

Bridging the Digital Divide - A Social and Technical Point of View

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Abstract — *The purpose of this literature review is to provide information about current status of digital divide, explore reasons for digital divide and issues rose on society and provide a summary of initiatives that can be taken to overcome digital divide. The scope is limited to explore ways of securing the needed infrastructure from a technical point of view and a social point of view.*

Index Terms — digital divide, bridging divide

I. INTRODUCTION

The Digital Divide has become a serious issue which exists between those who have access to global information resources and ones who are held back due to gaps in their social status, education, personal handicaps and poor digital infrastructure. Bridging the digital divide has begun to involve social dynamics and technological tools that support social interaction. In recent time with the development of technology and the world stepping into the age of information and communication era this matter has gained increased attention. Thus it is a very timely and apt issue to be addressed and solved.

The purpose of this literature review is to take a look at the issue of digital divide from a technical and social point of view. The document first defines the term digital divide and its boundaries in the section digital divide defined. 'Whys and wherefores of digital divide' section covers the reasons that bring the issue of digital divide into existence. Here the social and technical causes are discussed. Following section looks at the impact of digital divide in several different aspects. Thereafter the focus is on discussing several solutions that have been provided to address the digital divide. Finally the conclusions that can be drawn from the studied literature are stated.

II. DIGITAL DIVIDE DEFINED

Before exploring the social and technological aspects discussed in literature with respect to digital divide, it is important to establish the proper definition of digital divide which will help us to delve into deeper aspects of the issue. The term has been first coined by Lloyd Morisette with the vague meaning the divide between information have's and have not's. Although Morisette is accredited with coining the term this division of information have's and have not's was not something that was unheard of before that. [1]

Digital divide is defined in many ways in literature; an example of one such definition would be 'The Digital Divide refers to any inequalities between groups, broadly construed, in terms of access to, use of, or knowledge of information and communication technologies' [2]. However generally speaking we could comfortably say that digital divide refers to the marked gap of ICT resource access between groups which are high-level IT participants and which are low-level IT participants. Therefore an uneven gap of ICT diffusion exists between different countries, regions, communities, ethnicities and cultural groups etc. as measured by studies which capture data regarding mobile penetration, Internet access and other relevant criteria. There are many faces to digital divide which can thus be looked at as a multidimensional phenomenon encompassing three distinct aspects. The aspects of digital divide can be broadly stated as global divide - which refers to the inequality of internet access between developed and developing countries, social divide - which refers to the information gap between the social groups in a given country and democratic divide which essentially represents the divide between those who choose to engage in their activities with digital resources and those who don't. [1]

When considering the various viewpoints that have been presented to describe the digital divide it is evident that there seems to be a convergence in the idea that digital divide is not only about technological limitations or the high cost of hardware but that it has social component which plays a crucial part as well. This becomes an added incentive to look at the social factors affecting digital divide which are discussed in the literature along with the technology related factors. Nevertheless it is also important to emphasize that there are many other factors that affect the issue of digital divide other than the two stated above. Now that the digital divide issue has been properly defined without confusion we can take a look at the reasons which cause the existence of digital divide.

III. THE WHYS AND WHEREFORES FOR DIGITAL DIVIDE

In order to provide a sustainable and effective solution to any global issue the reasons which cause for the existence of that issue must be thoroughly and properly understood. In this particular context for the purpose of presenting solutions to bridge the digital divide, the root causes that give birth to

digital divide which are identified in literature have been presented. As per the main line of discussion in this literature review the causes of digital divide have been categorized as technology related causes and socially influenced causes.

A. Technology related causes

1) Limitation to the access of computers, connectivity and additional resources

Within the frame of discussing the reasons for digital divide the issue of unequal access to computers and digital resources, limitation of connectivity to the Internet and unavailability of additional resources is a key point. The Internet can be considered essentially as a set of information and communication technologies ranging from much needed computers to networks. In the sobering report released by the American National Telecommunications and Information Administration which documented the emerging patterns of digital divide, it was seen that even after a considerable time period of the arrival of computers to the market and the advent of the Internet, only a privileged class of people enjoyed the benefits of both. [3] The report also reveals the following facts.

