Volume 4, No. 3, March 2013
Journal of Global Research in Computer Science
ISSN-2229-371X
REVIEW ARTICLE
Available Online at www.jgrcs.info

ON CTA USABILITY AND RURAL DEVELOPMENT IN INDIA

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ABSTRACT:Computer technology is recognized as potential solution tool to effectively solve real life problems to improve the pace of rural development in India. Ideally, Primary infrastructures of rural chunk have a strong correlation with Computer Technology Artifacts (CTA) usability. In this, effort has been made to represent some coarse relationships as crude subjective metrics to quantify usability of hardware components that may affect informally or intangibly rural development in India. This paper provides a roadmap to business personnel and researchers to judge, and preferably, measure CTA usability to speedup rural development. This effort may also help to stop moving out people in India from roots known as villages of leaving basic work of agriculture into cities for employment in service sector.
Keywords: Rural Development (RD), Computer Technology (CT), Information Technology (IT), Internet.

INTRODUCTION

The pace of CT revolution in rural areas in India has not been able to bring out common man to take the benefits of CT because of not too much awareness, education and some time infrastructure is not user friendly. For this, effective use of CT resources is a feasible solution for overall qualitative improvement by providing timely and quality information inputs for decision making [2,11]. According to Prof. Grady Booch "Software is the invisible thread and hardware is the loom on which computing weaves its fabric". Ideally, hardware is the physical place where all kind of operations are carried out. It should be assessed for its usability to target its user. Moreover, design of hardware artifacts is an issue to reduce the invariable amount of effort incurred to use them. CT has played a major role in all facets of rural development to increase villagers' capability. The purpose of considering Computer Technology Artifacts (CTA) usability in [3,4,5,13,15] is to design a good hardware to rural people that takes less effort to use and make good human-computer interface i.e. easy to understand, easy to use, and easy to learn by majority of farmers. Formation up to remote level rural CTA technical infrastructure assets requires new investment for CT led RD that helps in all parts of life to rural community, through fulfillment of primary needs. CTA usability relationships represented here are subjective to guide to minimize said resource waster, and more efforts are required to make them objective. Even then, subjective approach indicator will help to increase productivity of CTA up to certain extend in rural environment. Basic objective of considering CTA usability is to create the awareness of research in the field of CTA usability of resources to popular CT services in rural areas. This will also helps to stop moving out people from villages of leaving basic work of agriculture into cities for employment in service sector where their survival and success depend on their ability to deal with information and knowledge.

The outline of this paper is as follows. We begin with the brief understanding of CTA usability in rural perspective in section 2. Observations on CTA Usability relationships and RD are roughly well described in section 3. CTA Usability issues summarized in table, and discussion is given in section 4 and 5 respectively. Lastly, conclude in section 6.

CTA USABILITY IN RURAL PERSPECTIVE

CTA usability is related to ease with which people of various backgrounds can handle & use CT physical components in rural environment. Ideally, CTA usability (U_b) of resources described in [3,4,5] is represented as inversely proportional of Use Effort (effort required to use resources (U_e)) in CT led RD, while U_e is "defined as cumulative sum of effort required to understand, learn and operate CTA resources in rural areas". Moreover, if any CT hardware component in rural area takes larger effort to use then its Use Effort (U_e) of hardware artifacts in CT led RD will be more and, result of that CTA usability (U_b) will become less. To raise the living standard of villagers in rural areas, one has to increase the functional value of U_b, by demanding such kind of CT components that takes less effort. Result of that villager will report fewer complaints to use hardware. Thus,

$U_b \propto 1/U_e$

OBSERVATIONS ON CTA USABILITY

To represent CTA usability, assumption is to how hard the physical component to use. However, In each category, pool of CTA is available as per requirement of application (say 1..N). Task of each physical CT component is performed by changing many finite states & properties (say 1.. M). These all put together and attempt has been made to represent in form of coarse relationship as crude subjective metrics to quantify usability of CTA resources in CT led RD climate in India to

keep usability high and costs low in day to day life to make better operation of this segment.

Input Class

CT is governed by commonly used input devices like keyboard, mouse, and scanner but devices like monitors, web camera, etc. provides significantly more user friendly environment for villagers to penetrate CT into their daily life. Thus,

Task of **T**ouch **S**creen **M**onitor (TSM) [3,7] is the screen on which visual display can appear in words, numbers, and graphics. Use of TSM is more significantly easier because interface itself is readily understandable by villagers through touching on the appropriate location of the monitor. It is more users friendly to learn and work on computer and provide relaxed environment for non– literate people. Therefore, CTA usability (U_b) of TSM in rural development will be more.

$$U_b(TSM) \propto 1/U_e(TSM) \quad (1)$$

Thus, use of TSM promotes IT in information centers. Result of that less effort will be required to learn and work on computers by the villagers.

