UI design recommendation for illiterate/semi-literate

A case study of online video sharing web application

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***Abstract*: Different approaches have been adopted for design an interactive and feasible software application considering illiterate/semi-literate user groups. These techniques are implemented in front-end design using pictorial links, buttons and icons. Another methodology that can be followed in back-end development to minimize the software complexity is to use micro interaction. In this paper a usability model is devised that can assist a software engineer to develop more feasible and interactive software system. The model is based on micro interaction which makes the system automated and intelligent.**

Keywords: Usability, HCI4D, ICT4D, software engineering, micro interaction, UI design

I. INTRODUCTION

Information Commutation and Technology (ICT) is widely used approach to share information among individuals. Rapid growth of ICT and its complexity cause digital divide for developing and developed countries. The term digital-divide was first recognized by US in 1990s [1]. Varying factors are involved in such technological disparity e.g. poverty, illiteracy, no-access to the technology. Even age divide is also a big challenge for ICT adoption. Elderly and adult groups are hesitate to adopt ICT due to less knowledge [2]. In developing countries, major facts that confine individuals from using ICT are illiteracy or having low read/write capability. Panacea to the problem is to develop an interactive and usable design for equipment that is used by ICT. System success or failure is dependent on usability. To extend the spectrum of ICT to the illiterate/semi-illiterate community, complexity of the system should be reduced and more attention should be given to increasing usability. The proposed model focuses on how to increase the usability of any system and reduce the complexity that is developed for ICT.

Information Communication and Technology for Developing Countries (ICT4D) is a growing field that considers how personal computers, smartphones and internet can help in socio-economic development of poor countries. ICT4D has many questions those are already asked by Human Computer Interaction (HCI) for many decades. According to ACM SIGCHI, HCI concerns with the design, evaluation and implementing interactive computer systems for human use. This means that HCI is central to ICT4D [3]. ICT4D and HCI4D **have** been adopted by HCI researcher's community which supports a level of goal and purpose. These growing fields are applied to redesign the interactive behavior of ICTs to develop a new and appropriate structure of ICTs and devise human centered approaches for constructing a better design [4].

Researchers in this field have worked for designing better User Interface (UI) for ICT tools targeting illiterate/semi-literate or non e-digital literate users e.g. non-textual, iconized or voice interface which helps the user to interact with the system [5]. But still these approaches are complex and require more feasibility. One question is that what if any text based input is required from the user in a web based form? Or what if multiple steps are involved for achieving a single goal? These approaches are associated with front-end designing. The proposed model can fetch more feasibility utilizing back-end development by implementing Micro Interaction. This problem can be better explained in the scenario 1.

Scenario 1:

"Alice is a semi-illiterate/non e-literate individual who is enthusiastic about smartphones and personal computers. She captures 30 seconds video clip using her iPhone and wants to upload to a video sharing website. She searches for the site on Google and finds a well-structured usable User Interface (UI) for the site. She can navigate through different pages because of iconized menus and links. the problem is that she does not know how to put descriptions about the clip which is recommended by the site. Because of multiple steps involved in uploading task, she leaves title, description and tags blank for the clip while uploading to the database. Now she tells her friend Bob about the clip to search in the current site for

watching. Unfortunately Bob fails to list her video using search because search engine does not find the video which uses the mentioned inputs to index the clip."

Section 11 of the paper contains literature review in the above discussed area. Section 111 explains how usability engineering can be utilized to attain interactivity in software system. Micro Interaction is the key component of the model that is delineated in section IV. The proposed model in section V will be implemented in back-end development. Section VI contains the result of effectiveness of the approach in a video sharing web application. The conclusion section VII contains the final words about the research.

II. Related work

Literature review reveals that researchers have worked a lot for making feasible software design targeting illiterate individuals. These approaches concern only with UI design which is a best effort. Here are some methods those are adopted to construct human friendly interface.