'The poorest households in central cities had the lowest level of access to telephones (with a market penetration rate of 79.8 percent), and the rural poor had the lowest level of access to computers (4.5 percent). This was at a time when white urban households had a telephone access rate of 96.2 percent and those with incomes exceeding \$75,000 had a rate of 99.2 percent. In terms of access to computers, white urban households had an access rate of 30.3 percent and those with incomes exceeding \$75,000 reported a 59.6 percent access rate. Among those households with computers, access to modems stood at 23.6 percent in rural areas, 43.9 percent in central cities, and 44.1 percent in urban areas.' [3]

Based on the above statistics it can be deduced that although the technology had been made available for a considerable time period its penetration has not happened in a desired rate thus causing a marked gap between information have's and have not's or in other words a digital divide.

It can be seen that the earlier efforts of bridging the digital divide looked primarily at issues of hardware and connectivity limitations as root causes. However with time it has been realized that the providing hardware and connectivity would be ineffective if adequate training was not provided. [23] Digital divide is not only just a function of access and speed of access but training and proper guidance to use the available resources to their maximum potential plays a crucial part as well. With these restrictions in the technological arena the burning issue of digital divide is created and in order to address the issue these causes have to be eliminated.

2) Second level digital divide

Although most of the literature focuses on the above mentioned limitations to resources there is another side to the causes of digital divide and that is the varying range of skills of the users that have access to the Internet. The ability and inability of finding information efficiently and effectively on the web creates a digital divide between users of the web. The capability of finding different kinds of information allows people to obtain the optimal benefit of the medium in use. If users do not have the skill in looking for the information that they require and thus cannot fulfill their information technology needs, then the access of the internet is of little use.

In a study which measures the skills of online users by the success/failure rate which shows the proportion of the respondents who were able to complete a certain task and the time to completion of each task measured in seconds to show the gradual differences in how long it is taken for people to find the information on the Internet the following results were obtained. It was seen that half of respondents (27 individuals) were able to successfully complete all tasks and an additional 31.5 percent (17 people) succeeded in locating four of the five types of information sought. However, the remaining ten people were only able to successfully complete 1-3 tasks. [4] The same study goes to show that overall, people spent anywhere from two and a half minutes to 33 minutes on five tasks regardless of whether they were able to successfully complete them or not.

Therefore digital divide not only encompasses the divide caused by hardware and other related resource limitation but the divide caused by the uneven distribution of skills of using the Internet and other resources.

B. Socially influenced causes

It is important that the digital divide does not lead to social isolation. There should not be groups of people who are not getting the advantages in digital technology due to lack of access or poor skills or etc. There is a substantial difference in the definition that the most people have about the Digital divide. "Digital have countries and Digital have not countries" [5]. Though this phenomenon does exist between countries, it deepens down into states, provinces, villages and communities as well as differences in ethnicity, age differences, family structure, education, motivation, races and genders. These reasons are identified as the core of the social factors governing the digital divide.

"Well-to-do and middle-class white men in wealthy countries' urban areas dominate the areas of technological knowledge and learning. Forty-one percent of all Internet users reside in the US, but even here African-Americans, Latinos, and Native Americans are underrepresented. Women make up

more than 50 percent of all US Internet users, but lag in terms of contributing to design and development." [6]

As in the above paragraph, not only in the "digital have not countries"[5] but also in the technologically advanced countries like US, Japan; still the digital divide exists. People who live in "Digital have countries" have greater access to resources than the others. The reasons for existence of digital divide of those countries are somewhat psychological and social.

Following categories can be highlighted as the pillars of social factors.

Age - According to these research papers(eg [8] and [10]) it seems that young generations feel more comfortable with the new technologies and far ahead of getting advantages from it more than old generations. Age has a inverse influence in computer anxiety, and related to computer experience.

Gender- Another factor where the division exists is gender category, specially with respect to the divide involving number of men and women in the computing field and who uses the digital information. As an example, in a program on women's studies and technology conducted to home-bound care givers who were mostly women; most people including faculty members drawn from three Arizona universities who came for the programme who resisted distance learning and instructional technology argued that the Internet was mostly male bound and in order to carry out such a project a women friendly space would have to be created first. [6] According to the researchers gender influence is getting unstable; but this would be different in different cultures because of the ethnic influences.

