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Usability Engineering, Human Computer Interaction and Allied Sciences: With Reference to its Uses and Potentialities in Agricultural Sectors—*A Scientific Report*

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Abstract

Human Computer Interaction is actually responsible for the designing of the computing technologies keeping in mind the aspects of Interaction. Some of the fields viz. Man-Machine Interaction (MMI), User Experience Designing, User Experience Design, Human Centered Designing etc and importantly all these systems and technologies are dedicated to the designing of interface of various tools and systems such as computers, laptops, electronic systems, smart phones etc. Information Technology field is growing rapidly and there are various technologies are increasing viz. Big Data Management, Cloud Computing, Green Computing, Data Science, Internet of Things (IoT), HCI, Usability Engineering etc. Usability Engineering is gaining as a field of study as well and dedicated in creation of the higher usability and user friendliness of the electronic tools and products. In this field few aspects and technologies are most important and emerging viz. Human cognition, behavioral Research Methods, Quantitative techniques etc for the development of usability systems. Designing, implementation, usability even in multimedia material viz. audio-video may also practice in the Usability Engineering and allied fields. Wireframes including few other prototypes are required in maintaining of the better and healthy man and machine interaction. As the field is growing therefore, it is applicable in other sectors and allied areas and among these agriculture is important one. In agricultural sector different applications of information technologies are increasing and among this Usability Engineering and HCI are important one. In pre production and also in post production; directly and indirectly this technology is emerging and growing. This paper talks about the basics of this technologies and also its current and future technologies with reference to academic potentialities of this branch in Agricultural Informatics programs.

Keywords: Agricultural informatics; Usability engineering; HCI; MMI; Agricultural sciences; User interface; Information dissemination.

1. Introduction

Human Computer Interaction is initially considered only as the technology that is responsible for the design, evaluation and also in implementation of the computing systems. Here in this technology (human utilization of the tools and technologies) human psychology; user needs play an important role. Gradually this is become a field of study and in many universities across the globe started offering as a degrees and academic programs. First in the year 1980, the term was used but popular since 1983, after the inclusion of its name in the book called Psychology of Human Computer Interaction by Stuart K Card and Newell, Carnegie Mellon University. In Human Computer Interaction and Usability Engineering various emerging tools and technologies are started to use to make user friendly as well as usable computing system [1-3]. In HCI another topic and area is become very important and valuable i.e. Usability Engineering, which is mainly restricted on the uses users studies and rather designing and interaction. For better and healthy practice of the HCI following Usability Engineering guidelines are better to use in respect of healthy and greater usable interface, systems and electronic interfaces including computing based interfaces or systems.

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- The ADA Guidelines for accessibility of state and local government websites.
- The Guidelines of Web Accessibility Initiative.
- The Section 508 government guidelines for all public-sector websites.
- The IBM Guidelines for accessibility of websites [4-6].

According to the ACM, the world biggest association of Computing, it is "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them"

2. Objectives

The paper entitled 'Usability Engineering, Human Computer Interaction and Allied Sciences: With reference to its uses & potentialities in Agricultural Sectors—*A Scientific Report' is a* theoretical and conceptual in nature and deals with following aim, objective and agendas—

- To learn about the basic of the Information Technology and its components including emerging technologies.
- To know about the Agricultural Informatics with its emerging technologies and role in making smart agriculture.
- To get the knowledge on HCI, Usability Engineering and allied domain with their evolution, features and functions.
- To learn about the applications of HCI, Usability Engineering and allied domains in the field of agriculture including its role in building of smarter agriculture.
- To get the knowledge on the issues as well as current challenges of implementing HCI, Usability Engineering and allied domains in the field of agriculture and allied areas.
- To proposed and suggest HCI, Usability Engineering and allied domain applications in the field of agriculture.
- To proposed and find out the emerging and possible programs on HCI, Usability Engineering and allied domain in respect of Agricultural Informatics.

3. Methods

This work 'Usability Engineering, Human Computer Interaction and Allied Sciences: With reference to its uses & potentialities in Agricultural Sectors—*A Scientific Report'* is theoretical in nature. Hence this work is interdisciplinary as well and thus depends on various secondary sources initially and for that various kinds of published secondary works consulted in the areas of Man-Machine Interaction (MMI), User Experience Designing, User Experience Design, Human Centered Designing etc as well as Agricultural Sciences, Agro Informatics. The primary sources has also been gathered, analyzed and reported in this work to learn about the possible applications in Agro Industries and company's current offering and services also been mapped. Moreover, websites of various other organizations have been checked and analyzed and also incorporated in this work to get the current picture of UXD, HCI and allied applications in the agriculture as well.

