DWIT COLLEGE

DEERWALK INSTITUTE OF TECHNOLOGY

RESEARCHERS HUB

A MINI PROJECT REPORT

Submitted to

Department of Computer Science

DWIT College

Submitted by

Avinay Basnet

10-31-2019

DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

Supervisor's Recommendation

I hereby recommend that this project prepared under my supervision by AVINAY BASNET entitled **"RESEARCHERS HUB"** in partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Information Technology be processed for the evaluation.

……

Ritu Raj Lamsal

Head of Electronics Department/Lecturer

Deerwalk Institute of Technology

DWIT College

DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

Student's Declaration

I hereby declare that I am the only author of this work and that no sources other than that listed here have been used in this work.

……

Avinay Basnet

10-31-2019

DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

LETTER OF APPROVAL

This is to certify that this project prepared by AVINAY BASNET entitled **"RESEARCHERS HUB"** in partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Information Technology has been well studied. In our opinion it is satisfactory in the scope and quality as a project for the required degree.

……	……..
Mr. Ritu Raj Lamsal	Mr. Ritu Raj Lamsal
Head of Electronics Department/Lecturer	Head of Electronics Department/Lecturer

ACKNOWLEDGEMENT

I would like to express my deepest appreciation to all those who provided me the possibility to complete this project.

I am highly indebted to Deerwalk Institute of Technology for their guidance and constant supervision as well as for providing necessary information regarding the project and also for their support in competing the project.

A special gratitude I give to my supervisor Mr. Ritu Raj Lamsal, whose contribution in stimulating suggestions and encouragement, helped me to coordinate my project especially in writing this report.

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My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

Name: Avinay Basnet

Roll No.: 615

Date: 10-31-2019

ABSTRACT

Software can significantly facilitate the management of the complete systematic literature review process (SLR). However, most specialized software for use in SLR processes is designed to meet the requirements of the health and medical sciences and social sciences, and there is a need for dedicated software for the specific research requirements of the software engineering. Furthermore, most of the software currently used is closed and the open source code alternatives require personnel with expertise in configuration and setup. I present Researchers Hub, an application for managing the complete process of systematic literature reviews that is web-based and developed in Python. It offers functionalities for supporting the process of planning, conducting, data extraction and reporting. Researchers Hub can be used locally through an in-house web server, as well as in a distributed manner, integrated with other online services.

Keywords: *Systematic literature review; Software engineering; Web-based software; Collaborative work; Django*

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LIST OF ABBREVATIONS

SLR	Systematic Literature Review
SE	Software Engineering
PICOC	Population, Intervention, Comparison, Outcome, Context
SQL	Structured Query Language
NoSQL	Not only SQL
ACID	Atomicity, Consistency, Isolation, Durability
MVT	Model View Template

CHAPTER 1: INTRODUCTION

1.1.Overview

Researchers Hub responds to the need for a software tool that manages the complete process of systematic literature reviews (SLR) of low to medium complexity in the fields of software engineering, field which have its particular requirements, distinct from those of other knowledge domains. Upon analyzing the results of the Kohl et al. review on software tools that partially or fully cover the stages of an SLR, it is observed that most of these tools have been designed with the health and medical sciences and software engineering in mind, albeit being promoted as tools for general use. SLRs designed from the perspective of these disciplines share characteristics that do not necessarily fill the requirements of other fields of knowledge. Developing a SLR-supporting software tool for the software engineering requires unifying various types of investigations like journals, articles and so on, in order to reach a conclusion. The software utilized must be flexible one that enables multiple ways of performing systematic reviews, while ensuring maximum transparency and rigor by recording each step followed by each evaluator, especially in discrepancy resolution.

The studies carried out in the software engineering (SE) environment on user requirements for SLR support software concludes that the research designs utilized are generally of an observational and post-facto nature, and the participants' profile is usually that of experts, making it difficult to establish blind procedures. Considering the main requirements described in the literature, Researchers Hub incorporates several tools to facilitate communication between users, which, added to its ability to handle large numbers of documents in a robust manner, enables the performance of medium to large scale SLRs. Besides this, metadata and files of already finished documents can be reused to update prior reviews. With regard to software development processes,

special attention has been given to the application's usability, test coverage, maintainability and documentation.

1.2. Background and Motivation

Performing a systematic literature review is a labor-intensive task that requires a huge amount of work form the researcher(s). It requires designing the protocol, adjusting the search string, filtering the results, sometimes more than a thousand of articles, selecting those articles that attends the include criteria and removing those articles that attends the exclude criteria. After that, the researcher might start to analyze the relevant result one by one. Not only this the researcher might lose the way because systematic literature review requires researchers to coordinate many sources. Basically, researcher is trying to convert a cobweb of ideas into a linear sequence.

Hence there was need of robust software that helps researcher to help through all those steps. Researchers Hub is designed to support researchers to perform systematic literature where distributed researchers can work together within a shared workspace, designing the protocol and conducting the search. As well as providing a way to document the whole process, the tool will remind researcher what is important during a systematic literature review.

1.3. Problem Statement

Systematic literature requires hours of works from researcher to reach conclusions. Performing a systematic literature review is labor intensive task because it requires identifying the objectives, PICOC, research questions, search string, keywords and synonyms, selecting the sources, the inclusion and exclusion criteria, a mechanism to build a quality assessment checklist and data extraction. Researchers Hub aims to help researcher through all these steps.

Researchers Hub is a web-based tool developed in Python that manages the complete process of systematic literature reviews in the context of software engineering. Researchers Hub helps researcher in planning, conducting and reporting the review.

During planning phase this tool researcher with the objectives, PICOC, research questions, search string, keywords and synonyms, selecting the sources, the inclusion and exclusion criteria. It also provides mechanisms to build a quality assessment checklist and data extraction forms. During conducting phase, researcher will be able to import bibtex files and select the studies, find duplicates among all the different sources, execute the quality assessment and extract data from the papers.

1.4. Objective

The major objective of this project is to develop a tool that is compatible with all operating system and helps researcher to perform systematic literature review. Furthermore, allowing distributed researchers work together within a shared workspace, designing the protocol and conducting the research. Also, guiding researchers though labor-intensive steps like designing the protocol, adjusting the search string, filtering the results, sometimes more than a thousand of articles, selecting those articles that attends the include criteria and removing those articles that attends the exclude criteria. After that, providing visualization like pie chart, bar graph and so on for data analysis.

1.5. Scope

Most of the specialized software that facilitate the management if the complete SLR process are designed to meet the requirements of the health and medical sciences and social sciences. Hence,

there is a need for dedicated software for the specific research requirements of the software engineering. Researchers Hub is developed to meet such specific research requirements of the software engineering. Researchers Hub responds to the need for a software tool that manages the complete process of SLR of low to medium complexity in the fields of software engineering, field which have its particular requirements, distinct from those of other knowledge domains.

1.6. Outline

This project analyzes the traditional way of performing SLR and the software available in the market to facilitate complete SLR process. This project aims to build a system that can significantly facilitate and meet the requirements of SLR in SE. This paper includes the method used to collect the functional requirement and system specification. This paper also includes the diagrams to illustrate the system architecture. Moreover, it provides information about the tools and technologies used to build the system. It also provides the information about how those tools and technologies are implemented. Finally, it includes the method used for system testing and system evaluation.

INTRODUCTION	• Overview • Background and Motivation • Problem Statement • Objective • Scope • Outline
BACKGROUND RESEARCH	• Literature Review • Current System

	• The Problem with Current System
SPECIFICATION AND DESIGN	• Requirement Elicitation and Analysis • System Design
IMPLEMENTATION AND EVALUATION	• Tools and Technology • Implementation • Evaluation and Result
CONCLUSION	• Conclusion
LIMITATION	• Limitation

Table 1: Outline of Document

CHAPTER 2: BACKGROUND RESEARCH

2.1. Literature Review

According to Kitchenham B [1], a systematic literature review is a secondary study with the objective to identify, analyze and interpret all available evidences from primary studies related to a specific research question. The activity to perform a systematic literature review involves planning, conducting and reporting the review.