In agriculture, crops get diseases and farmers cannot handle the situation. One of the recently work done by M.Namita and his colleagues is an automatic agriculture system that is capable of retrieving information from crops based on iconic interface. The system capture image of a leaf, identify disease and automatically response with remedy [6]. Restyandito and his contributers have utilized usability engineering while designing a cell phone interface. They conducted a survey and proposed iconic based cell UI and revealed effective result from its usage The survey was about to select random population from varying places those have either little usage of cell phone or totally not [7]. Another approach adopted by Indrani Medhi and his colleagues are a *not-textual User Interface.* The approach adopts different methodology than ionic interface. This *non-textual user interface* is based on ethnography which some sort of pictorial representation of a functionality. They have also used numbers instead of text [8]. Advances in ICT and availability of low cost hardware and software has enabled almost every person with a smart phone, to become a part of social network and taking advantage of this fact, Medhi has introduced a social network for low-literate farmers. *KrishiPustak* is a social network mobile application that assists farmers to post and replies to the content using smart phones. Farmers can distribute their problem and solution through groups and postings. This application uses iconic interface that helps low-literate farmers to share information on the net [9]. Zehra Lalje study illustrates that a thorough investigation about certain user's world, lives and concerns should be conducted before designing any mobile interface for illiterate users. User-centered approach is adopted in this study to first create a prototype on hardboards and test by the users. Images like telephone, torch, camera has been implemented in the design for user understanding [10].

As different graphical interface methods have been adopted for illiterate community, there are also other available methods such as voice input approaches. VoiKiosk is a vocal interface for villagers who can interact with the system. They can upload information to the system and maintained by the local community. Dial-an-Auto is a VoiceSite available to passengers and taxi drivers. An auto-driver can find their closest passenger in the street instead of waiting on their designated stands and vice versa [11]. Miqraah is virtual learning system of learning Quran online. It has two interfaces one for literate and other for blind/illiterate. The second version of the system starts normally when windows loads and use speech recognition engine to take voice commands. Interaction is totally based on voice commands [12].

Summarizing the above listed approaches, it can be concluded that these methods concerns only with physical interface for feasibility. The adopted approaches can be more refined by utilizing back-end development of a complex software system. In this approach of developing a software for Illiterate/semiliterate, all the possible actions will be burden for programmer not for the user.

III. User Centered Design Approach

Human Computer Interaction (HCI) has played a vital role in designing an interactive system. The key factor for a successful design is to ameliorate its usability. Usable designed should have features of effectiveness, efficiency, safe to use, easy to understand and memorable for future use. The goals of usable and interactive software should be fun, enjoyable and aesthetically giving pleasure to the user [13]. One approach for the user-centered design and reduce the software complexity is to introduce usability engineering in software designing phase. This method entails to form the requirements specification that is captured before the actual application development. Utilizing usability-engineering depends specifically on the target user actions and situations. So it is a plus point for this video sharing application that targeted users are illiterate/semi-literate. Usability engineering actually is to judge the success of a product in term of usability according to some explicit criteria. There is a list of criteria that will be used for usability testing and measurement for user experience for the software design [14]

- Time to complete a task
- Percent of task completed
- Number of commands used

While measuring the product, these criteria will be used to judge the success of the application according to comparison to the products that has not utilized the usability engineering and result will be drawn in tables and graphs.

According to ISO 9241-11, usability is an extent to produce a product for some particular users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use [15]

Another international standard ISO13407 also defines UCD in four steps which are [16]

- State the context of use
- Identifying the user and organizational requirements
- Producing design solutions
- Evaluating the design against requirements

One common component of these standards is to identifying your user. Is user novice or experienced? Are they literate or illiterate? Or is the user physical enable to use the system.

IV. MICRO INTERACTION ARCHITECTURE

The NewYork Philharmonic was in slow tempo and reached to the end. Audiences were hypnotized by the beauty of the sound and have spent hundreds of dollars to *Mahler's Symphony no. 9*. Performance was suddenly interrupted by a ringing alarm clock and going off. The owner was still unaware of his phone because he has flipped silent mode while attending the performance. Patron X has recently replaced blackberry by iPhone and was uninformed by the function of the phone that it will still ring the alarm while in silent mode. The sound that was happing from the front row, ruined the performance [17].On the next day, varying discussions and debates were started about the silent mode. Some have the opinion that there should be everything in silent mode and some was against them that only the explicit user actions should not undelay in the silent mode category. John Gruber explained that phone alarm should still ring even the user has flipped to the silent mode as iOS is following Human Interface Guidelines [18]. He said furthermore that if the mute action silent everything then there will be hundreds of people oversleeping each single day because they do not remember to turn on the ringer after muting the sound Silencing a phone should not silence every sound that is explicitly called by the user. For example if a user want to playback then it is specifically called by the user and should turn on the sound [19].

A simple example of Micro Interaction (MI) is switching a phone to its silent mode. An action to achieve a goal is called *use case* and MI spin around a single use case. MI can enhance and power any product or device which exists alongside or inside the product. MI is an alternate user action that engages a user with interface having pleasure and grace. In our daily practice, MI is implemented software, electronics and also in a large factory. For example auto-complete and copy-paste in a software product, making toast in a toaster and switching lights only in administration section of a factory.