4. Agricultural Informatics, UXD and Allied Fields

Agricultural Informatics is an interdisciplinary field of study and combination of two important subject viz. 'Agricultural Science' and 'Information Science' (or allied areas or field). In other word, it is the applications and interaction of Information Technology in the Agriculture and similar subjects and areas. This branch is also called as IT in Agriculture or Agricultural Information Technology. However the term Agricultural Informatics is most popular and becomes started as a field of study at different level of programs in many international universities. Agricultural Informatics uses different components of Information Technology such as—

- Database Technology,
- Software Technology,
- Multimedia Technology,
- Web Technology,
- Networking Technology etc.

The Agricultural Informatics additionally also uses the principles, methods and procedure in documentation, Information Management etc. However recently due to the advent of the IT and Computing various other areas also been started and these are started operation and uses of Agricultural practices viz. Cloud Computing, Big Data, HCI, Usability Engineering, Robotics and AI etc. Hence, developing a Smarter Agricultural is become easy with the applications of HCI & UXD and allied subjects in Agriculture and allied subjects. Recently, the applications of these technologies have growth tremendously in resent past. In the areas of pre production, post production, training and knowledge building in agricultural operation to the farmers, HCI and Usability Engineering and allied technologies are playing a leading role. The population may rise up to 9.7 billion in 2050 as per a study of the United Nations and in this context the food are needed and thus farmers gave are uses different emerging technologies in their agriculture and allied activities. Hence in this context allied branches may also be used viz.—

- Agricultural Information Systems (AIS)
- Agricultural Information Technology (AIT)
- Agricultural Information Science and Technology (AIST)

- Agricultural Computing
- Agricultural ICT. etc will play a great role.

In these subjects emerging subjects and technologies like HCI, UXD etc plays an important, intelligent cultivation and practice [7-9].

5. Usability Engineering and Allied Sciences: A Comprehensive Overview

Usability Engineering as a field of study is growing rapidly and this trend is growing day by day. There are other subjects which are also increasing viz.—

- Man-Machine Interaction
- Human-Machine Interaction
- Usability Experience Design
- Human Centered Designing
- User Centered Designing etc

5.1. Usability Engineering

Usability Engineering is the study, evaluation, designing, and development of interface of different electronic products as well devices based on user interface. Usability Engineering is helpful in   the designing of the interface of different kind of monitors (LCD, LED), websites, web portal, search engines, information retrieval system, ATM Systems and its Interface, Smart Phone and General Phone Interface etc [10-12]. It is an worthy tool in developing of sophisticated information systems which are human centered and deals with the instructiveness with proper utilizations of different renowned standard and guidelines viz—

- *International Standard Organization (ISO)*
- *National Institute of Standard and Technology*
- *IBM Guidelines*
- *ADA Guidelines* etc.

Usability Engineer basically involved in designing of smarter, interactive, efficient, less complex, easier interface creation [13-15]. Hence here prototype, usability testing and methods are applicable including information designing and content management. Some of the important tool and uses are illustrated in the Fig 1.

