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Experience Design and Measuring User Experiences for Single Page Application

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<p>The aim of this project was to design a platform for healthcare community in Ethiopia and evaluate the product at each phase of the development. The studies and researches made, are intended to show the relevance of giving attention to the users needs and experiences to achieve the capability of performing satisfactory service and management of the website. The case study of Tena web service was used show how to distinguish important usability problems in both admin and user side of the web application.</p> <p>Tena's website is primarily intended to benefit the community health care as a platform for healthcare professionals, such as nurses, and doctors. Moreover, it is designed to be able to exemplify how usability tests and small modifications can impact delivering the goals and needs. The administrators of the websites are capable of using the simple, specific functionality they want. Iteration of tests was conducted using a suitable method of usability testing. The results reached found are not just essential usability problems that need to be considered in every design. They also show how specific things planned according to experiences and needs of the user groups could be fruitful in developing products.</p>	
Keywords	SPA, Usability test, ROI, Usability metrics, UX, UI, HCD, HCI

Contents

List of Abbreviations

1	Introduction	1
2	Overview	2
2.1	User Experience and Usability	2
2.2	Measuring User Experience and Usability Metrics	4
2.3	Experience Design	7
3	Case Study of Tena	11
3.1	Participant Demography	12
3.2	Process to Elucidate the Requirements and Prototyping	13
3.3	First Testing and Results	16
3.4	Tena Application Testing and Results	18
3.5	User Satisfaction and Testing Single Design	27
4	Development	31
4.1	Architectural Design	32
4.2	Database Design	33
4.3	Software Implementation	34
5	Discussion	36
	References	38

Appendices

Appendix 1 SUS test questionnaire

Appendix 2 The Positive and Negative Affect Schedule (PANAS)

Appendix 3 Questionnaire Answers and Revised Answers

Appendix 4 Admin page screen shots

Appendix 5 The query to create the tables after the database is defined

List of Abbreviations

SPA	Single page Application
ROI	Return on Investment
PANAS	Positive Affect Negative Affect Schedule
SUS	System Usability Scale
UI	User Interface
UX	User Experience
UCD	User-centered Design
HCD	Human-Centered Design
HCI	Human-Computer Interaction
HTML	Hypertext Markup Language
CSS	Cascading Style Sheet
MYSQL	My Structured Query Language

1 Introduction

A system can be overwhelming in features. The advancements can be felt as intimidating. But at the end, users should be able to perform what they want when they come to use a service. Helping the participants throughout the learning curve can cost a considerable amount of time and energy from the development of the application well as the testing. The waste can be prevented and avoided by making the user go through the design and development process. Thus, making the interface user-friendly is all about letting the user to control the technology smoothly in easy ways without complications and frustrations to perform their actions. It may create an experience of something meaningful. Therefore, this project aiming is to show how designing from experience and testing the interaction in iterations lets the users get what users want of the website. The idea can be expressed best in user satisfaction, efficiency in time and also the content value. Almost each and every web development process can implement a user-centered usability test. Moreover, it will have astonishing benefits when used in any project of any content and size.

The case study in this thesis is a website application for medical professionals in Ethiopia to share their experiences and learn recent medical knowledge and treatments. The process was handled from a distance, virtually using remote communication technologies to find out requirements, testing and measuring the user experience. The case study is based on the studies of experience design and usability matrices in each of the iterations of the development process. Based on the severity of the problems found the service is built towards the satisfaction of the user test groups, which are expected to use the service. Metrics are used to detect experiences based on different factors as user satisfaction, errors, relatedness, and happiness.

2 Overview

The first wave of computers was not designed; instead they were engineered. People had to learn how to use them and speak the language of the machines. Things started changing in the late 1980s when a new emphasis on users came to fruition. [1,10-15] Human to computer interaction has been advancing ever since. Experiences, as an important aspect to take into account when designing services, devices and products for users; has been recognized. Design, as it has been said [2,9-30] is the formation of importance, and as Hassenzahl focuses out, the embodiment of experiences into something that is usable. It is not about how fancy an individual product is or how many functionalities it has rather, the main point is how user experience the process of using the product. [3,2.]

2.1 User Experience and Usability

User experience is a broader concept, which has lead to arguments between different experts. Every expert has his or her definition of user experience. Most agree on the involvement of a user, in the design process, and that the user is interacting with a product, system or another thing (interface), which again changes the actions and experiences of the user. [4,4.] It is not the term user that makes them different but the whole concept. "Experiences become user experience by focusing on a particular mediator of experiences- namely interactive products - and the according to emerging experiences". [3,2.]

According to the ISO standard's definition, three variables need to be defined for a service study. (See Figure 1.) These variables are users, context, and content. Context refers to where and how the users will be able to use the service. That includes business goals, politics, culture, technology, constraints and so on. Content refers to the aims and goals of the using the service and what the users should achieve from it. Content includes objectives, document and data types, volume, existing structure and ownership. Users include audience and participants. Users define the group for whom the service is intended. [5.]

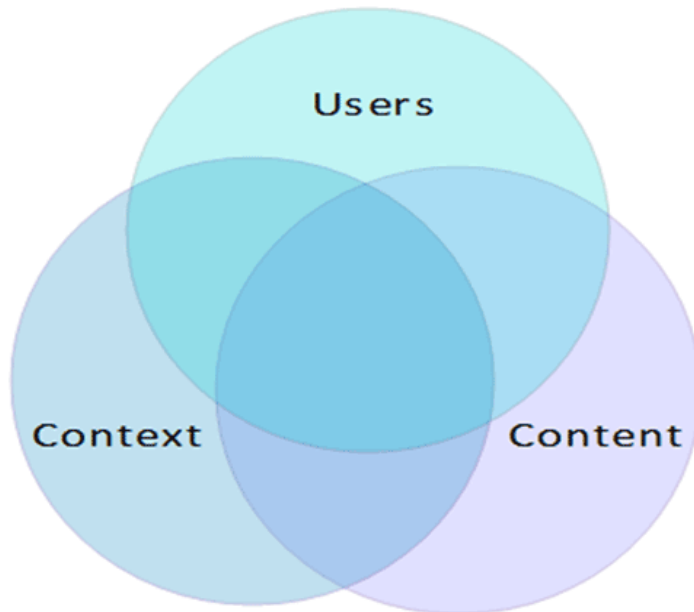


Figure 1. Concepts of User Experience [5.]

Usability was the term that researchers used when evaluating the fittingness of the product or service to its goals and the users' needs in a particular context for specific tasks. It originates from usability engineering. Usability Engineering is a discipline that provides structured methods for achieving usability in user interface design in a product development interface design during product development. User Interface Design (UID) is a subset of usability engineering.

Usability Engineering is a process of building "usability" into products. Various methods are involved throughout the design lifecycle. Methods can be incorporated into the design process easily. The methods help focus on the user throughout the process.

Ease of use, learning curve, subjective satisfaction, efficiency and effectiveness are the most common definitions that are given for usability. But before studying and measuring it, one needs to understand what it is and what it is not. Among the many definitions three of them are important for this thesis. The first definition is given by the International Standards Organization (ISO 9241-11), which identifies usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in specified context of use." [6; 7,25.] The Usability Professionals Association (UPA) definition focuses more on the product development process. They defined the term usability.

Usability is an approach to product development that incorporates direct user feedback throughout the development cycle to reduce costs and create products and tools that meet user needs. [4,4.]

In the very famous book ‘Don’t make me think’ Steve Krug gives a simple perspective.

Usability really means making sure that something works well: that a person of average or (below average) ability and experience can use the thing (product, tool or service) for the intended purpose without getting hopelessly frustrated. [8,5.]

When building web pages, or spaceships it is common to measure the usability of the system and risk minimization before the final product release. Mostly, usability tells whether the system succeeds in guiding its users through the interface to complete the goals of the system. Therefore, this thesis is about experience design of an interactive web application intended for medical professionals. The details covered in the thesis include usability of the interactive application mainly.

2.2 Measuring User Experience and Usability Metrics

Metrics are used for measurement and evaluation of a phenomenon. Usability matrices are no exception. Usability matrices refer to the measurements of usability. Usability matrices require agreement and guidelines to use as a reference, so that measurements can be made in a consistent throughout the process. Standard can be done by the reasonable sense of judgments as well as using already existing common standards.

As the science world uses different standard measurements for displacement, velocity, acceleration and so on; in usability, there are task success, user satisfaction, the number of attempts, task failure, completion time, efficiency and so on. The point is all usability metrics should be quantifiable, and one can measure it. [4,5.]

Measuring experience offers a lot more than a simple observation. Experience adds to the structuring the design, evaluation of the process, and insight into findings. It provides precise information to the decision makers and throughout the whole development process. Numbers are accurate and help to avoid “gut feelings”, or hunches.

Typical usability measurement and evaluation help overcome obvious usability issues but are hard to estimate in size and magnitude. It is easier to have all the user groups facing the same problem than two or three have a different problem experience. The situations give the magnitude of the problem and how likely the problem occurs. Usability metrics help to identify a way for finding improvements from one level of development to the next. Usability metrics are the only way for finding improvements by comparing each previous version with the current version. There are three possible outcomes:

- a) The newer version tests could be better than the previous;
- b) The latest version tests could be worse than the previous;
- c) There is no difference. [4,9.] Usability matrices are keys for calculating

Return On Investment (ROI).

The goals of this study are how the content will ultimately be used within the product or service lifecycle as well as what the users or actors (the study group) are trying to fulfill.

The five and more inclusive and general metrics used in this thesis are:

1. *Performance metrics*: relies on user behavior as well as the use of tasks or scenarios. For instance, to achieve some results, one needs duties and goals first. There are five main types of performance metrics in this area. (See Table 1.)

Table 1. Types of performance metrics

Task success	Measures how efficiently users can complete a given set of tasks. There is binary success and levels success.
Time-on -task	Measures the time required to complete the task.
Errors	Reflects mistakes made during the task. Pointing out confusing or misleading parts is helpful.
Efficiency	Measures the amount of effort a user puts to complete the task. As an example, it can be the number of clicks of buttons.
Learnability	Measures how the performance changes over time.

2. *Issue-based metrics*: usability issues are numerous and do not have a precise definition. However, these can be represented as anything that prevents task completion.

The other creates some level of confusion; that produces an error, not being able to notice something that should be seen, assuming something is wrong when it is not or complete when it is not entirely complete, performing the wrong action, misinterpreting content, confusing navigation and so on. [10,5-18]

How to identify an issue can be addressed as follows:

The in-person study - is defining tests for each user and determines every reaction.

The automated study - is referring to collecting verbatim (line by line and word by word) comments at the conclusion of each task.

Issue timing - is tracing the beginning and ending of a certain experience.

Granularity - this refers to particular technical accurate measurements.

