

# Adaptive User Interface and User Experience based Authoring Tool for Recommendation Systems

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**Abstract.** User preferences and contextual changes impact the duration of adaptation of user interface (UI) for a particular system, specifically recommendation systems. Static UIs lack reflection of these behavioral changes which lead to bottleneck in the fulfillment of user needs and satisfaction. Therefore, a mechanism to incorporate User Experience (UX) for embedded customization in the UI is required for longer adaptation of the system. We propose an Adaptive UI / UX Authoring Tool that adapts the UI with the help of the information extracted from the UX. UI is provided to the user in recommendation systems based on personal profile and contextual information. Continuous involvement of the user using feedback, web monitoring and gamification to measure his satisfaction and evolution of the personal and contextual information, adapts the UI with the help of UX. UX controls the evolutionary process of the adaptation of the user interfaces and also maintains the personalization aspect. The proposed system guarantees the longer duration of utilization of the services provided by the recommendation systems due to provision of personalized UI.

**Keywords:** Human Computer Interaction, Adaptive Interface, Personalized UI, User Experience, User Profile Evaluation

## 1 Introduction

The key to the success of recommendation systems lies in the functionalities provided in the user interface (UI). The functionalities are reflected by the user needs and contextual information representation in the UI. Even the user needs and contextual information changes with time, therefore the static behavior of the UI results in failure of these recommendation systems. Alexander et al. [1] describe the role of UI in recommendation system as a critical factor in effecting the characteristics such as overall system usability, system acceptance, item rating behavior, selection behavior, trust, willingness to buy, willingness to reuse the recommendation systems, and willingness to

promote the system to others [1]. These factors perseverance requires the involvement of the user in defining the layout of UI with User Experience (UX).

UX determines the lifeline of the UI by extracting the metrics based on the user involvement in the system to measure user satisfaction. Most of the researchers considers UI and UX as same entities but there exists huge difference between them, although they are related to one another. UX metrics define the patterns of interaction between user and the system to measure the effectiveness, efficiency, and satisfaction of the users [2]. This leads to the evolution of behavioral and contextual information in the knowledge bases and finally adaptation of the UI based on these changes. Therefore, a tool is required that manages both UI and UX in adaptive manner for the increase in adaption period of the recommendation systems.

We propose UI/ UX Authoring Tool that caters the UI and UX with the main objective to deal with the adaptive and personalized approach towards building and managing the user interfaces. The proposed system provides Adaptive UI by taking personal profile information, contextual information, and device usage information. Also, user feedback information, user behavior measurement, and user satisfaction measurement with gamification and web monitoring techniques are handled as UX. This eventually leads to the evolution of information in the repositories and personalization aspect incorporation in the Adaptive UI.

The rest of the paper is structured as follows: Section 2 describes the existing literature related to the UI and UX. The proposed system methodology is presented in Section 3. Insight into the system is provided in Section 4 with the help of scenario. Finally the system is concluded and future work is described in Section 5.

## **2 Related Work**

UI and UX has been the focus of many researchers as it specifies the lifetime of the system. Literature consists of such work that emphasizes on the importance of UI and UX for the success of the recommendation systems. Nowadays, AUI mostly use the computational approaches such as model-based, bayesian network, and mixed-initiative for adaptation of UI. Jiang et al. [3] proposed an AUI generation framework using web services that use service oriented approach dependent on programming language approach and the rule-based approach. Peissner et al. [4] developed MyUI system that made numerous experiments on user for examining the effectiveness and acceptability of various UI/UX adaptation patterns throughout their interaction. The UI/UX adaptation patterns were executed before adaptation that decreased the costs of adaptation by requesting an explicit user confirmation.

The trend of the UI shifted towards Performance Oriented Interface Design Models and many approaches were proposed based on this technique. Ibrahim et al. [5] considered many factors of UI design that impacts the performance of web applications based on Systematic Literature Review (SLR). They proposed a model that provide guidelines for refining existing web applications in order to utilize used resources in effective manner via its UI.

Wu [6] proposed AUI method of detecting user left and right handed grip of electronic devices and activated the UI accordingly. Dees [7] handled responsive design by automatically adjusting the UI according to screen resolution using media query technique.

In existing UI/UX systems, the UI is not based on context: in which context an application is used and how information is input. In our system along with context, we considered user experience based on many measurement factors such as trust, interaction, reaction, functionality, predictability, and individuality.

