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FIELD COMPUTERS FOR SPATIALLY REFERENCED SOCIAL SURVEYS

MSc Thesis

By

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for the Degree of Masters in Applied Science.

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DEDICATION

This thesis is dedicated to Cecil and Wilma Barodien.

University of Cape Town

DECLARATION

I certify that this thesis comprises only my original work except where due acknowledgement is made in the text to all other materials used.

G.E. Barodien

December 2001

University of Cape Town

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ABSTRACT

This study explores the use of a palm computer, linked to a hand held global positioning system receiver, by members of an informal settlement and a rural community to collect socio-economic (SE) data.

The theoretical foundation is taken from such disciplines as Semiotics, Human Computer Interaction (HCI) and Survey Research Methods. This theory was used to develop a methodology, which enabled the researcher to investigate whether it is feasible to use icons to represent SE variables, whether HCI theory is useful for assessing the field observations of the volunteers using the palm computer, and whether the data collected is useful in terms of informal settlements and Communal Property Associations (CPA's).

The research approach involved developing a set of icons, which were then pre-tested using feedback from volunteers in Mitchells Plain (Cape Town) before doing field-testing in Algeria and Imizamo Yethu. Next, two field studies were conducted. In Algeria and Imizamo Yethu, the volunteers were asked to identify a set of SE icons, they were taught how to use the palm computer and the CyberTracker software, and each volunteer was asked to conduct a mini-survey.

The volunteer responses to the SE icons were analysed using semiotic criteria to determine how well they identified the icons. Next, the field observations were assessed with usability criteria from HCI. Finally, the two data sets were evaluated to determine its usefulness.

The recommendations of this research are that if a set of SE icons is to be developed, the researcher suggests that symbols, which are well known by the community be used. That these symbols be tested in a 32x32 pixel format to determine if there is enough detail for recognition. Also, avoid detail in a picture that could cause confusion. Also, detailed investigations into the effect of culture, gender and background, as well as human perception is needed with the focus on communities. The main motivation for this is that informal settlements are a mix

between rural, urban, educated and not, and also having different cultures. Next, it is further recommended that tests in homogenous communities also be done to determine whether they do have the same mental concept. Further field studies are required to sort out various technical problems and to test a larger set of icons. Finally, other applications for this system should be investigated, e.g. land allocation distribution.

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GLOSSARY

Informal Settlement	Settlement where the structures (houses) are constructed of any material other than bricks
SE Icons	Term for icons, which are used to represent socio-economic data
Semiotics	It is the study of "signs" (Chandler, 1994)
HCI	Human Computer Interaction
GPS	Global Positioning System
CPA	Communal Property Association
SA	Selective Availability
DOD	Department of Defence

CHAPTER ONE

INTRODUCTION

This study explores the use of a palm computer, linked to a hand held global positioning system receiver, by members of an informal settlement and a rural community to collect socio-economic (SE) data. The research was motivated by the “UrbanModeler” Project, conducted by the Department of Geomatics (University of Cape Town) and their research partners, as is more fully explained in section 1.1

This chapter introduces various aspects of this study. First the theoretical framework, which overviews the theoretical disciplines pertinent to this study, is explained. Secondly, previous research, which has contributed to the development of the present study, is reviewed. Finally, the key research questions, the research method, the major assumptions and limitations of this study, and the plan of development for the thesis are discussed.

1.1 BACKGROUND TO THE STUDY

A research collaboration between the Department of Geography (University of the Western Cape), the Department of Geomatics (University of Cape Town - UCT) and the Department of Geomatics (University of Melbourne) started the “UrbanModeler” Project. The project was titled “Spatial Information Technologies to Support Urban Planning in Informal Settlements”. The project (Mason 1997:1) focused on acquiring spatial information using digital photogrammetric and remote sensing techniques. The information was then used in a Geographic Information System (GIS), to undertake various informal settlement management tasks, such as:

- Monitoring settlement growth (both in-fill and expansion);
- Relocating residents to formal housing;
- In-situ upgrading of settlements, e.g. through provision of basic infrastructure;

- Managing disasters such as floods and fires;
- Managing the local environment and resources.

The main objective of this research partnership was the development of an Informal Settlement GIS (ISGIS), which could be operated at the individual settlement level (Mason 1997:2). This ISGIS would integrate physical settlement data with the demographic data enabling improved decision-making regarding, for example, the locating of schools, infrastructure planning and upgrading, etc (*ibid*).

A project using ISGIS in a land management application commenced in mid-1996. The Department of Geomatics (UCT) was involved in the process of relocating residents of Marconi Beam settlement (Milnerton, Cape Town) to Joe Slovo Park, a project under a government housing subsidy scheme (*ibid*).

The relocation process was managed by a spatial database, which was generated in ArcView (GIS). The GIS comprised two components. One component was a MS Access database in which the data from a socio-economic (SE) survey was captured. The other was the shack polygon in Computer Aided Drawing (CAD) format, digitised from an aerial survey of the settlement in mid-1994. These two components were then linked (*ibid*).

The GIS facilitated the design of a “block based” relocation system, which incorporated the shack numbers, owner information and other data for each block. This made it possible for the property developers to create layout plans of each block, as well as monitor relocation and shack demolition (Mason, 1997:3).

The ISGIS was also used in disaster management. The ISGIS and Global Positioning System (GPS) technology proved effective after a fire, devastated parts of the Marconi Beam settlement in 1996. The GPS was used to capture the extent of the fire, which was then captured into ArcView. This made it possible to generate a list of the affected shack owners and the spatial extent of the fire damage (*ibid*).

Insight gained from using the ISGIS demonstrated to the research partners that it could only be effective if up-to-date spatial and socio-economic database records for the settlement were maintained (*ibid*). This led to the formulation of a number of ISGIS data acquisition issues, which provide the foundation for the present study. They are as follows:

- Rapid data collection techniques are needed to cope with the rapidly changing environment of an informal settlement and to ensure timely provision of decision support. (Mason and R  ther, 1997:6).
- Organising structures and determining who will collect what data. This would involve the harnessing of community participation in data collection and maintenance (*ibid*).
- It was also felt that suitable computer/user interfaces would be needed if computer illiterate community members were to be involved in data capture (Mason and R  ther, 1997:9).
- Other research by Barry (1999), suggests that social data should not only be collected cheaply but repeatedly.

The above data acquisition issues form the basis of the literature review in Chapter Two. This review highlights several theoretical disciplines that apply to this research such as, human-computer interaction (HCI), semiotics and survey research methods. Moreover, a previously researched application of a palm computer, the CyberTracker project, was found to be relevant to this study. This is explained in more detail in Chapter Three.

Core concepts pertaining to the theoretical background and the CyberTracker project, are discussed in the next section with respect to their role in this project.

1.2 THEORETICAL FRAMEWORK

This section introduces definitions of core concepts such as survey research methods, the CyberTracker project, human computer interaction (HCI) and semiotics as they are used in this document. Furthermore, the contribution of

these theories to the present study is also discussed. More detailed discussion of these concepts is included in Chapter Two.

1.2.1 Survey Research Methods Defined

This discipline was investigated because it provides a general technique for collecting data such as those pertaining to a society's characteristics, behaviour and patterns. Examples of such data are demographic and socio-economic data.

This general technique is based upon several distinct phases as described by Hoinville (1978) and Fowler (1984), which are applied in Chapter Four to describe the various steps that were used to design the research instruments and the field work approach. They are as follows (Hoinville, 1978 and Fowler, 1984):

- Qualitative work: Is the exploratory phase to help in the design of the questionnaire content and its construction.
- Questionnaire construction: Is deciding on questions to be asked, the precise wording of the questions, the sequence of questions, as well as the layout.
- Sampling: Is the task of determining those to be interviewed, deciding how many, where the interviews should be located and the method of selecting respondents.
- Fieldwork organisation: Requires well-developed management skills in recruiting, training and controlling an interviewing team.
- Data preparation: Involves transforming the raw data recorded on questionnaires into a form appropriate for analysis.

1.2.2 The CyberTracker Project

The CyberTracker research project was of interest to the author because it incorporated all three of the ISGIS data acquisition issues that were suggested by Mason and R  ther (1997) described in section 1.1.

CyberTracker is a data collection system, incorporating a palm computer with a graphical user interface (GUI), linked to a hand-held GPS (Edge, Steventon and Foster, 1996). Its development was seen as a way of ensuring that data on animal behaviour was up-to-date, continual and more representative (*ibid*). Edge *et al* 1996, believed that by spatially referencing individual observations through the use of a GPS, it could add important new dimensions for data analysis.

One aspect of the CyberTracker system that was unique at the time of its development was that illiterate and semi-literate animal trackers were trained to use it to collect data on a daily basis.

The CyberTracker project used insight gained from two theoretical disciplines, i.e., human computer interaction (HCI) and semiotics during the development of its data collection system. Guidelines were extracted from HCI for the design of the GUI to try and increase the usability of the interface. Semiotic theory was used to make assumptions regarding the ease with which the animal trackers would identify the icons depicted in the GUI (Edge *et al* 1996).

1.2.3 Semiotics Defined

A common definition of semiotics, which has been adopted for this research, is the “study of signs” (Chandler, 1994).

Semiotics originates from disciplines such as linguistics, philosophy and many others. Due to its multi-disciplinary nature, there is considerable variation among leading semiotic theorists as to what semiotics involves. However, the main focus of semiotics is to study “signs” in everyday speech, as well as anything, which “stands for” something else (*ibid*).

Some of the concepts of semiotics, which are pertinent to this study, are discussed in more detail in section 2.2.

1.2.4 Human Computer Interaction (HCI) Defined

A definition of HCI, which has been adopted for this study, is that it is the study of people, computer technology and the ways these influence each other (Dix, Finlay, Abowd and Beale, 1993).

Some of the topics in HCI are technical design, evaluation and implementation of the interacting machine, specification, algorithms, as well as programming the computer interface. However, an objective of HCI as a discipline is to determine how to make computer technology more usable for people (*ibid*).

This latter objective is of prime relevance to this research because it seeks to determine the usability of the palm computer when used by the volunteers. HCI issues, which contribute to this study, are discussed in section 2.3.

1.2.5 Contribution of Theory to the Present Study

Each of the theoretical disciplines and the CyberTracker project has contributed to the overall development of the present study in the following ways:

- The main phases of survey research methods, overviewed in section 1.2.1, were used in this study as the overall approach for developing the research instruments that will be explained in Chapter Four.
- CyberTracker's hardware and software was used to conduct the field tests. An overview of the CyberTracker data collection system follows in Chapter Three.
- Usability criteria were taken from HCI theory to assess the ease with which the volunteers from the informal settlement and rural settlement communities used the palm computer.

- Semiotic theory was used to assess the volunteers' responses to the icons, which were used to represent SE variables on the palm computer interface.

1.3 KEY RESEARCH QUESTIONS

The following key research questions emerged from a review of the literature.

They are:

- 1) Do usability criteria from HCI theory assist in assessing the field observations made in terms of the operation of the palm computer by the volunteers?
- 2) Is semiotic theory useful for assessing the user responses to SE icons?
- 3) Is it feasible to use icons to represent SE variables in the context of informal settlements and CPA's?
- 4) Is the data that are collected using the adapted CyberTracker software suitable in the context of urban informal settlements and rural communities?

1.4 RESEARCH METHOD

The research approach is based on the Survey Research method phases discussed in section 1.2.1. During the exploratory phase the Mitchells Plain volunteers assisted with developing a set of SE icons. This was done to reduce the researcher bias that was introduced in the initial development of the SE icons. It must also be noted that there is also unavoidable researcher bias in the interpretation of the responses of the volunteers in Chapter Five.

Sampling (interviewing) of households was affected by the availability of the respondents, as the fieldwork was conducted during working hours. Therefore, only households where respondents were available were used.

The fieldwork involved two case studies. The first was conducted in a formal settlement, Algeria, in the Cederberg. The second was in an informal settlement, Imizamo Yethu, in Hout Bay, Cape Town. Further details describing these study areas can be found in Chapter Four. Residents from the study areas acted as volunteers for testing the suitability of the graphical user interface (GUI), as well as performing a mini-survey using the palm computer.

1.5 ASSUMPTIONS AND LIMITATIONS

The following assumptions have been made in order to conduct this research:

1. The potential users of the palm computer will have basic literacy skills. This is an important requirement because, in normal survey conditions, some responses need to be handwritten.
2. CyberTracker software can be customised to add new icons and create different screen sequences to collect SE data.

This study has the following limitations:

1. Only certain socio-economic parameters were used for the interface design. This means that the field computer was only tested with a limited number of variables and there is no way of knowing how effective it is for collecting all types of socio-economic (SE) data. It also means that the volunteers were only exposed to a limited selection of SE icons.
2. The sizes of the icons were confined to a 32x32 pixel image because of the CyberTracker Software specifications. The design of each data collection screen is also restricted by the specifications of the software.

1.6 PLAN OF DEVELOPMENT

This thesis is sub-divided into the following chapters:

Chapter Two discusses the theory of human-computer interaction, as well as, semiotics, which is relevant to the present study. It also gives an outline of the survey research process.

Chapter Three gives a description of the CyberTracker system, including hardware and software, as well as explaining how it was used in the CyberTracker project.

Chapter Four gives a description of the study areas. It includes an explanation of how the research instruments were designed and a description of the fieldwork.

In Chapter Five the fieldwork results are described and analysed.

In Chapter Six, the research method developed will be analysed and the research questions revisited to determine whether the research objectives of the study have been met. Final conclusions will be drawn and recommendations for further study made.

CHAPTER 2

THEORETICAL BACKGROUND

2.1 INTRODUCTION

This chapter builds on the discussion, in section 1.2 and further explains the concepts and theories of Semiotics, HCI and survey research, which are relevant to this study.

2.2 SEMIOTICS

One of the issues that were faced in this research was determining the effectiveness of using icons to represent SE variables. To this end it is necessary to review semiotic theory, as the main aim of semiotics is to study “signs” in everyday speech, as well as, anything, which “stands for” something else (Chandler, 1994). Words, images, sounds, gestures and objects can represent the sign (*ibid*). The sign vehicle that is used for this study is the image, specifically, the icon. An icon is defined as “a sign whose form suggests its meaning”¹.

When a message is relayed and understood from the source to the receiver of the message, communication takes place. Communication is a key concept in semiotics and related disciplines (Nöth, 1990:168). It is used to designate human and animal, direct and indirect, intentional and unintentional, verbal and non-verbal, auditory, visual, and otherwise coded flows of information (*ibid*). There is a difference between basic communication and semiotic communication and various models are used to represent them (Nöth, 1990:168; Fiske, 1990:39). The next section explains these differences.

¹ www.brittanica.com

2.2.1 Difference Between Basic and Semiotic Communication

Basic communication as depicted in figure 2.1 is represented by a linear model. This model uses arrows to indicate the flow of the message between the source, the transmitter, the receiver and the destination (Fiske, 1990:39).

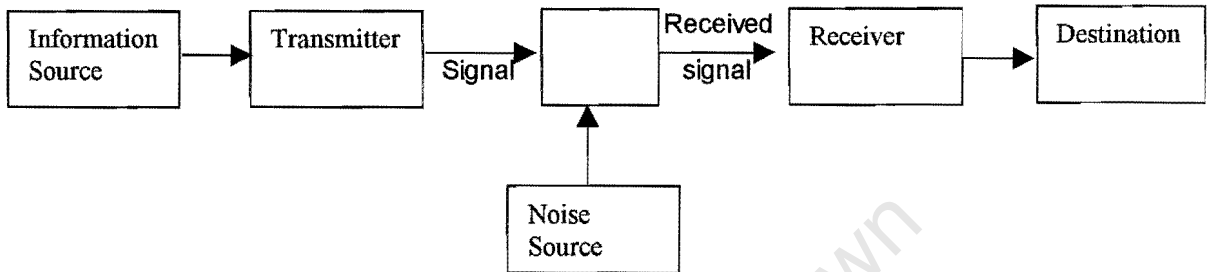


Figure 2.1 Shannon and Weavers (1949) linear communication model (Fiske, 1990)

In the semiotic context, the emphasis is on communication as the generation of meaning through the use of signs, rather than communication as a process.

In the semiotic model meaning is pivotal because it is the point of leverage in the life of signs (Sless, 1986:88). It tells us about the place of signs in the world, its origin, and how we might use it (*ibid*).

The models used for semiotic communication differ from the linear model because they are structural and use arrows that indicate the flow of the message.

Therefore, the structural semiotic model mainly concentrates on what it is that converts marks on paper or sounds in the air into a message. In addition these models appear to have the same general form. They contain three key elements, which must be involved in some way in order to study meaning (Fiske, 1990:41).

They are as follows:

- The sign;
- That to which it refers and;
- The users of the sign.

