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A Research Paper Presentation

on

An Architecture for Software Engineering Gamification

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Understanding the topic

The term “gamification” refers to the utilisation of game-like tools and mechanics in regular non-game workplace environment that can include using a software or a website in domains like education, marketing, business administration, economics, and psychology studies, not to mention the entertainment sector and a lot more. In software engineering, gamification is an emerging concept that aims at tackling lack of user interaction by embedding game-like features. This game-like feature does not necessarily mean that the business software will contain straight-up games. Gamification focuses on smaller details like screen transitions, action animations, passive software-usage credits that will further improve user’s engagement and motivation yielding to better results and outcomes along with reducing boredom and stress in work. In simpler terms, gamification is a fun approach to any work at hand, be it learning or teaching or straight-up business.

Understanding the paper

This research paper “An Architecture for Software Engineering Gamification” is more focused on the approach to implementing game-like tools in all sorts of easy and complex software. This paper understands the current mind-set of the software designers and the client and discusses the possibilities that the people today, despite wanting a positive and more successful outcome, do not embrace the idea of gamification due to its theoretical psychology-driven approach rather than practical statistics. In this paper, we tackle these problems from the point of view of a sceptic. However, this paper is not aimed at forcing gamification or showing that gamification can improve the result of software engineering companies, but rather focuses on providing the necessary tools to those companies who plan on welcoming the idea of gamification in their newer projects. The prime agenda of this research paper is to study the compatibility of the necessary tools in the modern software and addresses the software architecture of the gamification engine for gamification in SE environment.

The gamification of software has been in play for a few years now, and despite being an emerging or a newcomer of the ideas, many corporate giants have already adopted the idea and generated gamification based software for public access. From subtle implementations like the public feedbacks by almost all tech giants to not-so-subtle rewards systems by the tech giant Microsoft in the form of Microsoft Rewards, the concept of gamification has generated some huge positive results for the producers. As for the consumers, on the surface level, it has shown positive motivation to do things, but on the other hand, has created problems like addiction and resulted in mental sickness like frustration when they are unable to complete some task or quests due to

bug issues or even lose their daily streak due to real life callings to family-time, festivals and travelling. These are the challenges that an emerging concept is likely to see for a couple of years to come, but there are solutions to these by limiting the user engagement. This can be achieved by making the quests regular rather than daily, i.e., instead of renewing the quests every day to give a new one, the due time to complete those tasks can be extended to last a week before renewing, which will give the users more time to interact and complete. Keeping these challenges in mind, the authors of this paper have designed the necessary software architecture, a gamification model and a gamification engine for the gamification of software engineering environment.

Summarising background

There have been many researches in this field lately. One of the most significant lines of research in gamification has been the evidence of its usefulness, which was initially evaluated by Hamari et al by means of a literature review which concluded that “gamification does work, but some caveats exist”. Gamification in web applications was analysed in the literature review by Xu who concluded that gamification was based on superficial game mechanics like points, levels, leaderboard and badges. Much research work has considered the application of gamification in SE, the goal being to improve the product quality and project results by increasing people’s motivation and engagement.

Research Questions

Through this research paper, the authors aim at answering the following major questions:

- i. Can there be a gamification software that will allow the software organisations to transform work environment of a software into an integrated gamified environment while maintaining the organisation’s current tools?
- ii. Can the rewards for actions in any tool accumulate in a centralized gamified environment?
- iii. Does the design of behaviours, achievements and gamification rules provided by the framework makes the gamified work environment flexible? Can the change to game mechanics be modified through only the designer’s web interface without the need for touching a line of code?

Search Process, Study Selection Process and Analysis Process

The search and study selection process for this research process includes defining the major search terms that include the terms gamification, software engineering and architecture, as well as identifying synonyms for these three major terms. Next steps include linking the search keywords using logical terms AND and OR. Lastly, search process was concluded by selecting and surveying primary sources like IEEE, ACM, SCOPUS, Web of Science and ScienceDirect, which in this paper consisted of 127 unique papers. To analyse the data extracted after conducting study selection, authors for this research employed the thematic analysis steps following the guidelines by Cruzes and Dyba using NVivo 11 as a supporting tool. The thematic analysis process consisted of four important steps:

- i. Extract data
- ii. Code data
- iii. Translate codes into themes
- iv. Explore relations

Approach

An existing gamification approach was used that included the studies following an existing gamification framework that was proposed by someone else. A psychological approach was adapted as a gamification approach that included the normal work-environment that tailored motivational or inspirational theories to gamify an existing software. A new gamification approach was proposed, designed and followed that included studies that designed their own structured and step-by-step methodology to gamify an existing software as well as in-production software. The tools discussed in this proposal were compared against the custom-developed and off-the-shelf tools such as Redmine, TestLink, or JUnit, with the gamification engine.