According to Marshall & Brereton's [2] mapping study out of 14 software tools, 11 concentrate on the conducting phase of the systematic review, particularly the search stage, data synthesis and data extraction. For the search stage, there are available tools such as EndNote; however, the main problem with them is that they are closed. There is interest in accelerating the processes of screening and data extraction through partial automation using machine learning, with such tools as abstrackr, PEx, ExaCT. Rayyan is a free tool for use in the initial stages of planning, search and screening, that offers the great advantage of having a highly usable web interface and mobile application. Another similar open source code tool is CREBP-SRA, which is mainly focused on reference and search management, and secondarily, on the screening process. For the analysis and report stage, RevMan stands out for its capabilities in the preparation of protocols and articles, the development of meta-analyses and presentation of graphic results.

Supriya S. Pore, Swalaya B. Pawari [3] conducted a comparative study of SQL and NoSQL. The study highlights on the types of databases like SQL and NoSQL, it also differentiates among them. The axiomatics of SQL and NoSQL databases has been described in this paper. The study says that due to data consistency, ACID property is not used in the NoSQL databases.

These papers and documents helped me to decide the tools and technology to build the application. Kitchenham B helped me to understand review process is iterative, thus it is possible that, for

instance, the protocol will be refined following its evaluation, or that the methods of analysis planned will be improved once the data is obtained. Kitchenham B also helped me to understand the complete process of systematic literature review i.e. planning, conducting and reporting.

Selecting the right database is always a key part of any application. Supriya S. Pore, Swalaya B. Pawari provided fantastic explanation of why SQL (structured) database is the ideal choice of my application.

2.2. Current System

Software can significantly facilitate the management of the complete systematic literature review process. However, most specialized software for use in systematic literature review process is designed to meet the requirements of the health and medical sciences and social sciences. The software that inspired me most is Buhos, software designed to meet the requirements of social science. Buhos is an application for managing the complete process of systematic literature reviews that is web-based and developed in Ruby. It offers functionalities for supporting the process of searching, screening, data extraction and reporting. These are the features that inspired me to build this product but in the context of software engineering. Buhos can be used locally through an in-house web server, as well as in a distributed manner, integrated with other online services.

Data analysis is a vital part of systematic literature review so I decided to use Google Visualization for pie chart, bar graph and so on. Some other tools that performs systematic literature review are SESRA, SLRTool, SluRp, etcetera. All of above-mentioned software are paid software so I decided to make Researchers Hub a free tool that helps to perform systematic literature review.

2.3. The Problem with Current System

The traditional way of performing systematic literature review is a labor-intensive task and takes a lot of time because it requires designing the protocol, adjusting the search string, filtering the results, sometimes more than a thousand of articles, selecting those articles that attends the include criteria and removing those articles that attends the exclude criteria. Hence there was a need for a software that helps researcher through all these steps.

Buhos is one of the best software that helps to perform systematic literature review in the context of social engineering. However, there was a need of a software that perform systematic literature review in the context of software engineering. Tools like SESRA, SLRTool, SluRp, etcetera also help researcher to perform systematic literature review. All of above-mentioned software are paid software so there was a need of free software that helps to perform systematic literature review.

CHAPTER 3: SPECIFICATION AND DESIGN

3.1. Requirement Elicitation and Analysis

In order to understand the detailed complete process of systematic literature review I studied the guidelines provided by Kitchenham & Charters.

Before building any software, it is essential to conduct study on already available software developed for the similar purpose. Marshall & Brereton's mapping study out of 14 software tools, 11 concentrate on the conducting phase of the systematic review, particularly the search stage, data synthesis and data extraction gave me the detailed insight about the software that exists in current world meeting the similar purpose of Researchers Hub.

3.1.1. Functional Requirement

- The user shall add new systematic literature review.
- The main owner shall be able to add geographically distributed researchers where they can work together within a shared workspace.
- The user shall be able to design the protocol, adjust the search string and filter the results using inclusion and exclusion criteria.
- The user shall be able to analyze and extract data.
- The user shall be able to download the report of whole review steps.

3.1.2. Non-Functional Requirement

- The application must be easy to use.
- The query search must be fast and accurate.
- It must be free to use the software.

- The security must be high.

3.2. System Design

UML Diagram	Description
Use Case Diagram	It shows the interactions between a system and its environment
State Chart Diagram	It shows how the system reacts to internal and external events

Table 2: Various Types of Diagram

Diagram	Description
General Approach	It shows the top-level approach of how this application was designed
Deployment Diagram	It shows how the system is deployed when first launched and how it works.

Table 3: Various Types of Diagram

3.2.1. General Approach

General approach diagram shows the top-level approach of how this application was designed.

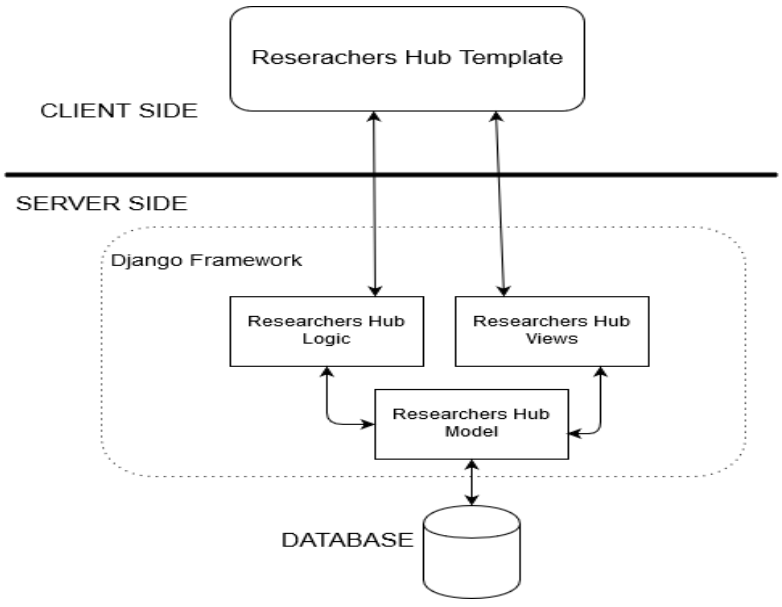

Figure 1: General Approach (MVT) Diagram of Researchers Hub

3.2.2. Deployment Diagram

Block diagram discusses the database chosen, services and business logic. Block diagram provides information about how these different blocks are connected and how they interact with one another to build a complete system.