Peirce and De Saussure introduced the two most influential structural models, which, are explained below.

a) Peirce's Model of Meaning

Peirce viewed the three elements of meaning as the three points of a triangle as depicted in figure 2.2 (Fiske, 1990:41,42). He further stated that each element is closely related to the other two, and can be understood only in terms of the others. These relationships are depicted by the double-ended arrows (*ibid*). In his model, the sign refers to something other than itself and is called the object. Someone then understands this object. This means that it has an effect in the mind of the user, who is called the interpretant. This interpretant is not the user of the sign, but what Peirce refers to in other texts, as 'the proper significate effect'. 'The proper significate effect' is a mental concept produced both by the sign and by the users' experience of the object (*ibid*).

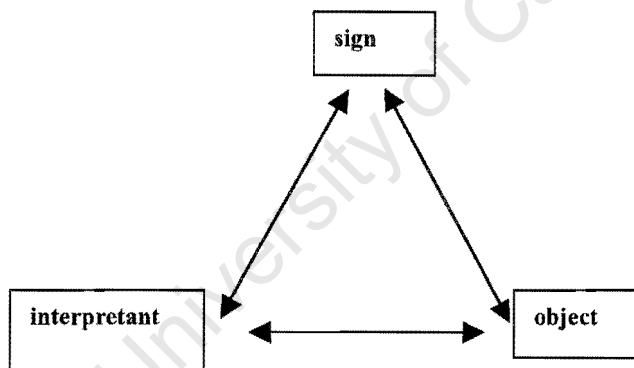


Figure 2.2 Peirce's Model of Meaning (Fiske, 1990)

b) De Saussure`s Model of Meaning

De Saussure`s model states that the sign consists of its physical form plus an associated mental concept (figure 2.3, Fiske, 1990:41,44). In his model, a sign consists of a signifier, which is the sign`s perceived image, and a signified, which is the mental concept to which it refers (Fiske, 1990:44). He further stated that this mental concept is broadly common to all members of the same culture who share the same language (*ibid*).

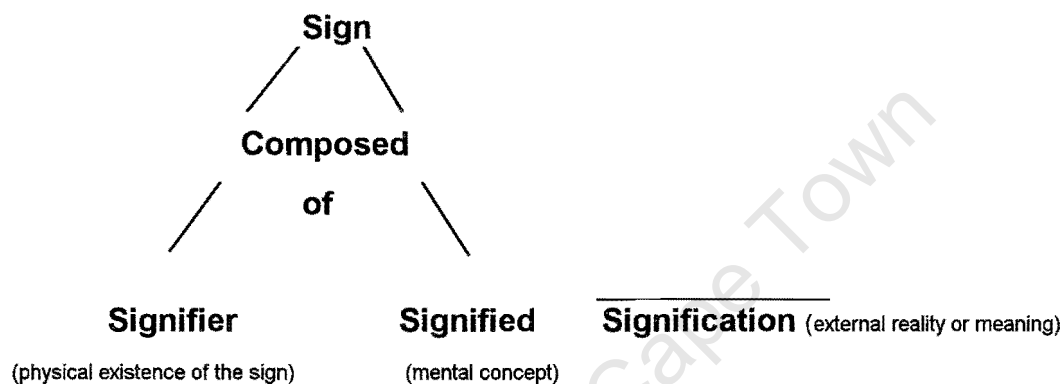


Figure 2.3 De Saussure`s elements of meaning

In comparing the two models, it can be seen that De Saussure`s model depicts a two-way relationship between the physical existence of the sign and the mental concept where these two components are not inter-related. In contrast, Peirce`s model depicts a three-way relationship between the sign, object and interpretant where these components are inter-related. In addition the formulation of the interpretant is only possible by both the sign and the users` experience of the object.

Even though De Saussure and Peirce clearly articulate how they perceive meaning and its various interpretations, there are still limitations involved when using graphical images. These are elaborated upon in the next section.

2.2.2 Limitations of Graphical Images

Various factors inhibit icon recognition and these are related to the limitations of the images.

One factor is that the images are easy to understand only if they depict enough of the object being represented to be recognised and are as realistic as possible in terms of scale and recognisable features (Fordham,1995).

Another factor, according to Fordham (1995), is that the concept of an image being used to represent a real-life object is not intuitive to all people, particularly not to people who live in rural environments, where the use of signs is uncommon.

These factors were considered during the selection of icons and the analysis of responses in section 5.1 will attempt to reveal whether these limitations played a role for the volunteers when they were identifying the images.

2.2.3 Relevance Of Semiotic Theory To Present Study

This review has highlighted several aspects of semiotics, which are relevant to the present study. They are:

There is a difference between basic and semiotic communication. In comparing the two types of communication, it is clear that basic communication can be represented by a linear model (Figure 2.1), whereas semiotic communication is represented by a structural model (Figures 2.2 and 2.3). The structural model uses arrows, which indicate relationships between elements. They also focus on what converts marks on paper or sounds in the air into a message.

After considering the two models of meaning, the researcher has adopted De Saussures' model because of its two-way relationship between the signifier and the signified. The elements in this model are not inter-related and need not be

understood only in terms of each other. Therefore, the elements in the model can be used separately. This is important for this research because the researcher wanted to be able to distinguish between recognition of physical form (signifier) and mental concept (signified), rather than the process of identifying the inter-relationships between elements that is required by Peirce`s model. Therefore, the analysis of the responses are based upon the elements of De Saussure`s model in the form of these two criteria, namely:

- Did they recognise the physical form of the icon (signifier)?
- Did they recognise the designated mental concept of the icon (signified)?

These criteria are used in Chapter Five to analyse the volunteer`s responses to the SE icons. Moreover, the analysis will attempt to determine whether the limitations, explained in section 2.2.3 played a role for the volunteers when identifying the icons.

2.3 HUMAN COMPUTER INTERACTION (HCI)

The main objective of HCI is to determine how to make computer technology more usable for people (Dix *et al* 1993). Usability is important for this study because people with no computing experience used the palm computer to collect SE data. The discussion thus focuses on specific aspects of HCI theory such as usability criteria and methods of usability testing. The use of this theory for analysing the observations from the usability study is also discussed.

2.3.1 Usability

The focus of HCI on usability originates from the broad range of users who are exposed to computer technology (Preece, 1994:4). Computer interfaces need to be intuitive and clear because present day users have a wide range of knowledge and diverse backgrounds (*ibid*). For example, some of these users include labourers, scientists and professionals (Hugo, 1998). This situation is in contrast

to the early days of computing when only highly skilled technical people used computers and software design that were focused only on system functionality (*ibid*).

The usability of a computer system can be assessed with criteria that were introduced by Bennett (1984) and Shackel (1990). These are learnability, throughput, attitude, and flexibility. These are explained in section 2.3.2.

2.3.2 Usability Criteria

Based upon the work of Preece (1994), the usability criteria are as follows:

- Learnability, which is the ease of learning the operation and functionality of a computer;
- Throughput, which is the ease of using the computer to achieve specific goals;
- Attitude, the positive or negative attitude that is created in the users by the system and;
- Flexibility of the system, which is the extent to which the system can accommodate changes to the tasks and environments beyond those first specified (Preece *et al* 1994:401).

These usability criteria can be tested by two methods, namely usability engineering and interpretive evaluation. These are reviewed in the section 2.3.3 below.

2.3.3 Methods Of Testing Usability

This section briefly describes the traditional method of testing usability, called usability engineering, and highlights the shortcomings of this method. It then introduces an alternative method called interpretive evaluation and provides a motivation for why it was used instead of usability engineering in this study.

a) Usability Engineering

Usability engineering has a scientific nature and is based on a form of experimentation known as benchmark tasks. In this process HCI researchers are able to manipulate variables associated with a design and study their effects (Preece *et al* 1994:654,655).

These tasks are performed in laboratories that have been built specifically to provide a controlled environment. This manipulation of variables is one of the problems with this method, since the test conditions are artificial and not representative of the real world (Preece *et al* 1994:655). Another criticism is that the subjects are given highly constrained artificial tasks, which have to be completed in a very short time. Also, little or no attention is given to the ideas, thoughts and beliefs of the subjects (Preece *et al* 1994:664). Since the late 1980's and early 1990's, researchers have started to move away from evaluator-controlled forms of evaluation in favour of more informal techniques, such as interpretive evaluation (Preece *et al* 1994:658).

b) Interpretive Evaluation

Interpretive evaluation has been derived from anthropology and sociology, and is focused on determining usability factors in relation to the context of the study (Preece *et al* 1994:658). This means that it is a method of collecting and analysing data about how people use technology in natural conditions, for example, at work, home and other real-life situations (Preece *et al* 1994:657). Interpretive evaluation is useful at various stages of system development, but particularly for feasibility studies, design feedback or post-implementation reviews study (Preece *et al* 1994:658). One advantage of this technique over usability engineering is that it provides data that reflect real usage more accurately (Preece *et al* 1994:659). Another is that, interpretive evaluation does not use metrics such as scientific benchmark tests to measure usability. Rather it

emphasises that data interpretation be done with reference to the wider work context and the users' general aims (Preece *et al* 1994:660-61).

2.3.4 Relevance of HCI Theory to the Present Study

HCI has made two contributions to this study, namely a set of usability criteria and a means to assess these criteria using the interpretive evaluation method.

Since the volunteers in this research had little or no computer experience it was necessary to evaluate how well they used the palm computer during the field study. To enable the researcher to do this, the usability criteria explained in section 2.3.2, namely, learnability, throughput, attitude and flexibility were used as a basis for gathering field observations. These observations are discussed in Chapter Five.

Also, the gathering of the field observations was conducted using the informal method of testing usability called interpretive evaluation. This method was explained in section 2.3.3 (b) and was used to assess the volunteers' use of the palm computer in natural conditions, such as their home environment in a real life situation, i.e., collecting SE data.

2.4 OVERVIEW OF THE SURVEY RESEARCH PROCESS

This field of research was introduced in section 1.2.1 but this synopsis is confined to the methodology for survey interviewing. The discussion includes question and questionnaire design, pre-testing, preparing survey data for analysis, sources of error and role of the interviewer. These issues are important in this research since it provides the basis for designing the research instruments in Chapter Four.

2.4.1 Question Design

In the early stages of survey research, considerable attention should be given to the question of design. Answers from well-planned questions are usually of value because they record what the researcher is trying to measure and they can reduce measurement error (Fowler, 1984: 74, 97). This, in turn, increases the validity and reliability of the data being gathered (Fowler, 1984: 74, 75).

2.4.2 Designing the Questionnaire

Once the foundation has been laid with a set of “good questions”, the next step is to plan the questionnaire. One of the issues that needs to be considered, is the order of the questions, since some researchers feel that it is better to start with straightforward questions to ease the respondent into the survey (Fowler, 1984:102); the more sensitive questions being reserved for the later sections of the questionnaire. The layout and format of the questionnaire should be carefully planned, since its aim is to make the task of the interviewer and respondent easier (Fowler, 1984:102).

2.4.3 Pre-Testing

A pre-test refers to the initial testing of one or more aspects of a study design (Babbie, 1973:205). The goal of pre-testing is to refine the research instrument, rather than provide descriptions of populations (Babbie, 1973:207). Formal pre-testing is an invaluable part of the questionnaire design, since it identifies questions that are confusing and ambiguous (Fowler, 1984:101).

2.4.4 The role of the Interviewer

The interviewer plays a central role in data collection and he, or she, has a great influence on the quality of the data that is collected. A key role of the interviewer is also to gain respondent co-operation (Fowler, 1984:107).

2.4.5 Preparing Survey Data for Analysis

Once the data have been collected by survey it must be translated into a form appropriate for computer analysis. This process is called coding, or data reduction, and is composed of the following steps (Fowler, 1984:127):

- 1) Formatting or organising the data;
- 2) Designing the code, that is the rules by which a respondent's answers will be assigned numerical values;
- 3) Coding, which is the process of turning responses into numbers;
- 4) Data entry, which involves keying the numbers on to disks, cards or tapes so that computers can read them;
- 5) Data cleaning, which is a final check on the data file for accuracy and consistency prior to analysis.

2.4.6 Coding and Data Reduction as Sources of Error in Surveys

The process of assigning numbers to open opinion questions, and the entering of this data onto a computer, can be a source of error. Error free data usually depends on the reliability and quality of the question and code. The process of data entry can also be error-free if proper verification procedures are used (Fowler 1984).

2.4.7 Relevance to Research

The steps, namely, question design, questionnaire design and pre-testing, as well as the basic method described and reviewed in this section provides the basis for the overall methodological approach in this study. They were used when designing the survey questions and questionnaires, when recruiting volunteers and for conducting the field studies. This is discussed in more detail in Chapter Four.

2.4.8 Summary

Chapter Two has reviewed Semiotic, HCI and Survey Research theory, and has contributed by forming the theoretical framework of this study. Firstly, semiotic theory provided criteria, which is used to assess the responses of the volunteers' to the SE icons, for the purpose of determining the feasibility of using them.

Secondly, usability criteria were obtained from HCI theory. These criteria are used for assessing the field observations made when the volunteers' used the palm computer. The investigation into HCI has also provided insight into the best method for testing usability, i.e., Interpretive Evaluation.

Finally, Survey Research theory has provided the researcher with a standardised procedure for tasks such as designing questions and questionnaires, choosing interviewers etc.

The next chapter briefly overviews the CyberTracker field data collection system and its components, as this system forms the technological approach for this study. Chapter Three in conjunction with section 2.4 forms the basis for Chapter Four, which involves the design of the research instruments.

Sections 2.2 and 2.3, semiotics and HCI respectively form the basis for Chapters Five and Six, where the results will be analysed and conclusions drawn. These results will then be linked back to section 1.3, to determine whether the research questions have been answered.

CHAPTER THREE

REVIEW OF CYBERTRACKER

3.1 INTRODUCTION

This chapter starts with an overview of the motivation for the development of CyberTracker. It also briefly summarises the results of using CyberTracker's icon-based interface and the overall usability of the system. Next, it describes the system components and concepts, which are unique to CyberTracker. This explanation of concepts is important for understanding certain sections of Chapter Four, which describes how this software was customised for the purpose of the present study.

3.2 THE CYBERTRACKER PROJECT

3.2.1 Motivation

As briefly discussed in section 1.2.2, the CyberTracker project was conducted in 1996 and used a palm computer linked to a GPS receiver as seen in Figure 3.1 (Edge *et al* 1996). It was developed for zoological research in response to the need for constant data updates to study animal behaviour and migratory habits. Its development was seen, as a means to overcome the shortcomings of current paper-based methods of data collection, which inadequately address the information needs of zoological research. Liebenberg, a game tracker, thus proposed the use of a palm field computer linked to a GPS as a possible solution (*ibid*).

The developed CyberTracker software, was based on a graphical user interface (GUI) for the following reasons:

- Because the trackers were illiterate, the researchers hypothesised that the use of images in the computer interfaces could successfully

communicate concepts to these trackers. This hypothesis was based on the fact that the trackers are already *au fait* with the concept of extracting meaning and information from images such as spoor (*ibid*).

- It was also felt that their expertise in tracking, for example, the distribution of rare species and small animals, combined with the use of technology could improve the data being collected (*ibid*).

Section 3.2.2 will briefly summarise the results, which were obtained during the CyberTracker project. This summary will focus on the results regarding the identification of the icons and the overall usability of the system.

3.2.2 Summary of Results

- The trackers found the identification of the icons representing activities to be easier than those representing animals (Edge *et al* 1996:76). The researchers concluded that the main reason for this was that there were fewer possibilities involved, i.e., only a few activities as opposed to many animals, which have only slight differences (Edge *et al* 1996:98).
- The trackers demonstrated an ability to be flexible and to grasp abstract concepts. For example, when they learned that an icon depicting a rhino performing a certain action represented the action and was not dependant on the presence of a rhino, this icon could be used without confusion to represent any animal performing the action (*ibid*).
- When identifying an animal from an icon, more attention was paid to the overall shape of the animal, rather than the details within the shape. For example, the zebra icon was difficult to identify because even though the most striking feature, the stripes, were clearly depicted, the trackers felt that the overall shape of the icon was that of a dog and not a horse (Edge *et al* 1996:76).
- The results of the timed response testing indicated that the trackers mastered the interface (Edge *et al* 1996:102).
- The researchers` observed the trackers ability to learn and comprehend concepts relevant to CyberTracker even though there was limited time

available for training (Edge *et al* 1996:98). The usability of this system was further confirmed by introducing it to another tracker who did not undergo any introductory training. This tracker was still capable of comprehending the concepts and to successfully use it within a short time with skill comparable to the trackers used in the initial testing (Edge *et al* 1996:102).

Section 3.2.2 has summarised some of the results of the CyberTracker study. This summary provides background information that can be used later in this thesis, in Chapter Six, to determine if there are any similarities in the results from the CyberTracker project and the present study.

This author has also decided not to use the same methodology of timed response testing but rather to use the interpretive evaluation method of usability testing that was described in section 2.3.3. The next section describes the CyberTracker system components and their functioning.