Methods and Results

The main advantage of the architecture discusses in this proposal is that many tools can be included in the same gamified environment.

This research paper has firstly presented the software architecture and its main components: the gamification engine and the software mechanisms to integrate the gamification engine with the organisation's Computer-Assisted Software Engineering (CASE) tools, and secondly, it presents the gamification model that has guided the design and implementation of the gamification engine.

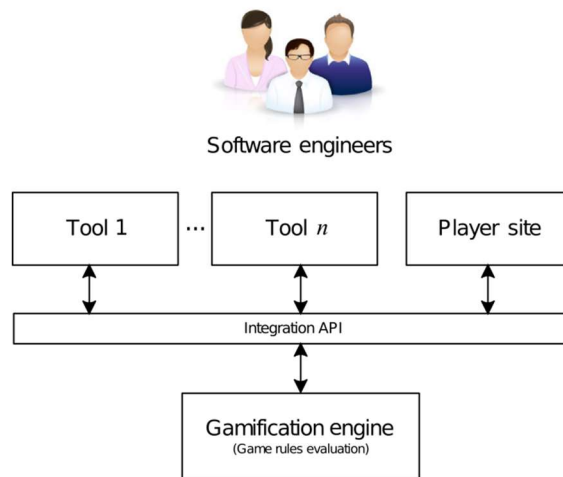


Fig. 1: High level view of the software architecture for gamification

As we can see on the fig. 1, the gamification engine is the central element of the architecture, since it receives all the behaviours carries out by the software engineer, and evaluates them. The engine provides an integration REST API that allows any other tools to communicate with it.