Fig-1. Creation of the HCC and interactive Systems powered by Usability Engineering
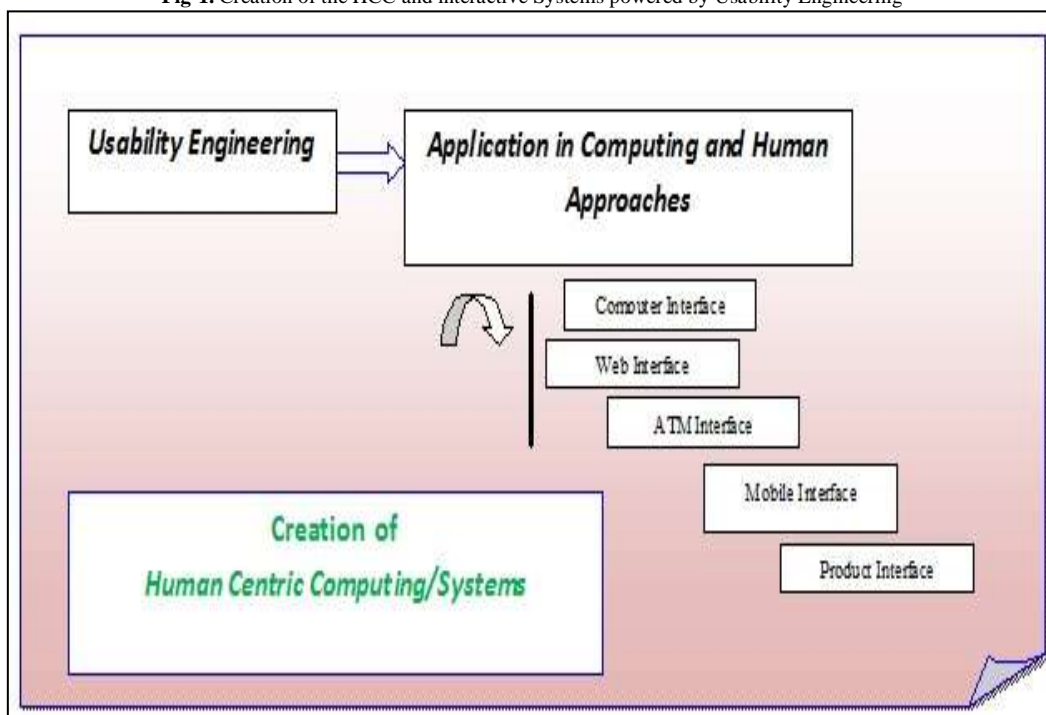
5.3. HCI

Human Computer Interaction in short called as HCI, it is very closed with the areas of Usability Engineering. This is useful tool and subject in Computer Science, Information Science, Information Technology and all the areas of Information Sciences and Technologies. Human Computer Interaction uses the field viz.

- applied psychology
- designing
- sociology
- engineering
- management

- mechanics

Usability Engineering & Human Computer Interaction both are closely related and depend on information technology. There are huge and emerging jobs in the field of HCI and more are emerging in near future [9, 16, 17]. HCI is also known (or related to) as following—

- Man Machine Interaction
- Human Centered Computing
- Human-Machine Interaction (HMI) etc

5.4. User Experience Design

User Experience Designing in short also called as UXD or simply called as UX. User Experience Designing is more concentrated on designing principles and apart from the manual tools, methods of the designing, it also takes the help of different kind of computer graphics and animation principles or multimedia technology as well Bechar and Vigneault [18]; Novák, et al. [19]; Shyamaladevi, et al. [20].

5.5. User Centered Design

User Centric Design is also called as User Centered Design. This is a kind of process, framework, guidelines in which main object is user and their need or expectations. In this field, the service demand of the users, their needs as well as limitations are normally considered as important. Due to its nature it is also called as User Driven Design and concentrated on various kind of design process, analysis etc and in all these healthy UCD practice is important. The first priority in UCD is to get actual user need and gradually user's need in each step including their requirement, concepts as well as pre-production models. Feedback and evaluation method is also considered as important in this including following two methods—

- Pre testing and
- Post testing.

Gradually other methods in User Centric Design need to follow in better usability and complete systems development.

5.6. Usability Testing

Usability Testing is also an allied concept of UXD, UCD, and Human Computer Interaction etc. It is further more systematic observation in a controlled condition and here users study on the products, services, systems are considered important. For usability testing apart from the technology based systems and techniques various other manual tools and procedures are followed viz. qualitative and quantitative techniques [6, 21, 22].

5.7. Interaction Design

Interaction Design, often abbreviated as IxD. This is Interaction in respect of designing of interactive documents, contents, multimedia systems, IT based systems, User interfaces etc. Hence this method is required in developing interactive digital products as well as services. Interaction Design, in Usability Engineering & Human Computer Interaction similar to other techniques mentioned above interaction designing is also play important role.

6. Smart Agriculture Vs. Usability Engineering and Allied Fields

Information Technology is an important applied science, which is responsible for the designing and development of the various information enriched systems and products using various sub technologies and emerging technologies. Among the emerging technologies few important are include—

- Cloud Computing
- Big Data
- Human Computer Interaction (HCI)
- Usability Engineering (UE)
- Robotics and AI etc.