Multiple observers - is referring to the benefits of having more participants to test.

3. *Severity Ratings*: that is the seriousness of the usability issues. Severity ratings need to be considered while doing testing. Frequency is also another important factor. That implicates unique issues have unique frequencies. The number of participants is also an important factor. Depending on the project and sensitiveness of the user issues, size varies and its importance as well.

4. *Self-reported metrics*: gives the most relevant information about user perception of the system and their interaction.

When it comes to measurement scales used in this thesis, the main scales are:

System Usability Scale (SUS) Score [4,144.] and

Positive Affect Negative Affect Schedule (PANAS) [3,47.]

5. *Behavioral and psychological metrics*: refers to the measuring emotional reaction of the user group test. These emotions include facial expressions, and even behaviors most participants are not conscious of like heart beat rate, pupil dilation increase in sweating and so on.

User satisfaction is the most important goal in usability engineering. A series of questionnaires would help find out the outcome of user satisfaction. The user satisfaction can be proved by comments of the participants at the end of the usability test. The criti-

cal points of Tullis Tom & Albert Bill, [4,7-11.] are how the users liked it, how efficient it is compared to other services, where it stands compared to similar products or services, what are the most significant usability problems and the improvement through the use cases. An example user case from Tullis Tom & Albert Bill was the Hoa Loranger who is a user experience specialist at Nielsen Norman Group consulting many large companies and author of *Prioritizing Web Usability*; her study was presented, and she used this procedure for one e-commerce web application, and it was a huge success story. In this study, as a stew of discipline, the interactive design and usability experience design are considered. These include interaction design, information architecture, industrial design, human factors, Human-Computer Interaction (HCI), visual design and content. [1,20-46.]

The most important part of any research is meeting the goal. Efficiency stands for the deviation between the goal and actual result. Engineering design tends to emphasize on reliability, cost, and efficiency. Human-centered design (HCD) is the process of ensuring people's needs are met, that the resulting product is easy to understand and usable, that it accomplishes the desired tasks, and that the experience of use is positive and enjoyable. [9,219.] Effective design needs to satisfy a large number of constraints and finally after all through iterations and test passes efficiency can be measured. All these series of tests are possessed to meet the goals and deliver an efficient, satisfying product.

2.3 Experience Design

An experience-centered design is about how to design for the richness of experience that technologies offer. [11,3.] As many in the field of usability and user experience have attempted to comprehend the distinction between "experiencing" and "experience," I was also puzzled for the meaning of the two. It seems that experience or user experience (UX) is not about technology, industrial design, or interfaces. It is about creating a meaningful experience through a device. "Experiencing" on the other hand refers to our consciousness regarding the constant stream of our actions, thoughts, and feelings in our everyday life. [12,9.]

It is human nature to feel. As humans we all want to be touched, moved and elevated by something other than oneself. The concept of experience design arises because of these feelings and similar reasons. Hacking and narrating the subjectivity out of those feelings directing one's life into products is experience design.

Experience is about memory, spun narratives and stories that summarize happenings of the past. Experiencing is everything that happens now in one's mind, that is the integration of all the physiological processes going on. Experience design is crucial in telling stories, and it is not the product that is essential but the experience it offers.

Products, which create anticipation and sharing experiences, are very significant. The reason digital cameras are popular, as well as Facebook and Instagram, is because it helps develop relatedness. They are capable of telling a story. For example comparing people who are going to a concert versus downloading the music and listening at home. It happens to be the people at the concert enjoys more. Going to a stand-up comedy event versus buying shoes online with the same price have the same results as well. The stand-up comedy is likely to be more enjoyable.

Therefore, it is not anymore about owning something, but it is about the things one can do with it that matter the most. One way to take into account the experiences is to design with user-centered design methods. The user-centered design is among the four approaches to interaction design. The approach of this thesis is not activity-centered design, system design or genius design. The idea and philosophy behind the user-centered design are simply users knows what is best since they are aware of their needs, goals, and preferences. A designer's job is to figure out the needs and provide a solution narration of the choices and stories in an end product and design development. It is hard to design a coffee machine without talking to coffee drinkers. The concept is designing for people, not for products to fit in people. [1,33.]

Engineers used to design software so that made sense to computers work, not regarding the way that people work. In the 1980s, thanks to the advancement of the human-computer interaction, it led designers and computer scientists into a different direction. The growth of processing speed and computing systems advancement encouraged

focusing on the design of software around users. This movement was then called user-centered design (UCD). [1,34.]

In UCD approaches, users are involved from the beginning to the end of the development as well as test iterations. User goals can be tricky because goals have a tendency of creating another nested series of goals from action theory. As an example considering the thesis project, one might ask ‘what is the goal?’ The answer can be to help medical professionals learn from current trends so basically it is the functionalities from engineering perspective, and the ‘do goals’ from psychology perspective. ‘But why?’ The answer can be to educate the professionals themselves and help other people. The ‘why’ is ‘the goal’. What is the goal there? The answer could lead to creating a healthy society. The ‘motor goals’ that is ‘how?’ Can be replied to through providing a platform that the medical professionals could get all the information they are seeking in different medical issues and learn from each other by posting their own articles and reading others. Therefore, it is tricky that user goals can get nested but choosing the right goal is important in research studies for designing in interaction design.

Marc Hassenzahl [3,4; 13.] explained the three level hierarchies of goals relates the actor’s self to the world through activity. (See Figure 2.) There will not be an actor’s life if there is no actor. Then there is no experience if there is nothing to be performed. The three level hierarchies represent the contents of the experience.



Figure 2. A three level hierarchy of goal [3,12; 13; 14.]

Designing for interaction is bound by ethics as any other field. It is the designer's responsibility to design products and services to meet the intended goals. Dan Saffer mentioned the book *IBM and the Holocaust* by Edwin Black that relates a story of a timber merchant from Poland, who arrived at a Nazi concentration camp as a prisoner. The Nazis assigned him five-digit IBM Hollerith number. This number was later tattooed to the forearm of the prisoners as part of punch card system specifically designed to track prisoners in Nazi concentration camps. The system tracked the prisoners and their availability for work. It will track the prisoners from one labor task to the other till they put to death. The Holocaust system was effective for the intended use but highly unethical. However, "good" design does not necessarily mean meeting some functionality, effectiveness, aesthetically pleasing manner alone but moral effects, the just and life affirming that can influence the users in a positive way. The good protects human dignity. [1,212.]

The concept of good design can be explained well in Marc Hassenzahl example [3,2.] a young woman was on a short trip to Dublin, and her phone woke her up early morning with 'I love you' SMS. Here, the telephone designer only encouraged collaboration between two people only. Encouraging experience and making one are altogether different things. Studying experience could give unexpected results.

3 Case Study of Tena

The name Tena comes from the Amharic language that means health. The purpose of the case study is to help medical professionals get update information for educating themselves as well as help patients get better service. Modern healthcare can be de-humanizing. The volume of activity in health industry, the sheer amount of people involved, and pressure on time and resources, can cause health professionals and patients to feel like cogs in the health system. For doctors, this means they become dis-engaged with their work. For patients and their families, it means they are not always getting right treatment with the compassion and respect they deserve. A poor patient experience is an important factor to the healing process and is connected to poorer clinical outcomes. To avoid this, educating doctors from experience helps for an effective way of medical services with low cost.

The case study is presented and organized into processes and stages. (See Figure 3.) The observation led to the idea generation and using the ideas drafts, and prototypes were made and tested. The process continues throughout again and again and in this thesis, it is held three times.

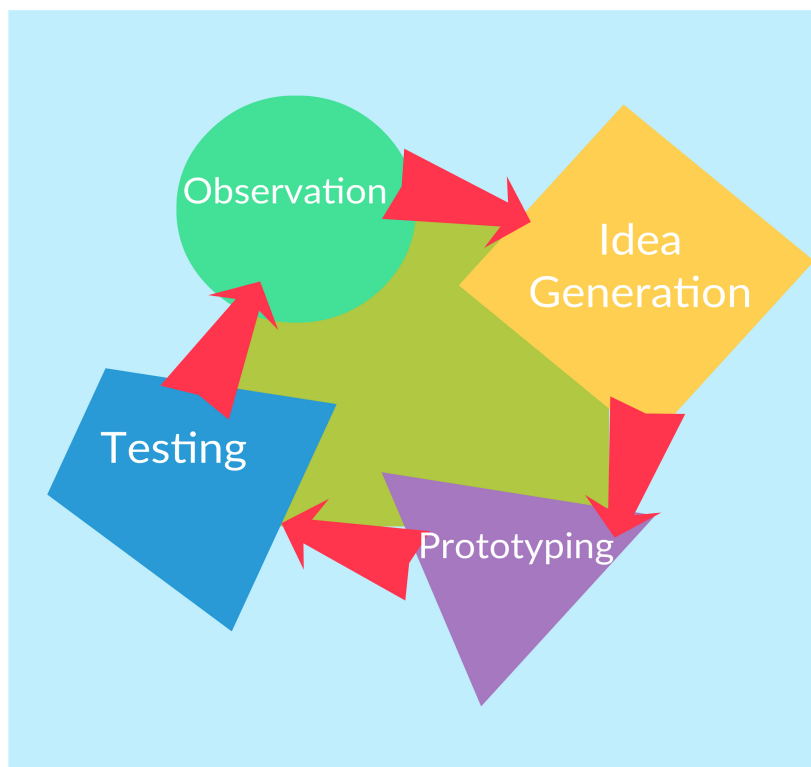


Figure 3. Development model. [9,222]

3.1 Participant Demography

User background should be from medical field because the question of building platform for medical professionals came from themselves. The platform is for the user, by the user, and to the user. The participating users have a different background of how to use the Internet.

User groups are two nurses, two general practitioners (GP) doctors and a health officer. A series of questionnaires were given during each iterations of the project. They had right age and gender variety. Even if the sample is small, as much as possible, an affect was made to include most professionals that have the potential to use the system.

The steps followed to meet the expectations start from research this includes checking out already existing systems. One by one participant were given three similar systems, which they used. The usage was observed. Five people participated in the case study. (See Table 2.) They are all interested and willing to post pictures and write their thoughts and share their experiences. The other important point was they all have Internet access.