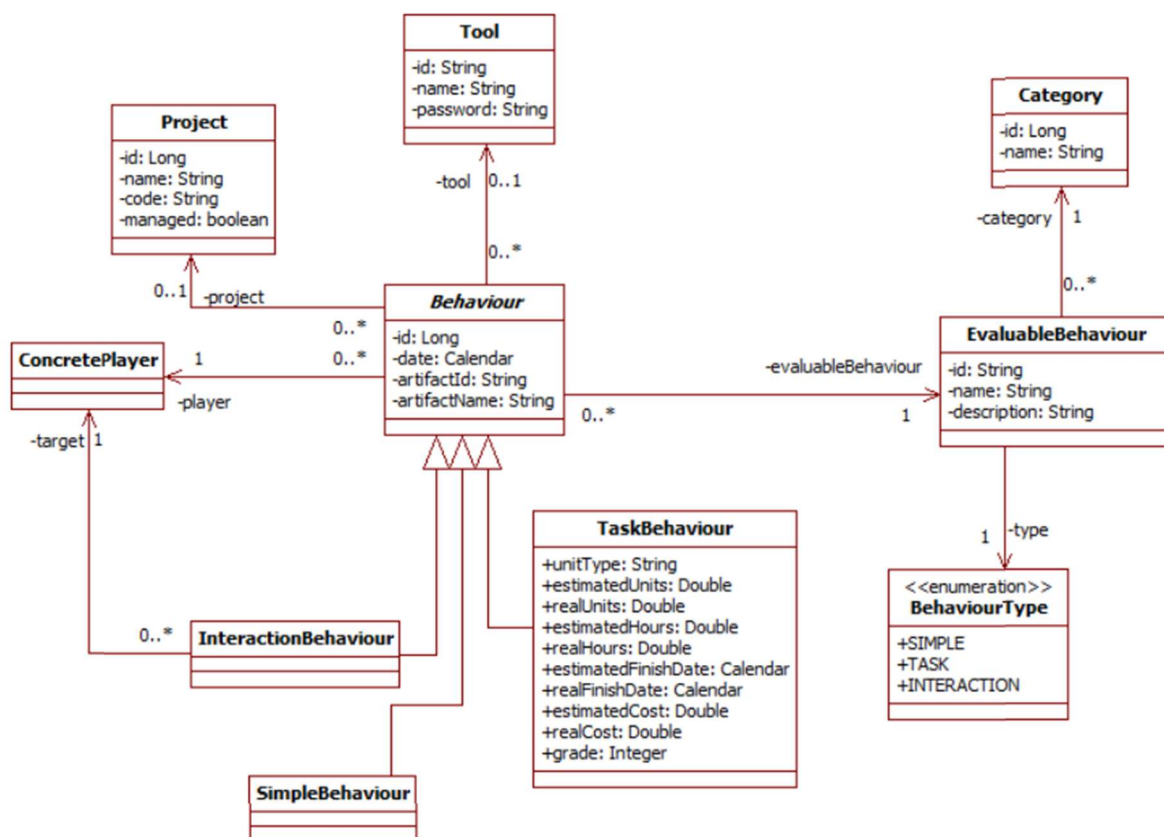


Fig. 2(a): Behaviour Model

The software architecture and the gamification engine are based on a model composed of three main elements: behaviours, achievements and game rules. The gamification engine will receive behaviours carried out by the users in their respective tools, and will evaluate these according to the game rules redefined by a designer to assign the corresponding achievements to those behaviours if the game rules consider them successful. Fig. 2(a), 2(b) and 2(c) show the class diagram summarizing the behaviour types, achievement classes and gamification rules in the model, respectively.

Fig. 2(b): Achievement Model

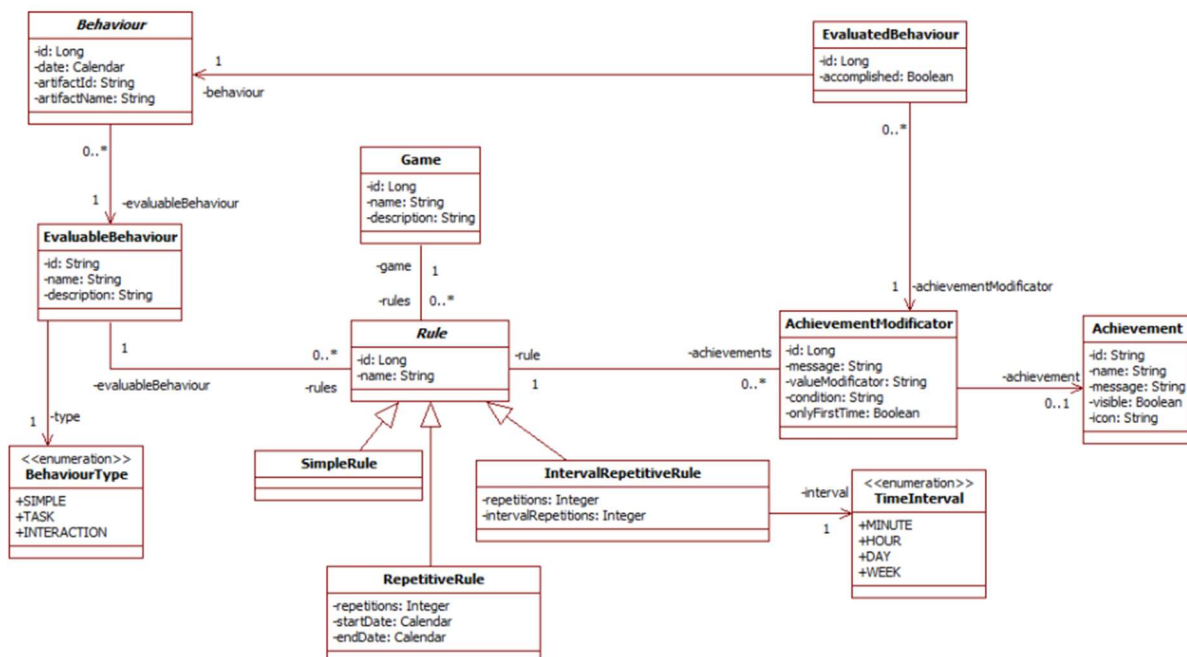


Fig. 2(c): Rules of the gamified environment

Fig. 3 shows the three-layer architecture this gamification engine is designed on. The first layer is the data persistence implemented as a RDBMS. The second layer is the engine model containing the data access layer and the business logic comprising the management of users, behaviours, achievements and gamification rules. The third layer consists of

Administration WebApp where the administrator of the gamified environment address the configuration of the engine through a web application interface for the administrators to manage gamification tools and REST API which provides a complete interface for all the tools of the gamified environment.

