Using Voice over IP to Bridge the Digital Divide - A Critical Action Research Approach

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Abstract— **There is a great disparity between those who have access to Information and Communication Technologies (ICTs) and those that do not. This phenomenon forms part of the *Digital Divide*. Many ICTs may be used to help overcome this divide if they are applied in a useful way, providing locally applicable content and services. Critical Action Research (CAR) is an approach used to develop such applications. CAR aims to empower people by involving them in the development process. Using CAR, this project investigates how Voice over IP (VoIP) may be applied in a productive way in an underserviced community. VoIP is an ICT used for sending voice over packet switched networks using Internet Protocol. It can be used to integrate data and voice to produce multimedia applications. In South Africa (SA), VoIP may only be provided by Telkom, the Second National Operator and the Under-Serviced Area Licensees. Using CAR and VoIP, an application is being developed to service a specific need of a particular rural community. The application will either provide a service to a small rural business or aid the provision of healthcare in rural areas. The project evaluates how well CAR integrates with a normal Software Development Lifecycle and makes policy recommendations for the use of VoIP in rural SA.**

Index Terms— **VoIP, ICT Development, Policy**

I. INTRODUCTION

One form of *Digital Divide* is the division between those who have access to Information and Communication Technologies (ICTs) and those that do not. In order to bridge this divide, ICTs should be used in needs-based applications with locally relevant content. If ICT applications do not have appropriate content or provide services required by the people expected to use them, they fail to attract users. Thus users must be provided with services that are accessible to them given their culture, beliefs and language. Critical Action Research (CAR) is one approach to develop such applications. It is focused on empowering people by involving them in all stages of the development process. This project uses CAR to investigate how Voice over IP (VoIP) can be applied in a useful way in an underserviced community. VoIP is an ICT used for sending voice over packet switched networks using Internet Protocol. Using VoIP, it is possible to integrate voice and data and develop a myriad of multimedia applications. Currently, VoIP use in South Africa (SA) is reserved for Telkom, the Second National Operator (SNO) and the Under-Serviced Area Licensees (USALs) [1],[2]. Using CAR and VoIP, a needs-based application is being developed to service a specific need of a particular rural community. Two application areas are

being considered[1]. Either a service to a Small, Medium or Micro Enterprises (SMMEs) in a rural area will be provided or an application to aid healthcare in rural areas through Telemedicine will be developed. The CAR approach is being integrated with a normal Software Development Lifecycle (SDLC) and recommendations for policy on VoIP in rural areas will be made. This paper provides background information on VoIP, CAR and current policies on VoIP in South Africa. This is followed by a discussion of related work and the objectives of the project. After this, the methodology for the project is described and conclusions are drawn.

II. BACKGROUND

A. Voice over Internet Protocol

The International Telecommunications Union (ITU) emphasizes that VoIP can be used in certain areas without the need for fixed line access [3]. For an example, it can be combined with wireless data technologies, such as Wi-Fi, to serve rural and remote areas. It is also cheaper for consumers due to the tariff structure around it. However, when using VoIP, consumers face a trade off between price and quality. ITU suggest nevertheless that VoIP can be used to enhance access to basic telecommunications. Hassan *et al.* argue that VoIP gives rise to low cost voice calls [4]. This is because there is no need for a dedicated communication line per each call as in Plain Old Telephone Service (POTs). Using VoIP, several calls can share the same bandwidth. The main challenges when using VoIP are packet loss, delay, jitter and limited bandwidth. Proenze agrees that VoIP is a useful technology for integrating voice and data but faces obstacles such as legislation and latency [5]. For these reasons, it is clear that VoIP should be investigated as an ICT for rural contexts in South Africa.

B. Critical Action Research

The Action Research (AR) method was developed by Lewin [6]. He emphasized the value of involving participants/stakeholders in every part of the AR process as they are experts in local culture, beliefs and practices [7]. Carr *et al.* describe this method as a spiral of cycles of diagnosing, planning, implementing the plan, observing results and reflecting on the results [8]. Evaluations of each acting stage form the basis for

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[1]A CAR approach dictates that the application area depends on the needs of the target community.
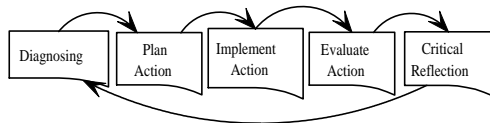
Fig. 1. The Critical Action Research Process

correctly planning the next step in the process. Each evaluation may lead to modifications in the ultimate goal. CAR, shown in Figure 1, is just a form of AR which has a strong emphasis on the empowerment of groups. It involves facilitating a change in a community through facilitating action. This action, like in conventional AR, is done in collaboration with the community members. According to Baskerville *et al.* [9], AR manages better than conventional methods to remain relevant to the real world. However, some AR can lack discipline and lead to context bound solutions. These problems are overcome by ensuring that AR interventions have good theoretical foundations, that all phases are well documented and the outcomes have restricted generalization. Thus, AR and particularly, CAR is a well suited methodology for the project being undertaken.

C. Current Policy on VoIP in South Africa

According to SA Telecommunications legislation, VoIP may only be provided by Telkom, the SNO and the USALs [1],[2]. USALs are being granted to one SMME per geographic area where the less than five percent of the population have access to telecommunications services or facilities. A USAL enables an SMME to provide telecommunications services and use VoIP.

III. RELATED WORK

A similar project involving handheld devices and CAR was undertaken by Blake [10]. Here, a field computer system was developed to gather complex data on animal behaviour that is observed by expert animal trackers. Trackers were consulted on every stage of the development of the system and their input was incorporated into subsequent designs. Empowerment was seen as affording the trackers greater recognition and rewards for their expert knowledge on animal behaviour through use of the field computer system to disseminate their information. The resultant application has become a successful product called CyberTracker.

IV. OBJECTIVES

The primary contribution of this research is to develop a locally relevant and culturally sensitive application for a rural setting, using VoIP, that services a specific need of a particular community. This is an application of CAR in ICT development. The secondary aspect to this project determines whether utilizing CAR in a Computer Science context is better than following a traditional SDLC, where clients are not involved in all stages of the process. Lastly, this research hopes to comment on whether current legislation governing the use of VoIP is detrimental or not to achieving access to ICT services other than basic telephony, particularly in underserviced areas.

V. METHODOLOGY

A CAR approach is being used and documented using appropriate description techniques and text. In the *Diagnosing* stage, a target community with existing infrastructure to host a VoIP application is identified and its present circumstances are analysed. This is done using semi-structured interviews with community members. The *Action Planning* stage elicits requirements for the application based on the information from the previous stage. During the *Action Taking* stage, the application and any supporting infrastructure required is implemented. At the *Evaluation* stage, the application is tested for correctness. It is also be tested in the target community to gauge whether it is perceived as useful or not. In the *Critical Reflection* stage, the response to the application is evaluated. Here any suggestions for improvements by community members are incorporated into the application. Lastly, the goals of the process and the design of the application may be altered. Further iterations of the process will take place as necessary and as time permits.

VI. CONCLUSION

The *Digital Divide* puts people without access to ICTs at a disadvantage. In order to overcome this divide, technology must be applied in such a way that appropriate applications with locally relevant content are developed. CAR is an approach that may be used to achieve such ICT applications and VoIP is an ICT that may benefit communities that experience this digital divide. The main outcome of this project is a VoIP application with culturally sensitive and locally relevant content developed using CAR. In addition, an assessment of how CAR compliments the SDLC and the policy implications of using VoIP in rural SA are being produced.

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