### 3 Methodology

We propose UI/UX Authoring tool to manage the Adaptive UI with the input from the UX in the form of feedback and other metrics as shown in Figure 1. The proposed architecture is divided into two main components: Adaptive User Interface (AUI) and User Experience (UX).

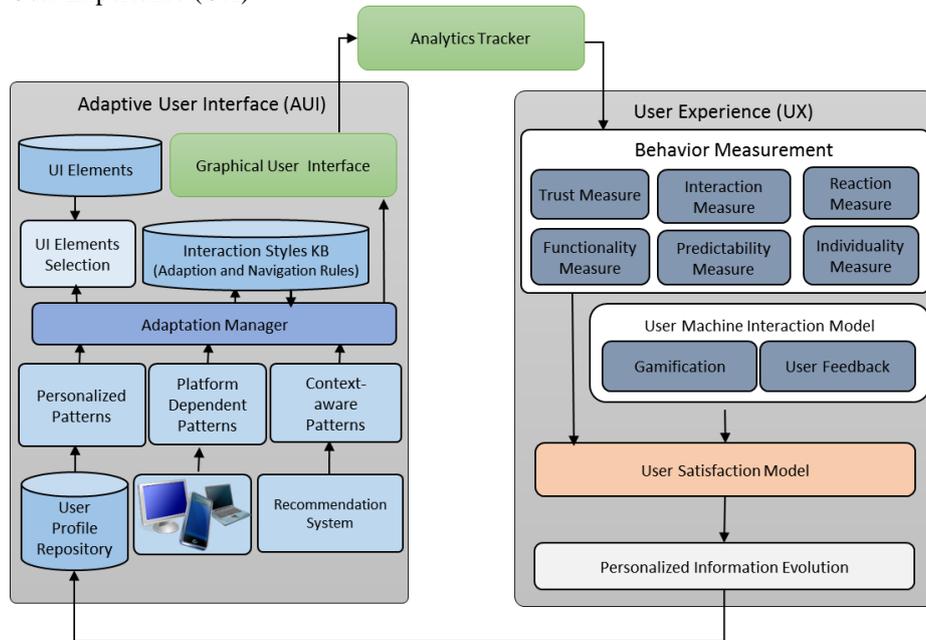


Fig. 1. The architecture of AUI/UX Authoring Tool

#### 3.1 Adaptive User Interface (AUI)

AUI is composed of many subcomponents that obtains user behavior and contextual information for representation in the UI. User information is captured and stored in the User Profile Repository and the contextual information is obtained from the Recommendation System. Also, in addition to these the device information is obtained from

the devices that the user uses. User Profile Repository is used for storing the user preferences in his daily life activities. Personalized Patterns are designed, developed, and executed based on the preferences stored in the User Profile Repository. The platform information is fetched by Platform Depend Patterns using style sheet by Media Query. Context aware Patterns obtains the current context about the user from recommendation system.

Adaptation Manager Component behaves as a coordinator between different internal components of the AUI. It takes initial input from the Patterns layer and forwards it to the Interactive Styles KB. Interactive Styles KB stores the adaptation and navigation rules that are personalized to specific users. These are used for adaptation of the user interface and also navigation between different graphical user interfaces. Interactive Styles KB send back the navigation rules to Adaptation Manager, the UI Elements Selection component retrieves the interface elements from UI Elements repository based on patterns for the Graphical User Interface component to build GUI accordingly.

### **3.2 User Experience (UX)**

Behavior Measurement consists of various user experience metrics to evaluate the response of the user. These measurement indicators are used for the evaluation of user response after initially seeing the personalized adaptive user interfaces.

User Machine Interaction Model interacts with the user through questionnaire, and games. The games are best choice to measure preliminary user states in addition to the updating of user profiles with the passage of time. Playing games provides a way to assess many attributes that are related to adaptive interfaces. We used different games such as cards matching, trail making (TM) and others for cognitive and motor test in order to evaluate the user memory, attention, hand precision and processing speed.

User Satisfaction Model process the information obtained from the different measurement indicators for finding out the user satisfaction. A threshold value is set for comparison and degree of adaptation to be carried out in the user interface. Personalized Information Evolution module takes input from the user satisfaction model and forwards the information to the AUI for evolution of the personalized repository. in Figure 2 shows the interaction among components of AUI/UX Authoring Tool.