Table 2. Participant demography

User groups professions	Number of participants	Age	Gender
Nurses	2	33	F
		26	F
General Practitioner (GP) Doctors	2	27	M
		26	F
Health Officers	1	41	M

The user groups are carefully selected through feasible information gathered from Haramaya University, School of Medicine (see Figure 4.) where future professional whom potentially use the service have participated. System Usability Scale (SUS) method using SUS questionnaire was used for the testing. (See Appendix 1. The self-reporting

metrics number 3). From their answers, significant influence makers happen to be the doctors, the nurses and health officers. The other important factor was the age variety. The professionals for whom the system is intended have an age variation from 23 to 55 on average, and the participants needed to be in the age range as evenly as possible. The research helped to include another group of participants. Due to the recommendations, 48.5% of the participants believed in health officers should be included in this design because they work in many areas as lead practitioners in areas government could not provide doctors because there is a shortage of physicians in the country. Gender variation was also a factor. The research showed that active women participation is a central problem in the profession and encouraging women to engage in active participation of using the platform could play a significant role. Therefore, the number of female participants was made 60%.



Figure 4. Participants for potential user tests

3.2 Process to Elucidate the Requirements and Prototyping

The details of requirements for building Tena application, was drawn out of the participants' experience through questionnaires and discussions held on Skype and Viber calls. The next observation was made based on what kind of Internet access they will be using as well as what kind of devices are involved. (See Figure 5.) The percentages in the figure shows among the participants 60% of them were using android phones and tablets, 20% uses windows phone and windows seven operating system in the healthcare facility and the rest 20% used iPhone to test the application through the process.

Moreover, another questionnaire was made to find out what requirements were missing in the mockups and how it should be handled. Throughout the process, the tests were conducted through video calls with the user group. The Skype desktop sharing was used whenever it was necessary to interact with the participants.

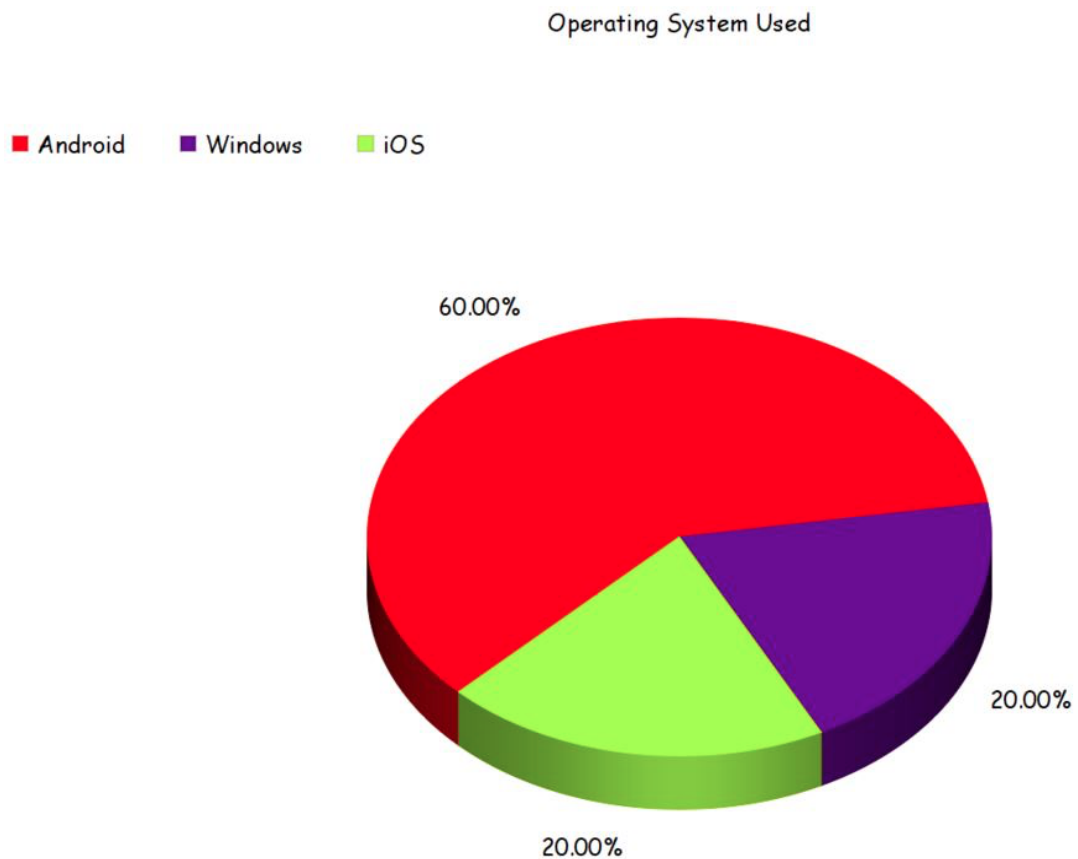


Figure 5. Operating systems used by participants.

The processes had three testing iterations and development stages. The first step was researching using questionnaires and interviews to figure out the problem to be solved with the medical professionals, as they are the user group. The discussion was done through Skype and Viber video calls. The main points of the debates were what problems they have in their academic working life as well as healthcare issues in Ethiopia. Finally, the problems from the questionnaire led to major areas of categories which future implementation was feasible. These five categories drawn out of the most severe problems are in areas of women's health and harmful practices, children's health, epidemic diseases and environmental and sanitation, news (new information) and community service inadequacy. (See Appendix 3.)

After the research, brainstorming followed and at this stage all the conclusions based on the research had to be shown. It led to the mockup and sketches of the project ideas. Prototyping is the first technical work that follows the research and questionnaires. Users defined the ideal system they wanted to use, and the prototype is a rough sketch of the scheme. The users provide a list of requirements during the research stage. (See Figure 6.)

Users need to login to the system, post articles, post pictures and links to related materials, manage their content anytime they want, discuss issues that are currently important and make a category based on the most abundant issues they are facing. The design is flat design with few clicks.

Based on the prototypes a simple system was designed. There will be categories in which users add articles and read from other professional's articles as well. The prototype developed first was a figure of the possible result and had no interactivity. The participants were tested using the digital images and the printed version.

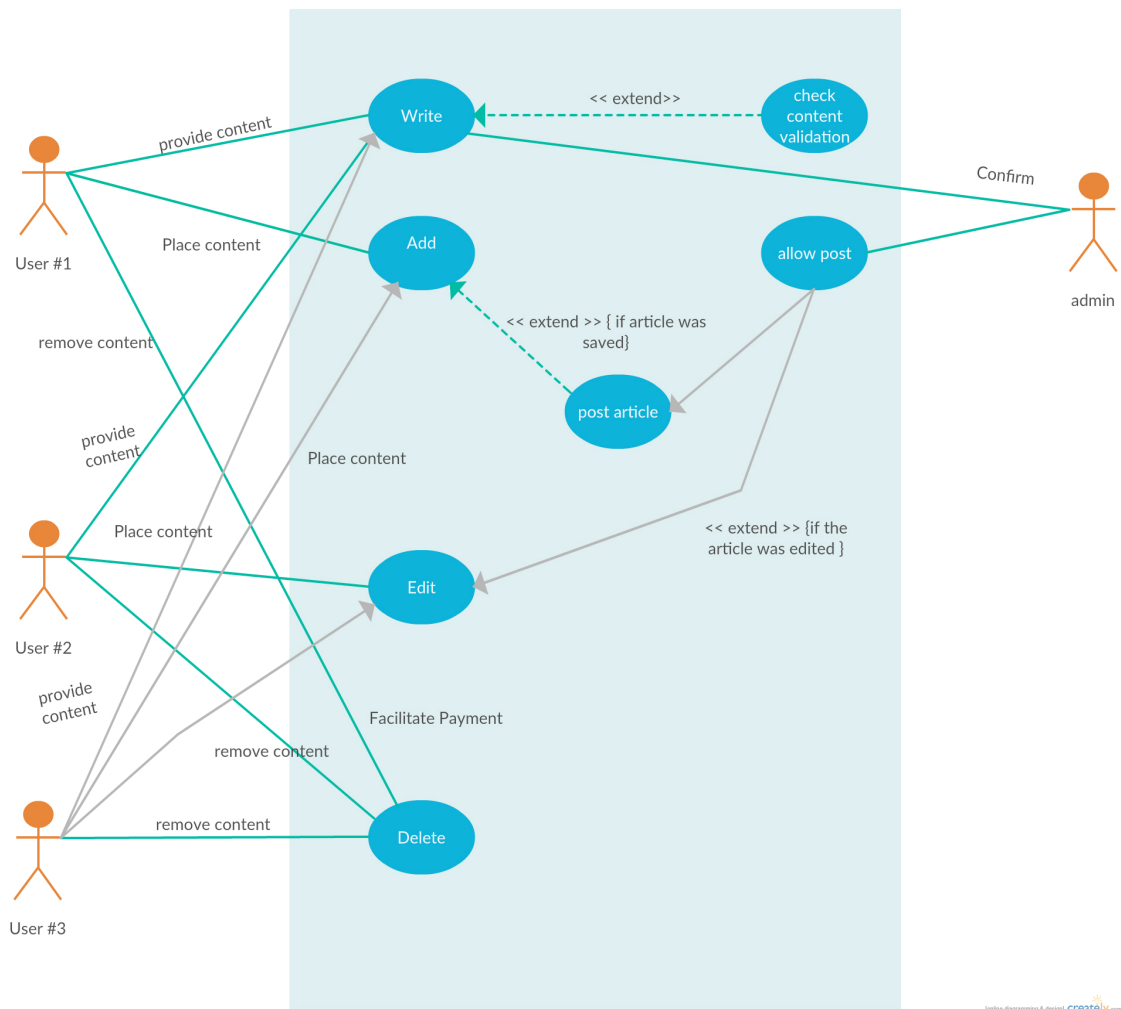


Figure 6. Use case Diagram.