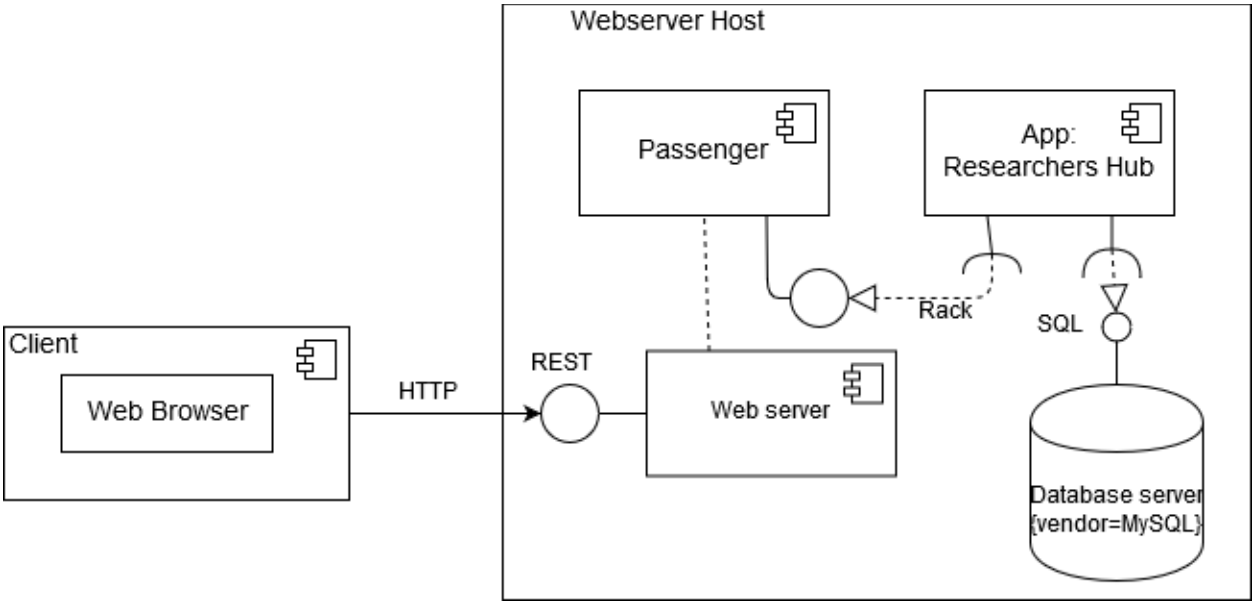

Figure 2: Deployment Diagram of Researchers Hub

3.2.3 Use Case Diagram

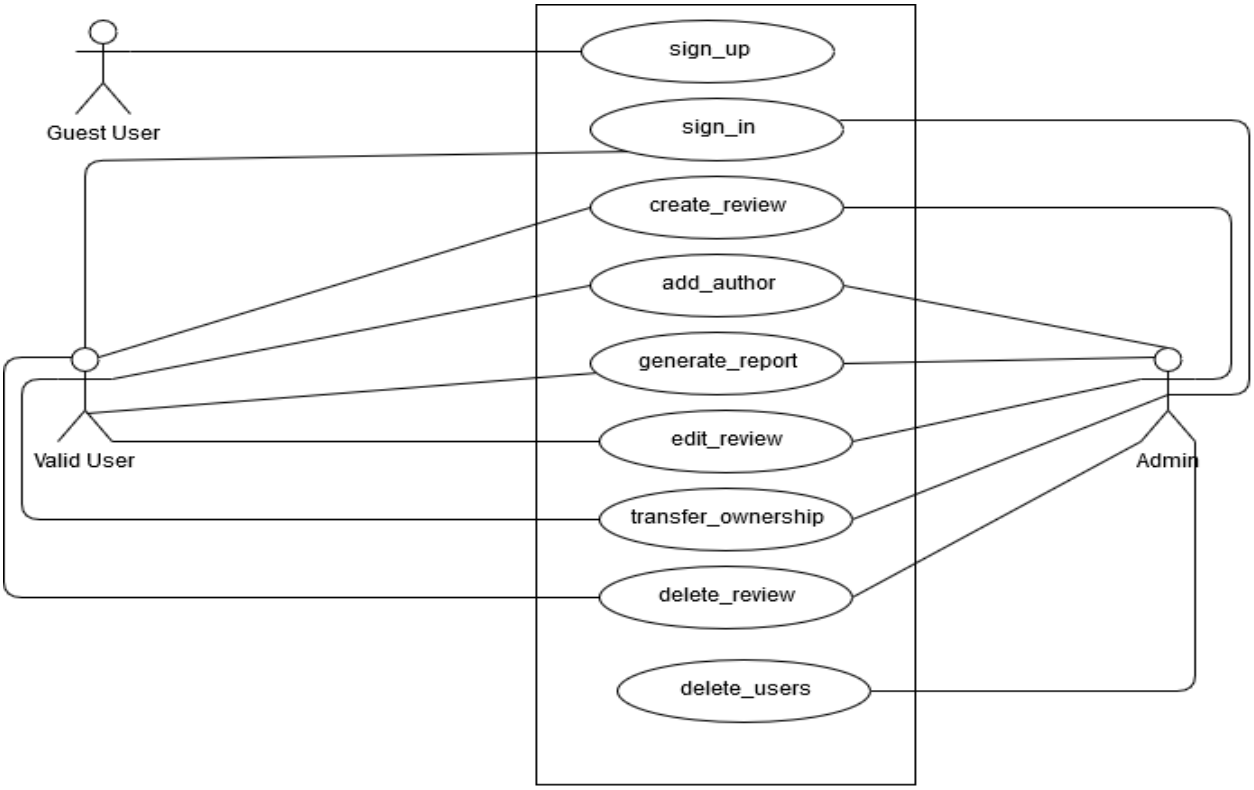

Figure 3: Use Case Diagram of Researchers Hub

3.2.4 State Diagram

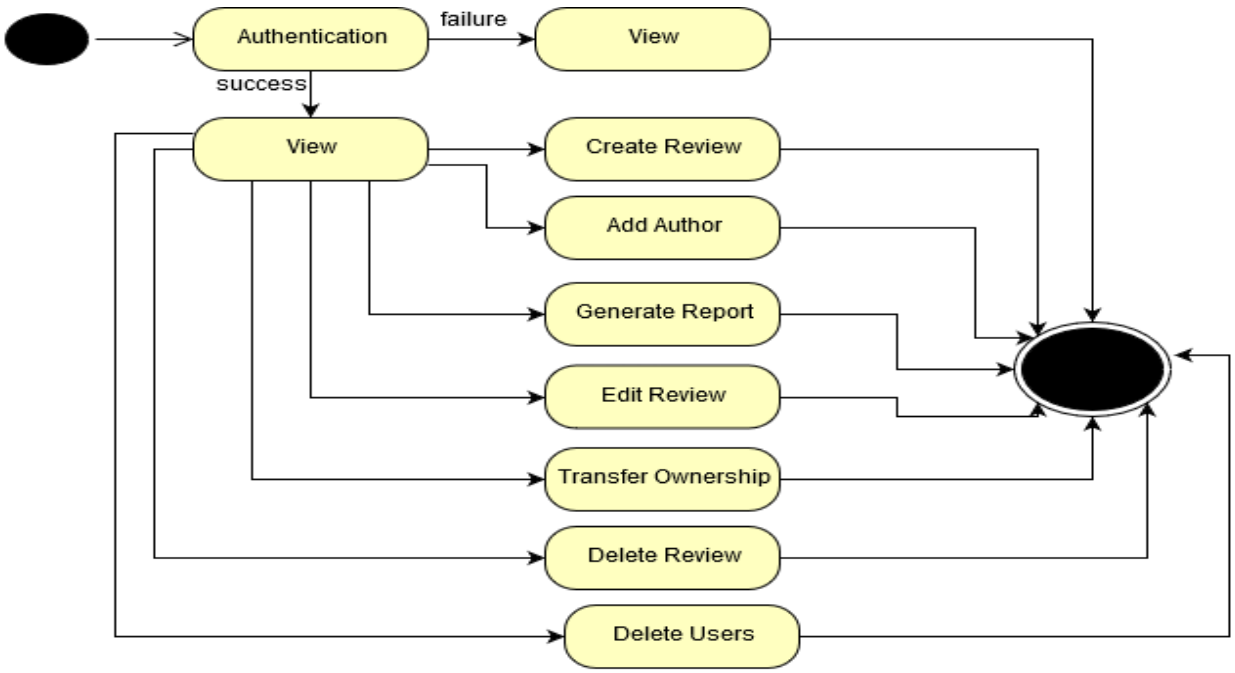

Figure 4: State Diagram of Admin

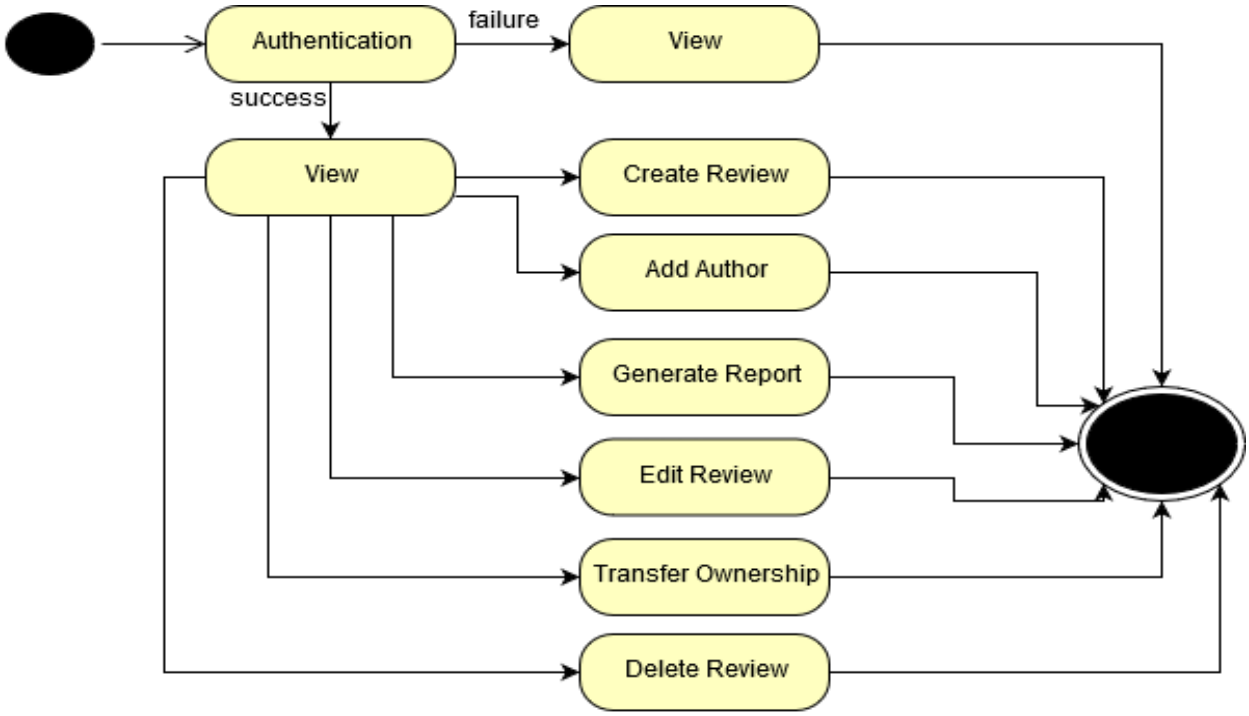

Figure 5: State Diagram of User

CHAPTER 4: IMPLEMENTATION AND EVALUATION

4.1. Tool and Technology

- System Specification and Design: Single Page Architecture Block Diagram, Class Diagram, Sequence Diagram and State Diagram are used.
- System Development: On the surface level system development can be divided as follows:
    - User Interface: HTML, CSS and JavaScript (JQuery) are used.
    - State Management: Python and Django are used.
    - Data Storage: MySQL is used.
- System Testing: To test the application Django's test-execution and utilities are used. For some views test are conducted using the unittest module built in Python.

4.2. Implementation

The Researchers Hub application runs on Django, a high-level Python Web framework that encourages rapid development and clean, pragmatic design. Since Researchers Hub is a web-based application it can run on web browser of any operating system.

An effort was generally made to look for already established libraries to provide functionalities to the system. BibTeX, a Python package, was used for the import and export of BibTeX. xlwt library was used for the export of spreadsheet files(.xls) compatible with Microsoft Excel. python-docx library was used for creating, updating and exporting Microsoft Word (.docx) files.

The Sequel library which provides ORM functionalities as well as an abstraction layer of SQL, is used to access the database. The system has been tested on MySQL. MySQL is recommended for intensive use by multiple users on a shared server as well as for immediate use of the application in a mono user environment.

Each resource has a distinctive URL to follow the REST style. For example, the review can be accessed with identifier 1 via the path /review/1, and its messages and route searches in routes/review/1/messages and /review/1/searches, respectively. Only the information on user authorizations and the output messages from actions on resources is stored from the session, such that each action on a resource can be carried out directly through accessing a URL.

A client can use any browser that is standard-compliant, that accepts HTML5 and Javascript. The system has been successfully tested in Firefox, Chrome and Brave. Bootstrap is used as the main tool kit to generate HTML, CSS and Javascript, since it ensures maximum compatibility between different types of browsers.

4.3. Evaluation and Result

The software Researchers Hub was evaluated considering three criteria. The first criterion was usability. Researchers Hub was used in a simplified SLR process by three participants. The second criterion was the extent to which Researchers Hub satisfied the requirements of SLR users in the SE field, assessed by using the method described by Al-Zubidy et al. The third criterion was coverage of tests and maintainability. For testing Django's test-execution and utilities were used. For some views test were conducted using the unittest module built in Python.

The Researchers Hub software usability test aimed to determine whether the participants were capable of using Researchers Hub to conduct an SLR. Usability requirements and problems were identified and an assessment made of the software's perceived level of usability. The test was held with three individuals. Five usability problems were identified and seven suggestions were made. Two bugs were also detected and immediately corrected following application of each procedure.

