KeepUP: A CMS tool for Medical Literature

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Introduction

Research Question : How can medical literature be made available to professionals and nonprofessionals in a simple application

Objective 1 : Conceptualise and design a CMS tool for Medical Literature that is useful to stakeholders

Objective 2 : Implement the design producing a prototype. Conduct functional, nonfunctional and usability testing

Objective 3 : Develop the main product and evaluate the usability of the application

Project Outline
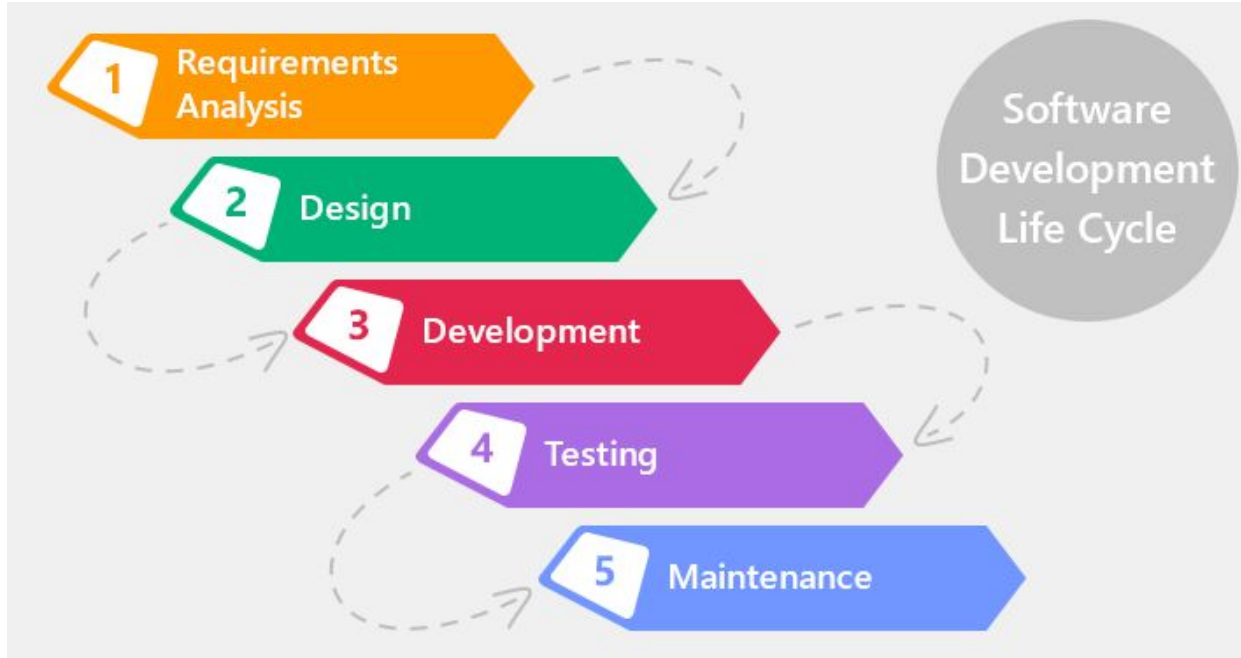
- ❖ Requirements Gathering

- ❖ Design

- ❖ Implementation

- ❖ Testing

- ❖ Evaluation

Figure 1 : The Waterfall Model of the Software Development Life Cycle (Gordiyenko, 2014)

Stage 1: Requirements Gathering

❖ Primary Research and Analysis

❖ Secondary Research and Market Analysis

❖ Identifying Stakeholders

Primary Research

❖ Method: Structured Interviews with Open Ended Questions

❖ Sample : 10 Interviews . Subjects varying in age

❖ Main Findings :

- 8 out of 10 interviewees said that the application would be useful to them
- clear trend of rising frequency on seeking out latest medical literature based on specific medical conditions with an increase in age
- 7 interviewees used the web as a medium
- Latest information using most accurate sources most important non functional aspect
- Simplicity, ease of use and learnability most important usability aspects