3.3 First Testing and Results

According to sketches, the user groups tested the idea. The first test went well. The participants were asked to use paper prints of the mockups and analyze the reactions they show. They gave positive comments on the first mockup, but one user said he did not understand the reason why moving thumbnail images is necessary. The user thought it was annoying while one other user explained it was a nice feature but in that case there was a need to drop that feature and change it to a normal list and then to make all users happy. The other point that helped the first test was they did not want many buttons to click as 3 out of 5 complained. Participants gave a response on a five-point scale ranging from not at all to extremely, using severity-rating metrics. The pro-

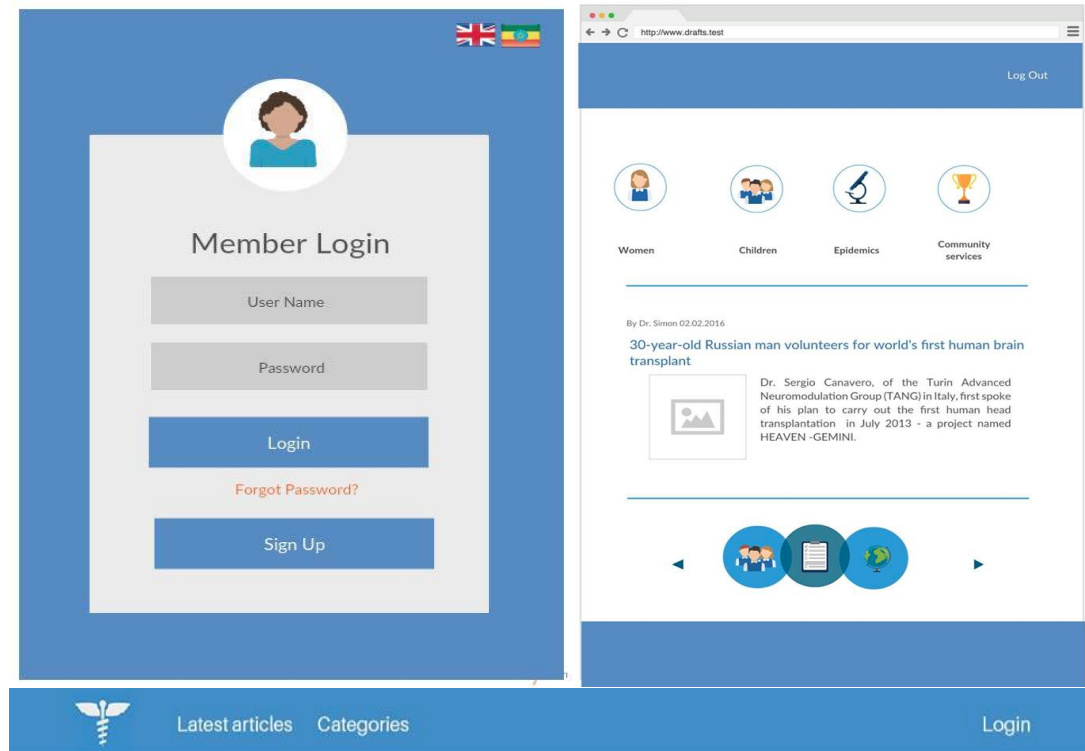
cess helped to avoid many button designs and replace them with few buttons. Also, the clicks needed to lead to another one in a logical way.

Twenty items and ten needs were measured (two items for each need). Affect was measured with the Positive Affect Negative Affect Schedule (PANAS, Watson et al., 1988, the self-reporting metrics number 3). The method consists of 20 adjectives of affect ten for positive affect and ten for negative affect measurements. The average of the responses to each set of ten was used as an index of experienced affect. [3,47] (See Appendix 2.)

The design requirements sketch was made ready to be tested by the users. (See Figure 7.) In the first part of the figure above the prototype was done to show the signup and login functionalities with a username and password. A language localization option was also introduced at this stage, and behavioral and psychological metrics were analyzed at this issue. Almost all the participants showed happiness for being able to post in Amharic. The effect created some sense of relatedness.

Due to remote testing, the prototype had to be a high-fidelity prototype. That is because it is purely digital and it can be easily be distributed on the web. [1,177-179.] The testing involves testing of the prototypes as well as the service in progress. It should be “field work” after that. The tests can be conducted in a laboratory, or remotely, depending on the necessary requirements and resources of the study, as well as nature and the development phase of the product. [15,26; 16.] It is also important to establish success criteria and targets. [16.]

Each person did the first test at a time. The single person test was repeated, and a pair of individuals were made to use it together, one person operating the prototype while the other guiding the actions and interpreting the results out loud. Using pairs and groups in this way causes them to discuss their ideas, hypotheses, and frustrations openly and naturally. Observations were made, by sitting behind those being tested (so as not to distract them).



By Dr. Simon 02.02.2016

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ADD

Figure 7. Prototypes based on use cases

3.4 Tena Application Testing and Results

The procedure following testing was development and technical implementations based on the first test and new requirements. The stage was challenging because

something could be misunderstood and through the process development, it was necessary to ask the user groups if they like some features or not. The challenge was that mostly the user groups do not like fancy UI feature that I am much interested in, and it drove me to a point where I had to realize the project was not for me but for the user, and I had to implement their requirements. Then the front end was implemented using HTML5, CSS3 and jQuery and the backend was implemented using PHP framework called CodeIgniter. (See Figure 8.)

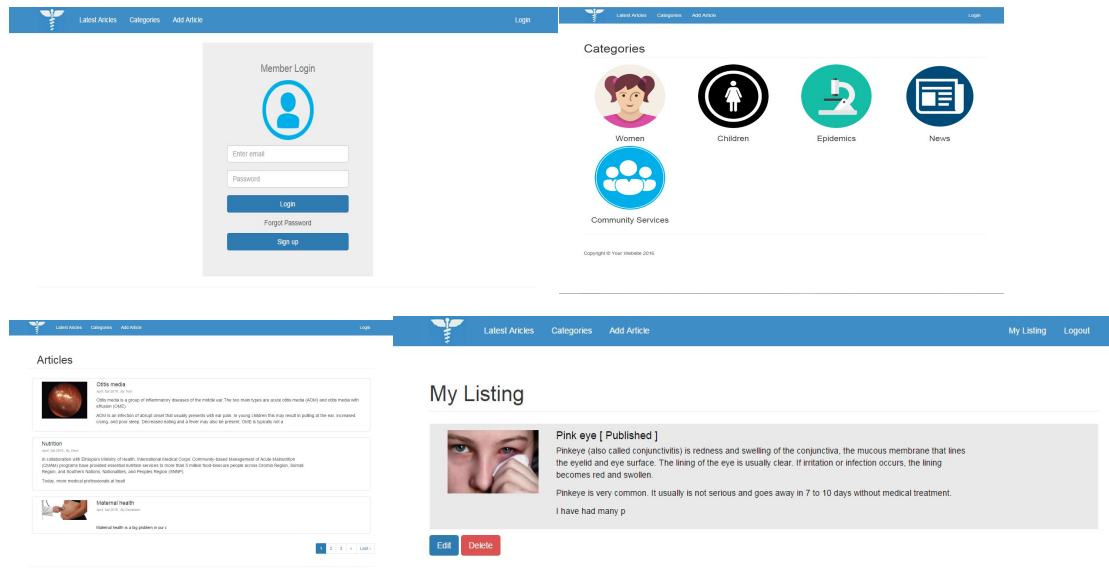


Figure 8. Few screen shots of the first development cycle.

The login represents how the users will be able to access the system. After login, the user wanted to do two things, either read or write an article. Based on the tests made people need to check things before contributing something. According to the Positive and Negative Affect Schedule (PANAS), the contents should be the first thing visible to the user. The design was made according to the preference of the user. The users can either check the categories or latest articles, which are listed below the categories. During the test, three out of four of the participants chose to read directly from the lists while two of them checked the categories and read from each category. The third design presented had an option of showing articles in chronological order and giving access to through categories.



Figure 9. Participant during the second test iteration

The testing was done through the existing website first version. (See Figure 9.) New scenarios were observed that help in creating the next version of the application. Minor font problems were found as well as a spelling error was discovered. The test was made using System Usability Scale (SUS). This scale has five severity ratings from one to five. (See Appendix 1.) Then another development was held according to the new requirements. After that, the final test was conducted.

The responses from the users, in general, suggested that the users felt that the service could help them learn more about current trends. The service will provide information shared amongst colleagues.

There were major results that indicate many usability issues based on the conducted tests. Task success was measured from the proposed task divisions. The results from the tests were measured using performance metrics. The tasks are listed below.

Task 1 was signing up.

Task 2 was logging in.

Task 3 was reading content, which includes the content availability check.

Task 4 was editing their articles.

Task 5 was deleting their articles was observed.

Task 6 was navigation

Task 7 was figuring out the categories.

1 Task success

Task success is the most common usability metric. When success is measured in this thesis, failure is also considered. Instead of looking at how many people succeeded versus how many failed, it also helps to analyze the failures themselves. Why did they fail to do those tasks? [17.] Because in the future development cycle, this is the issue to be addressed.

Each task has its goal as stated above in the task list. The first and second task were successful and pretty much straightforward but when it comes to timing in the first two tests, participants were slower. During the third task, positive affect from the Positive Affect Negative Affect Schedule (PANAS) showed bigger values with a positive affect mean score 25. The negative affects had a mean score value of 10. (See Appendix 2) All the participants were able to read the content in the end.

The next task was editing the participants' written contents. Two showed some confusion and needed extra help; the remaining three were able to perform the first test. The average of the test results also showed a positive affect mean value score of 27 and negative score value of 11. Deleting the contents was the next task. Deleting the contents was expected to be fairly easy since the editing was performed in earlier time. Surprisingly, the participants were having a higher negative effect on deleting their own contents of a score of 16 and a positive effect on a mean score 22. Later the navigation task was observed from the process. In the first two tests removing unnecessary buttons and putting two functionalities together made the navigation improvements. The task was improved from iteration to the next. The positive affect on the navigation task had a mean score of 21 and negative score with mean value 9. Figuring out the categories was also performed by two of the participants in the first test, in the second test

by four of the participants and in the last test by almost everyone. The mean positive affect score for figuring out the categories was 22.5 and the negative affect value was 8.6. The following figure demonstrates the data of those participants who were able to perform the tasks successfully. (See Figure 10.)

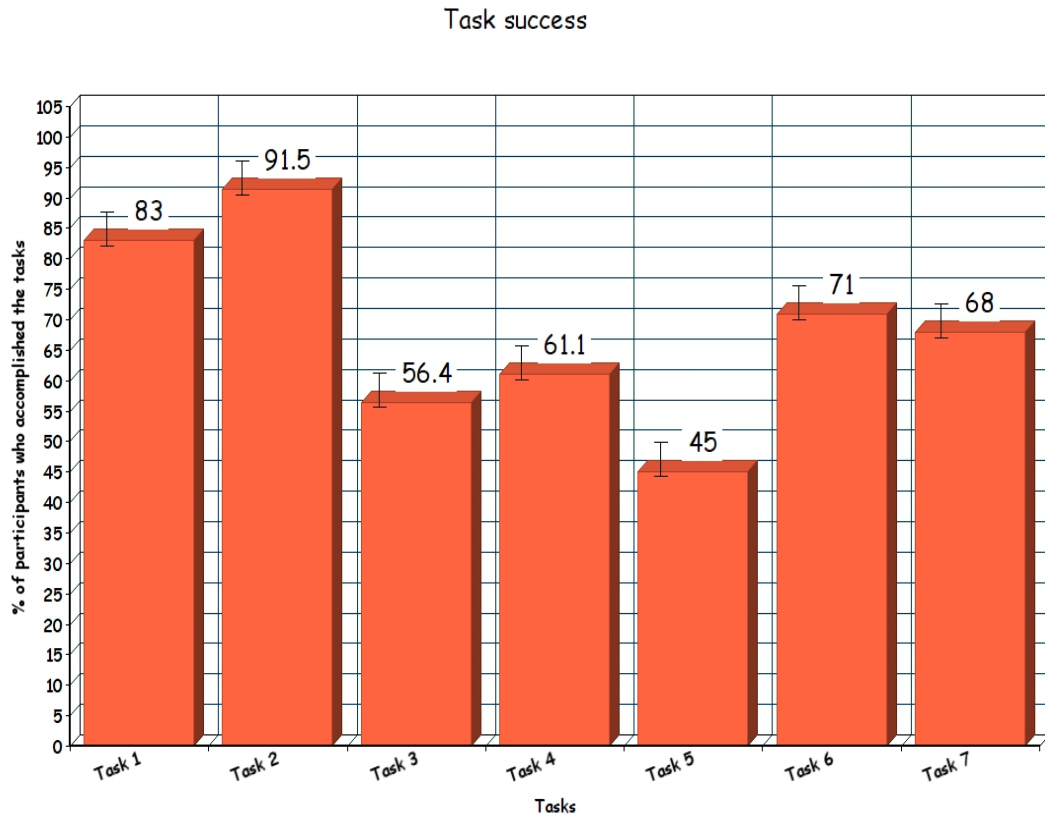


Figure 10. Task success.

