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Usability Engineering and HCI for Promoting Root-Level Social Computation and Informatics Practice:

A Possible Academic Move in the Indian Perspective

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ABSTRACT

Human-computer interaction talks about designing IT and computing technologies in the context of man-machine interaction. Man-machine interaction (MMI), human-machine interaction (HMI), usability experience design, human-centered designing, user-centered designing are the related areas and responsible for the designing and development of interface of electronics products viz. computers, laptops, systems, mobiles, smart phones, etc. Educational and training is important for the social as well as economic development in several contexts. Knowledge delivery system is the reason for development and also developed nation. A few current and emerging technologies which include big data management, cloud computing, green computing, data science, internet of things (IoT) are also allied with HCI and usability engineering in different contexts. India is a developing country, and more enhancement is possible with integration of IT. In the developed countries, various educational degree and training programs are running at Bachelors, Masters, and Doctoral degrees in the areas of HCI and usability engineering, but in a country like India, such programs are missing. In this conceptual paper, a few aspects of usability engineering and HCI have been explored for creating true IT-enriched society. The paper is also proposed some possible and future potential programs for a healthy social informatics world.

KEYWORDS

CT4D, Developing Country, Digital India, Higher Education, IHCI, Knowledge Society, MMI, Training and Development, Usability Engineering

INTRODUCTION

Human Computer Interaction is today not only a design, evaluation and implementation method of computing systems but also it is a human psychology based tool which is play an important role (Abdelnour-Nocera, J. et.al, 2017; Altbach, P. G., 2002). Emerging tools and technologies have normally used for a friendly and usable computing system. Satisfaction of the users is the major tasks of the Human Computer Interaction including allied domains (Bhattacharya, I., & Sharma, K., 2007; Cruz-Benito et.a., 2016). Usability Engineering which is an allied domains and tools responsible for the creation of higher usability as well as user friendliness. Human cognition, behavioral Research Methodologies empowered by the quantitative and statistical techniques are the key facets for the

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development of usability systems. Designing, implementation, usability enhanced with the audio-video system is the core matter of today's Usability Engineering practice (Churchill, E et.al. 2016; Garcia et.al, 2005). Wireframes including few other prototypes is essentially practiced by the Usability Engineers, globally. Among the Usability Engineering guidelines following (*in Table: 1*) are the

Table 1. Important guidelines for building improved HCI and Usability Systems

Guidelines for Creating Healthy Usable Systems
• 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.

responsible for the creation of healthy and greater usable computing systems.

OBJECTIVES

This conceptual research work which is theoretical in nature, has been conducted to learn and dig out following objectives:

- To dig out the features of Human Computer Interaction and Usability Engineering and other allied areas in brief.
- To learn about the current educational programs and its availability in the developed countries as far as HCI & Usability Engineering is concerned.
- To learn about the current methods and guidelines of HCI and Usability Engineering Systems.
- To know about the basic differences and comparison of Usability Engineering and HCI systems in detail.
- To learn about the need and essentialities of HCI and Usability Engineering in detail.
- To dig out the potentialities of HCI and Usability Engineering in existing degrees and programs in different context.
- To find out the main challenges and opportunities of the Usability Engineering and HCI education systems in Indian academics.

METHODOLOGIES

Like any other conceptual study this is also framed several features of theoretical research. The study has been conducted from the primary as well as secondary sources (which have published in books and journals) in the field of Human Computer Interaction, Usability Engineering, User Experience Designing etc. However, reviews of websites have been also conducted to gain about the emerging features and characteristics of Human Computer Interaction including its principle. Study also explores the common and current uses of HCI in the apps, websites along with online portals. For studying educational aspects of HCI and Usability Engineering i.e. to learn about the potentials and possible educational programs in Indian context, proper educational methods have been utilized. Several educational components, current educational programs were gathered from the educational sites and for that AICTE (All India Council for Technical Education), UGC (University Grants Commission), MHRD (Ministry of Human Resource Development) were taken into consideration. Though, the website of UGC has been considered as core link enter into other universities regarding the study and available programs of HCI as well as in the related areas.