These technologies are very important in designing, developing and building ICT enable smarter agricultural systems that called as Smart Agriculture or Digital Agriculture. Cloud Computing, Big Data and Robotics while responsible for the direct helps in pre production and post production. The fields of Usability Engineering (UE) & Human Computer Interaction (HCI) are responsible for the indirect role in helping agriculture and allied fields [23-25]. We already gathered about various aspects, features and functions of UE and HCI related areas, all these are very important and required in healthy UE Practice. Moreover following can be considered important in respect of agro based UXD and HCI systems designing and development viz.—

- To conduct various kinds of interviews to learn about the need of the farmers as individually or in the group is an urgent task; moreover here the planning also considered as important to adopt various kind of specified. Many users may not be able in ITC based product designing and development and in this regard Usability Engineering methods are important to learn about their actual interest, problems in operating devices etc.
- Focus group and collections of questionnaires is important to follow-up in designing of healthy Usability Engineering based Agro Products designing.

- Judgment regarding the Cognitive Walkthrough is valuable for usable agricultural systems designing and development [7, 20, 26].
- Heuristic Evaluations, RITE methods are important in the creation of healthy man machine interaction systems in respect of agriculture and agro based industries.

In the field of Agricultural Informatics, there are different types of applications opportunities of UE and HCI etc and in this regard important are considered with the following methods scientifically (refer fig 2).

Fig-2. important methods used in creation of healthy Usability Systems.
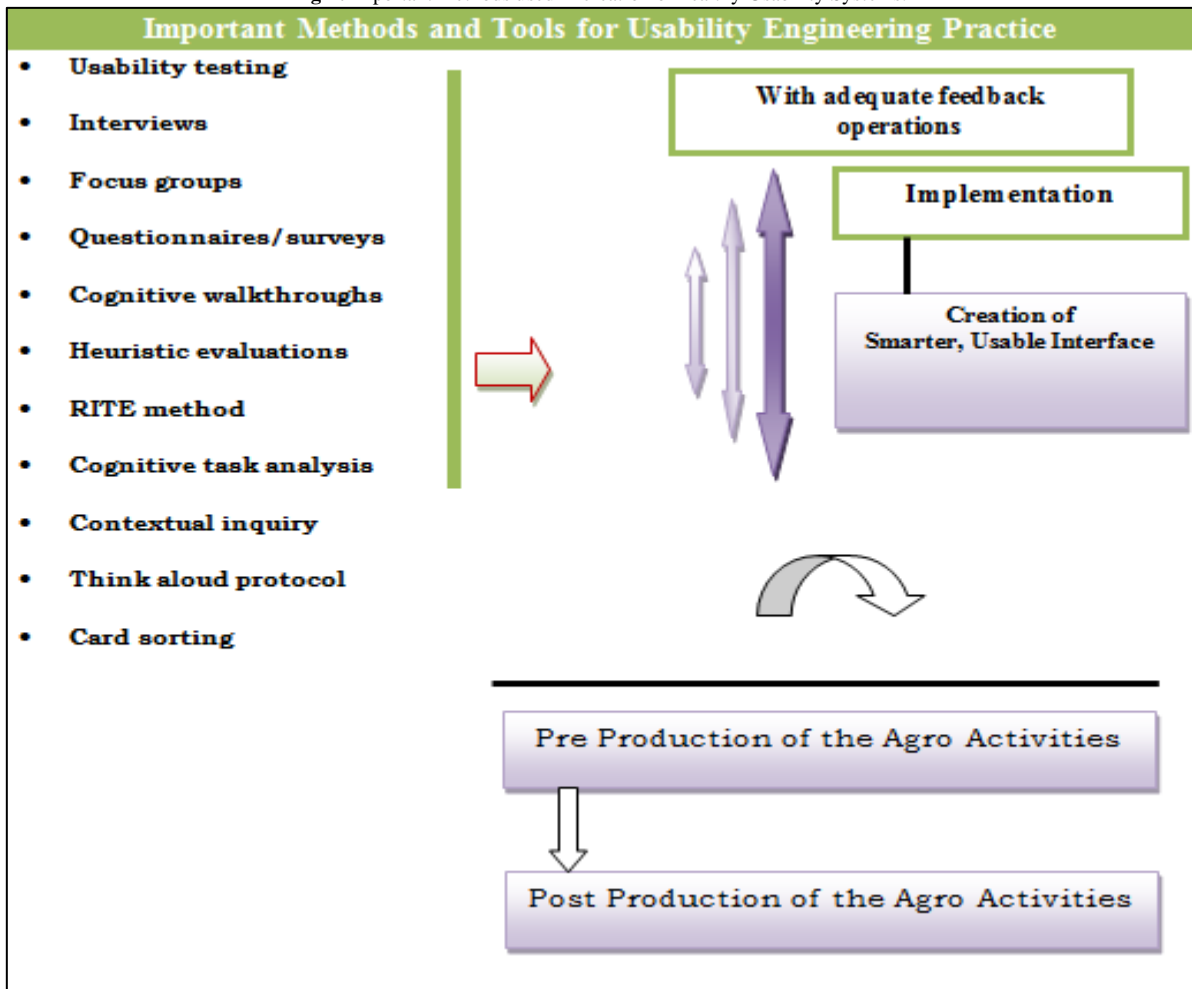
Further for enhancing the information systems and technologies in the agricultural sectors as far as usability and HCI related areas are concerned, following are important (also refer Fig 3)—