Market Analysis

Strengths	Weaknesses
·Latest articles from the trusted' *New England Journal of Medicine'* ·Free Application ·Audio/Visual Content	·Not Personalised to end user ·Mostly used by medical professionals ·Limited to one journal ·Only centralises the literature does not offer input of credibility ·No user interaction ·Only available on iOS platform
Opportunities	**Threats**
·Scope for a more personalised services ·Expand to other journals and sources of information ·Expand to other operating systems	·As the journal and application are the main sources of information, could be exposed to legal risk

❖ SWOT Analysis for NEJM This Week (Society, 2015)

Existing Systems Analysis

Strengths	Weaknesses
·Free application ·Offers credibility rating on information ·Desktop application - easier to read and use and larger number of people are skilled with using desktops over smartphones ·Allows medical literature to be added into favorite page ·Aimed at non professionals ·Only aggregates available data, is not the source of any information	·Not Personalised to end user · Does not have an established consumer following ·Consumers may prefer smartphone apps
Opportunities	**Threats**
·Scope for a more personalised services ·Potential to attracting non-physicians to use the app which has not been done in the market much	· Imitability is easy. Does not have sustainable competitive advantage with credibility rating system. Competitors could provide offering if successful

❖ SWOT Analysis of KeepUP App

❖ Competitive Advantage - offers credibility rating and is a desktop application.

❖ Credibility rating will be Core competency and focus of further development

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Secondary Research

❖ Research involved identifying gaps in the market and existing medical literature aggregators

❖ Based on Global Burden of Disease (GBD) of the World Health Organization (WHO) most prevalent conditions, which would be useful to include in the initial development of the application, are iron-deficiency anemia, hearing loss, migraine, low vision, asthma, diabetes mellitus, osteoarthritis (OA)

❖ Some of these conditions such as hearing loss and low vision do not have enough health care applications that include them. Including, these conditions in the application could fill a vital gap in the market

Identifying Stakeholders

Identifying the Primary, Secondary, tertiary and facilitating stakeholders

❖ Primary Stakeholders - Users of the System (health care consumers and clinicians , aged between 25-60)
❖ Secondary Stakeholders - Actors that produce input for the system (Online Medical Literature Sources)
❖ Tertiary Stakeholders - Actors that are affected by the success/failure of the project (Competitors, Possible investors of the project, Healthcare professionals)
❖ Facilitating Stakeholders - Actors involved in the conceptualisation, design, development and maintenance of the project (Designers, Developers and Testing team)

(Mosa, Yoo, and Sheets, 2012; University of Cape Town, 2010)

Stakeholder Analysis

Analysis of stakeholders in terms of the following aspects:

- ❖ Aims
- ❖ Sources of satisfaction
- ❖ Knowledge and skills
- ❖ Attitudes to work
- ❖ Work-group attributes
- ❖ Nature of activities
- ❖ Responsibility
- ❖ Working conditions

Establishing Requirement Specifications

Functional requirements

- ❖ App has to run

- ❖ Aggregator of sources

- ❖ Filtering of information

- ❖ Credibility Rating Mechanism

Non functional requirements

- ❖ Accurate filtering and aggregation of information

- ❖ Accuracy in the rating system

- ❖ Speedy Performance

- ❖ Responsive

Establishing Requirements

Usability requirements

- ❖ Simple/Clear design
- ❖ Ease of learnability fostered by help page and clear graphics
- ❖ Easy navigation between pages allowing ease of use
- ❖ Large font, scrolling and colour combinations following theories of Gestalt's law allowing ease in reading

Software Requirements and Hardware Requirements

- ❖ Sketch for Design Phase
- ❖ Eclipse IDE for Java Developers
- ❖ Oracle SQL - to build supporting DB
- ❖ Java API - to crawl data from web
- ❖ Desktop/PC
- ❖ Mouse, Keyboard