USABILITY ENGINEERING AND HCI

Usability Engineering is associated with the study, practicing as well as designing, development of usability interface in the electronics products and devices (Annand, D, 1999; Clemons, E. K. 1986). Among the benefits of Usability Engineering few important are include interface of the monitors (LCD, LED), offline unit, webpage and sites, information retrieval system, search engine, ATM Interface, Mobile Interface etc. Shaping an interface with operation definition of user requirement are the key aspects of UE and HCI (Collazos, C. A., et.al. 2016; Harmon, R. R., & Auseklis, N., 2009). As a similar and allied domain *Human Computer Interaction* play an important role for the designing and development of healthy and sophisticated information system.

The field usability engineering implies more on assessing as well as making recommendations and guidance to improve usability and clarity than rather than design, which is performed by the Interaction designing etc. (Harmon, R. R., & Auseklis, N., 2009; Hui, T. K., 2017). Though it is important to note that Usability Engineers may be engage in different sorts of designing viz. design of wire-frames including other prototype/s (Paul, P. K., 2016; Preece, J. 2016).

Finishing of an interface basically performed by the good interface and the task here should be hand based designing etc (Holden, R. J., et.al. 2016; Kushniruk, A., 2002). Graphic design is a vital in this respect and it also supports different kind of usability including the user performs and here design aesthetics is essential to enhance or detract ability of users to use the functions of different kind for the betterment of the interface. In the Usability Engineering, the design process normally requires proper balancing including technical and functional affairs and here mental model supported visual elements also play a lead role to create a system (Issa, T., & Isaias, P., 2015; Kettinger, W. J., Lee, C. C., & Lee, S., 1995; Kushniruk, A. W., 2016). The Usability Engineering practice must be operational and also usable based on user needs/ psychology (Khan, M., 2016; Paul, P.K. 2013b).

Among the areas of Usability Engineering and Sciences, Usability testing is another important one which is asked to use the actual or prototype interface (Karthikeyan, N., & Sukanesh, R., 2012; Paul, P.K., 2013a) Importantly Usability Engineering is responsible for the reactions, behaviors, errors, interviews in in-depth manner and here among the allied professionals important person is Usability Engineer (Lin, L., 2016; Pau1, P.K., K L Dangwal, 2014). The Usability Engineer normally recommends and helps in modification and changes of interface to improve the usability (Marquardt, N., et.al., 2017; Myers, B. A, 2016). Today there are many tools and techniques used for Usability Engineering and allied fields and here Usability Engineer is important one, among the popular tools few important are included.

The Web Metrics Tool Suite is from the family of National Institute of Standards and Technology and this is required for the HTML of a website having different kind of usability guidelines such as:

- Web Static Analyzer Tool, this is called as WebSAT and requires for checking web page HTML against typical usability guidelines for better clarity (Nah, F. et. al., 2015; Paul, P. K., 2016).
- Web Category Analysis Tool, this is called as WebCAT and with this kind of tool usability engineer normally construct a healthy and standard web category analysis.
- Web Variable Instrumenter Program, this is called as WebVIP and here instruments a website to capture a log of user interaction (Nakayama, M, 2015; Preece, J., & Rombach, H. D. 1994).
- Framework for Logging Usability Data i.e. FLUD a file format and parser for representation of user interaction logs (Nielsen, J.1994; Paul, P. K., & Ghose, M. K., 2018).
- FLUDViz Tool is responsible for the production of 2D visualization of a single user session for the usability systems.
- VisVIP Tool is a system that produces a 3D visualization of user navigation paths through a website and similar systems for user interface designing and development.
- TreeDec; this is another tool responsible for the adding the navigation of different pages of a website.

The Usability Testing Environment (UTE) another tool of Mind Design Systems which is available freely to federal government employees. The UTE is consist with test results and produces customized reports and can be used as quantitative measures (Paul, P. K. 2018; Queirós, A., 2015). The UTE Runner is another important affairs of UTE and it is required for demographic and survey questions. UsableNet Liftmachine is a product from the family of UsableNet.com and adheres with 508 Usability and Accessibility guidelines (including W3C Web Accessibility Initiative Guidelines).