Use of **D**igital **C**amera (DC) [3,8] makes it possible to capture and store good quality graphics and large video clips. It takes pictures by converting the light into a digital image. It is more user friendly and easily used to educate farmers, upload patient/plant/animal related images, movie clips to expert residing at large distance and quickly recommend a solution/treatment. Therefore, CTA usability will be more.

$$U_b(DC) \propto 1/U_e(DC) \quad (2)$$

Thus, use of DC will provide speedy help to rural people in real-time audio/visual consultation by collecting crop images and remotely analyze plant growth and condition

From combining the observations as equation 1 and 2, CTA usability of INpuT (INT) class is derived as an equation:

$$U_b(INT) \propto U_b(TSM) + U_b(DC)$$

N such input hardware artifacts may be used to do input task in rural segment and each device takes M finite number of stages to perform this task. Therefore, CTA usability of input artifacts can be represented as

$$\sum_{I=1}^{N}\sum_{j=1}^{M} U_b(INT)_{ij} \quad (3)$$

***Pr**ocessor Class*

Processor is an electronic circuit that works with the speed of internal clock. It is assisted by math coprocessor (also known as numeric and floating point coprocessor), and graphics coprocessor. The More powerful the processors, faster it can work. It provides aid to perform work more quickly and efficiently. Therefore, CTA usability will be

$$U_b(PR) \propto 1/U_e(PR)$$

Thus, greater the use of PR by/for villagers help to perform millions complex operations in less time to guide/instruct/warn villagers.

Similarly, CTA usability of **Pr**ocessor (PR) artifacts can be represented as

$$\sum_{I=1}^{N}\sum_{j=1}^{M} U_b(PR)_{ij} \quad (4)$$

Storage Class

Variety of storage artifacts, known as devices [8], are available that include to semiconductor, magnetic and optical memories. These low cost hand held storage devices are used for storage as well as backup of crucial data and also carry their backups at locations away from the place of work.

Optical **D**isk **(OD)** [8] uses laser mechanism to access (read/write) data and that can store large amount of data on a portable storage medium. Farmer can store large amount of concerned information and relevant data using optical disk and transport it anywhere. This allows them to use it at the time of need. Therefore, CTA usability of OD will be

$$U_b(OD) \propto 1/U_e(OD) \quad (5)$$

Thus, promotion of OD use among villagers, help to store and transport their related data, as well as available for use at the time of need.

Hard **D**isk (HD) stores and provides relatively quick access to large amount of data on an electromagnetically charged surface or set of surfaces. This helps to easily store and use voluminous amount of data related to agriculture and villagers personal files such as documents, pictures and video that promote CTA usability. Therefore,

$$U_b(HD) \propto 1/U_e(HD) \quad (6)$$

Thus, use of HD provides help to keep updated by storing latest information of agriculture, land etc. that speed up use of CT in rural development.

From combining the observations as equation 5 to 6, CTA usability of STorage (ST) class is derived as an equation:

$$U_b(ST) \propto U_b(OD) + U_b(PD) + U_b(HD)$$

Similarly, CTA usability of storage artifacts can be represented as

$$\sum_{I=1}^{N}\sum_{j=1}^{M} U_b(ST)_{ij} \quad (7)$$

Output Class

The purpose of output hardware artifacts is to deliver processed data from computer as information to the user in a nice form to understand like text, video, images and sound. These are available in variety of forms to facilitate farmers by providing new means and techniques of farming.

A **PR**i**N**ter (PRN) [7] prints words, numbers, or pictures from screen display to paper. Use of printers provides farmers good quality output on paper that generates interest in using CT services. Therefore,

$$U_b(PRN) \propto 1/U_e(PRN) \quad (8)$$

Thus, use of PRN will generate variety of printed document that may use by villagers as legal copy.

SPea**K**e**R**s (SPKR) or headphones are the functional device that gives output as sound and attached to the computers to incorporate voice based trainings for farmers [10]. Result of that people attract more to use CT resources which influences CTA usability.

$$U_b(SPKR) \propto 1/U_e(SPKR) \quad (9)$$

Thus, use of SPKR help to educate, train, and aware rural people in comparatively less effort.

From combining the observations as equation 8 and 9, CTA usability of OuTput (OT) class is derived as an equation:

$$U_b(OT) \propto U_b(PRN) + U_b(SPKR)$$

Similarly, CTA usability of output artifacts can be represented as

$$\sum_{I=1}^{N}\sum_{j=1}^{M} U_b(OT)_{ij} \qquad (10)$$

Network Class

Data that is transmitted over some channel is important to store, process, and present information for rural development. Many hardware artifacts known as devices such as Repeaters, bridges, switches, routers, hub, gateways, fiber optics, network interface card in [4] are often used to build rural CT infrastructure which provide more comfortable and safe rural life with equivalent services to those in the urban areas.