Education and literacy- Basically to get benefited from the technology people must know how to use it. Moreover there should be some introduction to get on with the technology. ICT has become a main subject taught in most schools all over the world but most of the adults didn't have that opportunity.

Also skills are important to get access to digital information. One example is people who are unable to read and write well will not get benefited from the information on the Internet as normal users.

Ethnicity- Different groups have different attitude to technology. One significant reason why some groups choose not to access the Internet is that the "content"[9] is not relevant or interesting to them. Basically the ethnic groups which are outside the western culture are deprived of accessing and sharing digital information. Consider a situation where English is not the first language, they have no means of learning it and they have no good reason to use a computer; simply a difference in access and expectations. This is the Motivational issue in digital divide, not intelligence or ability.

IV. IMPACT OF DIGITAL DIVIDE

United States, Europe and Northern Asia are the parts of the world that have a leading amount of Internet access whereas access is more restricted in the poorer and developing parts of the world such as Africa, India and Southern parts of Asia [11]. The initial start up cost has become the obstacle that keeps these poorer nations away from investing for new technology aspects. This ultimately makes these nations unable to afford and maintain Internet and other digital facilities. Further this problem results in a disadvantageous manner to these countries. Next concern is how digital divide impacts on society at many levels. A country which does not have Internet access implies that schools of that country do not get an acceptable level of chances to improve Information Technology literacy of the upcoming generation. Ultimately lack of IT literacy of the people in that country will cause numerous issues to the country in the case of competing with other countries at the international level [11]. On the other hand due to the rapid development of electronic services, the concerns about the potential impacts that can cause due to digital divide has grown up to a certain extent.

A. Impact on Education

In present day world Internet has become a resource which helps people to gather knowledge in an efficient manner. Unfortunately it has also become a major issue which causes digital divide around the World. People who do not have access to Internet do not get a single chance to access any of the web resources mentioned above [12]. At the end of the day these unequal opportunities will create a gap between privileged people and non privileged people which totally causes to build the concept called Digital Divide among humans. As an example we can take a student who has Internet facility and a student who does not have Internet facility. The student who has access to web resources has a good opportunity to improve his/her knowledge whereas other one does not get that opportunity. At the end this will become a really critical fact that decides the knowledge gap between two students. The core of this example applies to most of the situations that we can see in our day today lives [12]. The core idea is that the impact on the Education can be clearly seen through the incidents that take place in the present day society.

B. Impact on Language & Nation

The major problem that causes digital divide through Internet is language barrier. Most of the resources available on Internet are in English language.

"Over 68% of all Web pages are in English despite the fact that native English speakers comprise only 14% of the world population (Global Reach). In fact, of Web pages in languages other than English, approximately 63% are in other European languages (French, Spanish, Italian, and German, among others), reinforcing the racial digital divide via language." [13]

Thus this issue acts as a language barrier for certain countries. The countries like Japan, Germany, France, Spain and Portugal will be able to survive it somehow because those countries have a good literacy in English language, but the developing countries such as Africa, Southern Asia and parts of India have considerably very few people who are fluent in reading, understanding and writing English [13]. Therefore in educational and business activities, developed countries will have a good advantage over any other developing country. This causes the division among the nations. The impacts due to the division among nations can be more severe in this case.

C. Impact on Generations

In the present day world, Internet and other digital facilities are growing at a significant rate. Many companies experience the benefits that can be obtained through the usage of new technologies which make their lives easy. Therefore most of them are moving their business activities to Internet. Today, Most of the companies use Internet as their advertising media in order to promote their new business activities around the world [4]. Further due to the usage of credit cards, buying goods and making payments have become really convenient. On the other hand the companies started long ago venture to taste the benefits of the cutting edge technologies because of the traditional beliefs. This can cause the division between the old generation companies and new generation ones. Further today Internet and social networking has become very popular concepts among the younger generation which allow people all over the world to keep in touch. Ultimately this has caused a significant division between the older and younger generations. Since the older generation is not used to the usage of new technology, sometimes they are left behind unknowingly which can cause keeping senior citizens out of touch with the society, friends, family and businesses [4].