3.3 THE CYBERTRACKER SYSTEM COMPONENTS

The system was designed to facilitate the integration of several units, namely: the field data collection unit using a palmtop computer (Figure 3.1a), attached to a GPS (Figure 3.1b) and the data management system, which was implemented using a standard personal computer.

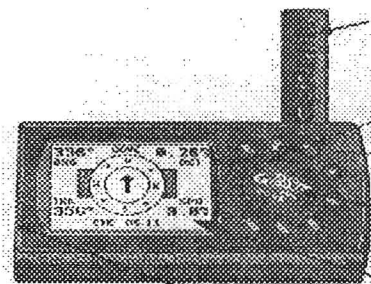
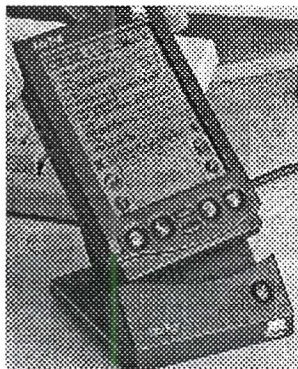


Figure 3.1 (a) The Palm Pilot and Figure 3.1 (b) The Garmin GPS

The CyberTracker systems allows the user to do the following:

- Gather data with the CyberTracker field computer (with or without GPS);
- Use the screen writer to customise screen sequences;
- View data with the CyberTracker geographic information system;
- Export data to Excel or Arcview for advanced analysis (Liebenberg, 1996).

3.3.1 Hardware

a) Palm Pilot

The Palm Pilot personal digital assistant (PDA) is a pocket-sized computer that allows the operator to enter and store information by writing on the screen with a stylus (Figure 3.1a). The professional version of this PDA, as used in the current study, has 1MB of memory and can store approximately 2000 observations (Edge *et al* 1996). It also has a 160x160-pixel display.

b) Global Positioning System (GPS)

GPS is a satellite navigation system developed by the United States Department of Defence (US DOD). It was designed for military use, but can be used by civilians as a positioning and navigation tool. When using a GPS receiver, a user can find his/her latitude, longitude, height and current world time (Edge *et al* 1996).

The satellites act as reference points because their orbits are accurately monitored by the tracking stations on the ground. Each satellite sends out coded signals and the receiver calculates its distance from the satellite by using the time the signal left and the time the signal arrived at the receiver (*ibid*).

Selective Availability (SA) affected the accuracy of the standard GPS. SA is the intentional degradation of the GPS satellite signals by the Unites States of America (U.S.A.) military. The purpose of SA is to limit the accuracy for civilian

users (*ibid*). SA was switched off in May 2000 and the accuracy of GPS data is vastly improved.

3.3.2 Hardware Integration

The integration between the various hardware components occurs as follows: Firstly, The Palm Pilot and GPS are connected with cables. Secondly, the Palm Pilot uses HotSync technology, which allows synchronisation and off-loading of data between the Palm Pilot and base station PC by inserting the Palm Pilot into the cradle that is depicted in the Figure 3.2. This is also used to offload new screen sequences onto the palm computer.

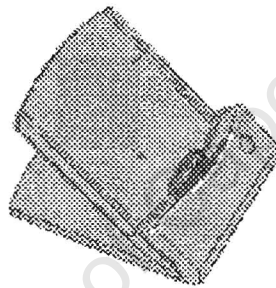


Figure 3.2 The Palm Pilot HotSync Cradle

3.3.3 CyberTracker Software

The goal of this discussion is to overview the basic functioning of the CyberTracker software, as well as its main components. The software was programmed to create an interface with a series of screens that follow a logical sequential order. It allows the user to loop back to the start screen in order enter new observations, or make smaller loops back to enter observations of the same category refer to figure 3.3 for graphical depiction of looping. Items are grouped on screens in a simple classification system, which ranges from specific to very specific information.

The screens may also be either icon-based or text-based interfaces (Edge *et al* 1996).

The key components in the basic interface design are depicted in Figure 3.3 below. In this figure the 'icon bar' is the space at the top for a title, a short description or for an icon that represents a question to be answered

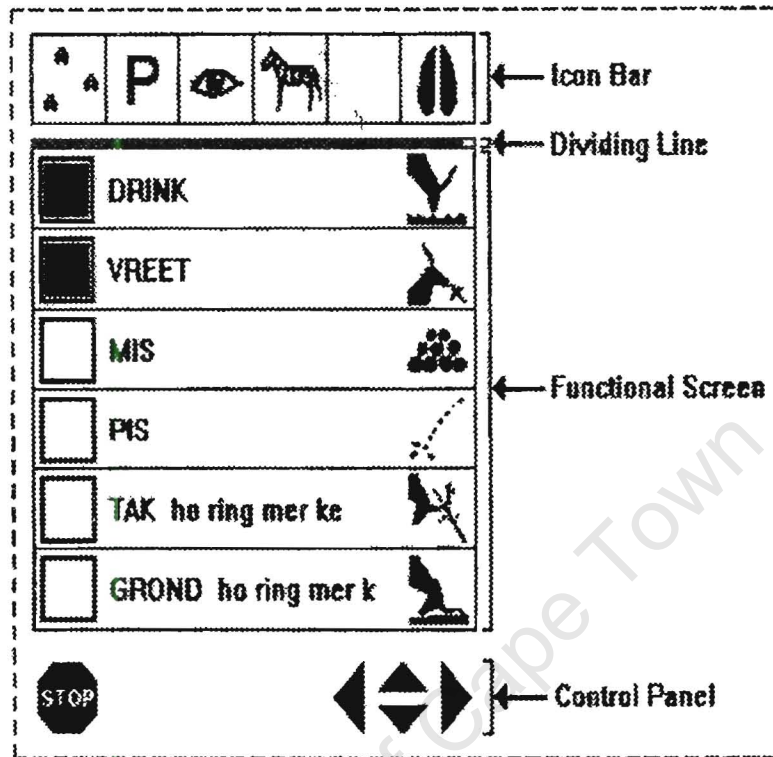


Figure 3.3 The Basic Interface design (From Edge et al 1996:37)²

Key to the functioning of each section:

1. **Icon Bar:** provides graphical or textual reminders of the purpose of the current screen and its relative position in the whole set of screens.
2. **Dividing Line:** provides a graphical divider between the functional screen and the icons above, as well as representing the current page number of a scrolling list screen by the number of small white squares on the right of the line.
3. **Functional Screen:** this contains the actual items of the current screen.

This software also has four basic screen types, which are depicted in figure 3.4 below.

² Text in Figures 3.3 and 3.4 are in Afrikaans.



Figure 3.4 Four Basic Screen Types (From Edge *et al* 1996:38)

Key to screen types:

1. **Radio List:** A single-selection item list for displaying several mutually exclusive options, for example, species of animal.
2. **Check List:** A multiple-selection item list for displaying options, which can occur simultaneously, such as activities.
3. **Number:** A number selection list for inputting numerical data.
4. **Notes:** A field notes screen for adding comments regarding unusual observations (using handwriting recognition or an on-screen keyboard).

The screen layouts, which have been depicted in figure 3.4, occur only in Version One of the software. Version Two, which was used in the present study, has two

additional screens. They are the scrolling number checklist, which takes the form of a counter and distance-sighting screen, for recording distant observations.

Other components of the software include the database manager and the screenwriter, which are operated from the PC. The database manager is used to modify existing interfaces or to create new ones.

The screenwriter allows users to import their own icons and develop a customised screen sequence for specific data gathering (*ibid*). Once the individual screens have been created, they need to be linked into a relationship called a screen sequence (*ibid*). If the sequence is not linked correctly, it affects the way that the data, which is to be collected, is stored in memory. This procedure is explained in section 3.3.4 and uses Figure 3.5 as a graphical depiction of the operation of a screen sequence.

3.3.4 Linking Screens into a Sequence

The first step in the creation of a sequence is to create a series of screens. In this example, the screens, which will be used, are volunteer name, animal type, animal activities, distance from sighting, and additional observations (Figure 3.5).

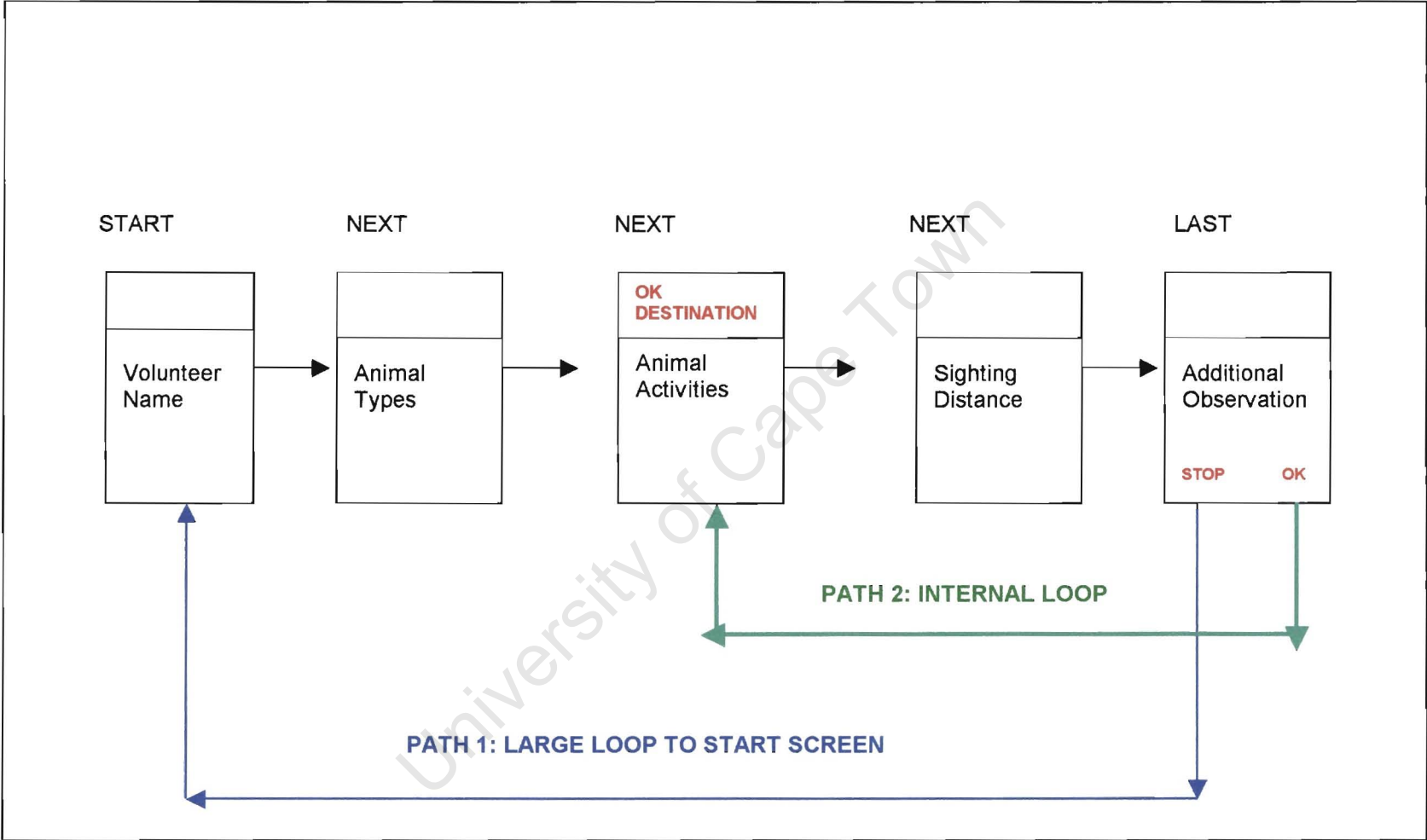


Figure 3.5 Schematic diagram depicting the operation of a screen sequence

The second step is designating the order in which these screens will follow each other in the sequence.

The third step is to define an **OK DESTINATION** screen. This is used to make smaller loops (Path 1 in Figure 3.5) back to the designated **OK** destination screen to enter observations that relate to the same animal type but other information regarding the type of activity that animal is engaging in. This command can be invoked by pressing the **OK** button on the palm computer when the last screen in the sequence is reached.

Once a sequence is operational, the first screen is always the **START** screen, in this case volunteer name. From this other screens follow, for example, animal types, animal activities, distance from sighting and additional observations.

As depicted in the diagram (Figure 3.5), there are **OK** and **STOP** buttons on the **LAST** screen.

Selecting the **STOP** button will take a GPS reading (where applicable), end the observation and invoke Path 1, which loops back to the **START** screen

Selecting the **OK** button invokes Path 2, which is an internal loop that goes to the designated **OK DESTINATION** screen, in this case animal activities, enabling the user to add observations about an animals` activities as previously explained.

3.4 Summary

This chapter has overviewed the motivation for the CyberTracker project, as well as some of the results. These results have provided insight, which the author used when conducting the present study. They will also be used later in Chapter Six, to ascertain whether there are any similarities between the two sets of results. The chapter has also described concepts that are unique to CyberTracker, including the hardware and software components of the system. An

understanding of the concepts and terminology is important background for understanding the descriptions in the next chapter.

One of the sections in Chapter Four describes the creation of customised screen sequences for the present study using the software and terminology, which has been explained in Chapter Three. Other sections in Chapter four include: A description of the study areas, the volunteers used, the selection of the socio-economic (SE) icons, and the fieldwork methodology.

University of Cape Town

CHAPTER FOUR

DESCRIPTION OF TWO FIELD STUDIES AND DESIGN OF RESEARCH INSTRUMENTS

This chapter is divided into three sections. In the first sub-section the two study areas will be described with regard to location, background information about the area and the volunteers who participated in this study. Secondly, the researcher will explain the design of the research instruments, particularly, how the icons were selected, which SE variable each icon would represent, which screens were selected to represent variables, as well as a providing a schematic diagram of the developed screen sequences. Finally, the fieldwork will be described with regard to the training procedures used, testing of icon recognition and usability testing.

4.1 DESCRIPTION OF TWO CASE COMMUNITIES

This description includes the location, general information about the areas and volunteers who took part in the field studies.

4.1.1 Algeria Community

a) Introduction

The Algeria community lives in the Rondegat River Valley in the Cederberg Mountains located in the southwest of South Africa. This village was established in the 1800's (SPP / Algeria Grond Komitee, 1997:3) and most of the families who live here have deep historical roots in the area. The community, which is composed of thirty-three families, are labour tenants of Cape Nature Conservation (CNC). In April 1997, the community assisted by the Surplus Peoples Project (SPP), started a project aimed at gaining ownership of the land on which they live. As a result of this process the community decided to use a Communal Property Association (CPA) Act

(SPP / Algeria Grond Komitee, 1997). A Communal Property Association is a form of legal body through which communities can collectively acquire, hold and manage land according to a written constitution (CPA Act 28/1996).



Figure 4.1 Location of Study Areas

In order to process the applications for the CPA, SPP found that they needed up-to-date SE data, especially the personal details of the villagers:

- The number of people in each household.
- The household composition, i.e., the number of males, females and children (could be useful for planning future infrastructure).
- A description of each structure (i.e., brick or wood).
- Access to services such as water and electricity.
- Present land usage, house or vegetable garden.

b) Volunteers

Three people from Algeria volunteered to take part in the field study. Their general profile is tabulated in Table 4.1 below.

NAME	AGE	GENDER	LEVEL OF SCHOOLING	COMPUTER EXPERIENCE
Volunteer One	48	Female	Grade Eight	No previous experience but has observed it being used on television.
Volunteer Two	33	Female	Grade Eight	Used a cash register at a convenience supermarket (point of sale terminal).
Volunteer Three	40	Female	Grade Ten	No previous experience but has observed it being used on television.

Table 4.1 Profiles of Algeria Volunteers

4.1.2 Imizamo Yethu Community

a) Introduction

Hout Bay is a coastal residential area with mountain scenery, rural atmosphere and a beautiful bay (Oelofse, 1994). It is situated in the southern Cape Peninsula, on the southwestern coast of South Africa (see Figure 4.1).

Hout Bay has been experiencing land invasions since 1988 and 1989 (Oelofse, 1994:6). By November 1990, the “squatters” had acquired legal rights to settle permanently on 18 hectares of land on the Western Cape Regional Service Council Forestry Site (Oelofse, 1994:7). In March / April 1991 the “squatter” communities were moved to this low-income-site-and-service settlement and Imizamo Yethu was created (Oelofse, 1994:2).

At the time that this field study was undertaken, in March 1999, the residents of Imizamo Yethu were in the process of applying for rights of ownership to the land that they are occupying. As part of the land relocation, the local municipality was in the process of conducting a SE survey and the author wanted to investigate whether a tool like the CyberTracker System could be used in this environment.

Survey questionnaires that were used in other informal settlements by the local municipality were examined to gain an understanding of the data requirements. The data required was as follows:

- House number.
- Building material.
- Position in household.
- Gender.
- Name and surname.
- ID number.