2 Time-on-task

Time-on-task refers to task completion time or duration of time to perform a given task. [4,74] Time-on-task is important because in this thesis in particular, because for experience-based design, there is a need for frequent and repeated tasks. Therefore, every time measuring the amount of time, tells the improvements made to perform a given task.

The results obtained during the seven task tests in the case study of Tena show the improvements from one test to the other. Since there were only three tests conducted

in a short development time, the difference in the results is not that big. The results shown in the figure below are time-on-task results and present average duration of the participants together. (See Figure 11.)

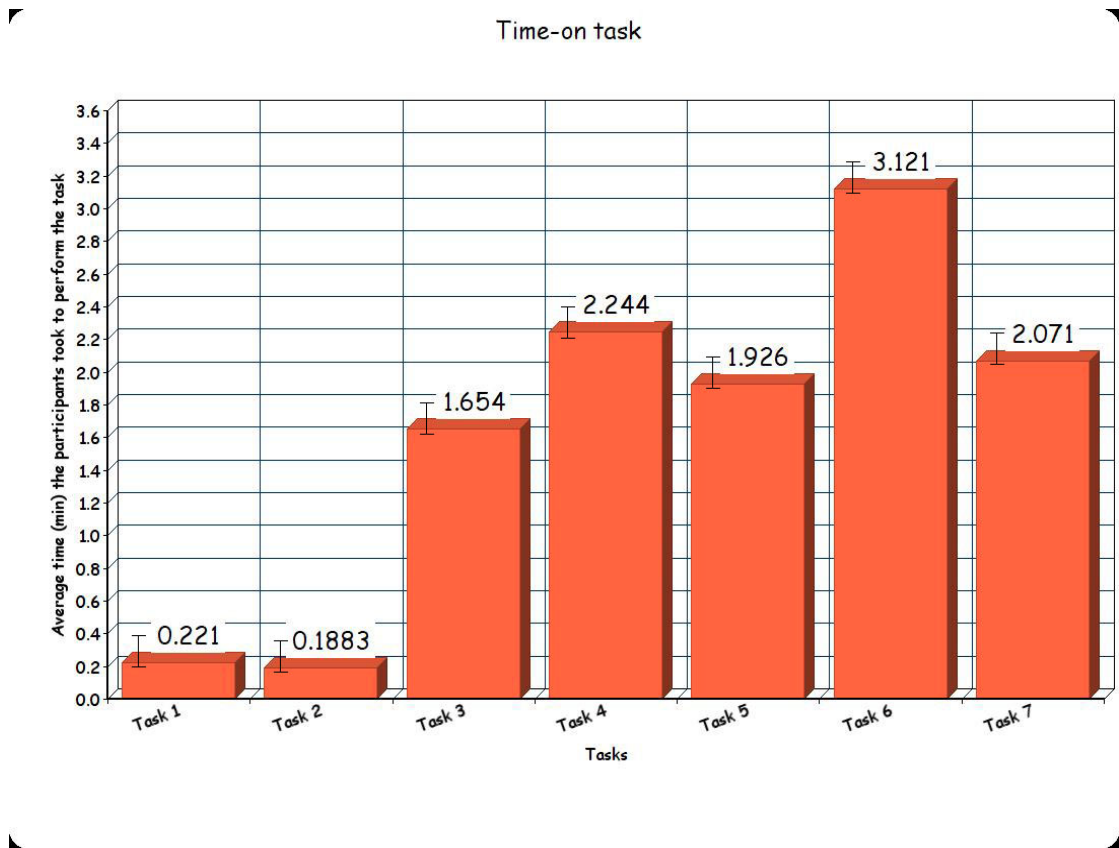


Figure 11. Time-on task distribution

3 Errors

Professionals sometimes consider errors necessarily the same thing with usability issues. [4,81.] Usability issue is cause of a problem while using the service, whereas one or more errors are possible outcome. The usability issues are the cause of the errors. Errors measurement might not be necessary for every task. In the case study, most errors did not come from performing each task. For example, while writing the content, one sports fan asked to post sports stuff too. The scenario contradicts heavily with the value of the design that is required; this is called the significant loss of efficiency. The other point is when an error results in task failure. Task failure happens when someone

posts some content of his liking and it happens to be wrong. The scenario showed that the admin should be someone who can crosscheck each post before approving the content.

The errors were measured in the case study's each iteration. Then the averages of the three case study errors were calculated. Then the results showed that 28.96% of the seven tasks were done successfully without significant errors. This mostly includes the first two tasks. 31.01% of the seven tasks were tested making a single or two errors and 21.47% of the tasks were done from three to five errors. The last major errors were noticed in 18.57% of the tasks. These higher errors mostly came from contents specifically from tasks three and five. (See Figure 12.)

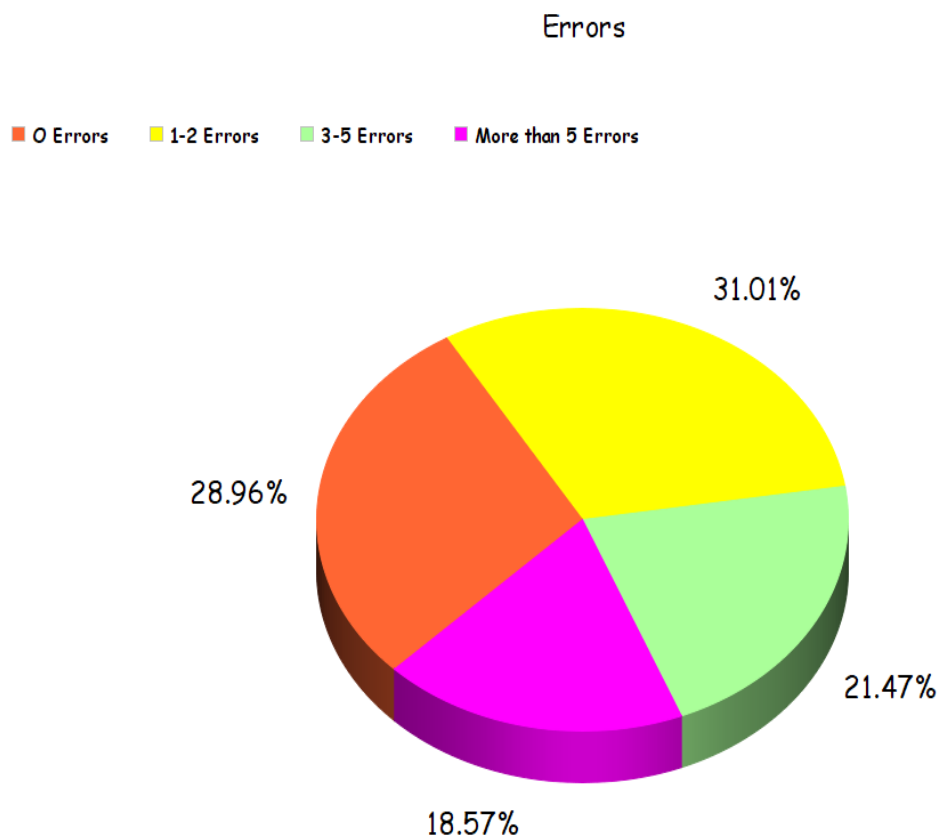


Figure 12. Errors

4 Efficiency

Time-on-task is usually used to measure efficiency. [3,87] The goal of the project is that user effort should be minimized when it comes to efficiency. The primary focus on the result was how well the user can perform the required tasks with a specific amount of time.

Observations on efficiency were made in Tena case study by the number of reasonable navigation as well as the number of clicks to perform a single task and the assistance needed. All this was observed by asking the participants to do the same thing again without any help. Then the results of the number of clicks per min of each task tested by every person were recorded. Finally, the average values of the number of clicks per minute of the participants were calculated. On average the participants had to click more often to perform task three, six and seven. (See Figure 13.)

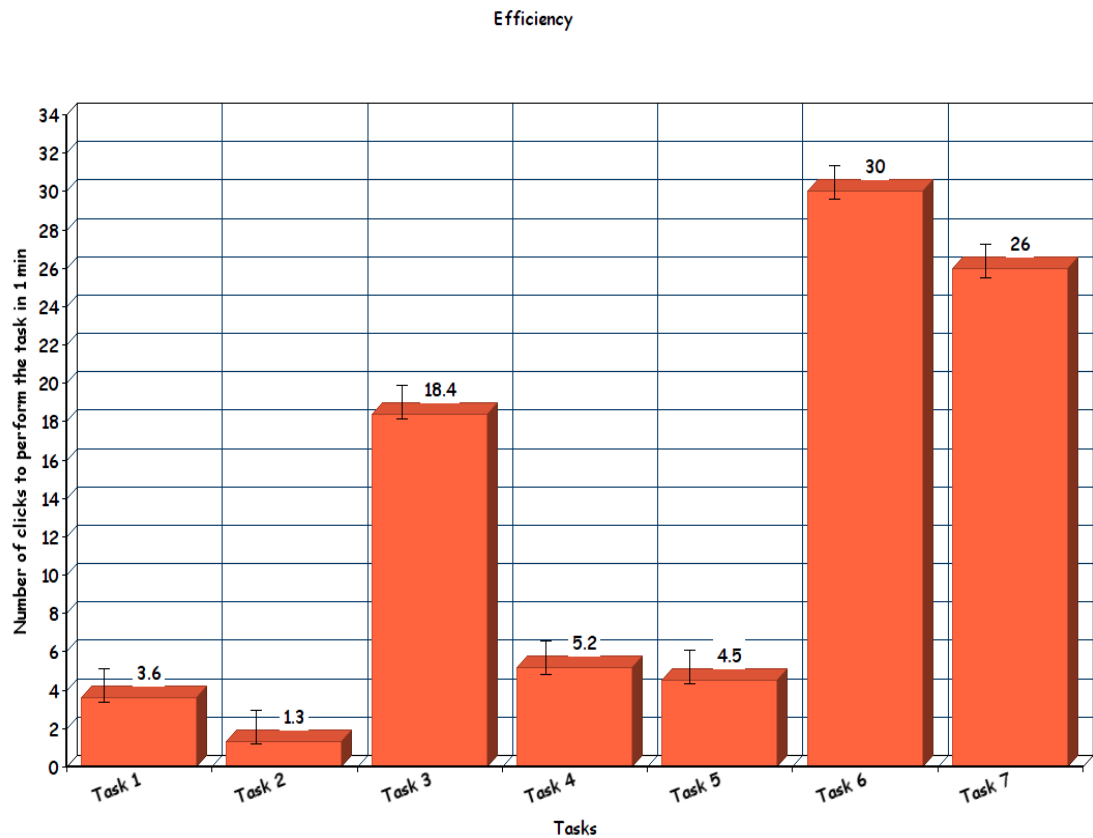


Figure 13. Efficiency

5 Learnability

Most products and services need some amount of time to learn and master. This is also the case for advancements. The learning curve is steeper because we, all have a long trend of development-led rather than design-led systems. [1,186]

