Developing a Smart TV System Using Scrum

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Abstract

This paper showcases the software development of the TaipeiTech Smart TV project group using the scrum methodology and software tools. Six teams with typically thirty members are working together within this project. The goal of this project is to develop key technologies of smart TV and create distinguished user experiences. We used scrum for managing and controlling software development processes and a two-level scrum was introduced for collaboration among multiple teams. Our experiences substantiated the effectiveness of scrum. Some of our achievements are demonstrated, including new natural user interfaces and functionalities of smart TV. Observations on using a scrum of scrums in academic teams are also reported.

Keywords: Scrum, Smart TV, Natural User Interface, User Experience

1. Introduction

Scrum is an iterative agile software development framework for managing product development [1]. Since its introduction, scrum has become one of the leading agile development methodologies and is widely used in companies and organizations. The scrum team comprises three core roles, the product owner, scrum master, and scrum team member. Each iteration of process is called a sprint, which starts with a planning event that specifies the sprint goal and identifies the work (stories) for the sprint. Each sprint ends with a sprint review and retrospective, that examines and confirms the progress and identifies lessons for the next sprints.

TaipeiTech (National Taipei University of Technology) has established an interdisciplinary smart TV project group, sponsored by the Ministry of Science and Technology (formerly the National Science Council) for years [2]. The first author of this paper serves as the principal investigator (PI) of the whole group. Smart TV distinguishes itself in Internet connectivity and new human-computer interaction (HCI), which enables numerous new applications and services, such as video streaming, distant learning, home surveillance, and on-line shopping. Our mission is to develop key technologies of smart TV and prototype a demo system.

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Major use cases of the proposed smart TV system are shown in Fig. 1. On the technical part, we aim to develop high-efficiency video codecs, high-performance networking techniques, and dynamic video streaming techniques to facilitate smart TV applications. On the usability part, it is asserted that smart TV should provide differentiated user experience (UX) for accessing new TV functionalities. We proposed using natural user interfaces (UIs) including gesture, body motion, eye movement, and voice for HCI of smart TV users. User identification was expected to be accomplished by using face recognition and speaker identification. Furthermore, a user could use a smart phone as an input/output device interoperable with TV. Consequently, a smart phone can not only act as a remote control, but also share data (images and videos) with TV viewers. We also intended to incorporate techniques of data mining and social networks to realize real-time personal content recommendation.

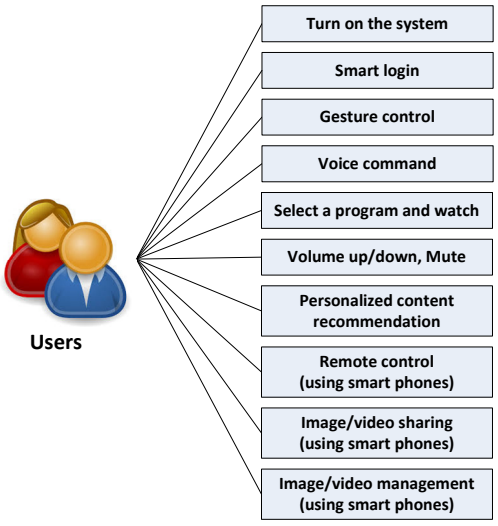


Fig. 1: Major use cases of the proposed smart TV system.

2. Software Development

The software architecture of the proposed system is shown in Fig. 2. The UX team organized design-thinking workshops and developed the persona and customer journey maps of smart TV users. This team also delivers the demo scenarios and handles UX evaluation. The two front-end (user-side) modules, VISION and AUDIO, handle the natural UI. The VISION module detects the positions and motions of fingers and human body using the Microsoft Kinect's time of flight (ToF) camera. The

AUDIO module, activated when a user searches a movie/TV program title, detects acoustic signals through microphone arrays. Three service modules VIDEO, NET, and MINING reside in the back end (server side). The VIDEO module converts an H.264 video into MPEG-DASH segments and the NET module streams the MPEG-DASH segments requested by a user. The MINING module provides for each program extra information such as actors, director, and synopsis, which helps a user make selection before watching. This module also fulfills personalized content recommendation using data in social networks. The whole system is integrated as an HTML-5 based web service. Over those modules, the MAIN team manages the entire project.