- Employment status.
- Previous place of residents and how long they are living in Imizamo Yethu.

b) Volunteers

Eight volunteers agreed to take part in this field study and their general profile is tabulated in table 4.2 below.

NAME	AGE	GENDER	LEVEL OF SCHOOLING	COMPUTER EXPERIENCE
Volunteer A	27	Female	Grade Eleven	No computer, typing or interviewing experience.
Volunteer B	29	Male	Grade Eleven	No computer or typing experiences. Has conducted an interview but does not have extensive experience.
Volunteer C	29	Male	Grade Nine	No computer or typing experiences. Has conducted an interview but does not have extensive experience.
Volunteer D	36	Female	Grade Ten	No computer or typing experiences. Has conducted an interview but does not have extensive experience.
Volunteer E	24	Female	Grade Twelve	No computer, typing or interviewing experience.
Volunteer F	20	Female	Grade Twelve	None. No typing experience. Has never conducted an interview.
Volunteer G	19	Male	Grade Twelve	Has used a computer on one previous occasion. No typing or interviewing experience.
Volunteer H	23	Female	Grade Eleven	Computer and typing experience as a cashier. No interviewing experience.

Table 4.2 Profiles of Imizamo Yethu Volunteers

From tables 4.1 and 4.2 it can be seen that the majority of the volunteers have no computing experience. The volunteer's performance when using the palm computer will be assessed against their lack of experience later on in Chapter Five.

4.2 DESIGNING THE RESEARCH INSTRUMENTS

The method that was used to design the research instruments and the fieldwork is based on the survey research method phases that were overviewed in sections 1.2.1 and 2.4. These were qualitative work, questionnaire construction and pre-testing. For the purpose of this study these phases will be called selection of SE icons, selecting screen type and fieldwork respectively and will be explained in section 4.2.1, 4.2.2 and 4.3.

4.2.1 Qualitative Work / Selection of SE icons

In survey research methods, this phase is used to explore the design of the questionnaire content and its construction.

An external study was undertaken before the Algeria field-testing in order to gather a sample of SE icons that could be tested. The researcher conducted informal discussions with five people such as a roofer, a housewife, a saleslady and many others. These volunteers live in Mitchells Plain (Cape Town) and have had no previous computing experience. These discussions yielded the icons that are tabulated in Tables 4.3 and 4.4.

i) Icons for Algeria Field Study
























Variable	Icon	Variable	Icon	Variable	Icon
Number of Rooms		Information about house		House Type (Brick OR Wood)	
Outbuilding		Electricity		Water	
Number of People In Household		Man		Woman	
House Number		Married		Single	
Divorced		Widow		Widower	
Girl		Boy		Garden	
Date of birth / Birthday		Employment Status		Garden	
Name and Identity number		Employment Status			

Table 4.3 SE Icons for Algeria Field Study

The six icons that represented number of rooms, information about the house, house type, whether there is an outbuilding, number of people living in the house, and house number all used the basic house picture with different detail to distinguish them from each other.

- The Mitchells Plain volunteers felt that the subdivision detail in the “number of rooms” icon would make it recognisable.
- For house type, they felt that the brick and wood features on the house would be intuitive.
- They felt that the addition of another structure next to a house would clearly represent that it was an outbuilding.

- The Mitchells Plain volunteers selected a house with people inside to represent number of people in household because they felt that meaning between picture and SE variable was clear.
- They also felt that a house with a number on it would clearly represent that the house number was the SE variable.
- They selected the icon of a house (no additional features) to represent additional information about a house because they felt that during field testing the other volunteers would get the mental concept from using the above-mentioned icons.

For gender (man / woman), they selected a basic picture of a man and woman since they found them similar to those, which are used on public toilet facilities and therefore easily recognisable to them.

They selected a picture of a birthday cake to represent age / birth date since it is common to them that a birthday cake is used for the celebration of a birthday.

They suggested combining the man and woman icons to represent a married couple for depicting marital status. Other suggestions by the volunteers regarding marital status icons were: widow and widower status to be graphically illustrated by crossing out the relevant partner. Divorce should be represented in a similar manner by crossing out the married couple.

They further suggested that in order to graphically represent a boy and girl, the man icon's size had to be decreased as well as that for the girl icon (and by adding pigtails).

For employment status they suggested that since the Algeria volunteers lived in a rural area that a man felling a tree, and saw and hammer would be more recognisable to them.

With regard to the garden, the volunteers suggested two icons, namely, a woman planting and a flower.

The volunteers found it extremely difficult to find ideas for the identity number and name icons. They could offer no suggestions. Therefore the researcher decided to use an icon representing a notepad because that sort of information usually needs to be written down.

ii) SE Icons for Imizamo Yethu Field Study











Variable	Icon	Variable	Icon	Variable	Icon
House Number		Building Material (Brick OR Wood)		Interviewees Position in Household	
Gender		Name & Surname		Identity Number	
Age		Employment Status		Employment Status	
Employment Status					

Table 4.4 SE Icons for Imizamo Yethu Field Study

The house number and type of building icons used were the same as the Algeria study.

For position in household the Mitchells Plain volunteers suggested that an icon with people of varying sizes be used. They felt that this would be easy to recognise. For gender they suggested the addition of a dividing line between the icon of a man and woman. They thought this would more clearly indicate male or female.

Further discussions with the Mitchells Plain volunteers, in addition to insights from the Algeria field test yielded a picture of a person with a question mark above it to represent Name and Surname.

Further discussions regarding an icon for identity number yielded the suggestion of using a bar code to represent identity number. They felt that this would be recognisable during the Imizamo Yethu field study because at the time bar coded identity documents were required to register for voting in government elections.

A picture of a birthday cake was selected to represent age / birth date, the same as Algeria.

They suggested that since the Imizamo Yethu volunteers live in an urban area that a picture of a man doing roadwork (road sign), a picture of a saw and a picture of a hammer and spanner would be easily recognisable.

4.2.2 Questionnaire Construction / Selecting Screen Type

Usually, the questionnaire construction phase in the survey research process is reserved for deciding on questions, phrasing of the questions, sequence and layout. In this study, this phase involved assigning a screen to each variable (SE icon) from the range of screen types that are depicted in Figure 3.4 (section 3.3.3). They were created using the database manager and screenwriter components of the CyberTracker software as is explained in section 3.3.3. In sections (i) and (ii), the screen assignments for the Algeria and Imizamo Yethu sequences will be explained and depicted in Figures 4.2 and 4.3 respectively.

i) Algeria

For the SE variables used in Algeria the following screen assignments were made and the format of the data is also given:

The house number was assigned a notes screen since the volunteers were required to fill in the information (text).

The type of building material, outbuilding, water, electricity and the garden were grouped together to be house properties and assigned to be a multiple selection screen. This meant that a number of options could be selected simultaneously (Boolean).

The number of rooms and the number of people were each assigned to be number screens, which meant that the relevant number simply had to be selected (integer).

Personal details were structured in a series of screens as follows:

- The “who are you” screen was designated to be a single selection screen, which allows only one choice to be made (Boolean).
- This screen linked to the ID number and name, which are notes screens (text).
- Next came age, which is a scrolling number checklist screen (integer).
- Marital status and employment status followed which are both single selection screens. The employment status screen was also designated to be an **OK Destination** screen, which was defined in section 3.3.4 (Boolean).
- The last screen is a note screen for additional observations (text).

The Algeria sequence, which is depicted in Figure 4.2 was structured in this way for the following reasons:

The house number, household properties, number of rooms and number of people screens were at the start of the sequence because it collected basic house

information. Since the “who are you” screen was next and defined as an “OK” destination screen (section 3.3.4) it means that the screens that follow, namely, name, identity number, age, marital status and additional notes form part of loop, which is activated when “OK” is pressed on the last screen (notes screen) in the sequence. When “OK” is pressed it loops to the “who are you” screen and the personal details of another person in the same house can be captured without re-entering the basic house information again.

The screens were selected by the researcher for ease of use and aesthetic reasons and each screen’s performance will be assessed later in Chapter Five when the results of this study are discussed.

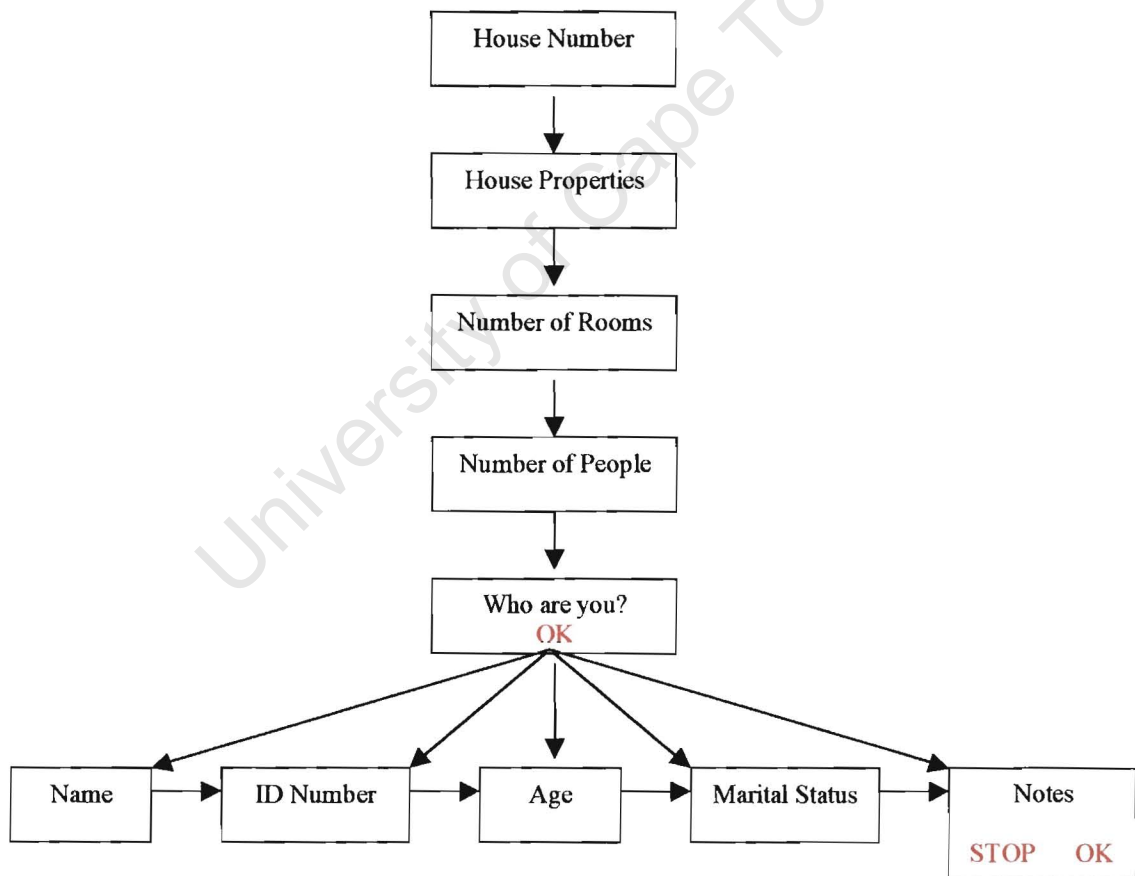


Figure 4.2 Schematic diagram of Algeria Sequence

ii) Imizamo Yethu

This sequence is very different to Algeria because insight gained regarding the performance of individual screen types during the previous field study was used when creating this sequence. Another reason is that there were different data requirements based on previous surveys. The sequence is structured as follows:

House number, building material, and position in household, gender, name & surname and ID number were all designated note screens. This is followed by age, which is a scrolling number checklist. Next comes employment history, "where they have lived before" and how long in Imizamo Yethu, which were also note screens. The final screen is a note screen for additional observations. The relationships between the various screens in both data collection sequences were created using the operation explained in section 3.3.4 and depicted in figure 3.3.

In this sequence the **OK** destination screen was allocated to position in house screen. The justification for using this structure is the same as previously explained for Algeria.

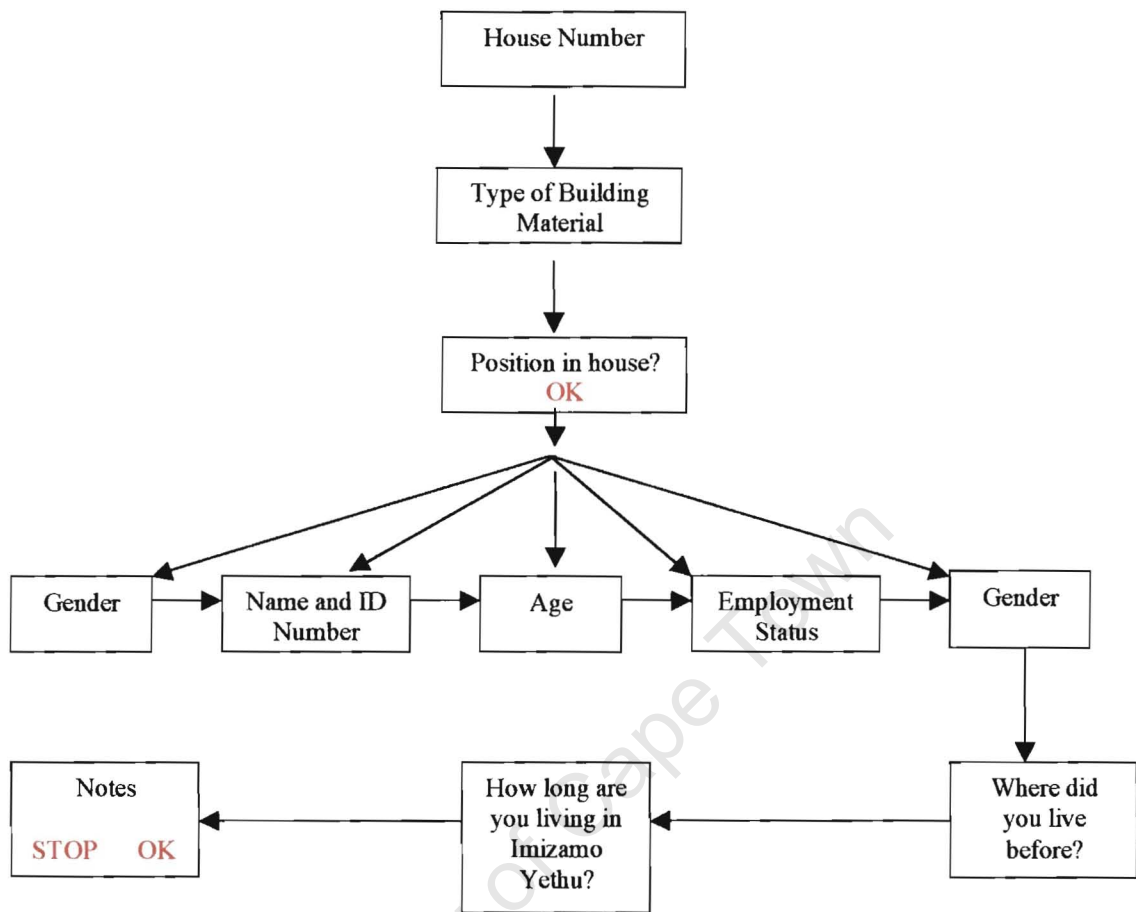


Figure 4.3 Schematic Diagram of Imizamo Yethu Sequence

4.3 FIELDWORK

This section explains the steps that were used when training the volunteers during the Algeria and Imizamo Yethu field studies.

At the start of the training session the researcher gave the volunteers a brief overview of what would take place and the aims and objectives of this field study. They then received an explanation of the data that would be collected during the survey. They were then given a questionnaire containing a list of icons and asked to make an association between the image and the SE variables and whatever other opinions they wanted to give.

In the case of Algeria the training was conducted in a group since there were only three volunteers. However, the Imizamo Yethu volunteers were divided into four groups of two. The researcher hoped that this would encourage group discussions after they had filled in the questionnaire.

The next phase was to show them the paper mock-ups of the screen layouts and explain the functionality of each (see Appendices containing the field manual). This was followed by an explanation of the control buttons on the Palm Pilot (see Appendix 1) and also the basic functionality of the field computer. Included in this explanation was how the Palm Pilot keyboard and stylus operates. At this time each volunteer was given an opportunity to handle the field computer and they also entered sets of example data, to familiarise themselves with the basic operations. The general approach to the training was informal and questions and discussions were incorporated into the training session.

The next section briefly explains the role of the researcher when observing the volunteers during the field-testing of the palm computer. This testing took the form of a mini survey, in which each volunteer had an opportunity to collect SE data using the palm computer from a small number of households.

The general approach used by the researcher when observing the volunteers was informal and ascribed to the interpretive evaluation methodology described in section 2.3.3. This means that no stringent tests were done on the volunteers but that the researcher simply made field notes during the study. These observations are qualitative and aim only to describe the behaviour and attitude of the volunteers when using the field computer. There are several differences between the two field studies and they are explained below.