DIFFERENT PROCESS AND USER INTERFACE DESIGN

A better and healthy User Interface Designing requires a good understanding of user needs and their choice (Rantanen, E.,et.al, 2016; Shein, E., 2014). Different phases are really important and valuable in user interface design and development depending on the project and in this respect user interface is most valuable and important:

- **Functionality requirements gathering:** Here list of functionally gathering is most important and valuable, based on users need (Rusu, C.,et.al. 2015; Sivaji, A., et.al. 2011).
- **User and task analysis:** This is another form of research in Usability Engineering and similar affairs.
- **Information architecture:** It includes the better designing of information systems including web pages. It is hugely depends on websites and web systems as well.
- **Prototyping:** Prototypes are required for designing and planning of good and healthy user systems.
- **Graphical user interface design:** GUI is required for the user research and also to find out usability problems and based on the type of interface and thus graphical user interfaces are highly required.
- **Usability inspection:** Usability inspection is considered to be cheaper to implement than usability testing and in the development process, evaluating prototypes or specifications for the system, here cognitive walkthrough studying new users etc. are highly appreciated.
- **Usability testing:** Testing of the prototypes on an actual user allows the designer to understand the design and here modern techniques are important and valuable.

Designing and creation of healthy human centered computing and interactive interfaces is possible with proper utilizations of HCI and UE systems and among the standard and guidelines few important are:

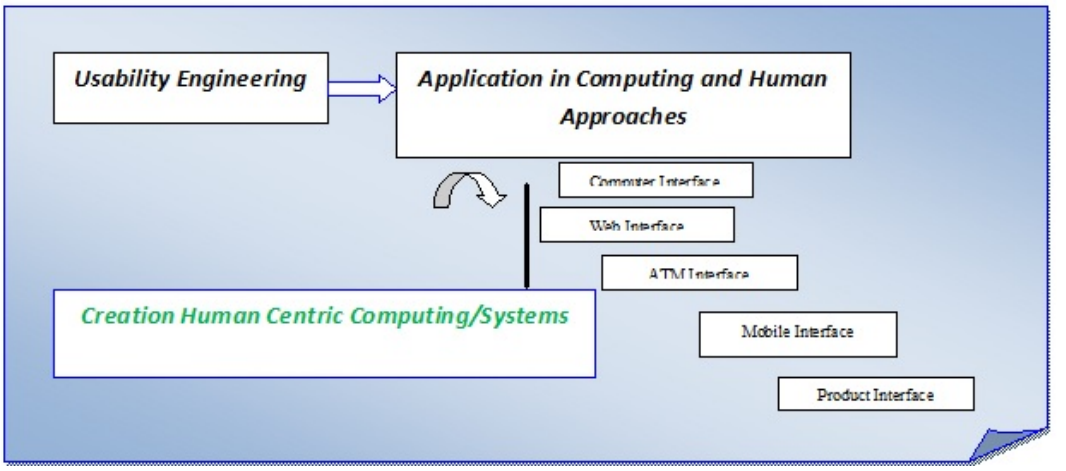
- International Standard Organization (ISO)
- National Institute of Standard and Technology
- IBM Guidelines
- ADA Guidelines etc.

Usability Engineer and HCI experts are basically responsible and engaged in designing of smarter as well as interactive and no doubt efficient interface creation (Scherer, S., 2009; Sun, S., & Teng, L., 2017). Prototype, usability testing and several add-on guidelines and methods are employed for the usable interaction and information designing. Among the important role of HCI and Usability Engineering areas few important have illustrated in Figure 1.

For a healthy Usability Engineering practice following are treated as most important and valuable:

- Conducting interview with individual or group is an urgent task in the field and to learn the actual need of usability. Moreover for the planning as well as adopting such specified principles in interface designing UE and HCI are considered as imperative.

Figure 1. Creation of the HCC and interactive Systems powered by Usability Engineering



- Regarding focus group and collections of questionnaires better survey are valuable for creation of healthy Usability Engineering.
- Ruling as well as judgment of Cognitive Walkthrough is also a valuable aspect for creation of healthy usable systems.
- Stepwise Heuristic Evaluations as well as RITE methods are very much important for creating modern and man machine interaction systems.