The process based on DISSMET methodology used by Al-Zubidyet al. was used to evaluate Researchers Hubs' suitability in relation to SLR user requirements in the field of SE. A rating system of Full (1point), Partial (0.5 points) and None (0 points) was applied to the software tool's coverage of 53 detailed requirements. The 53 requirements are divided into 11 consolidated groupings. Each consolidated group score is the average of the coverage scores of the detailed requirements making up the group. The overall cover-age score is equivalent to the weighted mean of the consolidated requirement scores, obtained by assigning a weight from 10 to 1, according to the order of importance in which the original study users ranked each requirement coverage. A conservative rating system was used, in which Researchers Hub was rated as having full coverage of a detailed requirement.

Testing a Web application is a complex task, because a Web application is made of several layers of logic – from HTTP-level request handling, to form validation and processing, to template rendering. Hence Django's test-execution framework and assorted utilities were used to simulate requests, insert test data, inspect Researchers Hub's output and generally verify the code is doing what it should be doing. Furthermore, Python standard library module, unittest, was used to test classes. When unittest are run, the default behavior of the test utility is to find all the test cases (that is, subclasses of unittest.TestCase) in any file whose name begins with test, automatically build a test suite out of those test cases, and run that suite.

CHAPTER 5: CONCLUSION

This paper presents Researchers Hub, a web-based systematic literature software that supplies the necessary functionalities for managing the complete literature review process, covering the stages of planning, conducting, data extraction and reporting. The performance of rigorous systematic summaries, developed in an efficient way, allows greater development in various scientific areas, as the preceding literature is better integrated into the new findings. The use of software allows researchers to track their decisions and disagreements, an extremely cumbersome process when performed manually. And because Researchers Hub can be used in a distributed manner, systematic reviews can be carried out by multiple researchers working in conjunction from their respective countries. This would be particularly useful in SE, for teams developing SLR running Global Software Development. During the development period, the software was integrated in a natural manner to the workflow of various researchers, who remarked on the improved organization of their work and how the software's capability for analyzing citation relationships between articles greatly facilitated gaining new insights into the literature.

CHAPTER 6: LIMITATION

The software's main limitation is the lack of independent evaluations, which would provide an objective vision of the application's adequacy in relation to the requirements and its usability. In addition, the preliminary test and surveying of requirements have only been carried out the researchers who are novice in performing SLRs, thus it is unknown to what extent this tool meets the needs of expert researchers. Considering the requirements viewed as most important by SLR users, Researchers Hub does not have the ability to an integrated search system that enables directly indexed bibliographic databases.

With regard to future steps to be taken, it is very important to resolve usability problems detected in the user testing, particularly the lack of complete consistency in GUI elements. In addition, the administration interface needs improvement, specifically the assignment of documents and the resolution of acceptance or rejection of instruments.