- UE and HCI etc are required in the designing and development of the website that are deals with agriculture, horticulture and allied activities.
- Web portals become important these days and there are increasing trend of this in almost all the sector. As far as agriculture sector is concerned, the web portal is increasing and this is an emerging tool for agricultural development as it is helps the farmers; directly and indirectly.
- Agricultural Networks are responsible for the development of the agricultural information centres and dedicated to collect, select, organize, process, management and dissemination of the information of agriculture and allied areas. In such networks links of different agro based websites are also provided and thus it is become very easy to use by the farmers to get knowledge on diverse areas of agro including current trends of cultivation, methods, weather and climate, market trend etc.

Fig-3. Uses of Usability Systems in divers Agriculture related activities
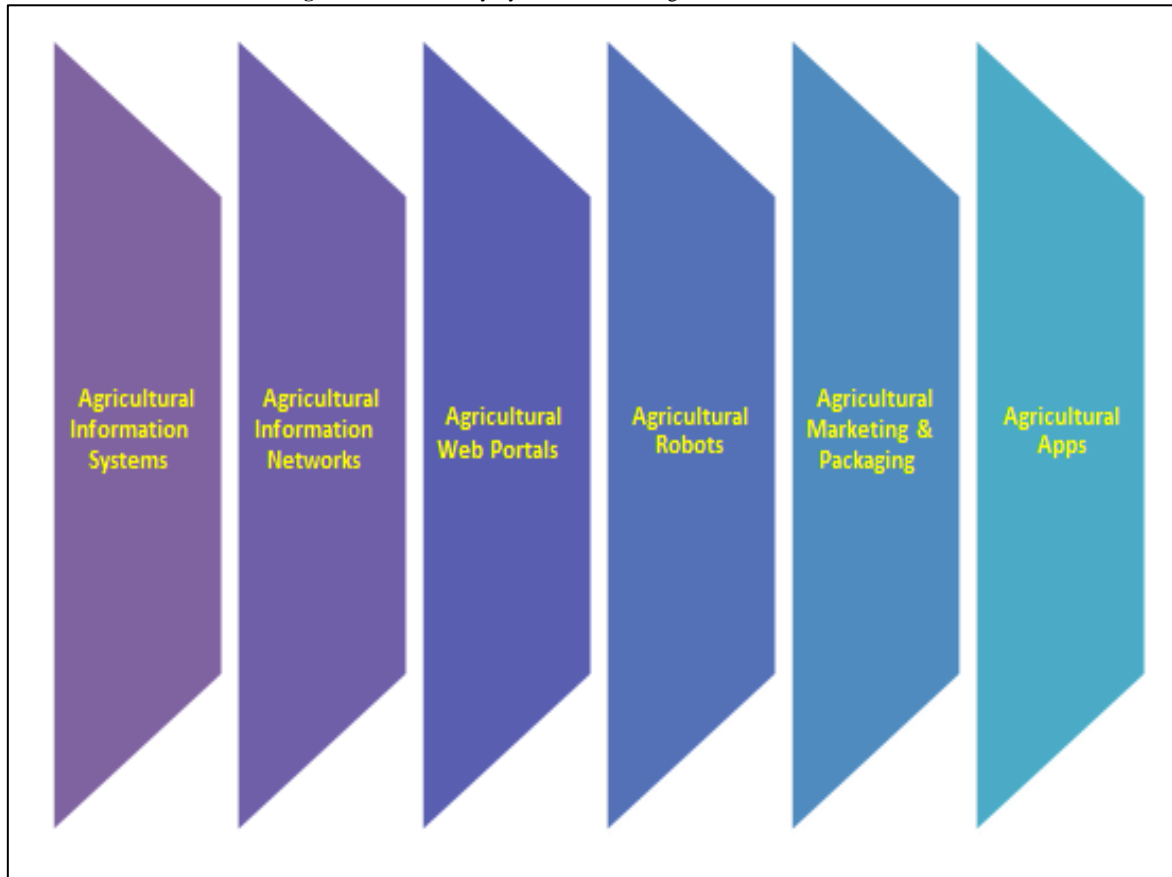
- UE and HCI etc could be consider as valuable and important in respect of Agricultural Information Systems designing and development, which can help in better documentation and make easy to understand the concepts on agriculture. Such Agricultural Information Systems can hold huge amount of books, periodicals, magazines, agricultural news papers for the betterment of the users and cultivators.
- Apps and its uses are rising in recent past in diverse areas including Business and Commerce, Education and Training, Healthcare and Medicine, Government and Politics, Management and Administration etc. and as far as Agriculture is concerned there are diverse areas in which UE and HCI etc are possible to use in sophisticated manner. Hence the agro related apps would be much more on healthy and sound in terms of designing, development of friendly apps [27-29].
- In Agricultural industries the products ultimately move to the market and thus in marketing of such agro products leaflets, brochure, websites etc could be used and here UE and HCI based principle is worthy to use.
- In pre production systems the Agricultural Information Kiosks are rising throughout the world and in such kiosks and screens the agro related contents, videos etc could be produce based on need of the cultivators.
- In packing of the agro foods and products the UE and HCI etc principles may be used to make the packets etc more good looking and interactive.
- This days drone technologies and sensors are used in different kind of agricultural activities viz. monitoring, spraying and in this regard UE and HCI technologies are using for designing the systems more advanced and modern!
- In the agricultural robots interface become common practice and in this interface UE and HCI systems are followed for better and healthy designing of the same [22, 30].