Re**P**eater (RP) is a device used to copies or repeats signals that it receives which provides help to carry boom of CT to remote places. Ideally, it amplifies all received signals before forwarding any where that prevent information loss as well as increases distance range that data can travel. Result of that network length maximizes and farmer benefited by providing more comfortable and safe rural life with equivalent services to those in the urban areas.

$$U_b(RP) \propto 1/ U_e(RP) \qquad (11)$$

Thus, Use of RP in rural segment brings prosperity by industrialization of agriculture business.

Switc**H** (SH) is used to connect individual devices on a network to communicate each other. It has the ability to store some address of devices so the data will only be sent to the required point instead of sending it to every point. Result of that it reduces the number of Broadcast domains to best facilitate the rural activities of farmers business.

$$U_b(SH) \propto 1/ U_e(SH) \qquad (12)$$

Thus, use of SH in rural area allow to connect multiple computers inside a network which provide help to people by substituting fresh markets places over Internet.

From combining the observations as equation 11 to 12, CTA usability of NeTwork (NT) class is derived as an equation:

$$U_b(NT) \propto U_b(RP) + U_b(BD)$$

Similarly, CTA usability of network artifacts can be represented as

$$\sum_{I=1}^{N}\sum_{j=1}^{M} U_b(NT)_{ij} \qquad (13)$$

Accessory Class

Computer accessories are concerned to the effective use of the computer. It is related to all part of computer system to make its use more effective and fast. Many components are used as a supplementary to improve capability of CTA which provide added support to enhance the use of computer system.

Uninterrupted **P**ower **S**upply (UPS) devices are crucial to ensure the longetivity of the IT equipment as well as provide backup mechanisms [10]. Use of UPS provide more help in rural areas to run electronic equipment more efficiently, when power is cut off, which increases productivity as well as life of devices such as computer, printer etc. Therefore, CTA usability of UPS in CT led RD is

$$U_b(UPS) \propto 1/ U_e(UPS) \qquad (14)$$

Thus, use of UPS helps to increase operational life of electronic equipment that ultimately indulges IT to promote rural development.

Solar **P**ower **P**acks (SPP) has potential to provide a feasible solution to shortage of power in rural areas. Solar power is a low-cost operational solution for the effective use of CT infrastructure in rural areas. It is primary ingredient for the use of low power consumed computers and often available all time in most part of India. Use of SPP in rural areas provide environment to promote CT where there is no break in power supply and people can work without fear of electricity cut. Therefore, CTA usability of SPP in CT led RD is

$$U_b(SPP) \propto 1/ U_e(SPP) \qquad (15)$$

Thus, use of SPP motivates people to use more computers by villagers in villages to speed up rural development.

From combining the observations as equation 14 and 15 CTA usability of *AcceSsories* (AS) class is derived as an equation:

$$U_b(AS) \propto U_b(UPS) + U_b(SPP)$$

Similarly, CTA usability of accessories artifacts can be represented as

$$\sum_{I=1}^{N}\sum_{j=1}^{M} U_b(AS)_{ij} \qquad (16)$$

Thus, we can conclude that CTA usability of resources in rural development can be described by sum of categories analyzed through equations 3, 4, 7, 10, 13, and 16 as follows:

$$U_b(CTA) \propto \sum_{i=1}^{N}\sum_{j=1}^{M} U_b(INT)_{ij} + \sum_{i=1}^{N}\sum_{j=1}^{M} U_b(PR)_{ij} + \sum_{i=1}^{N}\sum_{j=1}^{M} U_b(ST)_{ij} + \sum_{i=1}^{N}\sum_{j=1}^{M} U_b(OT)_{ij} + \sum_{i=1}^{N}\sum_{j=1}^{M} U_b(NT)_{ij} + \sum_{i=1}^{N}\sum_{j=1}^{M} U_b(AS)_{ij} \qquad (17)$$

$$U_b(CTA) \propto \sum_{i=1}^{N}\sum_{j=1}^{M} [U_b(INT)_{ij} + U_b(PR)_{ij} + U_b(ST)_{ij} + U_b(OT)_{ij} + U_b(NT)_{ij} + U_b(AS)_{ij}]$$

Hence

$$U_b(CTA) = K \sum_{i=1}^{N}\sum_{j=1}^{M} [U_b(INT)_{ij} + U_b(PR)_{ij} + U_b(ST)_{ij} + U_b(OT)_{ij} + U_b(NT)_{ij} + U_b(AS)_{ij}] \qquad (18)$$

Where K is defined as Use constant that shows cumulative effects of all equations in various categories primarily concerned with; first, the size of the CTA resources, second, familiarity to make mental model of operation about new technology such as computers, third, clarity and grip of physical component and fourth, design of the physical component such as functionality and buttons. Terms denoted are important to consider in its entirety, because of each individual factor encapsulate the power of total failure of functionality as well as performance of the system, directly or indirectly. Observations in equation (18) are based on relationships, and therefore are helpful to provide support to the rural development that are

trying hard for improving CTA usability of infrastructure by their user friendly specifications adopting for people of rural areas.