HCI is an interdisciplinary domain and combined from the areas of computing, information science and technology, applied psychology, sociology, designing. Though the Usability Engineering and HCI are closely related and depend on information technology. In India there is a huge possibilities in introducing Human Computer Interaction and allied programs in the allied academic units viz. IT and Computer Science, Software Engineering (Schmidt, N. H., et.al. 2009; Zachry, M., 2016). It is very much interesting to note that Computing and Information Technology is the most popular field and also available field in India. Hence it is easily possible to start HCI and allied programs which include:

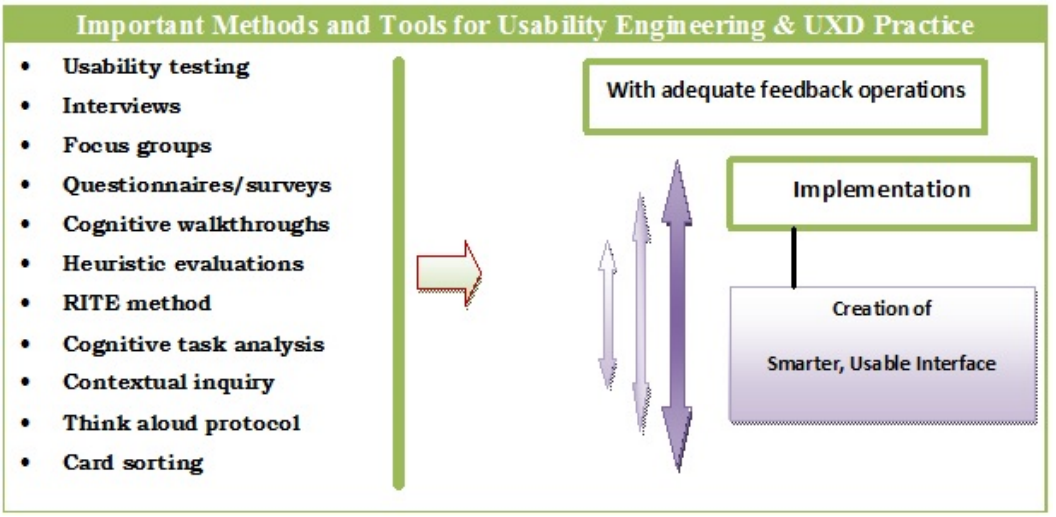
- Computer Science and Engineering
- Information Science and Engineering
- Computer Science
- Information Technology
- Computer Applications

Though due to interdisciplinary nature in some other departments also HCI and UE programs may be added i.e. Philosophy, Applied Arts, Designing, Psychology may be considered as valuable for a healthy interactive information system designing and development. Figure 2 provided the common methods which may be used in creation of healthy Usability Systems.

INDIAN HIGHER EDUCATION AND USABILITY ENGINEERING

India is one of the largest country in several context such as jurisdiction, population etc. India is also holds a rank in education as well due to its largest institutional number i.e. 40000 Higher Educational Institutes. Such institutes are include General Colleges (UG), General Colleges (PG), General Colleges

Figure 2. Methods and tools of Human Computer Interaction which helps in Practice of UXD



(UG+PG), Technological and Engineering Colleges, Business and Management Colleges, Diploma Engineering and Polytechnic Colleges, Architecture Colleges and so on. However in apex level India holds about 750+ Degree awarding universities, refer Table: 3 for more details on different kind of universities.

Among the Higher Educational Institutes most prestigious are the Institute of National Importance such as IITs, NITs, IIMs, IIEST etc which include Central Universities. Most of these organizations and institutions are governed by the different kind of bodies and councils and among these few important are listed in Table 2. The Institute of National Importance (INI) is treated as highest level of academic institutes and enjoy the super specialty focus, few institutes listed in Table 4.

