approach of GUI development method by Domain Specific Language for the creation of GUI. They presented the methodology for the GUI development of cross-platform mobile platforms and

web-based components. Sabraoui et. al.[6] have proposed the development of cross-platform mobile applications by the model-driven approach by utilizing UML based transformation methodology. Thanaseth et. al. [4] have proposed approach of GUI development by the windows navigation approach for mobile applications and presented methodology consists of JSON based parsing approach.

3. Development Methods for Android Graphical User Interface

3.1 GUI Development by Window Navigation Diagram

Window navigation diagram represents the transition of GUI screens. Window navigation diagram is an adoption of the state transition diagrams. The diagram is a simple block and arrow diagram which represents the transition between screens of Android GUI. A well-defined approach to the creation of Android GUI is presented in [8] and is employed with modifications in this paper for the healthcare application. The steps involved in GUI development in this paper by utilizing the modified methodology is represented in Fig. 1. The diagram is created in StarUML as shown in Fig. 2. The steps are as follows:

(1) The XML format file is defined from WND by well-defined XMI schema.
(2) The Object-oriented analysis of XMI schema leads to the creation of the conceptual model generated in JSON which is lightweight data interchange format. By utilizing conceptual model, navigation and presentation model for GUI.
(3) The navigation model is designed to represent the flow of activities occurred by utilizing each component on the mobile screen. The presentation model is created to represent the UI layout of each screen of the application. Both of these models are referred from a conceptual model of JSON.
(4) The user interface layout template is generated using XML and java for representation of actions in the interface.
(5) The given template is then parsed with the presentation and navigation model to generate source code in XML and Java files.
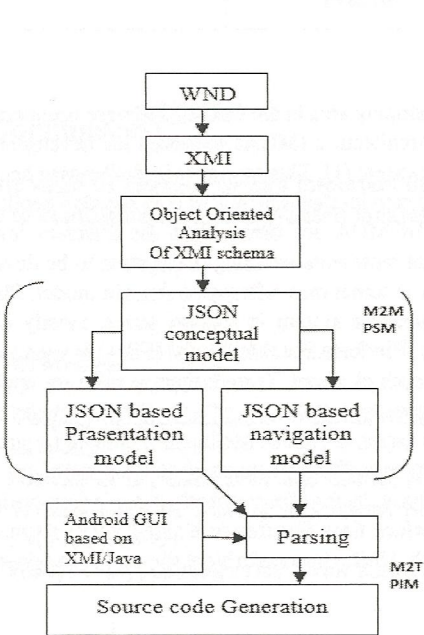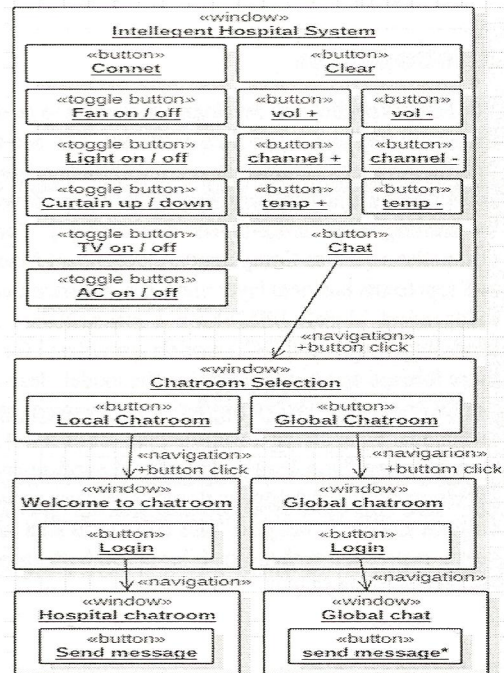

Fig. 1. WND Development Methodology

Fig. 2. Windows Navigation Diagram

3.2 GUI Development by UML Diagram

UML is playing an important role in software development for shifting the paradigm from code-centric to model-centric development. In this approach, UML object diagrams are utilized for system specification of the GUI development for mobile applications [7], as shown in Fig. 3. Following are the steps involved in this approach.

(1) The first step is to create the UML based object diagram of the Graphical user interface of application

(2) Next is the generation the XMI Schema for the object diagram for the healthcare application.

(3) JDOM API is configured in eclipse to map the first transformation to remove unnecessary complexities from the information present in the XML.