Repeating the process helped the users to get used to the system. Learnability was observed through time-on-tasks. The first two tasks were straightforward and did not take much time to learn and figure out. Tasks with four, six and seven were challenging, and improvements were slower than with the rest of the tasks. Tasks three and five were average. (See Figure 14.)

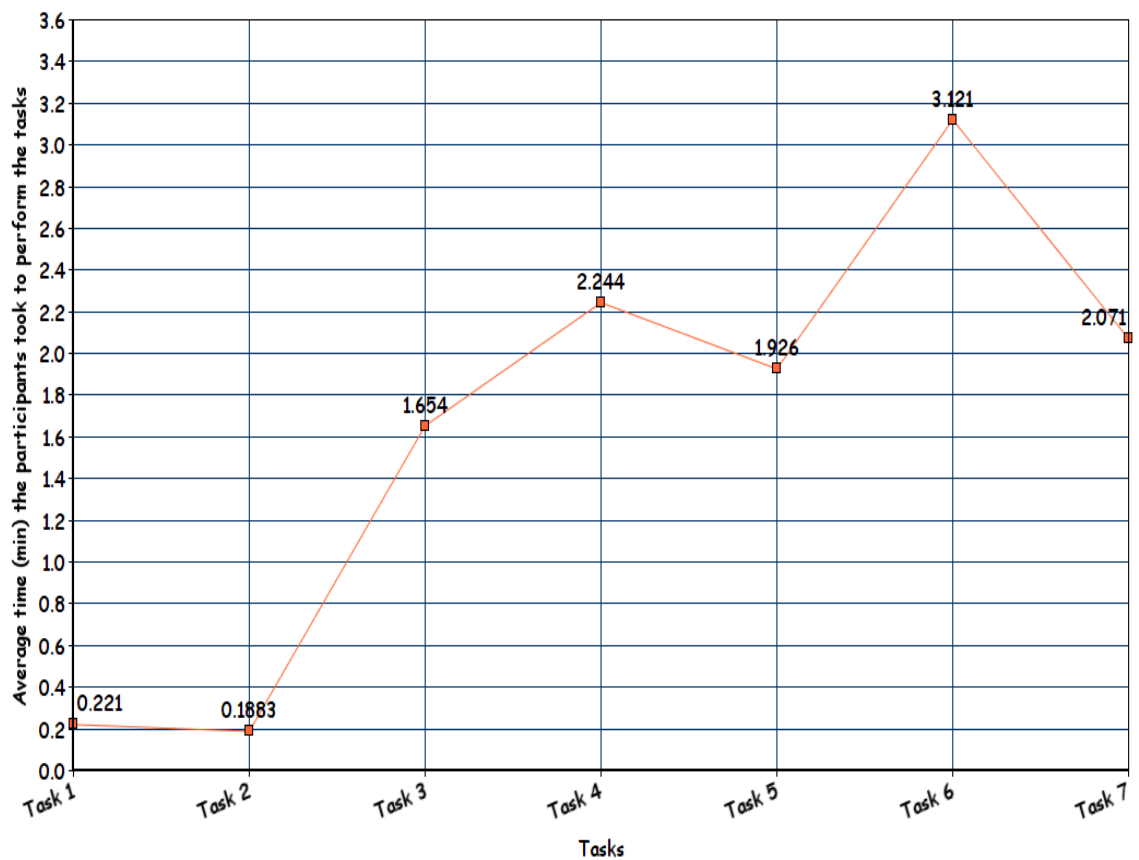


Figure 14. Learnability data based on time-on-task.

3.5 User Satisfaction and Testing Single Design

The first phase in development was building the necessary requirements of the participants. The second test was made from the development following the second test. At this stage, mostly basic functionalities were handled. The performance metrics change was not significant with the previous testing because the development did not focus on main functionalities at this stage. The main testing areas were user satisfaction, testing single design and comments from the participants. User satisfaction tells how well received the final product is. Testing single design helps to figure out undiscovered problems and bugs. The comments of the participants helped to build something better and give a clear image to the process development and maintenance of the service.

Quite many improvements were made with a similar short sign up procedure using username and password same as the login for the first time users. There were some bugs from the first iteration, for example links could not be posted. Also some other small bugs were fixed.

Testing Single Design

Single design test was performed to figure out usability issues that need to be removed or improved. For instance, the participants did not respond not so well to many clicks to be able to access contents. Thinking out loud tests assessed participants' feelings. [18,208] The thinking out loud is basically asking the participant to talk aloud to describe their actions.

After each site evaluation, participants were asked to rate the idea of the website on different characteristics. Testing the design was an essential measure as it reduces unnecessary work and costs.

Single design test phase is the user test performed when there was something substantial to prove. (See Figure 15.) From the first launch of the web application, the substantial issue to prove was task performance. This phase is critical to understand small usability problems such as loading time.



Figure 15. Participant during the third test iteration

Finally, when the project was in its final test stage close to ending product, the design was corrected from the previously existing iteration of testing. Then the satisfaction level was analyzed. (See Figure 16.) User satisfaction is subjective and strictly related to user's needs, expectations, and previous experience. [19,61] The result shown below is an average result. For every task participants showed different emotions and those emotions were analyzed to get the satisfaction results.

The result shows 20% of the participants showed minimal satisfaction. While 40% of the participants showed an average level of satisfaction with the service, 20% of the participants showed good level of satisfaction. The rest 20% showed extremely positive satisfaction level. The good thing with this result is that there was no participant who was giving up with the product and hated it.

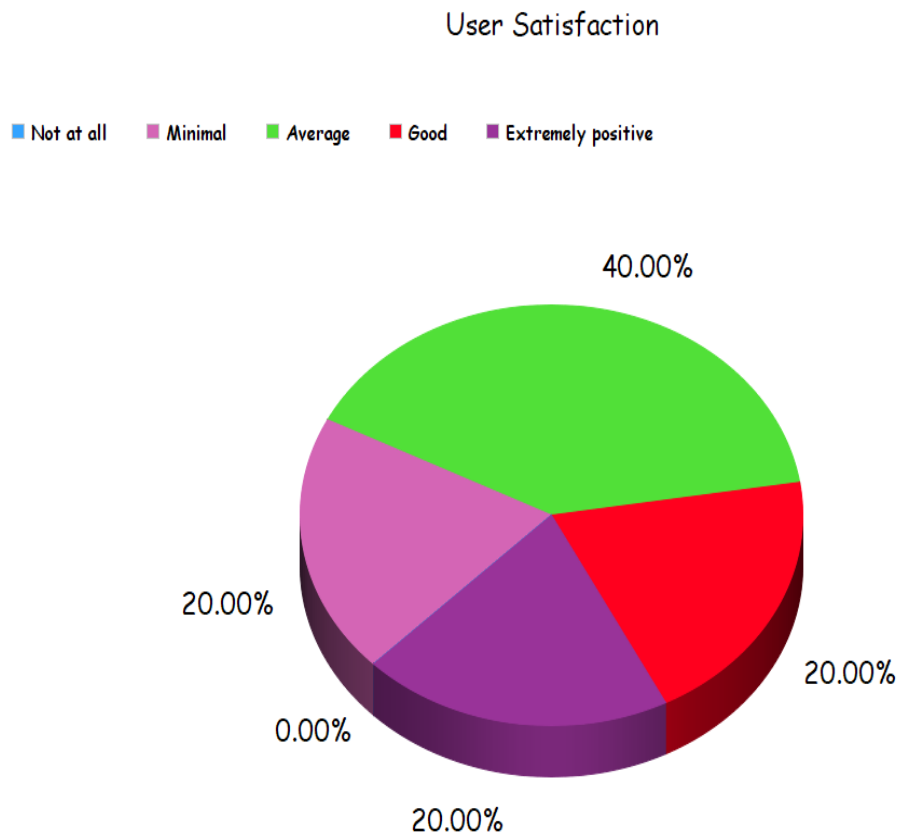


Figure 16. User Satisfaction.

Participant's Comments

Gathered user groups who participated in the case study are as similar as possible to the target population for whom the product is intended. The best practice was having them use the prototypes as nearly as possible to the way they would actually use them. For instance, one participant stated: "This is nice", and even though they had to struggle to perform the task. Another one gave also a positive feedback though it was not asked. In her words, "It is nice to be able to write my articles." These responses show the feeling of control is important to make the user confident as their voices can be heard depending appropriateness of the content. Even more, if the feeling of control was already there, even though she had to deal with some navigation issues, the feeling will be potentially greater after the major problems in usability will be solved.

After this stage, major problems and improvements met their intended goals. Then further development continued, and the main focus was the UI and the aesthetics that can be implemented. Language localization also is the next implementation to be tested in the future. Some research is expected to proceed the development and continue the iteration.

The comments were helpful in general. Honest opinions help the development of the project through experience development. The further development to meet intended goals and additional requirements are expected to follow the same methods.

4 Development

The process from research to the final usability test is the development of the system. The system is built in a fused-agile process model. Agile model is a project management methodology that helps the development of software with higher priority to satisfy the customer through an early and continuous delivery of valuable software. Agile model is the latest project management strategy that is mainly applied to project management practice in software development. Designers usually suggest that strict agile software development process could be development-led, and there may not be enough space for designers. Therefore, in this project, fused-agile, an agile model, which is based on experience design, was followed by the development process. It is best practice to relate agile project management to the software development process in a short time where the user expectations can vary throughout the development. [20.] Based on the requirement of the user groups, the fused-agile development process enabled to the realization of the design to be simple and helpful for the intended purpose.