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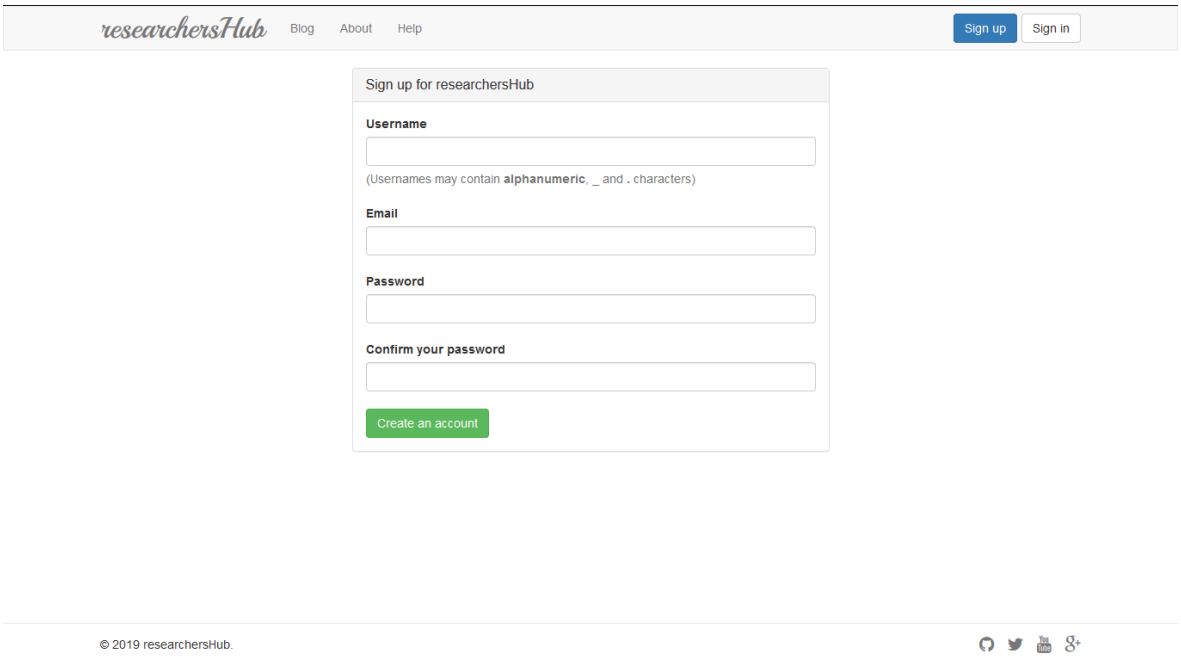
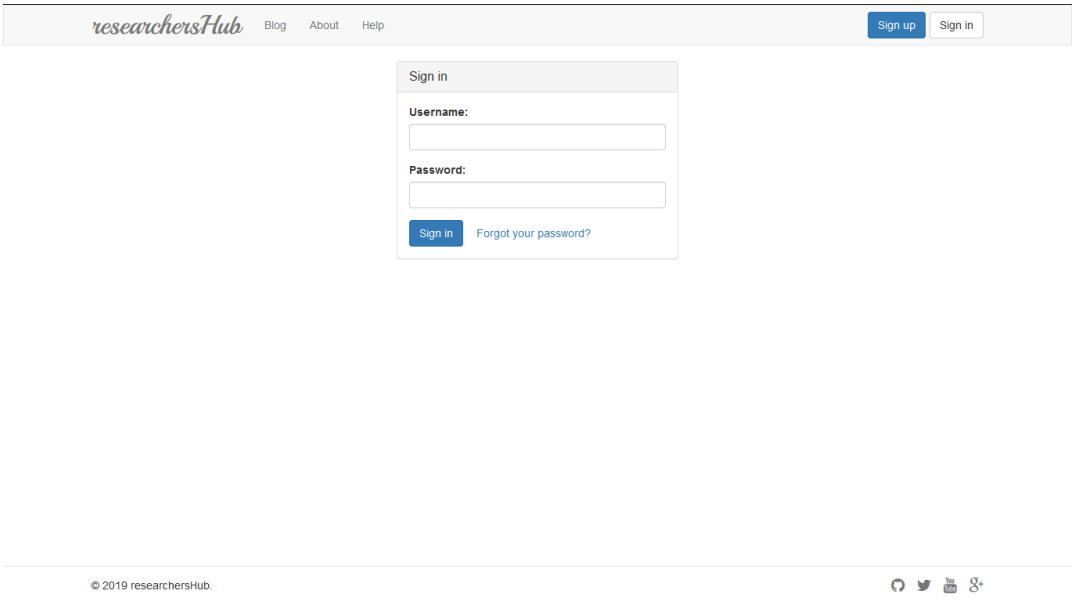
[5] “Documentation,” Django. [Online]. Available: https://docs.djangoproject.com/en/2.2/topics/testing/. [Accessed: 28-Oct-2019].

APPENDIX I: AUTHENTICATION

User can sign up to this application using following sign up form.

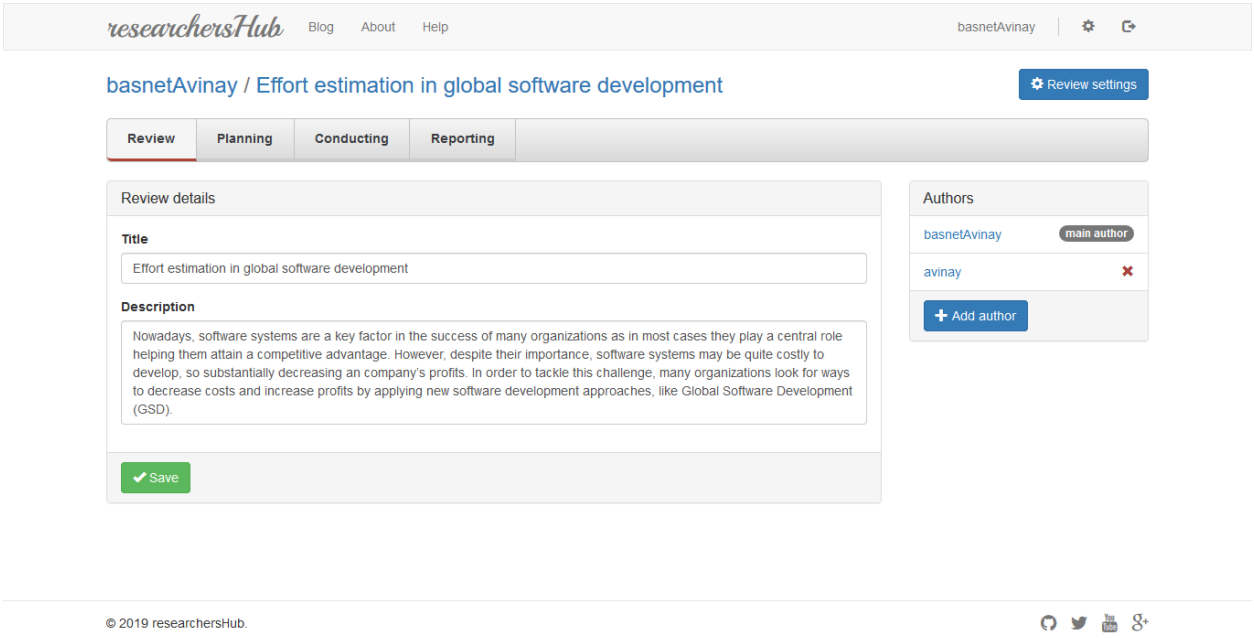


User or admin sign in to this application using following sign in form.