(4) In this step, the MDA approach is utilized by converting the platform independent model to the platform-specific model. This step consists of the utilization of Atlas Transformation Language for the transformation of PIM source model of the mobile application to the PSM target metamodel. After this procedure, the refined script is generated for GUI of application, that is later injected into the GUI of application.

The approaches are applied to healthcare application to compare the effectiveness of both methods. The complete view of GUI for application is represented in Fig. 4.
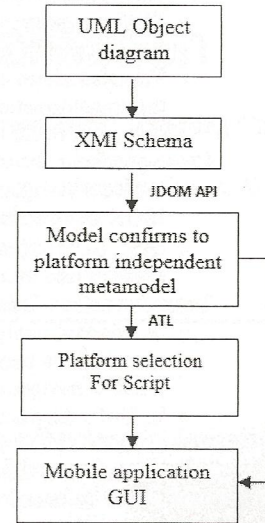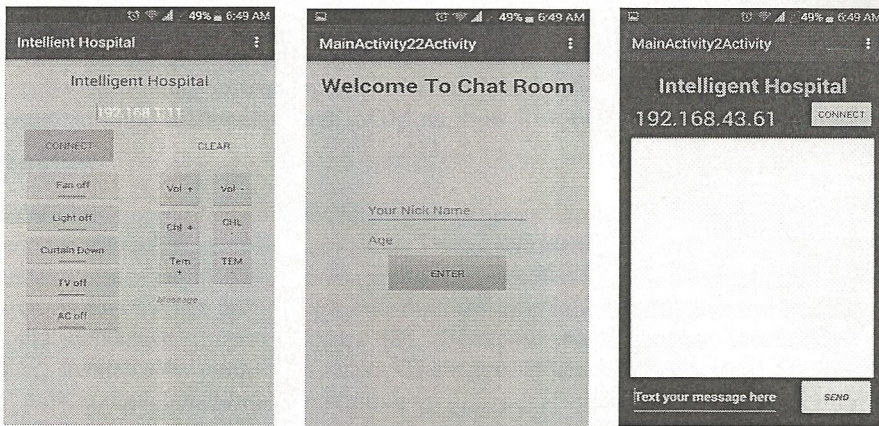

Fig. 3. GUI development methodology

Fig. 4. GUI representation of Android application

4. Comparative Analysis of GUI Development

The comparison of both development approaches is made and following are the key findings of this study.

1) **Screen Component representation:**
   - Window Navigation Diagrams are not accurate to represent each component of GUI window. It only represents those chose components which are responsible for navigation and other minor operations. Due to this lack of representation components such as edit text options are completed neglected.
   - Due to manageable ordering system of each component on window object diagram method for GUI development fulfill this gap of WND. Specific representation of each component in object diagram with the order is defined on the initial level of design.

2) **XMI Schema Generation:**
   - XMI schema transformation is responsible for the generation of XML script collectively for complete graphical user interface without a brief description of each screen specification.

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- XMI schema transformation is based on the generation of XML scripts which briefly describes the specification of each component on the screen. A detailed description component at initial phase leads to better development of GUI.

3) **Transformation Methods for XMI Schema:**
    - Platform independent model to platform-specific model transformation for WND method is done by the object-oriented analysis of XMI schema and then converted to the JSON.
    - Transformation of models is based on JDOM API mappings which are a well-defined specification for the transformation of the XMI script it leads to the fewer chances of errors for transformation as compared to the object-oriented analysis.

4) **Cross-platform development:**
    - Window navigation diagram method only supports the Android platform for the GUI development. JSON supports the Java semantics for GUI development.
    - UML class object diagram method is used to design GUI for any mobile application platform due to well-defined transformation rules in ATL.

5) **Transformation Rules.**
    - In window navigation, the transformation is based on the object-oriented analysis, due to which complexities may occur while creating a conceptual model which further leads to the ambiguities in window navigation model and presentation model.
    - In UML diagram method, the proper definition in JDOM API for first mapping and ATL rules are defined for the model transformation which reduces the chance of error occurrence and makes this method more reliable for GUI development.

5. Conclusion and Future Works

MDA provides a helping hand for automatic generation of software by providing a systematic approach to designing phase. In this paper, we compare the two different methodologies for development of graphical user interface of mobile applications by utilizing the platform independent model to the platform-specific model transformation and discussed their effectiveness based on different parameters. In the future, we will work on MDA development for other methods of android applications.

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