The practical part of this thesis consisted of two parts. The first part covers developing a content management system, namely Tena's web application. The second part goes through the process of making UI of the website application to show how the system is presented to the end user in order to achieve the functionalities. The following programs have been used to develop the application.

- HTML5
- CSS3 to make the web application responsive
- JQuery
- PHP as a backend language
- SQL Database Tools and devices used for programming

While developing the application, different applications and hardware were used. The applications that were used for development were:

- Sublime 3, text editor
- FileZilla, FTP Client
- Adobe Photoshop
- The device that was used for development and testing were:
- MacBook Pro
- For testing purpose, the following hardware were used:
- Smartphones (Samsung and iPhone)

- Tablets (Samsung and iPad)

4.1 Architectural Design

To make UI design work as separate as possible from the models, an architecture that utilizes REST APIs was designed. The backend development was done separately considering the UI requirements that were collected from the end users. The frontend was developed considering simplicity to the end user at the initial stage followed by integrating models using API requests. (See Figure 17.)

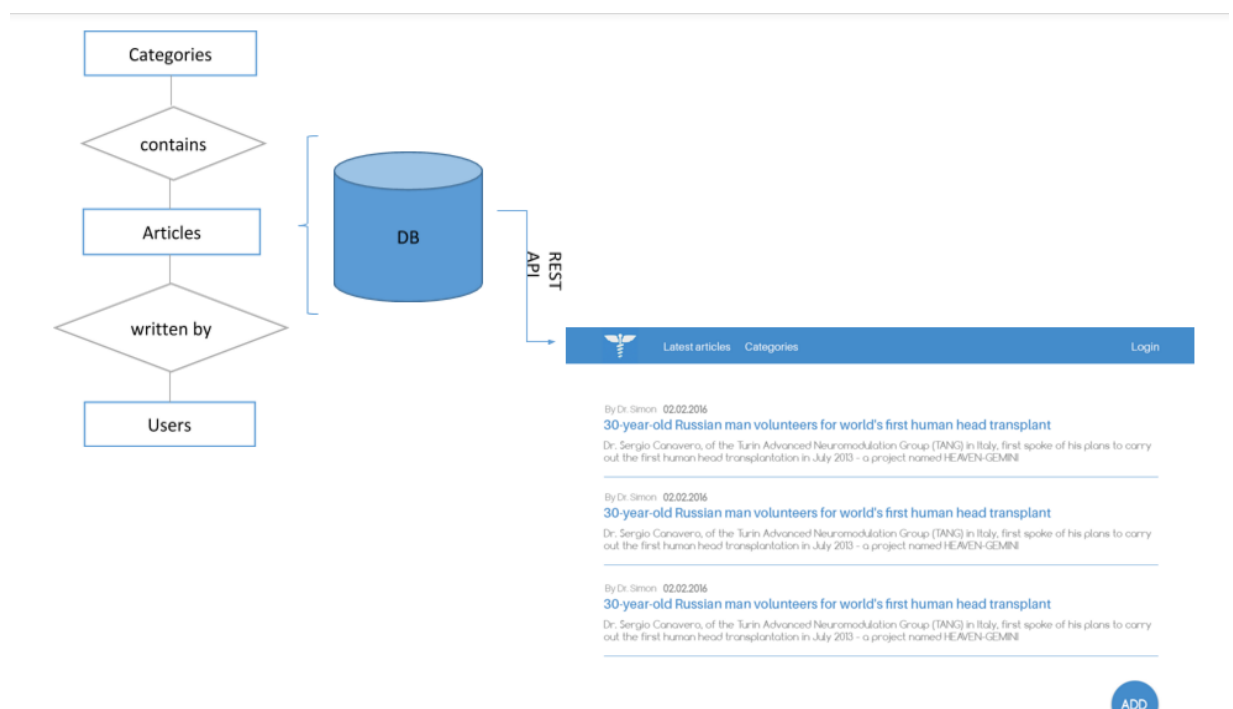


Fig 17. Mechanisms of application from use cases.

The architecture that utilizes REST API was used because the UI is experience-based design so it is easier to implement Backend API on a well-designed UI. The situation significantly speeds up the process because regardless of the speed of the front end development, the backend is API based and ready to use at anytime the UI is ready. The API based system is effective for projects that will be done in a short time.

4.2 Database Design

To persist users and data entered by users, a relational database is created and maintained using MySQL. The current scope of the project is small scale. Therefore, three tables were sufficient so three tables were created to hold the data related to user registration, a category of articles and underlying articles. The user table (`tbl_users`) contains all the user details including their scope, admin, and regular user, which are the available scopes at the moment. The category table (`tbl_category`) holds the categories that an admin user creates. The categories could be anything so that the users' current trends could be generalized. Currently, using the questionnaires, the current categories happened to be women, children, epidemics and community services. The last table is article table (`tbl_article`). The article table contains all the articles that are created by users of the application under one of the available categories. (See Figure 18.)

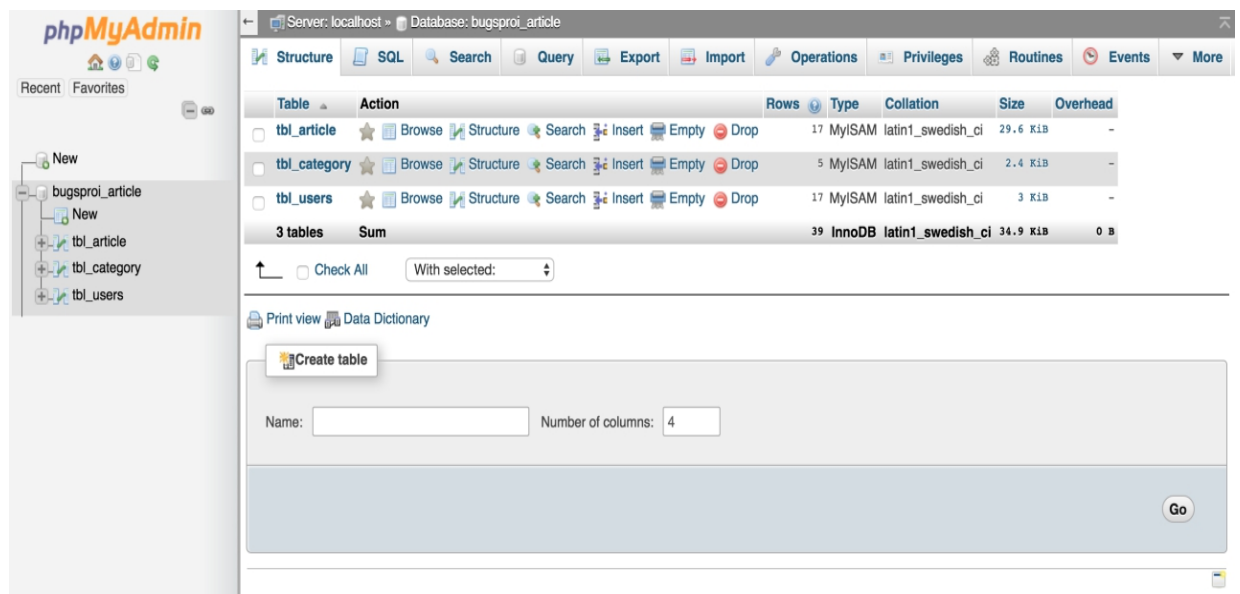


Figure 18. MySQL database design

The query was written to create the tables after the database was defined. (See Appendix 5.) Then the three tables, the article, category and users are implemented using the query language to set up the database. The query explains the characteristics of inputs of the table such as sizes.

4.3 Software Implementation

The front end

The technologies used to build the frontend for the first two-development cycle that are utilized in the second and third testing, are made using HTML5, CSS3, and jQuery. But the current development is done with Bootstrap 3 framework. The layout is intended to create the idea of the participants experience to a service. Therefore in the development process, there were basic requirements that should be met.

- Responsiveness
- Alignment
- Accessibility
- Functionality
- Content
- Readability

The backend

The technology used to implement the backend is PHP, and specific PHP framework called CodeIgniter was used. All the major management is done by the admin. This includes user management, category management, and article content management. These are the three core foundations of the article sharing service Tena provides at its current development stage.

The admin is in control of the backend. The backend basically has four sections. These are the dashboard, users, category and articles. The dashboard only shows the counts of articles and users. Under the users section there is a list of regular users and management, a list of administrator users as well as management and an additional functionality. The functionality is adding new users either regular or administrator users to the platform by activating their sign up. The category sections contain a list of categories and category management as well as adding a new category. The last section is article content management. The section has a list of articles, articles management and adding articles. The most important other functionality is the admin and it should approve any posted articles. Otherwise, nothing will be displayed. It is very important to

filter data that is posted by different users to prevent unapproved and inappropriate posts. (See Appendix 4.)

Then testing development of the application was required and done, and manual testing was performed. Even if a couple of test iterations concerning the user interface design have been done before starting to implement it, testing the application with the end users happens after this test. The devices used for developmental testing were Smartphones (Samsung and iPhone) and Tablets (Samsung and iPad). Regression testing is an important activity to ensure software quality, particularly when software is actively maintained and updated. [21.] It can also be used in the testing release phase of software development. A couple regression test runs were performed later to avoid any regression.

5 Discussion

Experience design is an approach for creating useful, precise products and services. Experience design perspective is beneficial, and technology in interaction design is now realizing the point. It helps from small applications like Tena and also large industrial standard systems. Therefore, products, which create anticipation and sharing experiences, are very significant. After all, it is about human interaction and building better technology. Design should show clearly the “why” of the designs and “what” designers want people to understand, see or experience “how” they could do it. It intrigued me that apparently the three level hierarchies of goals can change the way one thinks and see the half-filled glass rather than the half empty one. It starts with the “why” and then “what” and “how”. The “why” is the game changer. It is what makes the designs different in my experience because usually all the currently existing industrial designs include the “what” and “how” in their product architectures.

As convincing and valuable as it is, the major drawback of such designs is it can be time-consuming and costly depending on the user group and the project scale. It occurs that simpler things make the learning curve easier no matter what background one may have. The idea of sharing an article may not sound interesting, but when it fits the people who needed the experience, it means much more.

The study focused on all groups of candidates possibly using the service as professional young adults and older adults samples. The results of the studies show there is a need for further development. At the same time, some things have been accomplished and helped the users to share knowledge. The users have received the site very nicely as it is helpful to them. But still there is big room for improvement. The participants reacted so well when they found out future possibilities of improvements in different stages of the development.

The study was dynamic, and the idea of developing for experience helped the users visualize what is going to happen and gave insight for the participants before testing.