Stage 2 : Design

❖ Functional Specification and Flow

❖ Use Cases

❖ Design Mocks

❖ Database Design

Building System Requirements

Flow Diagram for user who wants to view latest articles, studies, journals on a medical condition
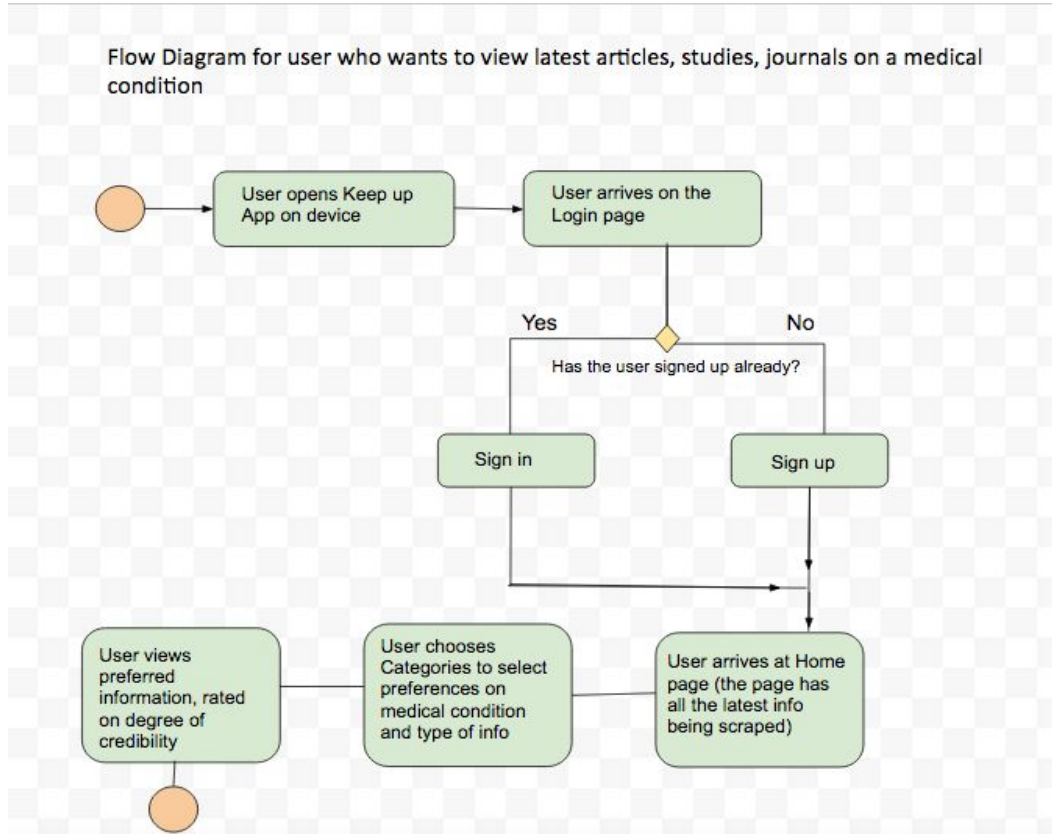
Figure 2 : An initial specification of how users will interact with the system

- ❖ Login - Authentication Process
- ❖ Aggregating Information in Home Page
- ❖ Displaying Rating under each headline
- ❖ Filtering Information in Preferences Page
- ❖ Displaying Results in the Search Results Page
- ❖ Favorites page to store articles to view in the future again

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Building System Requirements

Use cases are descriptions on how users will perform major tasks using the application.

They help to explain how systems should behave during the interactions with the user.

(U.S. Department of Health & Human Services, 2013)

- ❖ User signs up with application
- ❖ User logs in to the application
- ❖ User would like to view latest medical literature
- ❖ User would like to view latest articles on diabetes
- ❖ User would like to view favorite articles

Design Mocks

- Functional Aspects based on Use Cases

- Aesthetics based on Gestalt's Laws

- Usability Aspects based on usability requirement specifications developed through primary and secondary research

- ❖ Simple/Clear design

- ❖ Ease of learnability fostered by help page and clear graphics

- ❖ Easy navigation between pages allowing ease of use

- ❖ Large font, scrolling and colour combinations following theories of Gestalt's law allowing ease in reading

Design Mocks

Gestalt Laws

- Proximity
- Similarity

❖ Large font, scrolling and colour combinations following theories of Gestalt's law allowing ease in reading

Design Mocks

- ❖ Ease of learnability fostered by help page and clear graphics
- ❖ Easy navigation between pages allowing ease of use
- ❖ Simple/Clear design
- ❖ Consistent use of Colour Scheme and Placement of buttons
- ❖ Size and design similar to mobile applications for familiarity to users