In the case of Algeria the aim of the survey was to collect data, which would be used by SPP. However, in the case of Imizamo Yethu it was only a pre-test of the survey sequence and each volunteer only collected a sample of data. The motivation for a pre-test in Imizamo Yethu is that the informal settlement occupies an enormous area. The availability of respondents was also a consideration because the fieldwork was conducted during the day when people are at work. Another difference is that a GPS was used during the Imizamo Yethu study whereas it was not for Algeria. It was not used in Algeria because there were problems receiving a signal from satellites because the settlement is situated in valley, which affects satellite reception.

4.4 SUMMARY

This chapter described the study areas and their location. It also explained how the icons were selected and how the data collection sequences are structured. Other issues that are discussed include the training procedure used and the method used for making field observations.

Chapter Five presents the results of the icon identification and analyses the responses, it discusses the usability of the palm computer and CyberTracker software in terms of the field observations that were made, as well as assessing the suitability of the data collected in terms of its context.

CHAPTER 5

RESULTS

This chapter describes the three sets of data collected during the two field studies. Firstly, the responses made by the volunteers will be analysed using the two semiotic criteria derived in section 2.2.4. Secondly, the field observations made regarding the usability of the palm computer will be discussed. Finally, the data collected using the palm computer and the customised CyberTracker software will be assessed to determine whether its format is suitable for the collection of SE data in the context of urban informal settlements and communal property associations.

5.1 DISCUSSION OF VOLUNTEER RESPONSES

This section analyses the responses of the volunteers to the icons, which were assigned a mental concept by the Mitchells Plain volunteers and the researcher, as explained in section 4.2.1. The responses were analysed with the two criteria, which were derived from De Saussures' model of meaning (Fiske, 1990), as explained in section 2.2.4. They are:

- Whether the volunteers recognise the physical form of the icon (sign / signifier)?
- Whether they recognise the SE mental concept (interpretant / signified)?

5.1.1 Algeria Volunteers

This section discusses the volunteers' responses, which have been tabulated in Table 5.1. The responses are divided into three categories, namely:

- Recognition of the mental concept, i.e., correct responses.
- Recognition of physical form only.
- Other responses.


















SE ICON	MENTAL CONCEPT	RESPONSE VOLUNTEER ONE	RESPONSE VOLUNTEER TWO	RESPONSE VOLUNTEER THREE
1. 	How many rooms	View/ Window	Window	How many rooms
2. 	Information about house.	Exit & enter / Door	House with telephone	No electricity in house
3. 	Brick house	Building	No Response	Built House
4. 	Wood house	Incomplete	Wood House	Wood House
5. 	Outbuilding	No response	Public Telephone Cubicle	Water in house
6. 	Electricity	Light	Light	Electricity
7. 	Water in house.	No Response	Tap	Water in house
8. 	How many people in the house.	Half a building	House with three people	Double-storey
9. 	Man	Little Man	Son or father	Male
10. 	Woman	Woman	Daughter or mother	Female
11. 	House Number	No Response	No Response	House with electricity
12. 	Married	Boy & Girl	Mother and Father	Man and woman alone in house
13. 	Widow	No Response	Mother	Father alone with son & daughter
14. 	Widower	Girl with hands in air	Father	Grandmother with grandchild
15. 	Divorced	No Response	No Response	Grandfather with grandchild
16. 	Girl (<18)	Teenager	Girl	School girl
17. 	Boy (<18)	Alone	Boy	School boy

Table 5.1 Responses from Algeria Volunteers







18. 	Divorced	Playing	Non-people	No children
19. 	Do you have a garden?	Worker	Person busy with work	Physical labour / Working the land
20. 	Age	Hole	No Response	Electricity
21. 	Are you employed?	Cliff / Mountain	Person busy at the telephone cubicle	Is wood used
22. 	Are you employed	Tools	Tools	Is candles used
23. 	Do you have a garden?	No Idea	No Response	No response

Table 5.1 Responses from Algeria Volunteers. (continued)

i) Volunteer One

Volunteer One correctly identified the mental concept for three icons (9,10,16).

She also identified the physical form of six icons (3, 6, 8, 12, 19 and 22).

The rest of her responses indicate that:

- For six icons (1,2,14,18,20 and 21), she was unable to recognise either the mental concept or the physical form.
- No response was give to six icons (5,7,11,13 15 and 17).
- For icon number four she felt that there was not enough detail in the icon to make a proper identification.
- Finally, for icon twenty-three she said that she had no idea what it was.

ii) Volunteer Two

Volunteer Two identified the mental concept for three marital status icons (12,13 and 14). She also recognised the mental concept for an additional six icons (2, 4, 9,10, 16 and 17).

She was able to identify the physical form of five icons (6, 7, 8, 19 and 22).

The rest of her responses indicate that:

- She was unable to recognise either the mental concept or the physical form of four icons (1, 5, 18 and 21).
- No response was given for five icons (3, 11, 15, 20 and 23).

iii) Volunteer Three

She identified the mental concept for eleven icons (1, 2, 3, 4, 6, 7, 9, 10, 12, 16, and 17). She also recognised the physical form of one icon (19).

The rest of her responses indicate that:

- She neither recognised the physical form or the mental concept for ten icons (5,8,11,13,14,15,18,20,21 and 22).
- No response was given to one icon (23).

iv) Discussion of Algeria Results

This section discusses comments made by the volunteers during informal interviews after they completed their questionnaires:

All three of the volunteers experienced difficulty in making the association between the icons and the assigned SE mental concept. They felt that the icons were not very intuitive. Since these volunteers are from a rural environment, it appears in this case that the claim by Fordham (1995), that people living in rural environments do not find the concept of using an image to represent real-life objects intuitive (section 2.2.3), has been corroborated.

Another reason given for the poor identification of the mental concept was that there was not enough detail in the pictures for the volunteer's to make the identification. This also corroborates another of the limitations set forth by Fordham (1995), which states that images can only be interpreted if they depict

enough detail of the object being represented and are also as realistic as possible in terms of scale and recognisable features.

Furthermore, the volunteers mentioned that the details in some of the icons were misleading, ambiguous and caused them to misinterpret the image. For example, icon one had subdivision detail, which was meant to indicate that the house has a number of rooms. The volunteers mistook it to mean the windows of the house.

Another source of ambiguity is using the same icon to represent more than one SE variable. For example, icon seventeen was used twice to represent both a man and a boy (younger than eighteen) and this was confusing for Volunteer One.

Suggestions made by the volunteers for alternative icons were as follows:

- They suggested using a carrot for the garden mental concept.
- They also did not think the tap icon (7) was very intuitive.
- Finally, the volunteers voted unanimously in favour of using text to represent questions.

Another factor in icon identification is the ability of these volunteers to read and write. The researcher feels that this makes them more comfortable with the process of basic communication. A linear model, as explained in section 2.2.1, represents basic communication, where the path from information source to destination is a linear one, as depicted in Figure 2.1. This means that the volunteers will be unaccustomed to the semiotic communication process, which mainly concentrates on what it is that converts marks on paper or sounds in the air into a message. In this case, the volunteers had trouble converting the meaning represented by the icons into a SE variable.

The above feedback from the volunteers have led the researcher to conclude that this particular set of icons used in Algeria were not successful.

5.1.2 Imizamo Yethu Volunteers

This section discusses the volunteers' responses in Imizamo Yethu, which have been tabulated in Tables 5.2, 5.3 and 5.4 below. The responses are divided into three categories as was done in Algeria, namely:

- Recognition of the mental concept, i.e., correct responses.
- Recognition of physical form only.
- Other responses.






SE. ICON	MENTAL CONCEPT	RESPONSE VOLUNTEER A	RESPONSE VOLUNTEER B	RESPONSE VOLUNTEER C
1. 	House Number	House Number	Made of Wood	House Number
2. 	Type of building material (brick)	What kind of house	Made of Bricks	Brick House
3. 	Type of building material (wood)	No Response	Made of Blocks	Sheets House
4. 	Male or Female	Male or Female	Female or Male	Man and Woman
5. 	Position in household	Family Ages	Family	Family

Table 5.2 Responses from Imizamo Yethu Volunteers







6. 	Age	Date of Birth	Birthday party	Hat with candles
7. 	What is your name?	Are you the owner	No Children	Man
8. 	Identity Number	Identity Number	Barcode	Barcode ID
9. 	Are you employed	Your work	Are you working	Sign showing workers
10. 	Are you employed	No Response	No Response	Sign for a saw
11. 	Are you employed	No Response	Sign for spares	Signalling garage ahead

Table 5.2 Responses from Imizamo Yethu Volunteers (continued)

i) Volunteer A

This volunteer identified the mental concept for six icons (1, 2, 4, 6, 8 and 9).

She also only recognised the physical form of two icons (5 and 7).

No response was given to three icons (3, 10 and 11).

ii) Volunteer B

This volunteer identified the mental concept for four icons (2,3, 4 and 9).

He also identified the physical form for four icons (5, 6, 8 and 11).

The rest of his responses indicate that:

- He neither recognised the mental concept or the physical form of two icons (1, and 7).

- No response was given to icon number ten.

iii) Volunteer C

This volunteer identified the mental concept for four icons (1, 2, 3 and 8).

He also identified the physical form of six icons (4, 5, 7, 9, 10 and 11).

He was unable to recognise the mental concept or the physical form for icon number six.

iv) Volunteer D

This volunteer was able to identify the mental concept for four icons (1, 2, 4 and 5).

She identified the physical form of five icons (6, 7, 8, 9 and 10).

The rest of her responses indicate that:

- She neither recognised the mental concept or the physical forms of icon number three.
- She also responded that she had no idea what icon number eleven could mean.

v) Volunteer E

Volunteer E's response shows that she identified the mental concept for four icons (1, 2, 3 and 4).

She also identified the physical form of four icons (8, 9, 10 and 11).

She could not identify either the mental concept or the physical form of three icons (5, 6 and 7).


SE ICON	MENTAL CONCEPT	RESPONSE VOLUNTEER D	RESPONSE VOLUNTEER E	RESPONSE VOLUNTEER F
1. 	House Number	House Number	House Number	House Number
2. 	Type of building material (brick)	What is the house made of	Made of blocks	Blocks house
3. 	Type of building material (wood)	How many years	Planks House	Zinc House
4. 	Male or Female	Male or Female	Female / Male	Female / Male
5. 	Position in household	Are you the mother of house	Tourists	Family
6. 	Age	This is a cake	Road	Way
7. 	What is your name?	Asking if mother or father	Stop	No Response
8. 	Identity Number	This means of ID	Sign of barcode	Barcode
9. 	Are you employed	Road work	Road Work	Road Work
10. 	Are you employed	Saw	Saw	Saw
11. 	Are you employed	No Idea	Hammer and spanner	Hammer and spanner

Table 5.3 Responses from Imizamo Yethu Volunteers

vi) Volunteer F

This identified the mental concept for three icons (1, 2 and 4).

She also identified the physical form of six icons (3, 5, 8, 9, 10 and 11).

The rest of her responses indicate that:

- She could not identify the mental concept or the physical form of icon number six.
- She gave no response to icon number seven.










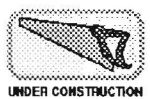

SE ICON	MENTAL CONCEPT	RESPONSE VOLUNTEER G	RESPONSE VOLUNTEER H
1. 	House Number	House Number	Number of House
2. 	Type building material (brick)	Made of wood	Next house post office
3. 	Type of building material (wood)	House in Mandela Park	Next is school
4. 	Male or Female	Your name	Male and Female
5. 	Position in household	Members of the house	Family
6. 	Age	Age	Birthday cake
7. 	What is your name?	Your Name	Man
8. 	Identity Number	ID Number	Barcode
9. 	Are you employed	Road sign	Work man
10. 	Are you employed	No Response	No Response
11. 	Are you employed	No Response	Yield Sign

Table 5.4 Responses from Imizamo Yethu Volunteers (continued)

vii) Volunteer G

He identified the mental concept for four icons (1, 6, 7 and 8).

He also identified the physical form of four icons (2, 3, 5 and 9).

The rest of his responses indicate that:

- He could not identify the mental concept or the physical form of icon number four.
- He gave no response to two icons (10 and 11).

viii) Volunteer H

In the case of this volunteer, she was only able to identify the mental concept for icon number one.

She identified the physical form of seven icons (2, 4, 5, 6, 7, 8, and 9).

The rest of her responses indicate that:

- She did not respond to icon number ten.
- She was unable to recognise either the mental concept or the physical form of two icons (3 and 11).

ix) Discussion of Imizamo Yethu Results

This section discusses comments made by the volunteers during informal interviews after they completed their questionnaires:

They felt that some of the icons were not intuitive at all and experienced difficulty recognising the mental concept. For example, Volunteer C said that some of the pictures were not easy to understand since he comes from a rural area. He further said that a cake with candles did not represent a birthday in his background; they have beer and a traditional meal instead. Suggestions for alternative icons were as follows:

- Volunteer C suggested that an image resembling a ceremonial jug would be more understandable to him.
- Other suggestions were that an image of a man pushing a lawnmower would be better for an employment icon.
- Volunteer D, suggested that a woman with a tray would be more intuitive to her for depicting employment.

Therefore, the comments made by these two volunteers indicate in this instance, culture, gender and place of origin (rural) does play a role in how people perceive and interpret images. However, these findings contradict the work of De Saussure, which stated that a mental concept is broadly common to all members of the same culture who share the same language (Fiske, 1990:44), because Volunteers C and D are both from the same cultural background and speak the same language. In their case gender seems to be causing the difference. Furthermore, Fordham (1995), which says that people living in rural environments do not find the concept of using an image to represent real-life objects intuitive (section 2.2.3), has been corroborated.

Volunteer H said that the main reason for her low rate of identification was that there was not enough detail in some images to make identification. This corroborates one of the limitations set forth by Fordham (1995), which states that images can only be interpreted if they depict enough detail of the object being represented and are also as realistic as possible in terms of scale and recognisable features.

Also, the details in some of the icons were misleading, ambiguous and led to misinterpretation. For example, Volunteer C said that the image of a shovel with a triangle was misleading, as he perceives it as a road sign. Another example is that of icon three, where the detail in the image was misinterpreted by the volunteers and caused them to incorrectly identify the icon as representing a zinc or sheet structure. The image was actually meant to represent a wood structure. This can be attributed to the fact that zinc or sheet structures are quite common in Imizamo Yethu.

In the researchers opinion the ability of the volunteers to read and write also contributed to their difficulty in identifying the SE icons. The same reasons as argued in section 5.1.1 (iv) apply.

Finally, the volunteers unanimously voted in favour of using text to represent questions.

The above feedback has led the researcher to conclude that this particular set of icons used in Imizamo Yethu were not successful because of the difficulty of selecting icons that would be intuitive to people of all cultures and gender.

x) Summary of Algeria and Imizamo Yethu Results

This section summarises the main differences and similarities between Algeria and Imizamo Yethu. The similarities are:

- All the volunteers felt that the SE icons were not intuitive.
- The Algeria volunteers and Volunteers Three and Four from Imizamo Yethu came from rural backgrounds. These volunteers displayed a particular difficulty with the icons.
- It was felt that the icons did not contain enough detail for identification.
- Some of the details in the icons led to confusion and misinterpretation.
- All the volunteers were able to read and write.
- Finally, all eleven of the volunteers voted unanimously for text instead of icons.
- The 32x32 pixel size, which is a technical limitation, affected the identification.
- Some of the results corroborate Fordham`s theories regarding the intuitiveness of icons to people from rural backgrounds.

The differences are:

- Algeria has a homogenous population and not Imizamo Yethu.
- Differing data requirements, therefore not all the SE icons were the same.

- Algeria is a rural settlement and Imizamo Yethu is urban.
- The Algeria study only used three volunteers all having the same gender.
- In Algeria icons were used for the field study and in Imizamo Yethu text was used in the interface.

In Chapter Six, this summary is used as a basis for drawing final conclusions and making recommendations for further study.

xi) Comparison between CyberTracker and the Present Study

Comparing the results of the present study with those of CyberTracker indicates the following:

Firstly, the Algeria and Imizamo Yethu volunteers focused on the details in the icon whereas the trackers concentrated on the overall shapes of the icons. This method of identification resulted in a high identification rate. Secondly, the Algeria and Imizamo Yethu volunteers had trouble identifying abstract concepts and found that the use of the same icon more than once to depict a similar concept misleading. This was not the case in CyberTracker. Finally, the only similarity was that the Algeria and Imizamo Yethu volunteers also learned to use the palm computer in a limited time period, and their usability tests were also successful.

5.2 Usability Study

This section discusses how the volunteers used the palm computer based on the usability criteria, explained in section 2.3.2. They are learnability, throughput, attitude and flexibility. As a reminder, learnability is the ease of learning and throughput is the ease of use. Attitude is the positive attitude that is created in the users by the system, and flexibility is the extent to which the system can accommodate changes to the tasks and environments beyond, those first specified (Preece *et al* 1994:401). Flexibility will be discussed in more detail in section 5.3 and will be focused on the data, which was collected.