The technical institute in India is governed by the AICTE and here a snapshot is depicted in Table 5. The Table is also expressed the possible reasons and areas of HCI which are easily possible to include. The following are the proposed way to introduce HCI and similar nomenclature in Indian academics.

Engineering and Technology

In India Engineering segment basically performed at the engineering colleges and in some colleges. BE/BTech (Bachelor of Engineering/Technology) or ME/MTech (Master of Engineering/Technology) are the common and available degrees. In respect of Computing related program CSE/IT is common and it is possible to offer HCI and allied domains in such programs. In Indian context offering full-fledged program on HCI and Usability Engineering may be tough enough and thus some possible programs also been proposed and presented in Tables 6 and 7.

It is possible use the allied departments such as Computing/IT departments regarding offering HCI related papers and courses. Some of the allied subjects like Cognitive Science (Applied Psychology), Designing Science (with Communication Studies) may be offered in the department specified in the parenthesis. Possibilities of guest or adjunct professorship in the IT/CSE departments may also possible. Hence this way adaptation and integration of such educational models in the existing IT, CSE, CA departments may help in introduction of Human Computer Interaction and allied field i.e. UE programs as major or honors or specialization program.

Table 2. Bodies and Councils working in the Indian Higher Education

Sl. No.	Bodies	Abbreviations	Domain/ Field of Interest	Head Office
1	All India Council for Technical Education	(AICTE)	Engineering and Management Education	New Delhi
2	Distance Education Council	(DEC)	Distance & Online Education	New Delhi
3	Indian Council of Agricultural Research	(ICAR)	Agriculture and Allied Sciences	New Delhi
4	Bar Council of India	(BCI)	Law and Legal Studies	New Delhi
5	National Council for Teacher Education	(NCTE)	Teachers Education and Physical Education	New Delhi
6	Rehabilitation Council of India	(RCI)	-	New Delhi
7	Medical Council of India	(MCI)	Medical Science	New Delhi
8	Pharmacy Council of India	(PCI)	Pharmaceutical Sciences	New Delhi
9	Indian Nursing Council	(INC)	Nursing and Allied Sciences	New Delhi
10	Dental Council of India	(DCI)	Dental Sciences	New Delhi
11	Central Council of Homoeopathy	(CCH)	Homoeopathy Systems	New Delhi
12	Central Council of Indian Medicine	(CCIM)	Indian Medicine Systems	New Delhi
13	National Council for Rural Institutes	(NCRI)	Rural Development	Telangana
14	Council of Architecture	(COA)	Architecture & Design Sciences	New Delhi
15	Veterinary Council of India	(VCI)	Veterinary Sciences	New Delhi
16	Indian Council of Medical Research	(ICMR)	Medical & Health Sciences	New Delhi

In Science

BSc, MSc degrees are most common in Indian academics and Computer Science and Information Technology is most common in this regard. The nomenclature of Software Engineering, Information and Communication Technology, Software Engineering etc are also offered in few colleges and universities with BSc/MSc degree. Thus Human Computer Interaction and UE programs may also

Table 3. Different types of universities in India

Universities	In Numbers	Location
Central Universities	**47**	Pan India with 28 States and UT
State Universities	**370**	Pan India with 28 States and UT
State Private Universities	**290**	Except some states and UT
Deemed Universities	**123**	Except some states and UT

