Towards a Persuasive Technology for Electricity Theft Reduction in Uganda

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Abstract. Technology for changing attitude and behaviour, known as persuasive technology, has been applied to solve many challenges, ranging from personal health and finance, to environmental sustainability. In this paper, an application to persuade electricity consumers in Kampala, Uganda, to partner with the electricity utility company in fighting electricity theft is proposed. The persuasive application will implement a number of persuasive techniques including tailoring, reduction, notifications and suggestion. These techniques, along with the choice of technology, were derived basing on Fogg's process of persuasive systems development.

Keywords: Persuasive technology · Electricity theft · Non-technical losses
Fogg's eight steps

1 Introduction

Electricity theft is a complex socio-economic technical problem in Uganda leading to loss of lives, property and at least $10 million in financial losses annually [1]. In attempts to curb this crime, the electricity utility company has implemented deterrent measures like prepaid metering, aerial bundle conductors and automatic metering. In addition, for sustainable results [2], honest consumers are encouraged to actively participate in fighting this vice through mass media campaigns.

However a study to understand electricity theft among consumers in Kampala [3] revealed that, (i) despite a recently concluded mass media campaign and the risk of possible fines or imprisonment, people are still not willing to engage in electricity theft reduction efforts; and (ii) people are not aware (and/or perhaps do not care) that electricity theft negatively affects even honest consumers. We argue that persuasive technologies may be better at convincing consumers to fight against electricity theft.

Persuasive systems are interactive computing systems designed to change people's attitudes or behavior [4]. Behaviour change support systems (BCSS), a class of persuasive technologies, are defined as "socio-technical information systems with psychological and behavioural outcomes designed to form, alter or reinforce attitudes and behaviours without using coercion or deception" [5]. Persuasive technologies have been used in a number of sectors including energy [6], health [7], aviation safety [8], and to shape social beliefs among rural Indian women [9]. Depending on the

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technology used, persuasive technologies are better than public campaigns for achieving attitude and behavior change because they can be tailored [7], are ubiquitous, offer anonymity [10] and make it possible to have feedback.

Persuasive design frameworks include Fogg's eight steps [11], Persuasive system design (PSD) [12], unified-framework for analysing, designing and evaluating persuasion systems (U-FADE) [13]. Each has strengths and weaknesses. We selected Fogg's eight step process as we deemed it most suited for our challenge. In this paper we discuss how we adapted Fogg's process to design a persuasive technology for increased willingness to fight electricity theft.

The rest of this paper is organized as follows: we offer a brief discussion of persuasive techniques in Sect. 2, and persuasive design frameworks and why we adapted Fogg's design steps in Sect. 3. In Sect. 4 we discuss how the adapted framework was used to develop a persuasive mobile application. We discuss and conclude in Sects. 5 and 6 respectively.

2 Persuasive Techniques

Fogg [4] proposed a functional triad that shows three perspectives of how computers can be used; as tools, media and social actors of persuasion. Computers can act as tools of persuasion through; *reduction*-making a certain task easier to do; *tunneling*-guiding a user through information*; tailoring*-providing user appropriate information; *self-monitoring*-allowing users to monitor themselves and providing real time feedback; *surveillance*-monitoring others in order to modify their behaviour; and *conditioning*-use of operant conditioning to change behaviour. Torning and Oinas-Kukkonen [12] proposed additional techniques which they classified into four persuasion dimensions; primary task support, dialogue support, social support and system credibility support.

3 Design of Persuasion Technologies

There are basically three frameworks for designing persuasion technologies; Fogg's eight step process [11], persuasive systems design (PSD) [12] and U-FADE [13].

3.1 Fogg's Eight Steps

Fogg's eight step process, shown in Fig. 1:A [11] begins by selecting an appropriate behaviour to target for change. The second step is to select an appropriate audience for the technology. Thirdly the team should find out why people are not performing the target behaviour. Reasons may be a lack of motivation, ability, or a trigger for behaviour or any combination of the three reasons. The team should then select the technology to use that favours both the audience and target behaviour. It will make it easier for the audience to adapt the technology. Steps 5 and 6 are identifying successful projects and imitating them. He then proposes that the team tests and iterates quickly (step 7). If the project is successful then it can be expanded (step 8).