Database Design

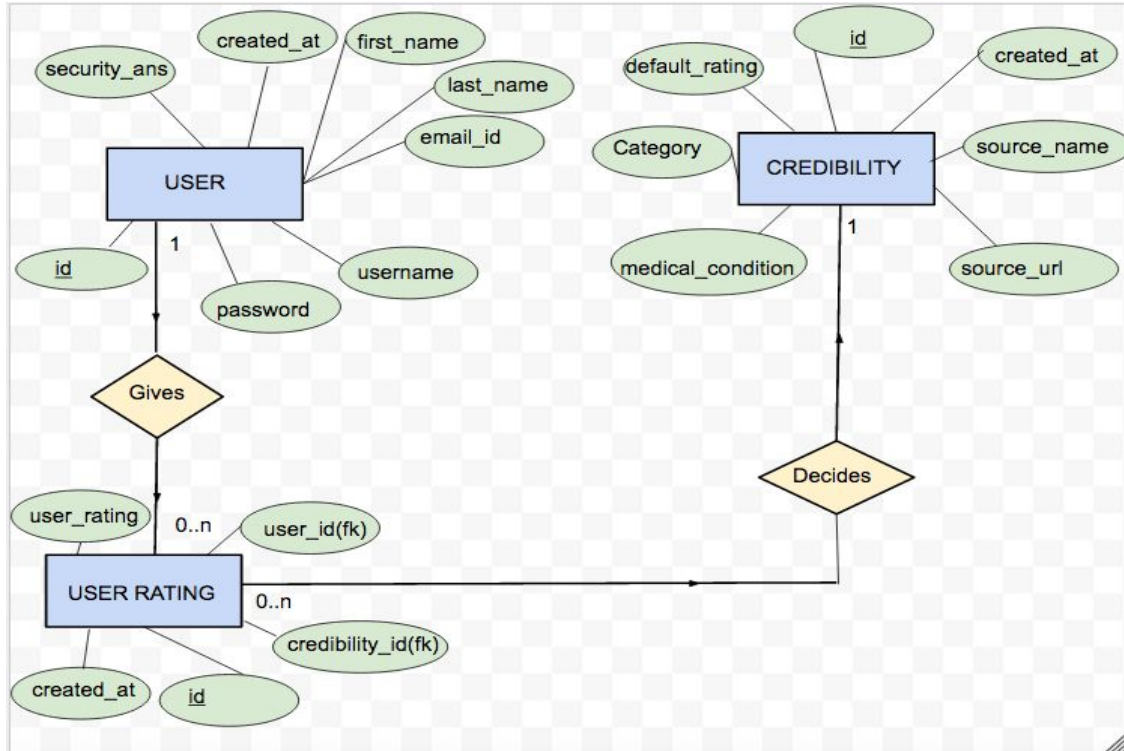Figure : Conceptual Schema of Database

The diagram represents a high level design of the database

The Conceptual Schema consists of three entities (User, Credibility and User Ratings) with attributes related to the entities and that build entity relationships with other tables where relevant.

The nature and degrees of the relationships are described in the diamond boxes and connections between the entities.

Database Design

Figure : EER Diagram of Database

The EER Diagram is a more detailed representation of the database design with details entailing the columns that would serve as primary, foreign and candidate keys in the database.

The EER diagram is summarise in the Relational Schema, which is a normalised form of the relations.

User (IdUser, FirstName, LastName, EmailId, Username, Password, SecurityAnswer, CreatedAt)
User Rating(IdUserRating, IdUser(fk), UserRating, IdCredibility(fk), CreatedAt)
Credibility(IdCredibility, SourceName, SourceURL, DefaultRating, CreatedAt, Category, MedicalCondition)

Stage 3 : Implementation

❖ Design Changes and Decisions

❖ Credibility Rating

❖ Softwares and libraries used

❖ System Architecture and Coding

Design Changes

❖ Eclipse IDE for Java Developers (Version: Luna Release (4.4.0))

❖ MySQL Workbench (Version 6.3.7) -

To create a local database to store user details and information on sources

i) A lighter weight technology that is useful for simpler architectures ii) Very fast