SUMMARIZED TABLE

Issues to represent CTA usability of resources/services of technical infrastructure to promote Computer Technology among rural section for rural development are summarized in table 1. If any hardware component of CT Infrastructure in rural area consumes greater effort, then its CTA usability will be less. Therefore, more effort required to understand, learn and operate CT hardware resources used in rural areas to determine the impact on rural development.

DISCUSSION

Use of CT in rural areas in India may bring prosperity among people by quantifying technical structural factors and tasks. As every product has a target audience and same is true for CTA. Therefore, many such number of significant main CT contributor (factors) are collected and represented in form of coarse relationships as crude subjective metrics to quantify CTA usability that may affect informally or intangibly rural development. Professionals may make use of the mention observations to be able to design and develop such a nice relationships to explain CTA usability of resources in CT led RD that is meaningfully workable in rural climate. The relationships in this work need extensive perfection based on statistical data obtained with clear-cut purpose for the analysis & promoting CTA usability of infrastructure and rural development relationships. CTA usability should be presumably assessed to target audience, and its users of rural community.

TABLE 1

S.No.	Main CTA Artifacts	CTA class Category	Status of CTA resources	Impact attribute of RD	Intrinsic worth of enhancing CTA U_b
1.	**T**ouch **S**creen **M**onitor (TSM)	**IN**pu**T** (INT)	Increase	Knowledge literacy	Increasing access of critical information, higher literacy
2.	**D**igital **C**amera (DC)		More	Quality Awareness	Real time picture, Reduce administrative delay, enhance transparency
3.	**PR**ocessor (PR)	**PR**ocessor (PR)	use	Efficiency, Service, Quality	Greater access of information, Integrated services to farmers, better and fast decision making, faster development
4.	**O**ptical **D**isk (OD)	**ST**orage (ST)	More	Productivity Economical viable	Keep essential information of crops, fertilizers, product, Access of personalized information, pesticides, medicines etc.
5.	**H**ard **D**isk (HD)		Improve	Storage	Large & variety of information accessibility, enhance accountability
6.	**PR**i**N**ters (PRN)	**O**u**T**put (OT)	Enhance	Business benefits Legal quality services	Quality documents, Getting ticket, return, land documents
7.	S**P**ea**K**e**R**s (SPKR)		Empower	People, Understanding, Less error	Greater awareness, lower effort, faster innovation, better understanding, increase morale
8.	**R**e**P**ter (RP)	**N**e**T**work (NT)	enhance	Service, Quality	Reduce transaction costs, improve efficiency, better service
9.	**S**witc**H** (SH)		large	Quality, Service	Avoid time delay, good governance, Exponentially increase power of information, technical improvement
10.	**U**ninterrupted **P**ower **S**upply (UPS)	**A**cce**S**sory (AS)	large	Efficiency, productivity	Better life of electronic equipment, More satisfaction
11.	**S**olar **P**ower **P**acks (SPP)		more	Service	Empower people of rural and remote place, low cost for villagers to offer IT services, sustainable development

CONCLUSION

Time-consuming speed of use to CT hardware infrastructure in rural areas is the one prime reason of low expansion of CT revolution in India. To overcome this problem, usability of CTA to its end user community should be assed to target rural people. Professionals may make use of the mentioned observations to design and develop relationships to explain CTA usability of resources in CT led RD which is meaningfully workable in rural climate. The relationships in this work need extensive perfection to transform coarse subjective metrics to objective, based on statistical data obtained with clear-cut purpose for the analysis of CTA usability of infrastructure and rural development relationships described in this paper. Further, this may be used to benchmark for the analysis & promoting CTA usability of infrastructure and rural development relationships. Because of availability of urban market under finger tips, this effort may also help to stop moving out people from villages of leaving basic work of agriculture into cities for employment in service sector.

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SHORT BIODATA

Dr. Sanjay Kumar Gupta has obtained M.C.A. and Ph.D. in Computer Science from Jiwaji University, Gwalior. Dr. Gupta general research focused on improving software testability and maintainability of object-oriented systems. He has authored/presented twenty eight research papers in various conferences and journals including International publications. His research interest lies broadly in areas of IT applications, and software engineering.