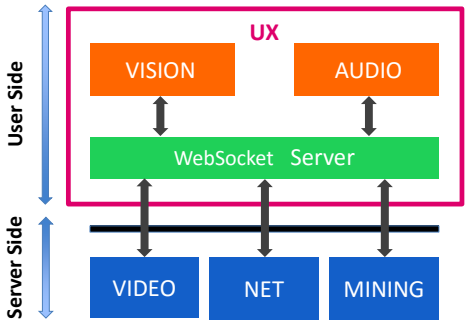


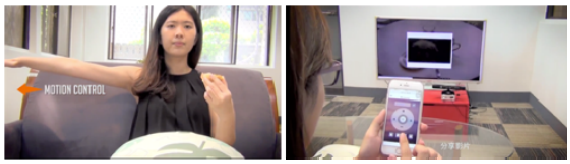
Fig. 2: Software architecture of the TaipeiTech's smart TV system.

As suggested and encouraged by our colleague Prof. Yu Chin Cheng, we adopted Scrum for project management in the beginning. We obtained full support of his ezScrum Promotion Team [3], including scrum tutorials and the help of establishing an ezScrum system. Although our project members are not experts in software engineering (SE), we adopted common SE methodologies and tools. We use Gitlab for version control and Jenkins for integration test. We also wrote two essential CMMI documents, RSD (Requirement Specification Document) and STD (System Testing Document).

In the development group, four teams (VISION, VIDEO, NET, MINING) belong to the Computer Science and Information Engineering Department, one team (AUDIO) belongs to the Electronic Engineering Department, and the other (UX) belongs to the Interaction Design Department. Around thirty people (including product owners, scrum masters, and members) are involved in this project. A two-level scrum was introduced for collaboration of multiple teams. The lower-level is the conventional scrum, operated by each team. A scrum of scrums, i.e., a scrum team composed of scrum masters of each team, is formed on top. We set a sprint to be a month (four weeks) and the project PIs of each team (product owners) attend the monthly sprint planning, review, and retrospective meetings. The sprint planning meeting determines the MAIN stories, which break down into stories/tasks of other teams. A weekly scrum of scrums is called by MAIN.

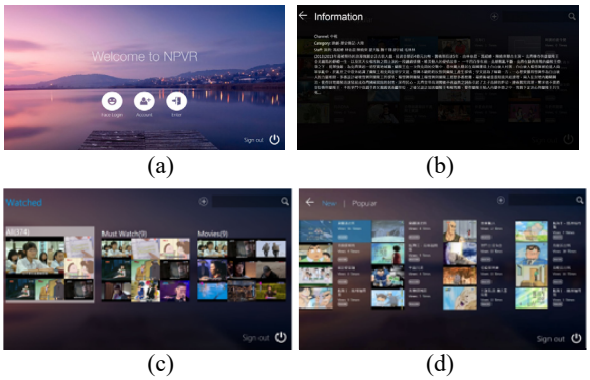
3. Results and Comments

We have successfully developed the proposed key technologies of smart TV and delivered a prototype system through the endeavor and collaboration of the whole project group. Fig. 3 shows the realized multi-modal interactions using gestures and smart phones. Fig. 4 illustrates the web-based graphical UIs of the system. The full functionalities of the system will be demonstrated at the conference venue if this paper is accepted.



(a) (b)

Fig. 3: Multi-modal interactions with the devised smart TV, (a) gesture control (b) using a smart phone as a remote control.



(a) (b)

(c) (d)

Fig. 4: Graphical user interfaces of the developed smart TV, (a) login page, (b) compiled video content information, (c) category selection, (d) program list.

Some remarks for adopting a scrum of scrums in this project are addressed below. A scrum of scrums is proven to be an effective management strategy in this project. However, since the team members are graduate students from different labs, some adaptations are needed in practice. It is difficult to locate common time slots for a scrum of scrums meeting and so weekly scrum instead of daily scrum is held. At the MAIN sprint planning, we estimate the number of working hours for a task using the rule of thumb. A task is mostly dedicated to a specific team member based on his/her expertise. Another problem is the change of scrum members caused by students' graduation. The job handover should be carefully managed for smooth transition.

References

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