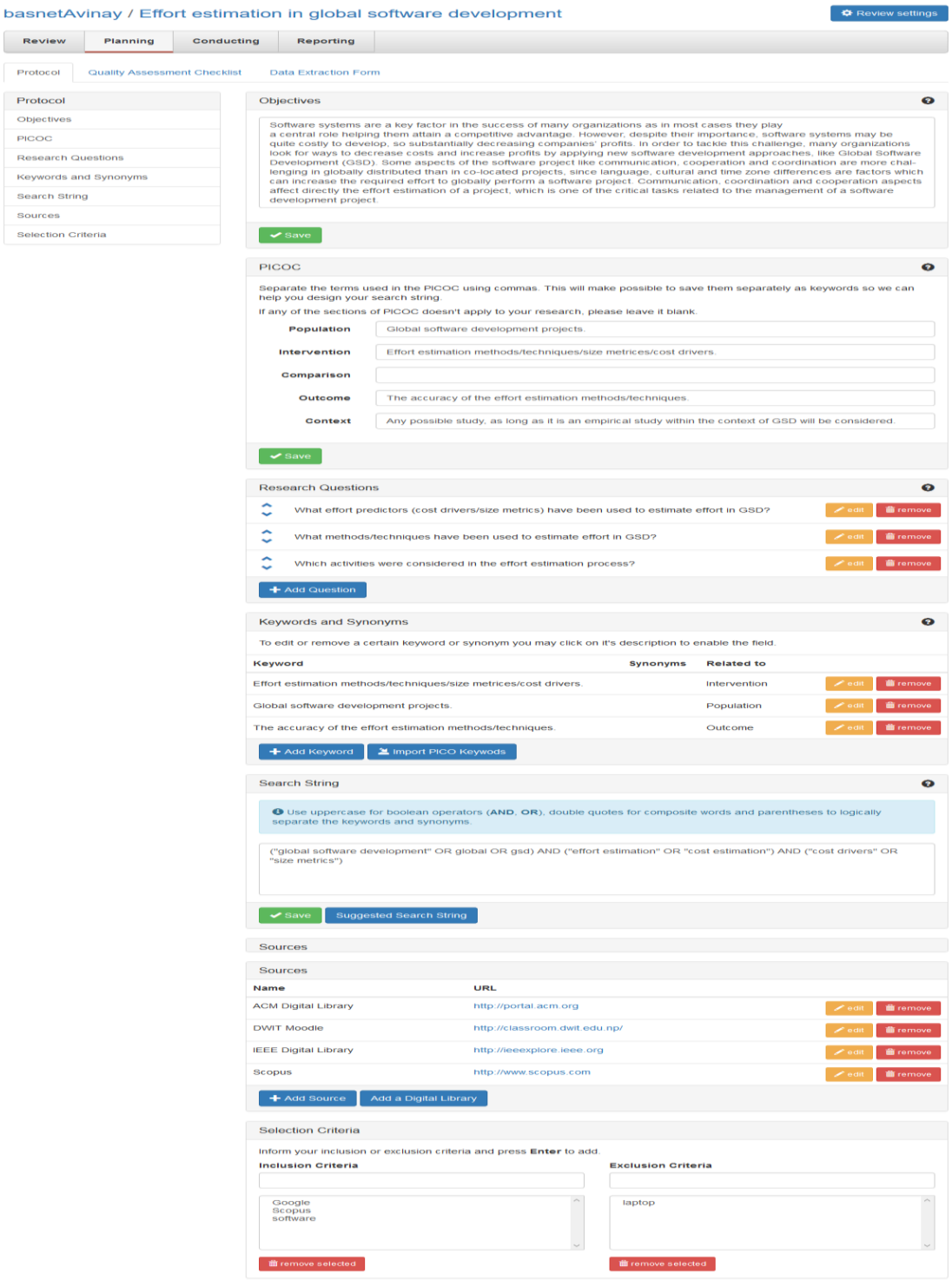
APPENDIX II: REPORT REVIEW

This is the page which is displayed after clicking on review where user can edit review details and add invite other users via clicking Add author button.



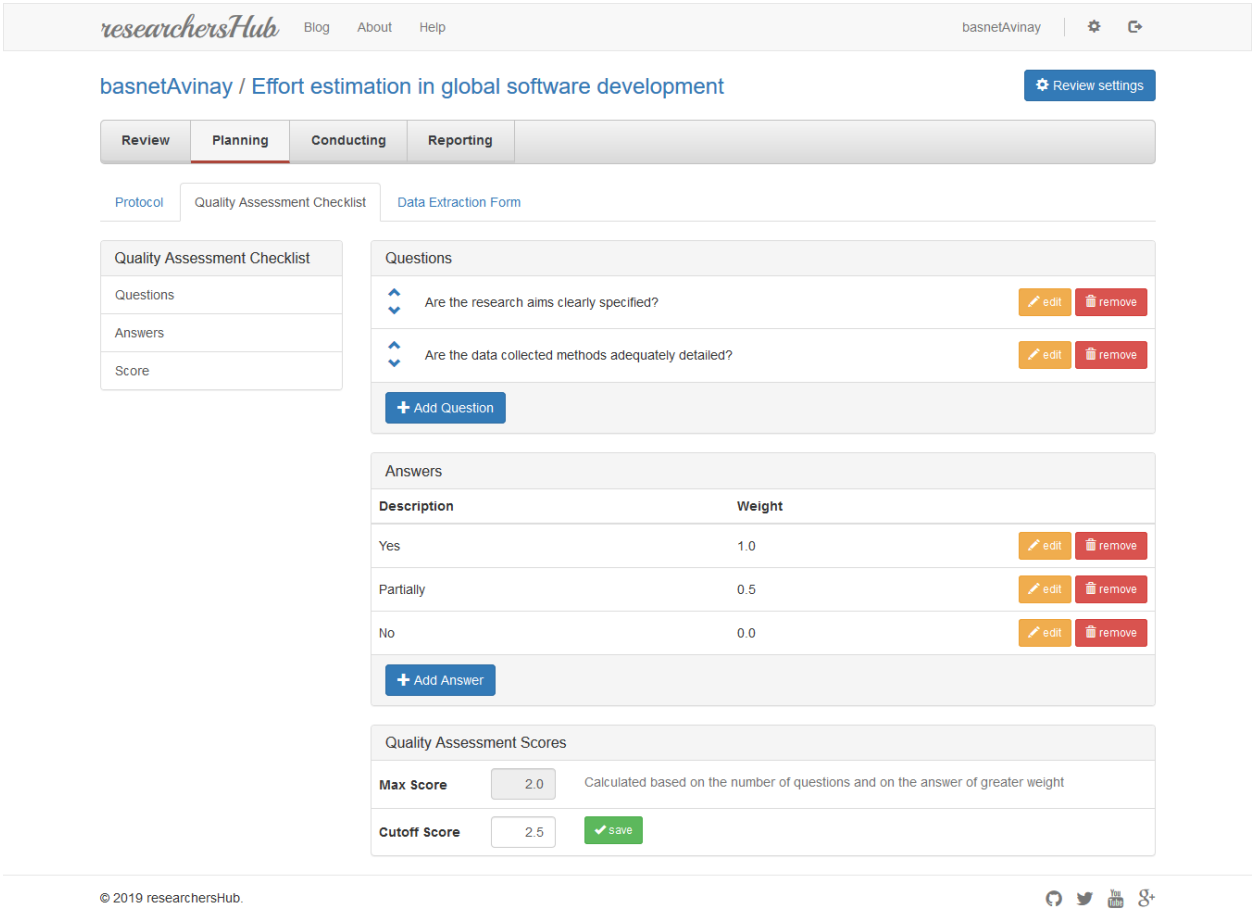
APPENDIX III: PLANNING PHASE (PROTOCOL)

This is the page where user can set objectives, PICOC, research questions, search string, keywords and synonyms, select the sources, the inclusion and exclusion criteria.