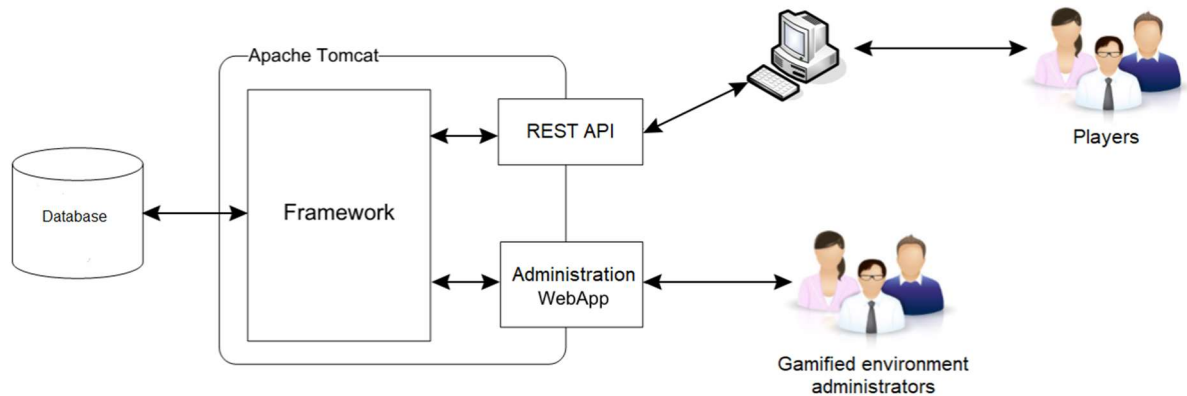


Fig. 3: Engine Architecture and Design

The authors not only proposed their engine through this research paper, but also performed practical integration of their engine in a small software development company that the authors have not disclosed and have referred to as SC consisting of 25 employees. The result was promising. Although the case study focused on the case of one single company, the tool suite considered presented a representative example of what we can find in most software development organisations. The gamification abstraction on which the engine is based on would support the gamification mechanisms of most companies. The integration of the SE tools into the gamified environment proceeded following the design and development of the engine.

Discussion and Conclusion

The gamification engine presented in this paper provides a valuable tool for incorporating gamification in SE workplaces. The software architecture for gamification composed of many tools that support different software process area. In real life application, the gamification engine was tested on a software that used off-the-shelf tools such as Redmine, TestLink and JUnit along with other custom developed tools, and it proved to be a major success. The gamification elements provided by the gamification engine cover most of the general purpose gamification elements. The effort of gamifying a work environment should not be neglected nor forgotten due to its importance for real organizations.

This paper presented a software architecture, a gamification model, and a gamification engine for the gamification of software engineering environments. The main feature of the proposal was to centralize the logging of the

behaviours of the people taking part in that environment. The gamification is simple and general, so it can fit the work environments of most software development companies. In addition, the model is extensible, that is, the model can accommodate any other needed type of behavior, achievement, or game rule.

Related Works: List of Primary Studies

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3. M. Hugos, Enterprise Games: Using Game Mechanics to Build a Better Business. Sebastopol, CA, USA: O'Reilly Media Inc., 2012.
4. K. Werbach and D. Hunter, For the Win: How Game Thinking Can Revolutionize Your business. Philadelphia, PA, USA: Wharton School Press, 2012.
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Citation

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Research Paper Links:

1. [<https://www.semanticscholar.org/paper/An-architecture-for-software-engineering-Pedreira-García/0907cd48c5743716bd699e4f5dd3dca5750713db>]
2. [<https://ieeexplore.ieee.org/ielx7/5971803/9087808/09087817.pdf>]