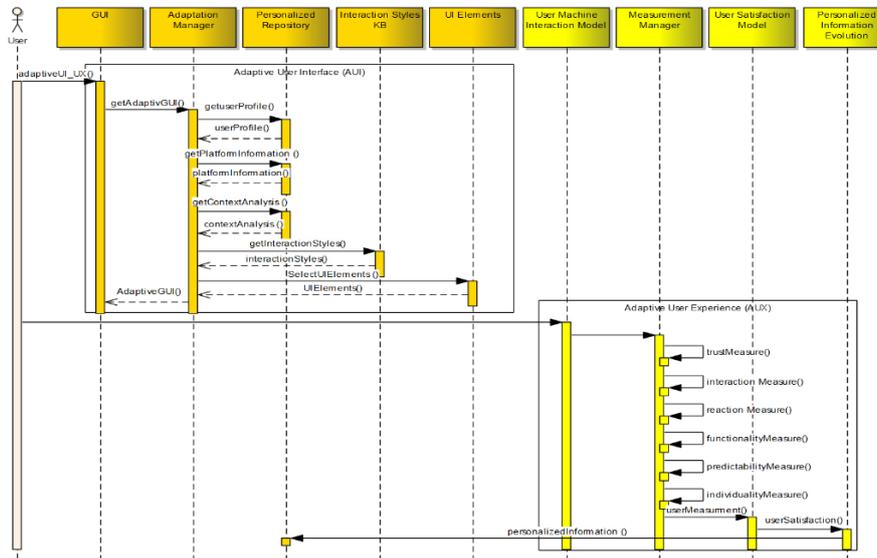
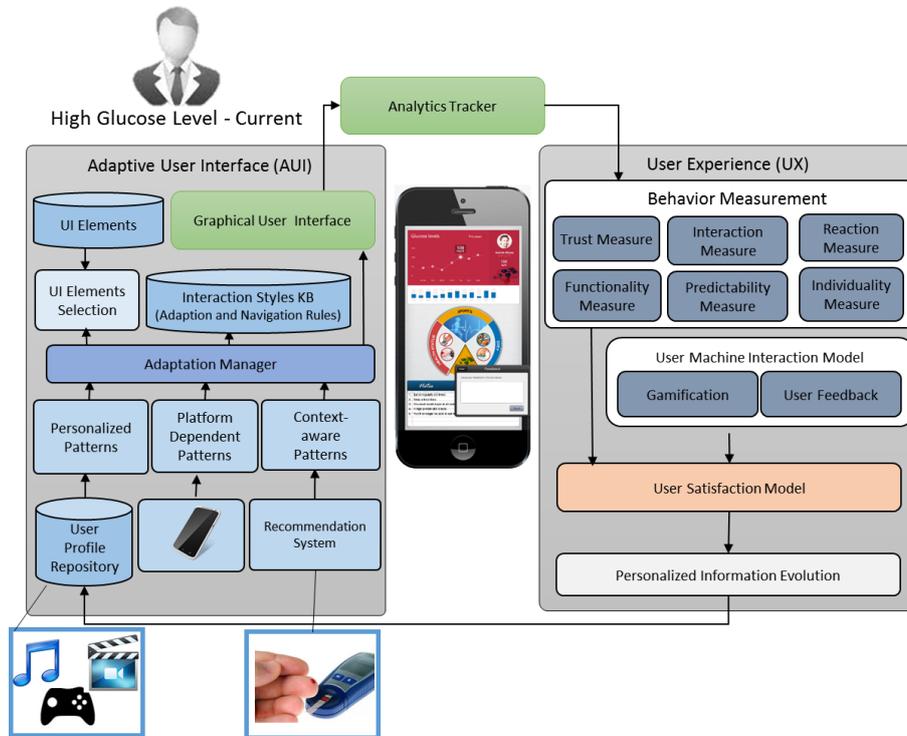


Fig. 2. AUI/UX Authoring Tool Sequence Diagram

#### 4 UI/UX Authoring Tool Service Scenario

We describe a scenario showing the personalized user interfaces and its adaption with user experience. A diabetes patient scenario is explained for UI/UX Authoring Tool to demonstrate the personalized user interfaces.