MI consists of four main parts to handle any single use case for achieving a goal. These parts are below:

A. Trigger

A software design needs functional requirements specification and should be converted to a use case model for drawing unique use cases. These use cases can be registration, uploading or deleting a record. Triggering the upload button is a user-initiated action to perform a file upload.

B. Rules

Some time it is hard to understand the rules; it is all about what is happing inside product. Rules may be sequential commands that are executed by a product and invisible for the end user..

C. Feedback

A user-initiated action normally produces result which is displayed on the screen in the form of voice, text or visual objects. A red badge on the top of the notification button is one kind of feedback that new notifications have arrived.

D. Loops and Modes

Often users turn back to the desired functionality that makes a loop. For example, if a user buys some product from eBay website and has already bought that product then the text of the buy button will be "Buy Another" instead of "Buy it Now".

Searching for weather in a website for a specific location is one kind of Modes [20].

As a result of discussing the MI, it is possible to reduce any use case complexity by converting each use case to MI that achieve the desired goal of the selected use case by a single trigger.

V. METHODOLOGY

The importance of MI implementation in software design cannot be overlooked, it is necessary to optimize the quality of a product because a poor software design may lead to the failure. Different surveys has been conducted about the web design and resulted that in spite of hard effort, many web applications still remain complex. A survey reported that only 56 percent of users has accomplished their desired tasks on e-commerce web sites. Forrester Research reported that 65 percent of visitors resulted in failure while online shopping and 40 percent users choose not to turn-back to the site [21]. The proposed model covers both front-end and back-end design to optimize the intricacy of any web application. This model can be used with any methodology like waterfall, agile or spiral as it concerns only with development or implementation phase.

The key concept of the model is to scan throughout use cases, generate use case scenarios and then convert these scenarios to MI. The conversion process is explained in section B. A test case is created to judge result of the converted use case to MI. If results are obtained according to the post condition of use case scenario then the conversion is succeeded. Figure 1 shows a brief detail of the proposed mode.

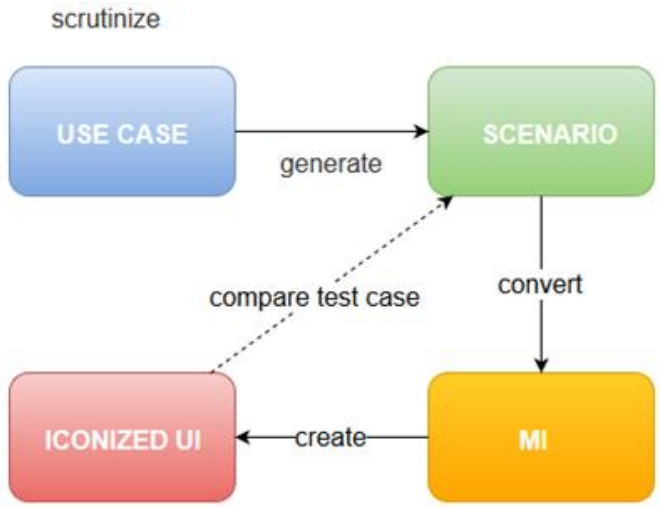

Figure 1: usability model of Micro interaction

A. SCRUTINIZE USE CASES

The core process of software engineering during system development is to draw a use case diagram for functional requirements. Use Cases are base actions performed by a user to accomplish a single task. In the context of video sharing application, there are three main use cases those will be converted to MI to improve the usability:

1. Registering a new user
2. Login to the application
3. Upload a file for sharing

Main aim of this research is to implement the usability model of micro-interaction in file upload process by illiterate/semi-literate. File upload has different complexities for illiterate/semi-literate as well as for non e-digital literate. As mentioned in Scenario 1 that bob was unable to find his cousin video in search engine because the video file has no database description record as Alice had not submitted. So this model enable the application to extract such data from video file called metadata and upload to the database gracefully giving fun and pleasure to the user. Figure 02 describes the complete process