7. Suggestions and Recommendation

Usability Engineering (UE) & Human Computer Interaction (HCI) and its applications are rising throughout the world and this is become an important criteria in developing friendly, easy interfaces and electronics goods in regard to agriculture and allied areas. The following could be consider as most vital and important in developing UE and HCI in agricultural sciences and sectors—

- UE and HCI are based on healthy and sophisticated designing principles and thus all such criteria should be followed.
- Proper manpower development should be keep in mind in respect of designing and staring of the educational programs on this. Further, more manpower developing is possible with possible programs on Usability Engineering and HCI and these are depicted in Table 1 herewith.

- A proper interaction of Agricultural field and with the UE and HCI for better understanding of the users and based on that the systems could be developed.

Table-1. Possible Agricultural Informatics specializations with UE and HCI

UE and HCI & Agro Informatics possible programs
BSc/BS-Agricultural Informatics (UE & HCI)
MSc/MS-Agricultural Informatics (UE & HCI)
BE/BTech-Agricultural Informatics (UE & HCI)
ME/MTech-Agricultural Informatics (UE & HCI)
MPhil-Agricultural Informatics (UE & HCI)
PhD (Science/ Technology)-Agricultural Informatics (UE & HCI)
DSc(Science/ Technology)-Agricultural Informatics (UE & HCI)

- Technological gap is an important issue and farmers in a developing country like India till not aware about the proper uses of many such devices and in this regard proper training, workshop, HCI & UE literacy be offered to them.
- Fund is an important issue for any kind of technological systems and in this regard proper steps and initiatives are essential to follow up.

8. Conclusion

Usability Engineering (UE) & Human Computer Interaction (HCI) are useful in many potential services to the farmers by the creation of better interface; interactive and good looking and easy to operate. Usability Engineering principle focused agricultural website, interface, display system initially practiced in the website and web portal but gradually it is started its uses in other facet like in mobile phones, tablets, laptops, ATM interfaces, television interfaces, interface and so on. For faster information transfer, here the use of information design including healthy information architecture, usability engineering etc are important. As far as agriculture and allied activities are concerned UE and HCI including other areas are applicable and rising rapidly. In pre production of agro related activities different electronic and IT devices are using HCI directly and indirectly. With the help of these technologies the laymen of the technology (i.e. farmers and other associates) can be able in easiest way of product operation etc.

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