The major difficulty faced during the research and development was doing everything with the user from distance, in other words virtually. It is very challenging because of the methods from requirement to development and testing as well as measuring was all done from distance. Scheduling for online contact hours was also difficult to match. But finally everything was managed and it is possible to do such projects virtually though the challenges are higher than field or lab studies.

The other problem was users providing contradicting requirements. Sometimes it is hard to fulfill all the needs of each participant. Therefore, some functionalities had to be omitted. The major drawback was time. It takes time during the development to go back and forth every time.

In the future Tena is going to be implemented and used by different health care centers at least in Ziway and Harar health care centers starting September 2016. There is still some case study in progress to make the UI aesthetically attractive based on the requirements of the users.

Plenty of improvements will happen shortly. One thing that has not been implemented is, the comment section. The other is video uploads and language localizations. Finally, when the requirements are fulfilled, the application will be launched.

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Appendix 1 SUS test questionnaire [22]

Strongly	Strongly disagree	Agree
1. I think that I would like to use this system frequently.		
2. I found the system unnecessarily complex.		
3. I thought the system was easy to use.		
4. I think that I would need the support of a technical person to be able to use this system.		
5. I found the various functions in this system were well integrated.		
6. I thought there was too much inconsistency in this system.		
7. I would imagine that most people would learn to use this system very quickly.		
8. I found the system very cumbersome to use.		
9. I felt very confident using the system.		
10. I needed to learn a lot of things before I could get going with this system.		

Appendix 2 The Positive and Negative Affect Schedule (PANAS) [23]

The Positive and Negative Affect Schedule (PANAS); Watson et al., 1988) PANAS Questionnaire This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate to what extent you feel this way right now, that is, at the present moment OR indicate the extent you have felt this way over the past week (circle the instructions you followed when taking this measure) 1 2 3 4 5 Very Slightly or Not at All A Little Moderately Quite a Bit Extremely

- | | |
|-----------------------|----------------------|
| _____ 1. Interested | _____ 11. Irritable |
| _____ 2. Distressed | _____ 12. Alert |
| _____ 3. Excited | _____ 13. Ashamed |
| _____ 4. Upset | _____ 14. Inspired |
| _____ 5. Strong | _____ 15. Nervous |
| _____ 6. Guilty | _____ 16. Determined |
| _____ 7. Scared | _____ 17. Attentive |
| _____ 8. Hostile | _____ 18. Jittery |
| _____ 9. Enthusiastic | _____ 19. Active |
| _____ 10. Proud | _____ 20. Afraid |

Scoring Instructions:

- Positive Affect Score: Add the scores on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19. Scores can range from 10 – 50, with higher scores representing higher levels of positive affect. Mean Scores: Momentary 29.7.

-Negative Affect Score: Add the scores on items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20. Scores can range from 10 – 50, with lower scores representing lower levels of negative affect. Mean Score: Momentary 14.8.

Copyright © 1988 by the American Psychological Association. Reproduced with permission. The official citation that should be used in referencing this material is Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. 10_P37

Appendix 3. Questionnaire Answers and Revised Answers

Study societal based research on nurses, health officer and doctors at Haramaya University teaching hospital.

Skills and Educational background

1. What is your educational level?

=> Nursing diploma, health officer, and physicians.

2. Have you ever taken any pieces of training?

=> The doctor is a fresh graduate, but the nurses have plenty of training with different organizations like WHO, UNICEF, and USAID.

3. Have you ever participated in a women's health projects?

=> They did major works on birth control, maternal health and HIV AIDS.

Experience

4. What is the biggest problems women face in Ethiopia coming to a health center?

=> Early marriage and anorectal fistula, maternal health and harmful practices, abuse and birth control.

5. How are the major common health problems usually affecting women?

=> Anorectal fistula, maternal health and female genital mutilation and related problems.

6. What do you think programs will help women improve their societal health care awareness?

=> Strong health extension work, educating young people to integrate and make changes in the society and counseling and therapy in healthcare centers.

7. How do you think it is easier to interact in a community smoothly about healthcare?

=> Educating the community that it is important, and it is nothing to shy out from, creating a relationship between the medical professionals and the society as well as learning certain tribal values and cultural integration.

8. How does culture affect health care in general?

=> Culture is an essential element as one could have shy traditions and cultures which make it difficult to teach and integrate. The other is there could be harmful practices

that are overlying on the culture, and it would be good to do real work how to take the thorns out of the beautiful elements of the culture through health education.

9. What are the keynotes of environmental factors in the area?

=> Drought can hurt families apart and women face a lot of problems.

10. What are your experiences that you face which were out of your scope?

=> They suffered skin diseases that they could not cure, and plenty of other complicated cases and they always refer to Tikur Anbessa referral hospital in Addis Ababa.

11. What are the most common diseases that can be avoided but still a problem?

=> Cholera, malaria, tuberculosis and waterborne diseases are the most common ones.

12. What is the awareness in the regarding timely basis medication treatment?

=> There is always an improvement, but there is still a lot to come. The awareness is very much at an infant stage.

Appendix 4. Admin Page screen shots

A. The home page of the admin

The screenshot shows the admin dashboard for Tenaforum. The top navigation bar is green with the site name 'Tenaforum' on the left and a user profile 'Bilen' on the right. A dark sidebar on the left contains 'MAIN NAVIGATION' with links for Dashboard, Users, Category, and Articles. The main content area is titled 'Dashboard' and features two summary cards: '18 Posted Articles' and '17 User Registrations'. A breadcrumb trail at the top right reads 'Home > Dashboard'.

B. Users group management section

The screenshot displays the 'Registered users' management section. The top navigation bar is green with 'Tenaforum' and 'Bilen'. The sidebar shows 'MAIN NAVIGATION' with 'Users' selected. The main content area is titled 'Registered users' and includes a search bar and a table of users. The table has columns for Name, Email, Type, and Articles Count. Below the table, it shows 'Showing 1 to 10 of 14 entries' and a pagination control with 'Previous', '1', '2', and 'Next' buttons.

Name	Email	Type	Articles Count
admin@gmail.com	sdfsdf	Online User	0
anoopkp.mit@gmail.com	Anoop	Online User	1
anoopkp04@gmail.com	Anoopkp	Online User	0
anoopkp06s@gmail.com	Anoop	Online User	0
cristy.developer@gmail.com	Cristy	Online User	0
demelaszeleke@yahoo.com	Demelash	Online User	1
dere@haramaya.com	Dere	Online User	1
geraworkeden@gmail.com	Tina M. Gera	Online User	1
getahuneleni@gmail.com	Elu Get	Online User	1
mailtomtd@gmail.com	KPS	Online User	0

C. Category management section.

The screenshot displays the 'List Category' page in the Tenaforum application. The left sidebar contains navigation options: Dashboard, Users, Category (selected), Categories, Add Category, and Articles. The main content area shows a table with the following data:

ID	Name
1	Women
2	Children
3	Epidemics
10	News
16	Community Services

At the bottom of the table, it indicates 'Showing 1 to 5 of 5 entries' and includes 'Previous', '1', and 'Next' navigation buttons.

D. Article list view section.

The screenshot displays the 'List Articles' page in the Tenaforum application. The left sidebar contains navigation options: Dashboard, Users, Category, Articles (selected), Articles, and Add Articles. The main content area shows a table with the following data:

Image	Category	Title	Active
	News	Properties of Cancer Cells	Published
	News	Otitis media	Published
	Community Services	Nutrition	Published
	Women	Maternal health	Published
	News	Pink eye	Published
	Women	Sulthan Bathery Land	Un Published
	Community Services	Volunteer work	Published
	Epidemics	AIDS	Published
	News	Environmental Trends	Published

E. Article management section.

The screenshot displays the 'Add Article' interface within the Tenaforum application. The interface is divided into a dark sidebar on the left and a main content area on the right. The sidebar, titled 'Tenaforum', contains a 'MAIN NAVIGATION' menu with options: Dashboard, Users, Category, and Articles. The 'Articles' menu is expanded, showing 'Articles' and 'Add Articles'. The main content area has a green header with the 'Tenaforum' logo and a user profile 'Bilen'. Below the header, the page title is 'Add Article' and the breadcrumb is 'Home > Articles > Add Articles'. The form includes a 'Title' text input, an 'Article Image' field with a 'Choose File' button and 'No file chosen' text, a 'Category' dropdown menu, and an 'Active' dropdown menu set to 'Active'. A rich text editor follows, with a toolbar containing options for Paragraph, Font size, Bold, Italic, Underline, Text color, Background color, Bulleted list, Numbered list, Indent, Outdent, Undo, Redo, Link, and Unlink. The editor area is currently empty. A 'Save Changes' button is located at the bottom of the form.

Appendix 5. The query to create the tables after the database is defined.

```
--  
-- Structure for table `tbl_article`  
--  
DROP TABLE IF EXISTS `tbl_article`;  
CREATE TABLE IF NOT EXISTS `tbl_article` (  
  `id` int(11) NOT NULL AUTO_INCREMENT,  
  `title` varchar(255) DEFAULT NULL,  
  `user_id` int(11) DEFAULT NULL,  
  `cat_id` int(11) DEFAULT NULL,  
  `text` text,  
  `art_image` text,  
  `active` int(2) DEFAULT NULL,  
  `created_date` datetime NOT NULL,  
  PRIMARY KEY (`id`)  
) ENGINE=MyISAM AUTO_INCREMENT=44 DEFAULT CHARSET=latin1;  
  
--  
-- Structure for table `tbl_category`  
--  
DROP TABLE IF EXISTS `tbl_category`;  
CREATE TABLE IF NOT EXISTS `tbl_category` (  
  `id` int(11) NOT NULL AUTO_INCREMENT,  
  `cat_name` varchar(255) DEFAULT NULL,  
  `icon` varchar(255) CHARACTER SET utf8 NOT NULL,  
  PRIMARY KEY (`id`)  
) ENGINE=MyISAM AUTO_INCREMENT=18 DEFAULT CHARSET=latin1;  
  
--  
-- Structure for table `tbl_users`  
--  
DROP TABLE IF EXISTS `tbl_users`;  
CREATE TABLE IF NOT EXISTS `tbl_users` (  
  `id` int(11) NOT NULL AUTO_INCREMENT,  
  `email` varchar(255) DEFAULT NULL,  
  `user_type` int(2) DEFAULT NULL,
```

```
`active` int(2) DEFAULT NULL,  
`password` varchar(255) CHARACTER SET utf8 NOT NULL,  
`name` varchar(255) CHARACTER SET utf8 NOT NULL,  
`created_date` datetime NOT NULL,  
PRIMARY KEY (`id`)  
) ENGINE=MyISAM AUTO_INCREMENT=21 DEFAULT CHARSET=latin1;
```