5.2.1 Algeria

a) Learnability

The training was undertaken in a group as the researcher felt that this would create a more relaxed atmosphere. The instruction was one hour and forty-five minutes long, and included the icon identification and the palm computer training.

The screen types, operational buttons and operation of the palm computer were first demonstrated using paper mock-ups. During the demonstration, questions were asked freely and in some cases members of the group were able to assist each in understanding.

Once the basics of the operation were understood, each volunteer was given an opportunity to operate the palm computer and to input a set of test data. Mostly, the volunteers assisted each other if problems were experienced while using the palm computer to input the test data.

From observing the volunteers it is apparent that the palm computer in conjunction with the CyberTracker Software fulfils the learnability criteria because of:

- i) Speed and ease of learning;
- ii) The minimal amount of training that was required for the volunteers to use the equipment.

b) Throughput (ease of use) and Attitude

i) *Volunteer One*

This volunteer started using the palm computer to collect data seven hours after the actual training session. Because of this she was hesitant at first and unsure of her ability, and often asked the researcher for assistance. However, after visiting a few households, she became accustomed to using the palm computer again and was able to run through the screen sequence (figure 4.3) without difficulty.

The only problem experienced by this user was with using the Palm Pilot on-screen keyboard. The volunteer stated that her lack of familiarity with the layout of the keyboard and the size of it caused the difficulty.

Near the end of her data collection session this volunteer had overcome the keyboard problem and appeared to the researcher to be proficient in using the data collection system.

ii) Volunteer Two

This volunteer was able to use the palm computer and run through the data collection sequence with apparent ease from the start of her fieldwork session.

She stated that the only drawback was the size of the Palm Pilot on-screen keyboard.

However, as she continued the fieldwork she was able to overcome this difficulty and even taught herself to delete typing errors. This had not been demonstrated in the training session. Therefore, intuitive use of the palm computer occurred.

iii) Volunteer Three

This volunteer started using the palm computer to collect data four hours after the actual training session. Initially this volunteer asked the researcher for assistance, as she was apprehensive that she could not remember the functioning of the palm computer. However, as the fieldwork progressed the researcher observed that she knew how to operate the field computer and run through the data collection sequence.

She also stated that she was experiencing difficulties with the Palm Pilot on-screen keyboard because of its size.

Near the end of her fieldwork session she appeared more confident and no longer sought prompting from the researcher.

5.2.2 Imizamo Yethu

The eight volunteers were subdivided into four groups consisting of two volunteers per group. Group one consisted of volunteers A and B; group two consisted of volunteers C and D; group three consisted of volunteers E and F; and group four consisted of volunteers G and H.

This was done because there was limited time within which to do the fieldwork and there was only one Palm Pilot. It was also hoped that group work would make the atmosphere as relaxed as was experienced in Algeria.

a) Learnability

Each group was given a training session, which lasted approximately ninety minutes and included the icon identification and the palm computer training.

The screen types, operational buttons and operation of the palm computer was explained and demonstrated to each group using paper mock-ups. During these sessions the volunteers discussed the diagrams among themselves and assisted one another when problems arose. This was also very useful for those volunteers who needed additional explanation in Xhosa. During the explanation of the screen sequence they interrupted often with questions and appeared to understand the explanations.

Once the basics of the operation were understood each volunteer was given an opportunity to operate the palm computer and to input a set of test data. At this stage the researcher observed the partners in each group interacting with one another and the palm computer to try and determine for themselves how it operated.

From observing the groups during the training session the researcher can determine that the palm computer in conjunction with the CyberTracker Software fulfils the learnability criteria because of:

i) Speed and ease of learning;

ii) The minimal amount of training that was required for the volunteers to use the equipment.

b) Throughput

i) *Group One*

During the use of the palm computer the researcher made the following observations about this group:

Volunteers A and B experienced a problem using the keyboard screen several times and the operation had to be explained again.

They also experienced a technical problem with the palm computer, where the keyboard screen caused the current question to be obscured. This can be attributed to the size of the Palm Pilot screen and that text was being used instead of icons.

Volunteer A skipped a number of screens because she continuously pressed the next button and Volunteer B continuously scrolled out of the screen sequence.

ii) *Group Two*

Volunteer C continuously scrolled out of the sequence because he pressed the incorrect control buttons. He also could not remember when and how to use the OK and STOP buttons on the palm computer. Volunteer D also experienced several difficulties. She scrolled out of the sequence, had trouble with the operation of the keyboard, which had to be explained to her again and she also experienced the same problem as Volunteer A (Group One), where the keyboard screen caused the current question to be obscured.

iii) Group Three

The researcher observed the following problems experienced by Volunteer E: she could not remember how and when to use the STOP button. She also experienced the problem where the keyboard caused the current question to be obscured. This led to another problem, which was entering the data in the incorrect place. Furthermore, she accidentally pressed too hard on the next button, which caused her to skip a few screens.

Volunteer F in contrast to Volunteer E, scrolled through the sequence with very little mishap and only needed a reminder about the use of the OK button.

iv) Group Four

In the early stages of using the palm computer, Volunteer G needed a bit of prompting about the order of the screen sequence. However, after the first few interviews he no longer needed assistance and became quite proficient at using the palm computer. Volunteer H used the palm computer with ease and experienced no apparent difficulties, and even intuitively taught herself to delete typing errors with the backspace key.

5.2.3 Conclusions about observations

Generally, the volunteers experienced a variety of problems. These mainly involved the operation of the palm computer and the data collection sequence. There was also the problem with the keyboard screen covering the current questions.

This problem was not pertinent in Algeria because icons were used and not text. This is a limitation of the hardware and software that was revealed during the field- testing. A test to check whether this could be fixed was outside the scope of this particular study due to time limitations.

Informal discussions with the volunteers who had performed poorly during the

test survey said that it was because of nervousness, lack of confidence and the technical problems. They also felt that if the test survey had been longer, they would have had the opportunity to improve with practice. This would have improved throughput substantially.

5.2.4 Attitude (Algeria and Imizamo Yethu)

Generally the attitude of the volunteers was observed to be enthusiastic and their initial scepticism about their ability was mainly due to lack of experience. The Researcher feels that their ability to work in their own environment and in an informal testing setting made a large contribution to this positive attitude. There was not an instance where the researcher observed resistance to the technology even when problems, which were discussed in 5.2.3, were experienced. Rather the researcher observed perseverance, cheerfulness and a willingness to learn new things.

In the researchers opinion the volunteers positive attitude prevented them from quitting when they experienced setbacks such as technical problems and forgetting any operations.

The researcher has to conclude that the positive attitude displayed by the volunteers encouraged them to learn to use the data collection system effectively and therefore the throughput and attitude criteria are fulfilled.

5.3 Data Collected using Customised CyberTracker Software

This section describes and discusses the types of data, which were collected in Algeria and Imizamo Yethu using the customized CyberTracker Software.

1) Algeria

The screen assignments for this sequence were explained in section 4.2.1. However, the screen types and data formats are summarized below:

- Notes Screen (alphanumeric)
- Multiple selection screen (true/false - Boolean)
- Number screen (integer)
- Single selection screen (true/false – Boolean)

The complete Algeria dataset can be found in Appendix 2.

Data captured using the multiple selection screen (brick / wood) captures a true or false value. The same happens for marital status and employment status (single selection screens). Although these screens are visually pleasing, the Boolean data that it captures have several disadvantages:

- They are cumbersome in terms of data storage
- The format is not very useful
- Editing is required to convert Boolean values into a more useful format.

The data captured using the number screen (no of rooms and people) and the scrolling checklist screen (age) was applicable for the data collected. All other data collected using the Note screen were in a useful format. However, this screen requires the user to manually type in the entry, which introduces typing errors (see section 2.4.6).

The Imizamo Yethu screen sequence was very different to Algeria because insight gained regarding the performance of individual screen types was used selecting screens and the data requirements were different. Ten of the eleven screens were Note screens and the eleventh screen (age), was a scrolling number checklist screen.

2) Imizamo Yethu

The complete Imizamo Yethu dataset can be found in Appendix 2.

2.1) Socio Economic Data

All data was captured using Note screens except age, for which a scrolling checklist screen was used. This data set was in a more useful format but the use of Note screens does have several drawbacks:

- The format of the data is not uniform (upper and lower case mixed). This has to be predetermined.
- Data such as gender was captured in a mixed format: some using the first letter (m/f) and others writing male /female in full.
- The introductions of typing errors as discussed in section 2.4.6 were also a cause for concern.

2.2 GPS Data

This SE dataset also had an added feature of coordinate location since a GPS was linked to the Palm Pilot when the data was captured. These GPS points were incorporated into GIS software (Arcview) and a point file was generated and overlaid onto a geo-referenced and rectified aerial photograph of Hout Bay, as depicted in Figure 5.1.

The only drawback to this data is that Selective Availability, as explained in Chapter Three, was still active at the time of the field survey. Therefore, the error for this GPS data is between 50 and 100m. However, this is no longer a problem for future field surveys as, Selective Availability has been switched off by the United States DOD. Consequently, GPS data is now more accurate.

Each of these GPS points has attribute data associated with it and when used in the manner depicted in Figure 5.1, it becomes possible to determine the location of each dwelling with respect to the rest of the settlement & other infrastructure in

the area. Spatially referenced data also provides more options for display and analysis.

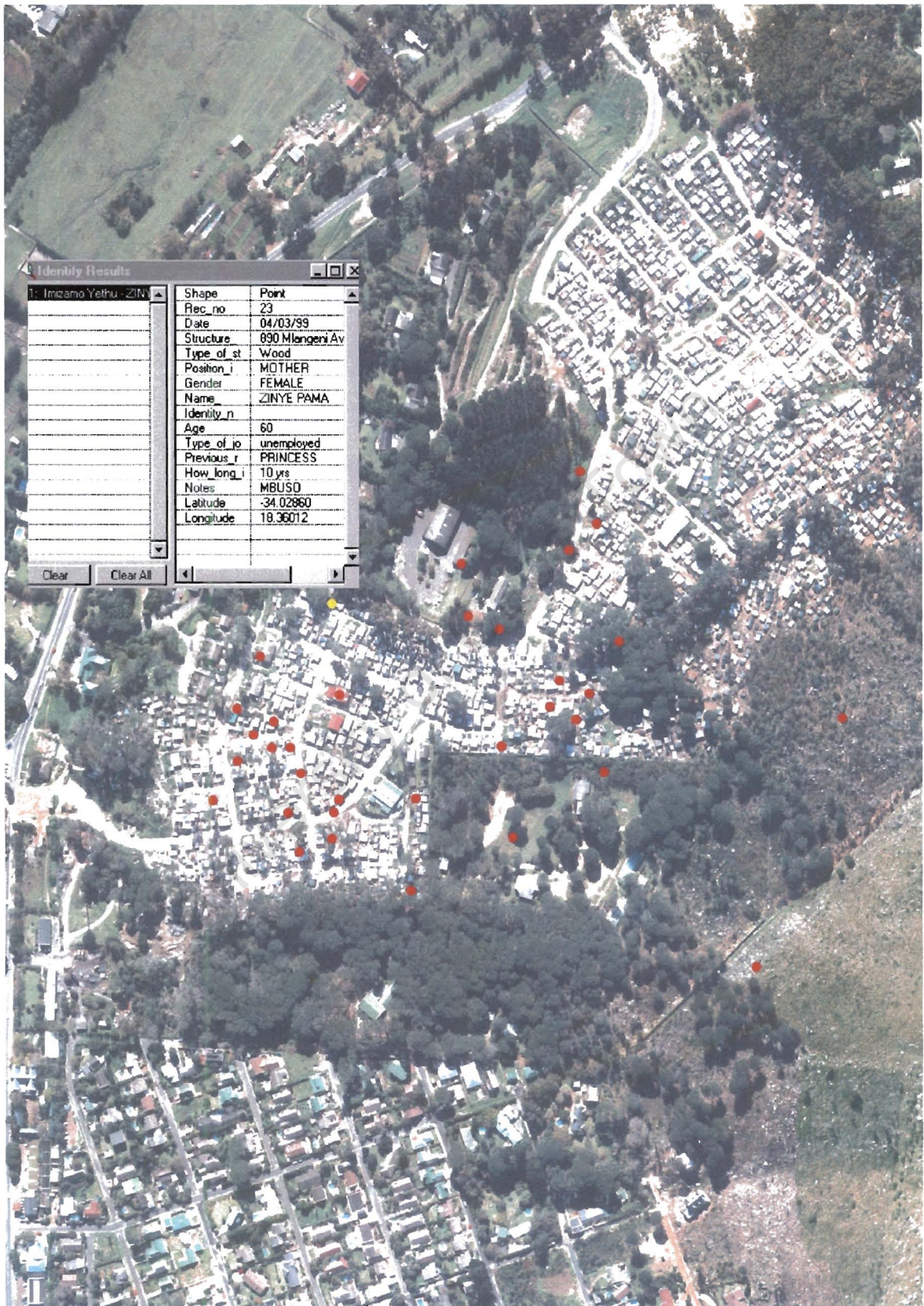


Figure 5.1 This is a georeferenced and rectified aerial photograph of Hout Bay. It depicts the GPS points (in red) that were captured using the CyberTracker data collection system in Imizamo Yethu.

5.4 Conclusions.

The preliminary conclusions discussed in this section are based on the data gathered in Algeria and Imizamo Yethu. They are as follows:

- The limitations of graphical images as described in Chapter Two, were factors in the low success rate of icon identification.
- People that belong to the same racial background, culture and speak the same language do not necessarily have the same mental concept. Two examples are:
 - The Mitchells Plain volunteers who were involved in the development stages of the icons have the same racial background as the Algeria Volunteers and yet the Algeria volunteers did not respond very well to the SE icons.
 - Volunteers C and D (Imizamo Yethu) are from the same culture and speak the same language but their gender contributed to them having different mental concepts. Therefore, people with similar backgrounds do not necessarily have the same mental concept. This does not support De Saussure's theory that people from the same background have the same mental concept, as explained in Chapter Two.
- People from rural environments have difficulty finding graphical images intuitive.
- Literate people have more trouble with semiotic communication as was demonstrated by the low success rate in identifying the mental concept. This is in contrast to illiterates, as in the case of the CyberTracker project, where the game trackers had experience due to their work in interpreting images such as spoor and other signs that animals leave behind. This project was summarised in Chapter Three.

From the above points the researcher concludes that for both Algeria and Imizamo Yethu the SE icons, which were designed were ineffective for communicating their mental concepts.

Furthermore, based on the field observations and the data collected the following can be concluded:

- It is possible for people with no computer experience to learn to use palm computers with limited training.
- Careful consideration should be given to the data required so that appropriate screens are used to capture data. This is supported by the data captured and which is depicted in Appendix 2.
- While the single selection and multiple selection screens are aesthetically pleasing they capture Boolean data, which does not make optimal use of disk space and the data is not in an immediately usable format. This can be seen in Appendix 2
- The format of manually entered data should be predetermined and strictly enforced to collect a homogeneous data set. If this not done then a mixed data set will be captured as in the case of Imizamo Yethu.
- Even though the use of the Notes screen solves some of the problems associated with the single selection and multiple selection screens, its main drawback is the introduction of typing errors.
- Linking a GPS to the Palm Pilot allows the data to be geo-referenced. This increases the value of the data and makes it possible to display and analyse the data in many more ways.
- CyberTracker software fulfils the flexibility criteria for usability because it is possible to customise the software to specific requirements as depicted by the two different data sets collected.

CHAPTER 6

ANALYSIS, FINAL CONCLUSIONS AND RECOMMENDATIONS

The aim of this chapter is two-fold. Firstly, the research method that was developed for this study will be evaluated and conclusions will be drawn about its effectiveness with respect to the results of the field tests, which were explained in Chapter Five. Secondly, the research questions posed in section 1.3 will be answered. These research questions are:

- 1) Do usability criteria from HCI theory assist in assessing the field observations made in terms of the operation of the palm computer by the volunteers?
- 2) Is semiotic theory useful for assessing the user responses to SE icons?
- 3) Is it feasible to use icons to represent SE variables?
- 4) Is the data that are collected using the adapted CyberTracker software suitable in the context of urban informal settlements and rural communities?

6.1 Analysis and Conclusions of the Experimental Design

The theoretical foundation for the research method developed in this study is multi-disciplinary and draws methods from Survey Research Methods, Semiotics and HCI.

The approach was to base the framework for the research method upon distinct research phases as described by Hoinville (1978) and Fowler (1984), and explained in section 1.2.1. These phases were then customised for this study as shown in section 4.2, and used to design the research instruments.

Semiotic theory contributed in several ways: Firstly, the literature provided information about the models of meaning of leading semiotics theorists Peirce and De Saussure. Criteria for analysing the volunteer responses to the SE icons were synthesised using De Saussure's model of meaning. Secondly, the limitations of

graphical images are described. Thirdly, it described the difference between semiotic and basic communication models.