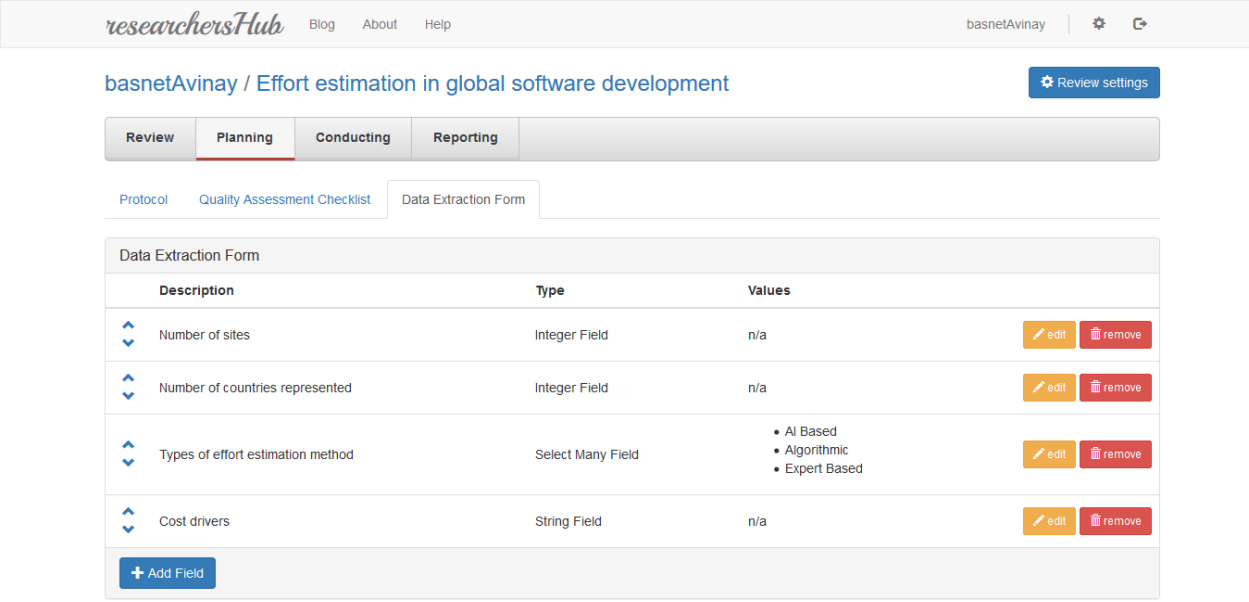
APPENDIX IV: PLANNING PHASE (QUALITY ASSESSMENT)

This is the page where user can prepare questions, answers, and cut off score for quality assessment.



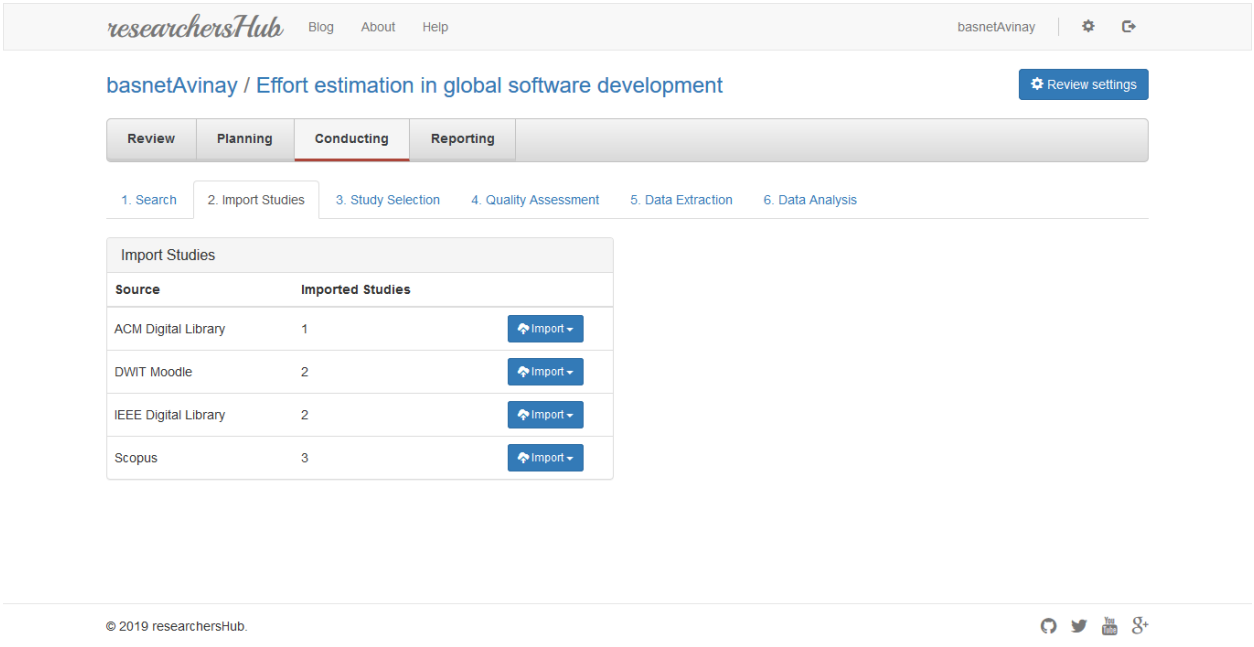
APPENDIX V: PLANNING PHASE (DATA EXTRACTION)

This is the page where user can describe the type of data to be extracted.



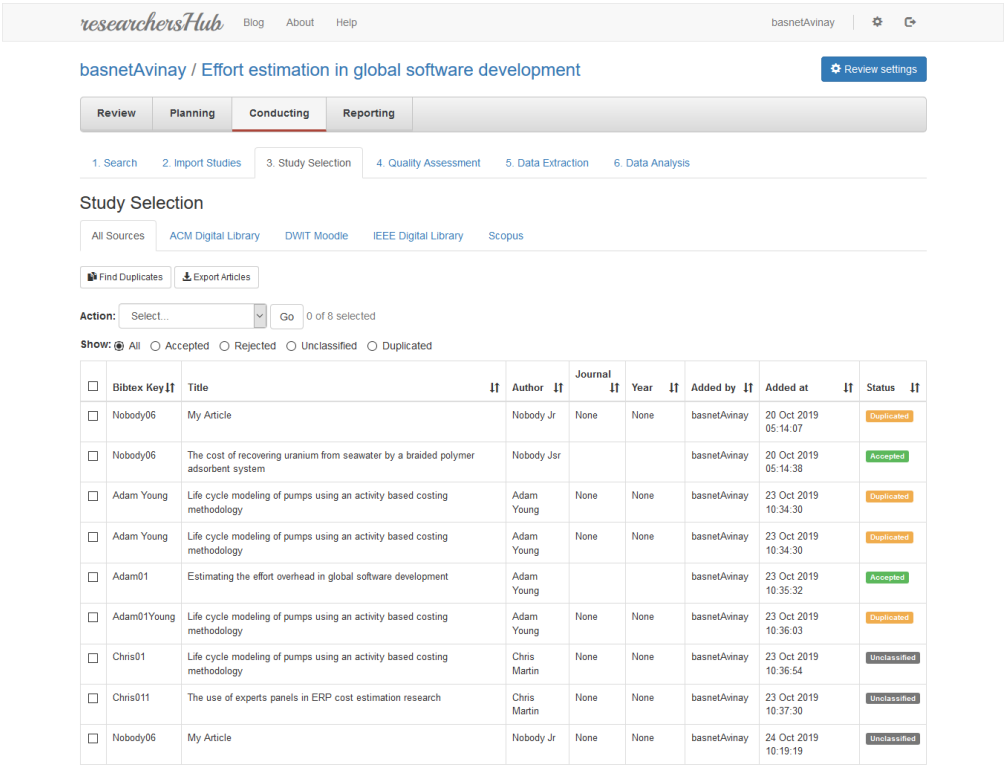
APPENDIX VI: CONDUCTING PHASE (IMPORT STUDIES)

This is the page where user can import bibtex files for the sources defined in planning phase.



