CRUISE: A Platform for Crowdsourcing Requirements Elicitation and Evolution
http://cruise-platform.in

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Presentation Outline

✓ Research Motivation and Aim
✓ Related Work
✓ Research Contributions
✓ Technical and Design Challenges
✓ Solution Approach
✓ Experimental Design and Setup
✓ Experimental Results
✓ Observations and Conclusions
✓ References
Research Motivation and Aim

Requirements Engineering

Process of defining, documenting and maintaining requirements

1. Requirements elicitation
2. Requirements analysis
3. Requirements specification
4. Requirements validation
5. Requirements management
Research Motivation and Aim

What Makes a Good Requirement?

- Cohesiveness
- Completeness
- Consistency
- Correctness
- Currency
- Customer/User Orientation
- External Observability
- Feasibility
- Lack of Ambiguity
- Mandatory
- Metadata
- Relevance
- Usability
- Validatability
- Verifiability

Reference
Specifying Good Requirements
Donald Firesmith, Software Engineering Institute, U.S.A.
http://www.jot.fm/issues/issue_2003_07/column7/
Research Motivation and Aim

Crowdsourcing

The practice of obtaining information or input into a task or project by enlisting the services of a large number of people, either paid or unpaid, typically via the Internet

- Crowdsource Design (logo design)
- Crowdfunding (money donation)
- Microtasks (breaking work up into tiny tasks)
- Open Innovation (work together on a project)
Research Motivation and Aim

Application of Crowdsourcing in Requirement Engineering

Explore the applicability of crowdsourcing to one of the RE activities, requirements elicitation or gathering
Research Objectives

Research Questions Guiding Our Work

**RO1**: To design and develop a crowdsourcing based requirements elicitation platform. The platform design and development includes building a website and implementing processes and structure which should guide the platform users to participate and complete their respective tasks effectively and efficiently.

**RO2**: To investigate the effectiveness of the proposed platform in terms of the quality, completeness, and coverage of the elicited requirements.

**RO3**: To compare and contrast the proposed crowdsourcing based platform with traditional approaches and discuss the limitations of the proposed approach and future research directions.
Related Work

Previous Work on Crowdsourcing for Requirements Engineering

**Breaux and Schaub** [17] have explored crowdsourcing for extracting privacy requirements from privacy policies. Their study reveals increased requirements coverage as compared to manual extraction by trained experts.

**Sutcliffe and Sawyer** [20] recommend social collaboration for facilitating categorization and prioritization of requirements for product lines.

**Muganda et al.** [21] advocate group-thinking for prioritizing and refining the requirements.

**Lim et al.** [22] have explored the potential of crowdsourcing for stakeholder analysis.
Related Work

Previous Work on Crowdsourcing for Requirements Engineering

Lim and Finkelstein [23] suggest using social networks for large-scale requirements elicitation.

Adepetu et al. [24] have proposed an outline of a platform to support RE activities in general using crowdsourcing, CrowdREquire.

Snijder et al. [25] suggest Crowd-Centric Requirements Engineering (CCRE), and through a prototype of CCRE, Refine, they demonstrate that CCRE can provide engaged stakeholders and valuable inter-action among those stakeholders.

Requirements Bazaar tool, developed by Renzel et al. [26], aims at requirements elicitation and prioritization of requirements.
Proposed Tool: CRUISE

Design Challenges - I

- Should guest users be able to contribute to projects or only registered users have the permission to contribute?
- Should the registration be controlled or any user can register and go ahead with contributing to projects?
- Who holds the owner-ship of the project?
Proposed Tool: CRUISE

Design Challenges - II

- What should be the various roles associated with the users?
- Should requirements gathering be itself broken to some sub-tasks, i.e. should the users be given with guided questions?
- How and when a requirement can be marked as finalized to be promoted to development?
Proposed Tool: CRUISE

Schematic Diagram
Proposed Tool: CRUISE

Dashboard of a Logged-In User

<table>
<thead>
<tr>
<th>Projects you own</th>
<th>Brief Overview</th>
<th>Date Posted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Room Booking</td>
<td>User Management</td>
<td>25 December, 2016</td>
</tr>
<tr>
<td></td>
<td>This module will take care of managing details of registered users.</td>
<td></td>
</tr>
<tr>
<td>Mobile App for room-booking</td>
<td></td>
<td>25 December, 2016</td>
</tr>
<tr>
<td>Course Registration project</td>
<td>Login Module</td>
<td>05 January, 2017</td>
</tr>
<tr>
<td></td>
<td>This module is used by the presently registered students (who are going to 2nd year or onwards). These students will login to their respective dashboard and select the subjects they want in their upcoming semester.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Projects As Contributor</th>
<th>Brief Overview</th>
<th>Date Posted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Library Management System</td>
<td></td>
<td>25 December, 2016</td>
</tr>
</tbody>
</table>
Proposed Tool: CRUISE

Guest Vs. Registered Users

Only those users who get an invite from the project owners or from the admin users of CRUISE can register.