HCI provided theory on the importance of usability, provided usability criteria, as well as, highlighting methods for testing usability. The interpretive evaluation method was specifically selected for testing usability in the field tests because it is an informal method, and recommended for use in the user environment.

From the above literature, the researcher was able to develop a research method, which has a framework based upon established Survey Research Method theory. Also, semiotic theory was used to analyse the responses to the SE icons and it was found that in the context of Algeria and Imizamo Yethu using icons to represent SE variables was not feasible for the following reasons:

- Most of the volunteers felt there was not enough detail in the icons for the volunteers to make identification.
- Details in a picture can be ambiguous and cause the volunteer to misinterpret the image. Examples of these were provided and discussed in sections 5.2.1 and 5.1.2.
- Another source of ambiguity was using the same icon to represent more than one SE variable (see sections 5.2.1 and 5.1.2.)
- The responses indicate that for the most part the volunteers did not find the icons intuitive.
- Overall, the volunteers displayed an inability to complete the semiotic communication process, as explained in section 2.2.1, which would have allowed them to make the association between the icon and its associated mental concept. The researcher feels that their ability to read and write meant that they were mostly familiar with the basic communication model as depicted in Figure 2.1. This is supported by the comparison made in Chapter Five, where it is shown that the illiterate game trackers had a different approach to identifying their icons than the volunteers used in this study. Of particular interest is that this study's volunteers found details in the icons misleading and the illiterate trackers rather focused on the overall shape of the icon.

- The use of a road sign as an icon appears to confuse the volunteers and leads to misinterpretation (see sections 5.2.1 and 5.1.2.)
- Feedback from Volunteers Three and Four have highlighted that culture, gender and place of origin (rural) plays a role in how people perceive and interpret images. However, the researcher also observed that the volunteers from similar backgrounds did not necessarily have the same mental concept as was posited by De Saussure in section 2.2.1(b).
- In addition the volunteers agreed unanimously in favour of using text to represent questions.

Based upon the above the researcher has to conclude that: Semiotic theory was useful for assessing the user responses to SE icons. Furthermore, it is not feasible to use icons to represent SE variables in the context of this study.

In the researchers opinion the interpretive evaluation (HCI) method provided a relaxed atmosphere for the volunteers and that this was reflected in their positive attitude during the field-testing even when problems were experienced. Usability criteria were used to assess the field observations and enabled the researcher to reach the following conclusions about the usability of the palm computer and data collection software:

- The volunteers from both studies needed a limited training period to learn the basic functioning of the palm computer and CyberTracker software. Thus, the learnability criteria of the tool were fulfilled.
- Even though six of the Imizamo Yethu volunteers experienced technical difficulties they were still able to successfully complete the task of collecting a sample of data with the data collection tool. Thus, the throughput criteria of the tool were still fulfilled.
- The general attitude of the volunteers towards the palm computer was positive and enthusiastic. The researcher never observed a negative attitude towards the technology when technical problems were experienced.

- The description of the two different data sets in section 5.3 shows that the CyberTracker software is flexible in that it allows the user to customise screen sequences as needed. However, this customisation is limited within programmed parameters.

Therefore, from the above it is concluded that usability criteria from HCI theory can assist in assessing the field observations made in terms of the operation of the palm computer by the volunteers.

This section aims to answer research question four: The data, which was collected in Algeria, while being relevant, was not in a very useful format. This was mainly due to the screen types used. This data required editing before it could be used.

Imizamo Yethu's data was in a more useful format than Algeria. However, since Notes screens were used for the majority of variables this increased the chances of introducing typing errors, which is a major source of error as explained in section 2.4.6.

Therefore, SE data can be collected in urban informal settlements and rural communities but the choice of screen type is an important factor in determining the quality and usability of the data.

The final conclusions for this study are two-fold: Firstly, from the above discussion it can be concluded that this research method proved effective for extracting a variety of data from the field tests, as well as, providing criteria with which to analyse the data and reach conclusions. Secondly, the Researcher concludes that because all the usability criteria of learnability, throughput, attitude and flexibility have been fulfilled, as shown by the results, that the use of the Palm Pilot and CyberTracker by communities in both informal and semi-formal communities to collect SE data is feasible.

However, there were a few drawbacks: A larger set of volunteers should have been used in the pre-testing phase when the preliminary icons were being selected. The use of more volunteers for icon design could have produced a better set of icons. More field-testing is required to further refine this data collection tool before it can be used in the context of informal settlement management. These provide the scope for further study, which is explained in the next section.

6.2 RECOMMENDATIONS

The researcher makes the following recommendations based on the findings of this study.

- 1) Although this study has shown that users prefer text to icons, if a set of SE icons is to be developed, the researcher suggests that symbols, which are well known by the community be used. That these symbols be tested in a 32x32 pixel format to determine if there is enough detail for recognition. Also, avoid detail in a picture that could cause confusion.
- 2) Detailed investigations into the effect of culture, gender and background, as well as human perception is needed with the focus on communities. The main motivation for this is that informal settlements are a mix between rural, urban, educated and not, and also having different cultures.
- 3) Since informal settlement communities are not homogenous it is not always possible to predict that people from the same communities will share the same mental concept, so it is recommended that associations between assigned mental concepts and icons must be taught. However, it is further recommended that tests in homogenous communities also be done to determine whether they do have the same mental concept.
- 4) The findings of this study indicate that with judicious planning of the screen types and sequences the software allows the collection of useful data.

However, for an understanding of the amount of error that the users of the palm computer introduce into the data, larger samples should be tested. Also, this study did not include processes for quality control. Therefore, it is recommended that quality control procedures be investigated for this system.

- 5) Further field studies should be conducted in informal settlements with a larger set of volunteers and SE variables.
- 6) Further testing should be conducted to determine whether any of the technical limitations like the 32x32 pixel size or text over-running the screen when there are long questions, could be fixed.
- 7) Other applications for this system should be investigated, e.g. land allocation distribution.

The researcher found that the use of icons do not necessarily simplify the collection of information. The palm computer with the text interface was however readily accepted and used with confidence by the volunteers. The data collected was also easy to download and insert into planning software. The researcher thus concludes that the palm computer provides a useful tool for collection of data in informal settlement communities by community members. Also, this data collection system has the capacity collect data that is up-to-date, which is indispensable for management and planning in informal settlements.

REFERENCES

Babbie, Earl R. (1973). *Survey Research Methods.* Wadsworth Publications, Belmont, California.

Barry M 1999. *Evaluating Cadastral Systems in Periods of Uncertainty: A Study of Cape Town's Xhosa-speaking communities,* PhD thesis, University of Natal, Durban.

Bennett, J (1984). *Managing to meet usability requirements. In Visual Display Terminals: Usability Issues and Health Concerns.* Englewood Cliffs, NJ: Prentice-Hall.

Chandler (1994). *Semiotics of Beginners.* www.aber.ac.uk/~dgc/semiot.html

Oelofse, C. (1994). *The Surrounding Community's Perceptions of the Development of an Informal Settlement in Area A Case Study of Hout Bay.* MA Thesis, University of Cape Town.

Dix, A, Finlay, J, Abowd, G, Beale, R (1993). *Human-Computer Interaction.* Prentice Hall International (UK) Limited.

Edge, Steventon and Foster (1996). *Field Computers for Animal Trackers,* Honours Project Thesis. University of Cape Town.

Fiske (1990). *Media Matters: Everyday Culture and Political Change.* University of Minnesota Press, Minneapolis, Minnesota.

Fordham, P, Holland, D, and Millican, J, (1995). *Adult Literacy: A Handbook for Development Workers.* Oxfam Publishing Company.

Fowler, Floyd J. (1984). *Survey Research Methods.* **Sage Publications. Beverley Hills, California.**

Hoinville. G, Jowell.R, and Associates (1978). *Survey Research Practice.* **Heinemann Educational Books. London.**

Hugo (1998). www.usabilitysa.co.za

Mason, S (1997). *Low Cost Information Technology Options for Tackling South Africa's Housing Problems.* **Submitted to IMIESA.**

Mason, S. and Rüter, H. (1997). *Managing Informal Settlements Spatially, Proceedings ASPRS Annual Conference, Seattle.*

Miriam-Webster Dictionary. www.brittanica.com

Nöth, Winfried (1990). *Handbook of Semiotics.* **Indiana University Press.**

Preece, J (1994). *Human Computer Interaction.* **Addison-Wesley: Wokingham, England.**

Shackel, B (1990). *Human factors and usability. In Human-Computer Interaction: Selected Readings.* **Hemel Hempstead: Prentice-Hall.**

Sless, David (1986). *In Search of Semiotics.* **Croom Helm, London and Sydney.**

Republic of South Africa 1996. *Communal Property Associations Act 28/1996.*

APPENDIX 1

This appendix contains the Palm Pilot screen mock-ups, which were used during the fieldwork to train the volunteers (refer to section 4.3).