❖ RSS Feeds -

i) Useful to use as an aggregator ii) Easily accessible iii)Comes in the form of headlines iii)Provides latest information

❖ Removal of Starred Page from Design

i) To focus on core competency of providing credibility rating

❖ Credibility Rating of Sources based on a set of criteria

(TutorialsPoint, 2016) 22

Credibility Rating

Criteria	Description	Weightage
Information Accuracy	·Is the information current? ·Is it backed up by existing research? ·Is the information reviewed?	3 points
Author/Publisher Credibility	·Author Credibility Perception ·Advertising/Promotional messages present ·Details about Publisher present and Source of funding	4 points
Peripheral Judgement	·Web Address ·Website Credibility (quality of navigation and template design)	3 point
Overall Rating		10 Points

Table 2 : Criteria for assessing Credibility of the sources of information

The criteria is based the most important aspects that influence the credibility and perception of credibility of the source, to the user

- ❖ Measuring Information Integrity
- ❖ Measuring Source Credibility
- ❖ Measuring Peripheral Judgement

(Spyridakis and Freeman, 2003; UCSF Medical Center, 2002; Centers for Disease Control and Prevention, no date)

Softwares and Libraries used in Code

Java Libraries	External Libraries
Javax.swing	mysql-connector-java (Version 5.1.39)
java.util	Jsoup (Version 1.9.2)
java.io	
java.net	
java.sql	
java.awt	
java.xml	

System Architecture of KeepUP Application
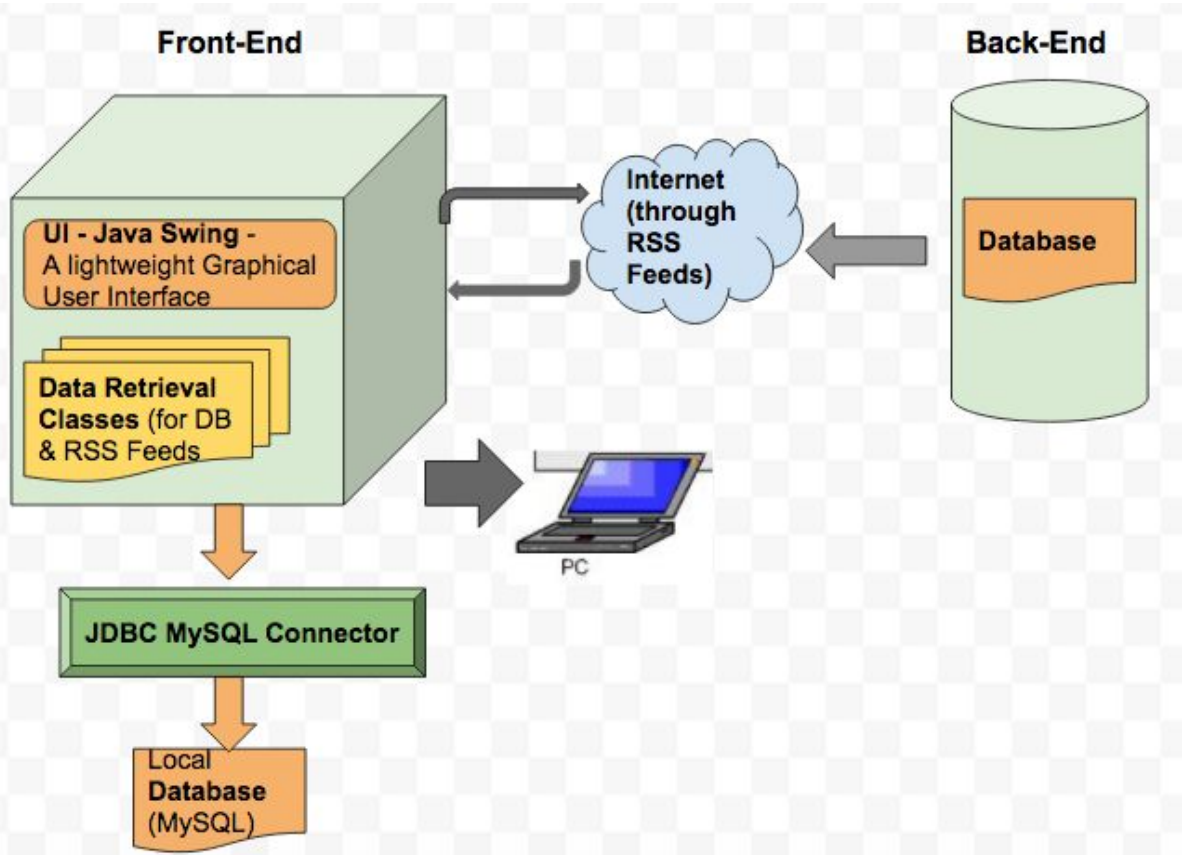
System Architecture of KeepUP Application