Table 4. Different types of Institute of National Importance in India

INI/ Higher Educational Institutions	In Numbers	Location
Indian Institute of Technology [IITs]	**23**	Bhubaneswar, Chennai, Delhi, Gandhinagar, Guwahati, Hyderabad, Indore, Jodhpur, Kanpur, Kharagpur, Mandi, Mumbai, Patna, Ropar, Roorkee and Varanasi
Indian Institute of Information Technology [IITs]	**23**	Gwalior, Allahabad, Jabalpur, Kancheepuram, Sri City, Guwahati, Vadodara, Kota, Trichy, Una, Sonepat, Kalyani, Lucknow, Dharwad, Kurnool, Kottayam, Manipur, Nagpur, Pune, Ranchi, Surat, Bhopal, Bhagalpur
National Institute of Technology [NITs]	**31**	Agartala, Allahabad, Arunachal Pradesh, Bhopal, Calicut, Delhi, Durgapur, Goa, Puducherry, Hamirpur, Jaipur, Manipur, Meghalaya, Mizoram, Nagaland, Jalandhar, Jamshedpur, Kurukshetra, Nagpur, Patna, Raipur, Rourkela, Sikkim, Silchar, Srinagar, Surat, Karnataka, Tiruchirappalli, Uttarakhand, Warangal
Indian Institute of Engineering Science and Technology [IIESTs]	**1 (4 are in process)**	Shibpur (West Bengal)
Indian Institute of Management [IIMs]	**20**	Calcutta, Ahmedabad, Bangalore, Lucknow, Kozhikode, Indore, Shillong, Rohtak, Ranchi, Raipur, Tiruchirappalli, Udaipur, Kashipur
Indian Institute of Science Education and Research [IISERs]	**05**	Calcutta, Mohali, Thiruvanthapuram, Pune, Bhopal
Other Central Funded Higher Educational Cum Research Institutes	**Approximately 150+**	Pan India with 28 States and UT

offer as a major or specialization in these exiting fields. It is important to note that physical and intellectual infrastructure, availability of future students etc are very much important in the HCI or UE program as a full-fledged degree (Refer to Table 8).

In Computer Applications

Apart from BSc, MSc another subject is very much popular in India i.e. Computer Application. In this domain both BCA and MCA degrees are available. The Master of Computer Applications is offered in 1459 institutes with a total intake of 110585. It is interesting to note that still specialization in **MCA** is not proposed by AICTE. But there is a wonderful possibility to offer HCI/UE/UXD etc in MCA. Naturally, **BCA** program may be offered as Human Computer Interaction/UE/UXD/Human Centered Computing. Hence few more possible nomenclatures have been listed in Table 9.

NEED OF USABILITY ENGINEERING FOR THE CREATION OF TRUE DIGITAL INDIA

Building a Digital India is an important agenda of Government of India. People and common mass is very much interested to build a Digital India at per international trend and requirement. We have to

Table 5. Indian Higher Education at a glance

Streams	Number of Institutes	Total Intakes *(as on 2015)*	Remarks on Cloud Computing potentiality
Architecture	177	(Annual Intake of 11070)	Special program on Information Designing, IA with UXD may be offered
Engineering	6375	(Annual Intake of 1903722)	Separate program on HCI or UE may be offered. Honours or Specialization are also possible.
Management	3217 (MBA)+ 600 (PGDM)	(Annual Intake of 366439)	Techno-Managerial programs on Usability Management etc may be offered
Computer Applications	1469	(Annual Intake of 110585)	Specialization may be offered in with HCI Usability Engineering UXD Information Design Information Architecture etc.
Polytechnic	4276	(Annual Intake of 1308008)	Special thrust may be given in higher semester for Cloud Computing papers etc.

Table 6. Possible HCI and allied courses Engineering Segment: The potentialities at a glance

Possible UG/PG Degrees in Engineering/Technology	Research based possible Degree in HCI & UE related fields
BTech/BE/MTech/ME-Human Computer Interaction / Human Centered Computing & Systems Science /Usability Engineering with UXD	**MTech/ME (Research)**-HCI/Human Centered Computing /Usability Engineering
BTech/BE/MTech/ME - User Experience Designing & Information Management/ Web and User Interface Management/ Usability Systems with HCI	**MSc-Engg. (Research)**-Human Computer Interaction & Informatics/ Interaction Sciences and Information Design /Usability Systems and Engineering
BSc/MSc (Engineering)-Human Computer Interaction & Web Systems/Human Centered Computing with IT / Usability and Interactive Designing	**MPhil/PhD/D.Sc. (Research)**-Human Computer Interaction & Informatics/Human Centered Computing with Interaction Sciences /Usability Engineering

start educational programs in diverse areas of Information Technologies and there emerging programs and subjects such as Big Data Management, Cloud Computing, HCI, Usability Engineering etc may play a vital role. Introduction of HCI and Usability Engineering is required following steps for ease implementation:

- Creation of awareness among the mass regarding the technological products and services.
- Proper initiatives and project execution by the public administration departments and Government Department.
- Willingness towards implementation of HCI and Usability Engineering in the common services as well as public governance.
- Strengthening research in HCI and integration of this technology in the Service Science sector.
- Creating educated products in the field of HCI and UE related areas with Bachelor Degree, Masters Degree, Doctoral Degrees etc.