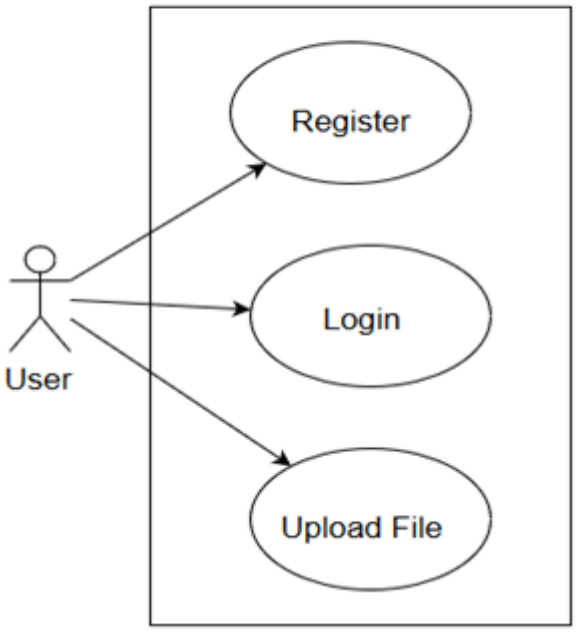

Figure 2: use case diagram

Before programming for any use case it is recommended that scenario should be generated to perform the action. Scenario consists of different paths to be followed by the user to complete the task. It has also pre and post conditions that meet the requirements after completion. The desired scenarios are mapped to the mention use cases in the tables 01 and 02

Table 01: Use case scenario for Registration

Use case name	Registration	
Pre-condition	User has no previous account on the database	
Standard flow	1	Input bio data(first name, last name, email, username, password, city, province, country)
	2	Trigger registration function
	3	Validate the data
	4	Store in database
Post condition	Redirected to the confirmation page on success else error page	

Table 02: Use case scenario for Upload File

Use case name	Upload File	
Pre-condition	User has already registered on the system	
Standard flow	1	Select a video file
	2	Input related data (title, description, tags etc.)
	3	Trigger upload function
	4	Store the file on server and meta data in database
	5	Redirect to the video view page
Post condition	Video should be indexed by search engine	

B. CONVERSION

Registration process has different inputs, which is uncomfortable for the user like illiterate/semi-literate and non e-digital literate and cause failure to submit the data. First step for the conversion is to select a trigger and then the define rules. MI emphasize only on achieving goal not to accomplishing steps. So rules are the core component of the MI. In this context, three triggers will be used, two invisible-triggers and one visible-trigger for registration use case. First trigger will be fired on "email" input, second on "city" and the third triggered will be fired on "Signup" button control

Table 03: MI Table for registration (email)

Microinteractions for registration use case		
Name	Email	
Trigger	KeyPress	
Rules	1	Extract first name from email prefix
	2	Extract last name from email prefix
	3	Extract username from email prefix
Feedback	Put and show all extracted data in its proper inputs field	
Loops	Show error message with redirect link to login page if user exists	

Table 04: MI Table for registration (city)

Microinteractions for registration use case		
Name	City	
Trigger	KeyPress	
Rules	1	Populate province input from database where the city belongs to the province
	2	Populate country option from the database where the province belongs to the country
Feedback	Put and show all extracted data in its proper inputs field	
Mode	Specific to Pakistan location structure	

Table 05: MI Table for registration (signup)

Microinteractions for registration use case		
Name	Signup	
Trigger	Button Click	
Rules	1	Create the user record in the database
	2	Login with the credentials
	3	Redirect to upload page
Feedback	Show graphical notification of saving records e.g. loading image, system busy image	
Loop/Mode	null	

In a typical design the user has to submit 9 inputs and that can be complex for a beginner or illiterate/semi-literate. But after conversion to MI, it has just 3 inputs submissions.

The second conversion to MI is for upload video file to the database along with metadata. The upload use case strictly need three types of metadata (title, description and tags), which is necessary for indexing the video, and will be saved on the server. Metadata about the video file can be obtained by using ffmpeg library which is written in C. It is available with GPL and LGPL license [22]. Title of the video, name, resolution, duration etc. can be obtained utilizing libavcodec, the core component of ffmpeg.

So the process of conversion is illustrated in the table 06.

Table 06: MI Table for File Upload

Microinteractions for Upload File use case		
Name	Upload	
Trigger	Button Click	
Rules	1	Extract title from the video metadata
	2	Extract name from the video metadata
	3	Generate tags (comma seperated0 of single words by combination of name and title
	4	If metadata does not exists then generate about elements from the file name
Feedback	Populate name, title, description and tags fields with the extracted data	
Loops	If the video is already exists in the database then show information dialog with renaming options	

C. ICONIZE NAVIGATION OBJECTS (links/buttons)

The third component of the model is to create Graphical User Interface that engages a user with the system. While targeting digitally non-expert community, the best way to design UI is to use pictorial or iconic interface. Figure 03a and figure 03b illustrate the registration process in video sharing web application.