NUMBER SCREEN

PALM PILOT

3COM

QUESTION?				
1	2	3	4	5
6	7	8	9	10
11	12	14	15	16
17	18	19	20	21
22	23	24	25	26

Abc 123

Stop/
Off

Stop

←

↓

↑

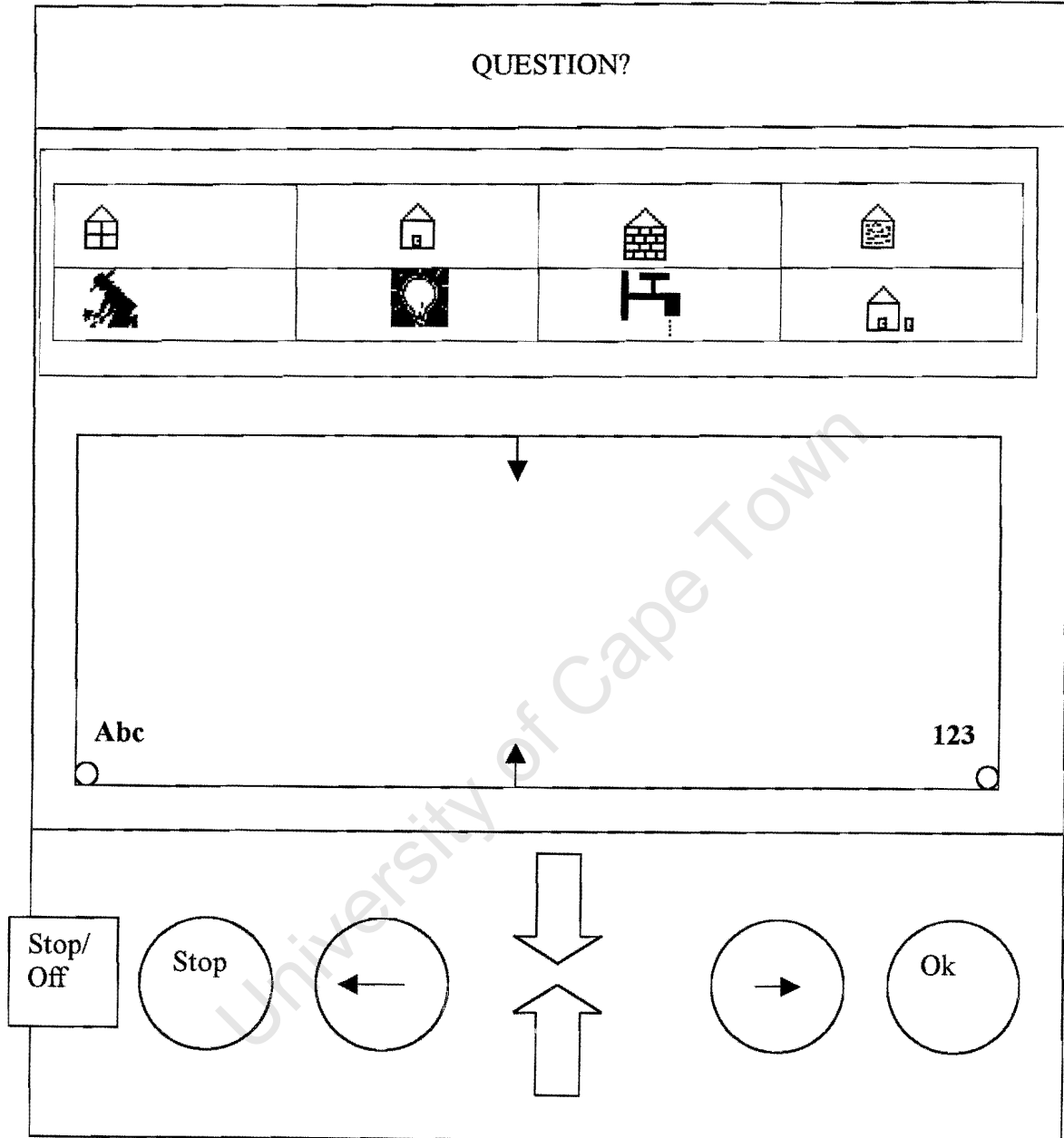
→

Ok

MULTIPLE SELECTION SCREEN

PALM PILOT

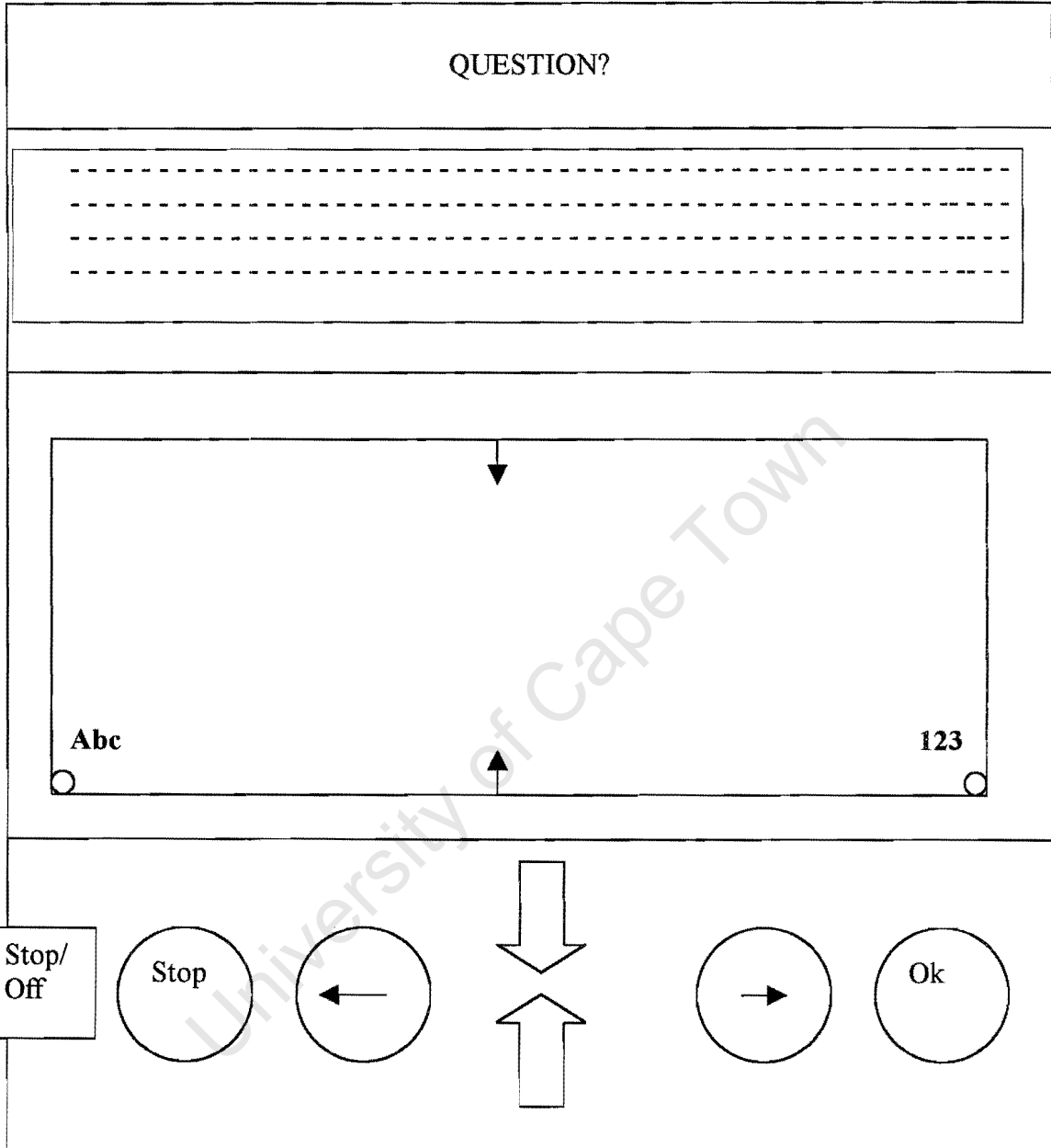
3COM



NOTE SCREEN

PALM PILOT

3COM



SCROLLING NUMBER CHECKLIST SCREEN

PALM PILOT

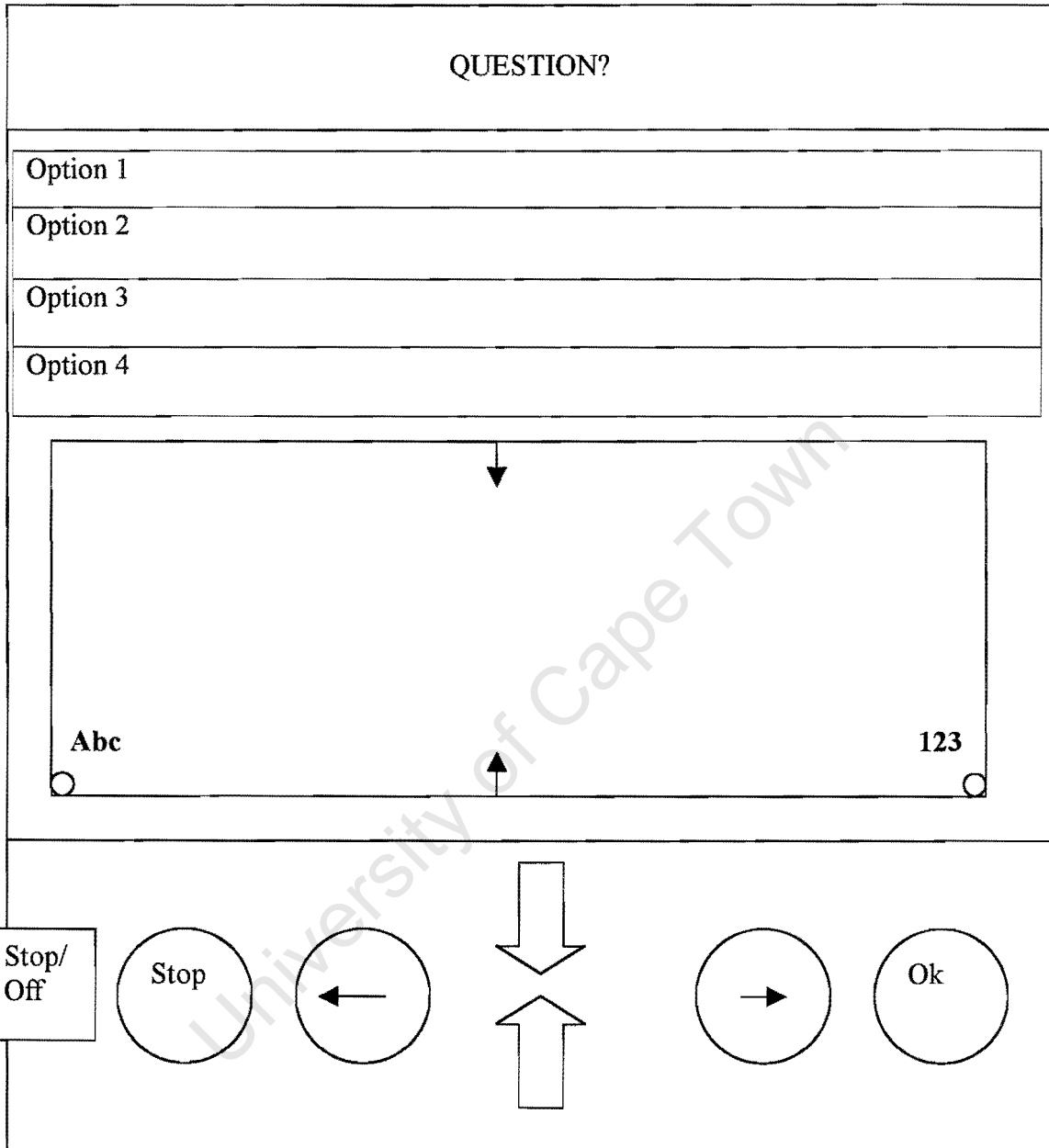
3COM

QUESTION?		
Age	○ ⁺	○ ⁺
	-	-
↓		
Abc		123
○	↑	○
Stop/Off	○ Stop	○ ←
	↓	○ →
	↑	○ Ok

SINGLE SELECTION SCREEN

PALM PILOT

3COM



APPENDIX 2

This appendix contains data that was collected in Algeria and Imizamo Yethu (refer to section 5.3).

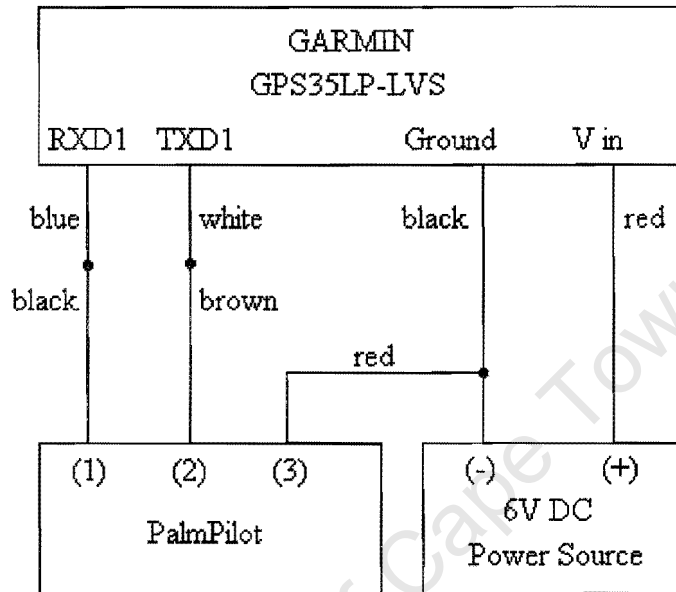
University of Cape Town

HOUSENO	BRICK	WOOD	OUTBUILD	ELECTRIC	GARDEN	WATER	NOPEOPLE	NOROOMS	ADULTMALE	AD FEMALE	FEMALE18	MALES18	NAME	IDNUMBER	AGE	SINGLE	MARRIED	WIDOW	WIDOWER	DIVORCED	F TIME	P TIME	UNEMPLOYED	RETIRED	
2758	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	2	1	2	1	terens burrows	6509275222	32	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	
2758	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	2	1	2	1	james burrows	2208295055	75	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
2758	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	2	1	2	1	della burrows	6805090154	30	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
2758	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	2	1	2	1	darryl botha		12	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2758	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	2	1	2	1	stephanie burrows		8	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2758	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	2	1	2	1	shannon burrows		3	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	johannes zimri	2809295166	71	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	jurie zimri	5403135150	44	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	ricardo zimri	7710225171	20	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	christina zimri	3205090073	66	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	catharina zimri	5206250006	46	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	beverley zimri	7804050259	22	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	rene zimri		17	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	nazley zimri		13	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2753	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	9	6	3	3	3	0	rencia zimri		1	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
6958	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	7	5	1	2	2	2	dawid ockhuis	6202075133	36	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
6958	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	7	5	1	2	2	2	johanna ockhuis	6208300128	36	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
6958	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	7	5	1	2	2	2	maria simson		20	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
6958	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	7	5	1	2	2	2	frederik simson		16	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
6958	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	7	5	1	2	2	2	gert simson		13	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
6958	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	7	5	1	2	2	2	shane' ockhuis		8	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
6958	FALSE	FALSE	TRUE	TRUE	FALSE	TRUE	7	5	1	2	2	2	deolene ockhuis		4	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	4	6	1	1	1	1	jakobus jantjies	6212055281	35	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	4	6	1	1	1	1	muriel jantjies	6602030164	33	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	4	6	1	1	1	1	clarke jantjies		6	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	4	6	1	1	1	1	wynoma ramson		11	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2760	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	5	6	3	1	0	1	jan koopman	4711015074	50	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
2760	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	5	6	3	1	0	1	randall koopman	8901275085	18	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
2760	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	5	6	3	1	0	1	russell ockhuis	7710275138	20	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
2760	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	5	6	3	1	0	1	johanna koopman	5809050222	42	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
2760	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	5	6	3	1	0	1	morne koopman		15	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
7129	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	5	6	2	2	0	1	johannes tamboer	5302175199	45	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
7129	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	5	6	2	2	0	1	johannes tamboer	7908125196	19	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
7129	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	5	6	2	2	0	1	magrieta tamboer	4701140131	51	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
7129	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	5	6	2	2	0	1	fransiena september	4711140176	20	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
7129	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	5	6	2	2	0	1	hendrik tamboer		12	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2759	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	4	1	0	1	petrus hanekom	4006225027	58	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
2759	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	4	1	0	1	nicolaas hanekom	7010135166	28	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
2759	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	4	1	0	1	jakob hanekom	7209275052	25	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
2759	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	4	1	0	1	petrus hanekom jr	7710275017	20	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
2759	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	4	1	0	1	eva hanekom	5003050026	48	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2759	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	6	6	4	1	0	1	james hanekom		16	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	3	6	1	1	0	1	jakob van rooi	7104015125	27	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	3	6	1	1	0	1	geraldine van rooi	7210080226	25	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
na	TRUE	FALSE	TRUE	TRUE	FALSE	TRUE	3	6	1	1	0	1	jerome van rooi		4	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
6976	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	4	5	2	1	1	0	mario koopman	7504245173	23	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
6976	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	4	5	2	1	1	0	frederik koopman	4101165040	57	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
6976	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	4	5	2	1	1	0	maria koopman	5007240114	48	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
6976	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	4	5	2	1	1	0	linette koopman		15	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
2756	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	5	6	2	2	0	1	gert kotze	4712165070	50	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
2756	FALSE	TRUE	TRUE	TRUE	FALSE	TRUE	5	6	2	2	0	1	christopher kotze	7605305051	22	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE

Rec No	Date	Structure No	Type of Structure	Position in House	Gender	Name	Identity Number	Age	Type of Job	Previous Residence	How long in iyethu	NOTES	LATITUDE	LONGITUDE
1	04/03/99	178 Tambo Road	wood	father	m	Mbuso Bovi	789965586	19	unemployed	East London	3 months		-34.03010	18.36017
2	04/03/99	178 Tambo Road	wood	mother	f	Andiswa	740828095	21	cashier	Khavelitsha	4 yrs		-34.03010	18.35900
3	04/03/99	7181 kotane street	Bricks	male		Mbuso Bovi	800505194083	19	cashier	East London	3 months		-34.02990	18.35982
4	04/03/99	7181 kotane street	Bricks	mother	female		740828092805	26	Housekeeper	Mowbray	25 yrs		-34.03040	18.36010
5	04/03/99	7181 kotane street	Bricks									test	-34.03020	18.36012
6	04/03/99	944 MANDELA RD	Wood	Father	Male	NYANISO DYASI	N/A	30	Drive	FAST LONDON	7yrs		-34.29900	18.35982
7	04/03/99	943 MANDELA RD	wood	mother	female	NOBESUTHU MKOSI	7909067917080	20	STUDENT	CONSTATIA	4 months		-34.29500	18.36015
8	04/03/99	959 Goniwe	Wood	Father	Male	KHAYA NONGAWUZA	N/A	24	unemployed	Khavelitsha	4yrs		-34.02970	18.35955
9	04/03/99	7185 Goniwe	mother	Wood	Female	Mzomba Nobongo	8008060832087	33	Housewife	Paarl	9 yrs		-34.02940	18.35923
10	04/03/99	957 Goniwe	Zinc	mother	female	Gloria Makeleni	7109091039083	27	Sheff baker	Uitenhage	3yrs		-34.02980	18.35938
11	04/03/99	956 Goniwe	Zinc	Mother	Female	Nogahle Covi	6701101099080	32	Unemployed	Princess st	9 yrs		-34.02970	18.35972
12	04/03/99	X188 Ajax	Wood	Mother	Female	Lulama Nguma	5701135001500	42	Unemployed	Site B	2 yrs		-34.03050	18.35980
13	04/03/99	8669 Ajax	Wood	Mother	Female	Noloviso Mbiko	N/A	22	Unemployed	Willovale	4 yrs		-34.03080	18.36063
14	04/03/99	722 February	Wood	Father	Male	Nick Agostinho	7403235088084	24	Soani Bakery	Vryburg	4 moths		-34.03020	18.35970
15	04/03/99	605 Molefe	Wood	Mother	Female	Thabisa Class	N/A	28	Unemployed	Noodgedagt	8 yrs		-34.03010	18.36088
16	04/03/99	579 Molefe	Wood	Mother	female	Nongayithini Hans	488095835084	51	Unemployed	Sada	10 yrs		-34.03040	18.36178
17	04/03/99	559 Jaynard	Zinc	Niece	Female	Philliswa Makhoniwa	N/A	23	Unemployed	Jduitywa	1 yr		-34.02970	18.36168
18	04/03/99	H246	Zinc	mother	female	Bukelwa Nkosini	6409230646082	35	Gilquin Crescent	Whittlesea	3yrs		-34.02950	18.36237
19	04/03/99	h189 Molokwane Street	wood	Mother	female	Bonolwe Melane	N/A	26	Pizza Maker	Calatranskel	5yrs		-34.02990	18.36283
20	04/03/99	7375 MOL EKWANE STREET	Zinc	Father	Male	SITHEMBELE MTHULU	7603145922088	23	SECURITY	WILLOW VALLE	3yrs		-34.02930	18.36250
21	04/03/99	7384 MOL EKWANE STREET	WOOD	MOTHER	FEMALE	ANDISWA NOAYI	N/A	21	UNEMPLOYED	TUKKERSTAD	4yrs		-34.03140	18.36403
22	04/03/99	7333 TAMBO ROAD	WOOD	MOTHER	MALE	NO KWAKHA SOTHYANTYA	N/A	39	cocker	PRINCESS	10 yrs		-34.02880	18.36187
23	04/03/99	860 Mlangeni Ave	Wood	MOTHER	FEMALE	ZINYE PAMA	N/A	60	unemployed	PRINCESS	10 yrs		-34.02880	18.36012
24	04/03/99	7193 CRISS HANI	zinc	SON	male	SANDI SOBEKWA	7502026355089	24	CASHIER	PRINCESS	10 yrs		-34.02930	18.36018
25	04/03/99	X185 CRISS HANI	WOOD	MOTHER	FEMALE	CYNTHIA TANYA	7309260627086	28	CSHIER	BELLA	1yr 6months		-34.02890	18.35945
27	03/03/99	7789 tambo road	brick	mother	F	Zoleka Sibara	7802220719082	20	Unemployed	tarkastad	3 yrs	Test	-34.02890	18.36007
28	03/03/99	7378 tambo road	brick	mother	F	Thandeka Nogqwazi	7404180571086	24	Unemployed	Whittlesea	2 years	Test	-34.02890	18.36017
29	03/03/99	7378 tambo road	Zinc	mother	F	Thandeka Nogqwazi	7404180571086	24	Garden worker	Whittlesea	5 years	test	-34.02890	18.35923
30	03/03/99	7378 tambo road	Zinc	mother	F	Thandeka Nogqwazi	7404180571086	24	Garden worker	Whittlesea	5 years	test	-34.02950	18.35957
31	03/03/99	7378 Tambo Road	Zinc	I									-34.02830	18.36132
32	03/03/99		509 Blocks	Father	Male	Themba Gideon Mana	5103185311088	48	Caretaker	Suikerbos	9 years		-34.02920	18.36222
33	03/03/99	508 Tambo Road	Planks	Mother	f	Cynthia Nogqwazi	5112180444087	48	Domestic Worker	Whittlesea	13 Years		-34.28600	18.36147
34	03/03/99	508 Tambo Road			planks	Mother	F	48	Domestic Worker	Whittlesea	13 years		-34.02940	18.36213
35	03/03/99	508 Tambo Road	Planks	father	M	Te David Mbele	60 N/A	60	N/A	Durban	14 years		-34.02870	18.36138
36	03/03/99	403mkonto	planks	mother	f	Nokumula Nguvu	7104140715189	28	Domestic Worker	Harare	8 years		-34.02950	18.36485
37	03/03/99	402Mkonto											-34.02720	18.35918
38	03/03/99	402 Mkhonto Str	Planks	father	m	Lwandile Mangala	6805065113081	31	N/A	Transkel	6yrs	Zoleka	-34.02890	18.36278
39	03/03/99	359 Ngovi Str	planks	Father	m	Eric Petelo	75009088021089	24	N/A	Tarkastad	1 yr 3 mths		-34.02760	18.36243
40	03/03/99	359 Ngovi Str	Planks	father	M	Theminkosi Mcinzba	7412155319080	25	N/A	tarkastad	1 yr	zoleka	-34.02800	18.36258
41	03/03/99	432 Mnkwane str	Ceiling board	Father	M	Lucky Mzelemu	6812256021982	30	Seaman	Durban	6yrs	Zoleka	-34.02820	18.36232

APPENDIX 3

PalmPilot-Garmin GPS35-LVS Integration



PalmPilot HotSync cable

- (1) pin 2 = connection 6 = black
- (2) pin 3 = connection 8 = brown
- (3) pin 5 = connection 1 = red