Table 7. HCI and allied courses and its possible offering in related Engineering Degrees, especially with the Computing and IT as Major or Specialization

Possible UG/PG Degree (Engineering/ Technology) Specializations	Possible UG/PG Degree (Engineering/ Technology) Specializations
BTech/BE-CSE (Human Computer Interaction)/(Web and Human Centered Computing) /Informatics with Usability Engineering	**MTech/ME- CSE** (Human Computer Interaction)/(Web and Human Centered Computing) /Informatics with Usability Engineering
BTech/BE - Communication Engineering (Human Computer Interaction & Communication) /Usability Engineering and Communication Systems	**MTech/ME-** Communication Engineering (Human Computer Interaction & Communication) /Usability Engineering and Communication Systems
BSc (Engg.) in CSE/IT (Human Computer Interaction and IT)/(Human Centered Computing and Online Management) /Usability Engineering with Digital Technologies	**MSc (Engg.) in CSE/IT** (Human Computer Interaction and IT)/(Human Centered Computing and Online Management) /Usability Engineering with Digital Technologies

Table 8. HCI and Usability Engineering in Science platform Information Science/IT

In Information Science/IT
BSc/MSc–Information Science (HCI)
BSc/ MSc- Information Technology (HCI)
BSc/ MSc- Information Science & Technology (HCI and UXD)
BSc/ MSc- Information & Communication Technology (HCI & Web Systems)

Table 9. HCI and Usability Engineering and allied nomenclature in Computer Applications

In Computer Applications
BCA (HCI and Web Development)
BCA (HCI and Internet Science)
MCA (Web Engineering and HCC)
Integrated MCA (HCI with Internet Technologies)

Hence Government; Central and State including Union Territories, NCR and other governing regions need to take proper initiatives in launching of HCI Technologies including its practical utilization in different sectors and obviously training, educational programs.

SUGGESTION AND FURTHER POSSIBLE R&D

HCI Technologies are possible to start in several capacity and settings and it is important that all these technologies needs to start in collaboration with several planning which include:

- Programs may be offered in flexible mode of learning (with same amount of timings/ credits etc), apart from Full Time mode.
- HCI Technologies related programs should be started in the industrial units in a particular term with joint venture.
- Programs in Online and collaborative mode may be started for better and required manpower development to meet actual corporate demand.
- HCI Technologies may be offered in interdisciplinary culture with Web Systems, Internet Science and Information Design focus.

- Proper academic collaboration with the industry is required for real social informatics practice and to build a true Digital India.
- HCI Technologies and allied domain need to offer as per industrial player's consultation to prepare relevant and up-to-date manpower.
- Proper steps as well as measures are required to start program at international level, with initiation of international nomenclature etc.
- HCI Technologies may started in collaboration with other departments and centers with other technologies such as Database, Web Technologies, Internet Technologies and so on.

CONCLUSION

Cloud Computing, Big Data technologies, Human Computer Interaction are the most emerging name for the creation of intelligent and sophisticated Information infrastructure. India is moving towards knowledge society and economy and for this standard information technologies are highly desired. Government agencies are also (apart from industry) offering social informatics services and projects. Proper policy as well as regulation, framework are must for a sustainable development HCI based system development. Preparation of Human resources and skill manpower are the need of hour. Proposed courses, programs which have explored in this paper may help in development of digital societies and humanities in many respects. Moreover creation of HCI is required to create usable interactive computing systems, ATMs, Public Kiosks etc to build a Digital India and thus skilled manpower are also required for its solid implementation and realization. Therefore Indian and developing countries needs proper initiative in developing proper environment, strategies in developing manpower in HCI, Usability Engineering, UXD etc.

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