Java Swing is used to create the UI of the application

Data Retrieval Classes are used to call database elements and RSS Feeds based on the user's specifications

The Local Database is integrated with the front-end through JDBC MySQL connector

RSS Feeds are called from the web to the front-end. The Feed is filtered and displayed on the UI

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Stage 4: Testing and Evaluation

❖ Functional Testing

❖ Usability Testing

❖ Usability Evaluation

❖ Recommendations for further development

Functional Testing

Black-Box Testing Method to test all functions at Unit Level (Page by Page). Created a Test Plan Table with following layout to identify bugs and missing functions (Saleh, 2009;)

Test #	Test Cases	Input	Expected Output	Actual Output	Bugs

Assessed Bug Severity by Industry Standard Severity Rating

- **Severity 1: Extremely Urgent** (Hot fix - fix asap)

- **Severity 2: High** (Blocker - must fix before next release)

- **Severity 3: Medium** (Critical - must fix before next release)

- **Severity 4: Low** (Major - should fix if time permits)

- **Severity 5: Very Low** (Minor/Trivial - would like to fix but can be released as is)

Usability Testing

Technique: Goals Operators Methods and Selections rules (GOMS) model
i) provides an insight into the user's behaviour ii) verification that a method exists to perform the task iii) verification of the efficiency of the method iv) verification of how simple the method is (Lorin, 2002)

Experiment
Uses Keystroke level model, a simple variant of the GOMS method is used. It consists of keystroke level actions like moving the mouse or pressing a key on the keyboard.

Likely User Goal : User would like to view latest medical literature

Results : Total time taken for task: MPKR MPKH MKKKKKKKK PHK MKKKKKKKK PK R MMMM PKR (Raskin, 2000)
$$2.65 + 3.05 + 2.95 + 4.65 + 1.3 + 5.4 + 1.3 = 21.30 \text{ seconds}$$

- New users take 21.3 seconds to select an article in the home page to view. The time taken includes the authentication process.
- Skilled users can view an article he/she is interested in within 20 seconds. For a user on the go, this would be easy to use and allow immediate consumption

Usability Evaluation

	Usability Criteria and Heuristics	Complied
Learning	User control and freedom. Recognize instead of Remembering.	Yes
Error prevention	Help the user to recognize, diagnose, and recover from errors. Help and Documentation.	Partly (Bugs known)
Memorization	Consistency and Standards. Help and Documentation.	Yes
Efficiency	Flexibility and Efficiency.	Standard for all users
Satisfaction	System state visibility.	Yes
Efficacy	Static and minimalistic design	Yes

Table 5 : Tukuchiy framework applied on KeepUP (Barrera-León et al, 2016)

Usability Evaluation through Tukuchiy Framework, that is a variant of Nielson's 10 Heuristic rules and user interface laws like Hick's Law, Fitt's Law, and Practice Law.(Card et 1983 ; Nielsen, 1994)

Recommendations for Further Development

❖ Use of APIs to crawl data from the web

❖ Launch the Applications on mobile web applications, such as Android and iOS platforms, taking advantage of new technologies like Angular 2

❖ Develop the credibility rating mechanism to be automated through an algorithm

❖ Automate the development process through Automated Testing

❖ Bring in remote database capabilities

Conclusion

❖ This project followed the software development life cycle of a desktop application called KeepUP.

❖ KeepUP can be used by professionals and nonprofessionals to easily access medical literature from a wide range of source in one medium.

❖ The application is an aggregator of information and provide functions such as filtering of the information and credibility rating for the sources of the information.

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