According to the facts mentioned above it is clearly evident that impact of digital divide towards the society has a negative side of it which causes a major impact on underprivileged people's lives. Therefore there is a high risk that the impact can ultimately become a burning issue in the future. Therefore it is high time to make the people pay attention towards bridging the digital divide.

V. BRIDGING THE DIGITAL DIVIDE

Currently carried out initiatives for reducing the digital divide are mainly two folds. They are *Infrastructure development* and *Paradigm shifts*.

A. Infrastructure development

The solutions in this category are related to the development of the infrastructure such as supplying computers to the rural areas, establishing connectivity between computers, producing technical solutions for special populations, and producing portable technology. Let's consider the solutions which are available to provide better infrastructure to the areas in need.

1) Cheap network connectivity

Almost all of the researchers have focused their attention on providing wireless network connectivity solutions. The reason for this is fairly obvious since it will be an unfeasible solution if a wired connection is used to provide these services. Wi-Fi (2.4GHz 802.11b) connectivity has been identified as a key network type facilitating faster network services while providing a wide coverage and lesser money to Mega bytes ratio [14]. The next candidate is WiMax(IEEE 802.16 family) , which is a point-to-multipoint technology that supports multiple licensed and unlicensed frequencies in the 2-6GHz range [17].

2) Community Computing Centers

Community Computing Centers (CTCs) is a concept that was emerged from the idea of community computing. It is a resource-sharing model in which users are provided with free or low-cost computer and Internet access. Usually CTCs are simple rooms which are located in public places like schools, libraries, etc [15].

3) Community networks

Community networks are a very broad concept. All in all it's the network that gets created when all of the above mentioned solutions are interconnected with the necessary man power [15]. Community network is often tightly connected to the concept of free culture. Free culture is providing free services using free software, free tools and free infrastructure. Community networks often provide free content, free training to members and support other geographical communities.

B. Paradigm shifts

The solutions in this category are related to eliminating social factors that cause digital divide. The main focuses are an education based paradigm shift which involves a new understanding of digital divide and decreasing the gap in IT education, promotion of multicultural digital content for different social groups and creation of national IT policies.

1) Reformulate an understanding about digital divide

Researchers suggest that a new understanding of digital divide must provide adequate social, cultural and historical context for social justice through education. This is attainable through a concept called multicultural education, which is a progressive approach for transforming education to address its current shortcomings, failings and discriminatory factors [19]. This will lead to a more complete and progressive understanding of digital divide, thus helping to reduce ethnicity issues that causes divide.

2) Multicultural Digital Content

Even when required infrastructure and supports are in place, socioeconomically disadvantaged users find that online world is not created with their needs in mind [19]. Initiatives are taken to promote non-English resources with cultural diversity and content which aims variety of literacy levels. The expectation is increase of interest of different social groups towards digital content.

3) National Policies

Importance of establishing national level policies for development of information technology is essential for eliminating digital divide. This includes the reformulating government policies including education and e-governance towards Information technology.

VI. CONCLUSION

As discussed the solutions for digital divide are twofold. The technology related solutions shows promise for future researches through innovative designs. However not much of a impact is done by current technological researches for elimination of digital divide [9]. Some technological solutions are not implementable in several regions of the world and even some implemented solutions are rendered unusable due to social factors. For example several HCI solutions proposed are hard to be implemented in Asian countries due to lack of voice recognition technology related research for complex languages. Community computing centers and usable redesign of the digital content seems to have impact on the issue but should be carried in parallel with paradigm shifts.

Although redesigned products have been proposed for universal usability the prices of these products are way off the reachability of most of the population in the world. And it is clear that even the regular products which give access to technology are off the limit of many of the people in the world [18]. So in order to truly provide the necessary products to the masses to reduce the digital divide a program to create economical development should be run in parallel.

The paradigm shift solutions seem the most impacting and the sustainable solution of the proposed. Currently those concepts are brought to live only in limited case studies. For paradigm shifts to make an impact, those solutions should be widely implemented and given the needed time since paradigm shift occurs over long time. However for the

paradigm shifts to take place we need a policy that goes beyond digital content. Before we can decide on appropriate digital divide policy we need to be clear about our goal. When studying the nature of the issue it seems to be a move away from the real inequalities. Researches should be done to study about decreasing the gap between real live inequalities which essentially the base for digital inequalities.

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