3.2 Persuasive System Design (PSD)

Oinas-Kukkonen and Harjumaa [12] defined a generic 3 step process for Persuasive system design. The first step is to analyse the persuasion context and select persuasive design principles, secondly to define the requirements and lastly to implement the software. Persuasion context is made up of the intent, the event and the strategy. The intent includes the persuader and the deliberate target behaviour that the system is to cause in the user [12]. The event contains the use, user, and technology sub-contexts. The use sub-context refers to the problem domain-dependent features in the form of well-known problems in the domain; user sub-context includes traits of the application user, and technology sub-context refers to the features of the technological platform. Lastly strategy includes the message and the route/form. While message refers to content, route is the form in which the content selected is delivered for intended transformation [12].

3.3 Unified-Framework for Analysing, Designing and Evaluating Persuasion Systems

Wiafe [13] proposed the unified-framework for analysing and designing and evaluating (U-FADE) persuasion technologies. Building on PSD, it starts with event analysis that is made up of user and use analysis. User analysis evaluates the users level of cognitive dissonance [14] using the 3-dimensional relationship between attitude and behaviour (3D-RAB) model and use analysis is done basing on the persuasive technologies organisation (PTO) model. Then persuasion strategies are selected using the persuasive pathway model (PPM). These strategies are summarized in transitions description cards (TDC). After development, the system is evaluated basing on the 3D-RAB model.

3.4 Selecting the Persuasive Design Method

Persuasive technology development, like any typical software, follows software engineering practices, with the water fall model as a guide. However persuasive design is about achieving one requirement-system persuasiveness [12]. Thus the presented design methods can also be seen as a software engineering process that mainly elaborates requirements engineering, with some aspects of design and development. For example, PSD is mainly requirements engineering, while UFADE is both requirements engineering and usability testing. Fogg's eight steps, however, cover all software engineering stages.

Secondly, PSD and U-FADE are suitable for developing behaviour change support systems. Therefore they focus on understanding the user and use case, and proposing persuasive features based on individual users. This study targets changing attitude and behaviour of a society rather than an individual. We need a method with a broader focus than both PSD and U-FADE. Fogg's eight steps fit this criterion. Thirdly, Fogg's process is open (beginning with a selection of target behaviour and audience) and closely follows a typical software engineering water fall model with iterations within design, development and testing. Indeed Yamakami [15] described it as a "good guidance not only for creating persuasion, but also for introducing innovation". For

these reasons, we based our persuasive technology on Fogg's process. It has been used by Da Silva *et al.* [16] to design a role playing game for stretching, while Pereira *et al.* [17] used it to develop a mobile application to change eating habits.

4 Adaptation of Fogg's Eight Steps

We designed a persuasive system to improve attitudes towards electricity theft reduction by adapting Foggs's eight steps as shown in Fig. 1:B.