Initially, user preferences, platform and context information are extracted by patterns components. In the scenario, the user preferences are watching movies, listening music, playing games, and he is diabetes patient used Samsung S3 smartphone, and currently he is having high glucose level as contextual information obtained from the recommendation system as shown in Figure 3. The Adaption Manager adapt GUI according to patterns such as GUI are adjusted according to Samsung S3 screen and specific UI Elements are selected from the UI Repository based on user preferences and the context. In current context user is having high glucose level, the Adaptation Manger Adapt UI accordingly. The user glucose information is displayed along with diabetes related application and some Games. Initially, GUI are not much interactive, the user experience is lacking and the layout is specific to the theme.



**Fig. 3.** AUI Workflow Output

Over the time UX module track the user behavior via behavior measurement module using analytics tracker that includes application usage, usability, interaction measure (less number of clicks), reaction measure (complexity), functionality, measure (less features), predictability measure (easy navigation), and individuality measure (color scheme). The user has also played TM game (needed to connect 12 successive nodes correctly and fast) which measures some discrete factors: game completion time, wrong clicks amount that helps in finding some cognitive and motor skills of that user such as attention and processing speed. All information is obtained and provided to the user satisfaction model that calculates the user satisfaction. If the threshold value is achieved then it means that user is satisfied with the current UI and based on the information in the repositories carry on with the personalized interface. Otherwise, as is in the scenario, if threshold is not achieved then user is not satisfied and information needs to be categorized and repositories should be evolved. The entertainment is the preference of the user but entertainment stuff was missing in the previous UI. Also, user has started using Tablet (I-Pad), and color schemes should be changed to purple and blue with more interactive GUI. The entertainment, tablet, and current status of glucose stable information is categorized by the Personalized Information Model. This information is forwarded to the repositories for evolution of the new knowledge. The color schemes, platform information (I-pad), and entertainment information is matched for a particular

theme to be selected from the Interactive KB. The final theme is selected and then information is forwarded to the UI Elements Selection module. The UI Elements selection retrieves the UI elements from the UI repository and new adaptive user interface is displayed to the user in shown in Figure 4. The new adaptation is based on the personalized information such as new navigation style with preferred color schemes along with entertainment stuff.

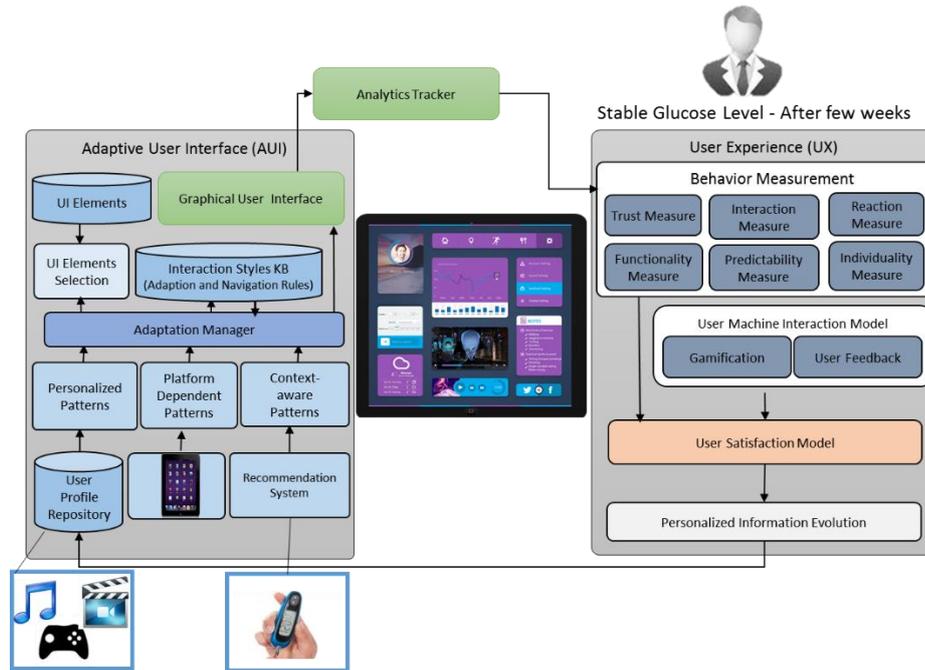


Fig. 4. UX Workflow

## 5 Summary

In this paper, we proposed AUI/UX Authoring Tool framework for recommendations systems. The framework considered User Experience for adapting the user interface. User experience controls the evolutionary process of the adaptation of the user interfaces and also maintaining the personalization aspect. The AUI will be develop using User Interface Markup Language (UIML) [8] that is based on meta-language which offer an XML based representation for UI.

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