Invited users can browse the projects, express their willingness to contribute to some project, and start contributing to projects.

We have not restricted formation of project’s moderation group at tool level, leaving this decision to project owner as he may like to continue as moderator, or he may like to choose a moderator group.
Proposed Tool: CRUISE

Project Ownership and Access Control

We decided to let contributors only view the project details. However, they can add modules as well to the project.

Moderators can decide later whether that module should be a part of the project or not.

CRUISE allows the users, who have created the project, to modify, archive, and delete the project.

The privilege to archive or delete a project also lies with the CRUISE administrators so that the projects that have not been accessed for long and are lying idle may be removed to avoid any cluttering of projects in CRUISE database.
Proposed Tool: CRUISE

Requirements Identification

User may choose to gather requirements from crowd and seek scores for requirements in terms of likes, comments, follow-ups, and priorities of requirements.

With the help of moderation group, the project owner may finalize the requirements statement and its priority.

Project owner can seek opinion on finalized requirements statements.

The moderators only can commit a requirement, i.e. can finalize a requirement to be promoted for design and development.
Experimental Study

Validation of Proposed Approach - I

We decided to carry out our experimental study with under-graduate students who are currently doing a course in Software Engineering (SE)

We were able to incentivize the students and keep them motivated in the study through a small percentage of marks in their SE course project grades

We identified two groups: One of the groups, thus, was in the role of control group while the other one formed the hypothesis group in our study
Experimental Study

Validation of Proposed Approach - II

We hypothesized that requirements collected through CRUISE are almost similar (at least 90% similarity) to the one collected through traditional requirements elicitation techniques.

The course advisor assigned project titled – ‘Automate students’ registration process at the onset of the semester’ to both of these groups.

The control group has 5 members, and the hypothesis group has 6 members.
Experimental Study

Hypothesis Testing – Creation of Control Group - I

The control group is supposed to collect requirements by interviewing the Dean and the program office that is responsible for registering students at the beginning of semester through a manual process of form filling and approvals.

The hypothesis group is supposed to work as moderator for the ‘registration’ project created in CRUISE.

We conducted meetings with the hypothesis group and the crowd.
A total of 17 requirements were collected through CRUISE.

The control group collected requirements for the same project using interview technique of requirements elicitation. They collected a total of 8 requirements from the Dean and the program office.

The requirements collection phase was then followed by comparative study of the requirements collected through the two different ways – traditional and using CRUISE.
Experimental Study

CRUISE and Interview Requirements Comparison

<table>
<thead>
<tr>
<th>Total Requirements in CRUISE</th>
<th>Requirements Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both in CRUISE and interviews data</td>
<td>Through Cruise only</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
</tr>
</tbody>
</table>

This study is intended to analyze not only the number of requirements identified through manual reviews and through our tool but also the quality of the elicited requirements and the time taken to prioritize the requirements manually against the time taken to carry these tasks through tool.
Observations and Conclusion

Takeaways from a Quantified Comparison Study - I

The requirements gathered through CRUISE, and missed through interviews were about one module only - ‘administrator’, and the privileges of the user acting as administrator.

The requirements elicited during interviews but not found in CRUISE tool included categorization of registration application users as ‘new’ and ‘old’.

Another missed requirement through CRUISE was related to getting students’ consent on a couple of forms for ‘new’ students (in addition to registration form).
Observations and Conclusion

Takeaways from a Quantified Comparison Study - II

The requirements gathered through CRUISE platform are at least as good as collected through interviews.

There was a miss of one (business) aspect but at the same time, there was a value addition in terms of ‘system administrator’ role and his privileges.

These observations answer RO2 and RO3 as – with a careful crowd formation, crowd control and moderation, one can expect the quality of requirements gathered using crowdsourcing approach as good as elicited through traditional methods of requirements gathering.
References

List of Papers Referred - I

References

List of Papers Referred - II