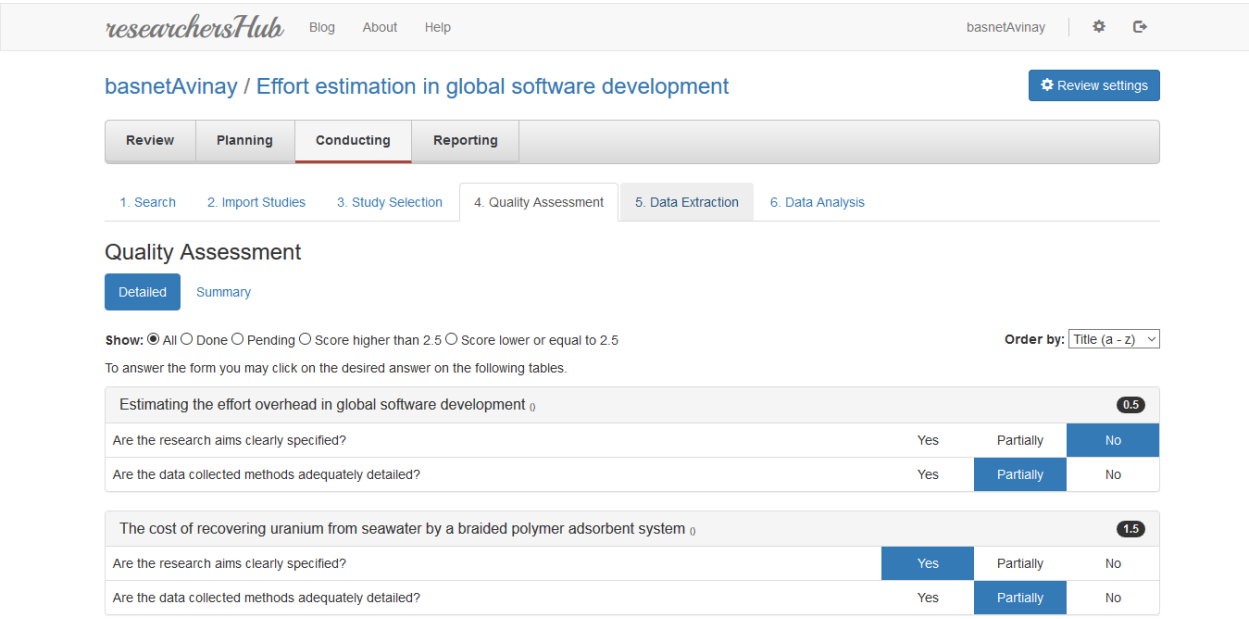
APPENDIX VII: CONDUCTING PHASE (IMPORT STUDIES)

This is the page where user can select studies, find duplicates resources and resolve them.



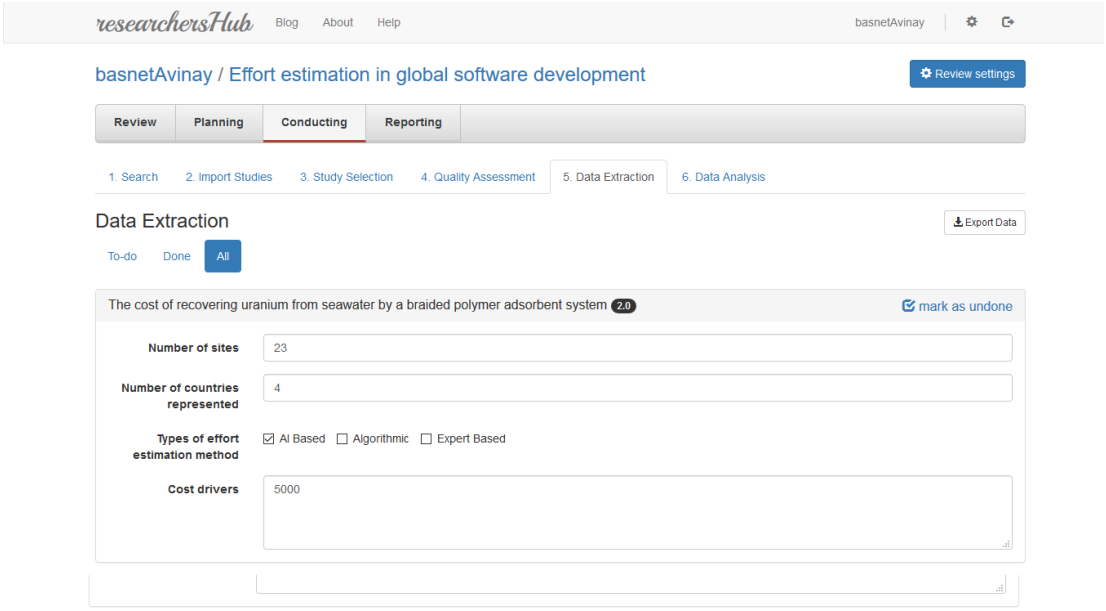
APPENDIX VIII: CONDUCTING PHASE (QUALITY ASSESSMENT)

This is the page where the quality assessment question developed in planning phase are answered. Only accepted study can be answered.



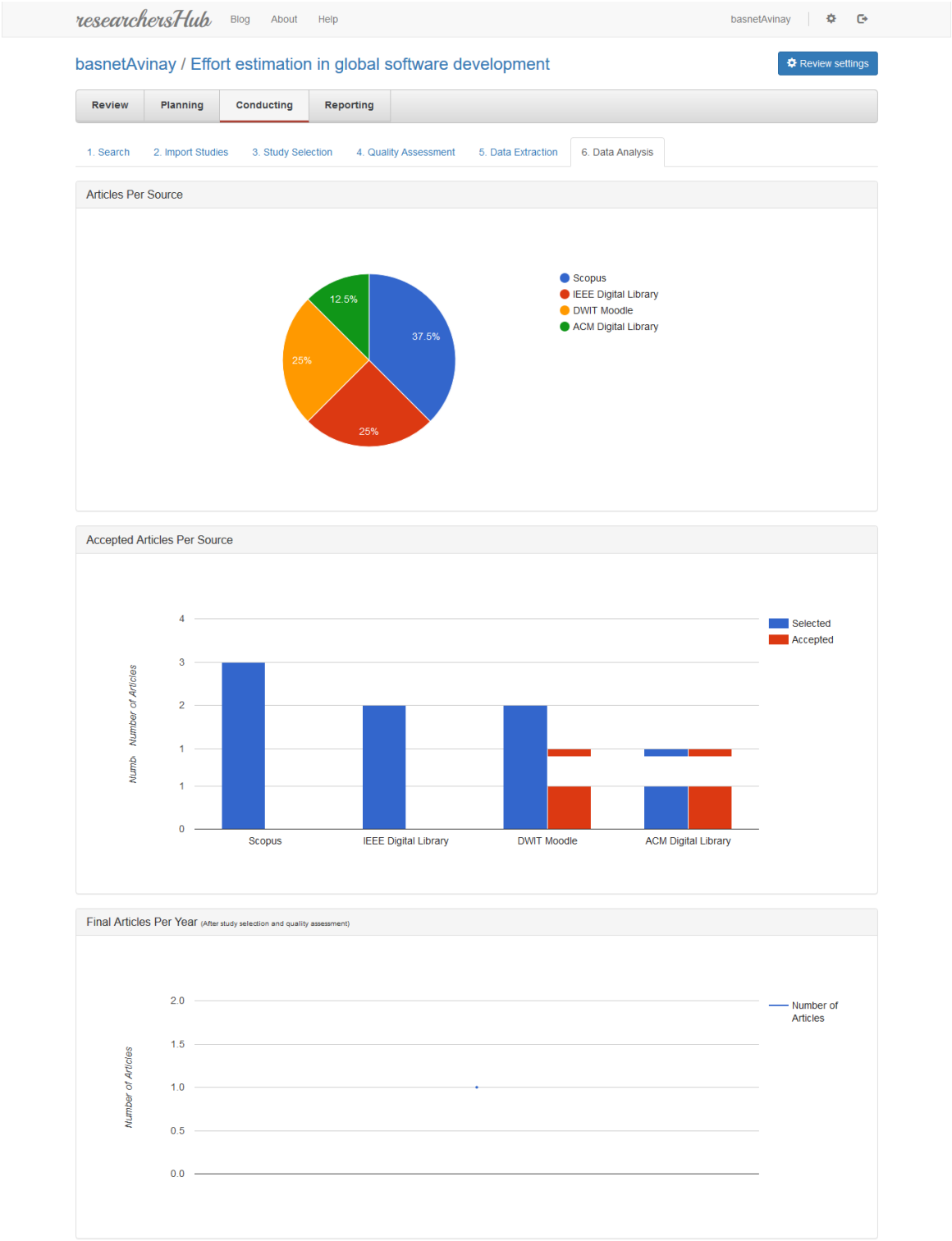
APPENDIX IX: CONDUCTING PHASE (DATA EXTRACTION)

This is the page where user can extract the data in ".xls" format.



APPENDIX X: CONDUCTING PHASE (DATA ANALYSIS)

This is the page which displays the analysis of the study selected and unselected.



APPENDIX XI: REPORTING PHASE

This is the page where user can export review process in ".docx" file.