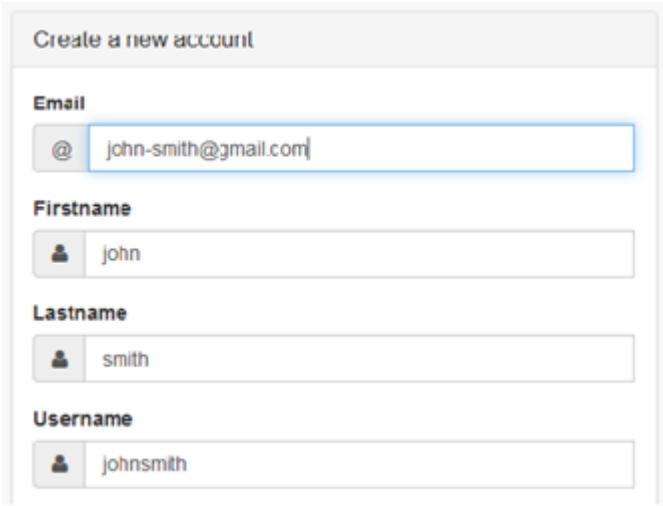

Figure 3a: Populating other input fields from email input field on key press trigger

Triggering the keypress event by email input control will call a function, which calculate other related inputs using regular expression, and populate the associated input controls. The another trigger (figure 03b) of city control will invoke a function, which extracts the related data from server according to entity relationship rules, and set the state and country controls as well.

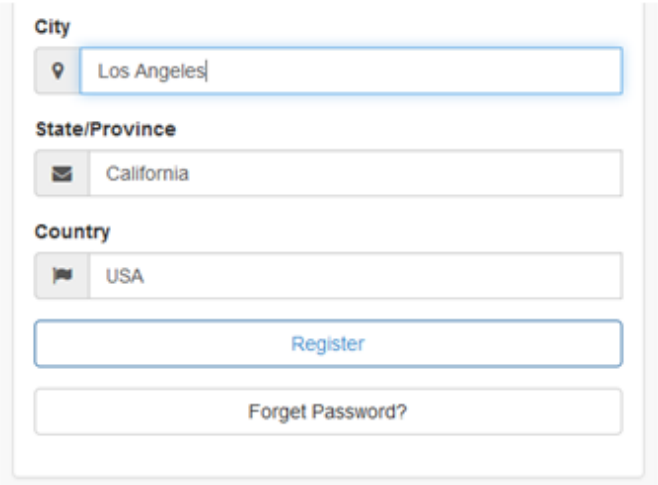

Figure 3b: Populating state and country input fields by extracting data from database using belongsTo relationship.

Each scenario has two core options of Pre and Post Conditions. Post conditions would be take into account while conversion. The dotted arrow from UI to scenarios is compare mode to test if the result is same to the post condition then all is going well else change programming algorithms.

VI. Results

After adopting user-centered approach for any product, which may be software and hardware, it is crucial to experiment with the target user in terms of testing the product for its usability. The actual user behavior can be documented for analyst to observe the design and avoid erroneous product before the final release. The criteria that should be taking into account may be the time completed for a task. What was the degree of the task completion e.g. ease of use, hard to complete the task or failed to accomplish. Was the product learnable if someone wants to revisit the interface or not?

The subject should be given different tasks to complete and obtain the specific goal e.g. upload a video, search for a video, list your own uploaded file etc.

10 subjects were randomly selected for the usability test and the average behavior was recorded in table 07.

Table 07: Usability Test

Task Name	Time Taken	Average success	Degree	Errors	Learning
Signup	80s	98%	easy	10%	twice
Login	50s	90%	easy	2%	once
Upload	45s	98%	medium	2%	once
Search	40s	98%	medium	2%	twice

The average success percentage was greater than 90 and the cause of 10% failure for signup was user existence in the database. Login field has 10% failure of incorrect input name or password. Upload success percentage illustrates that 2% of file upload failure was server problem and refused the large file for upload. The error field shows the mistakes occurred by the subjects while typing incorrect inputs. Learnability property of the model was 50%. The subjects learnt signup and search methods by visiting the interface twice. Login and upload actions was learnt by subjects in first attempt.

VII. Conclusion

HCI is playing a central role in designing interactive software systems. A successful product can be achieved by adhering to user-centered design. Software remains still complex in spite of designing a better GUI. It can be made further more feasible by automating each task in back-end development by implementing Micro Interaction. Micro Interaction is a way to do a job with a single click/key press. So any software or web application complexity can be reduced both in front-end and back-end environment.

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