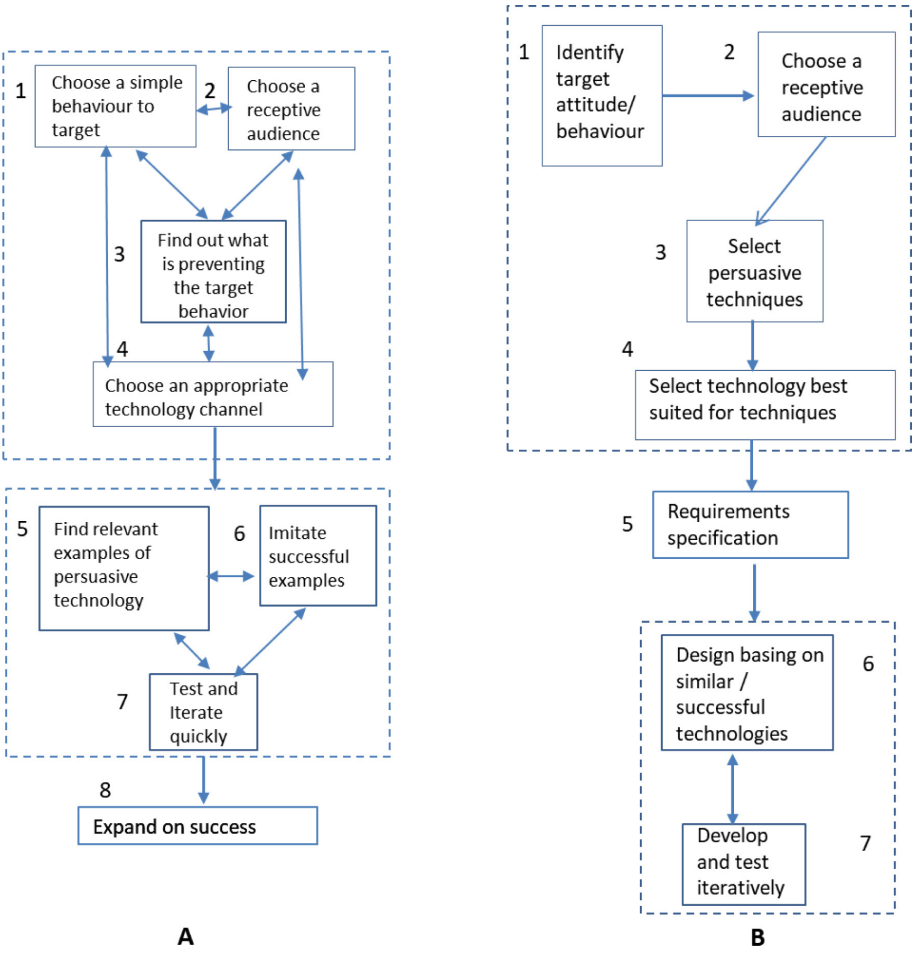

Fig. 1. A: Fogg's eight steps for design of the system [11], B: Our adaption of Fogg's process.

4.1 Step 1: Identify Target Behaviour/Attitude

We modified this from choosing a behaviour to identification of behavior/attitude. In reducing electricity theft, there are a number of behaviours and attitudes to change. There are; attitudes and behaviours associated with the actual event of using electricity illegally (basically attitudes and behaviours of the culprits), and the attitudes and behaviours of those that do not use electricity illegally but in one way or another encourage those engaging in the crime [2]. We decided to focus on the latter. This is because culprits were not easy to identify and they would not be a willing audience to engage.

Since the earlier mentioned study (in introduction) revealed that people are not willing to engage in electricity theft reduction [3], we focused on changing the attitude that "*electricity theft is not my problem*", to "*electricity theft is my problem. let me deal with it*". Hopefully if that attitude is changed then individuals would engage in electricity theft reduction efforts.

4.2 Step 2: Choose Audience

This step remained unchanged. It is very crucial in developing this application because the general population is very heterogeneous; a mixture of illiterate, semiliterate and highly literate. Their technology skills levels, as well as attitude to electricity theft, vary. We design an application for the educated population that is technology savvy and uses the various technologies, including smart mobile phones.

4.3 Step 3: Selecting Persuasion Techniques

We reasoned that the basis for Fogg's third step, "understand why people are not performing the desired behaviour" is to select persuasive techniques, thus our third step. Part of the earlier mentioned survey (refer to Sect. 1), respondents were asked: "What would you do if you found your neighbour stealing electricity?" [3]. Responses of those who said they would not take any action to reduce electricity theft were classified under the following themes:

- Individualism: People do not want to be bothered.
- Utility: They feel it is the utility's job to fight electricity theft.
- Financial sympathy: These said they would do nothing because they appreciated the other person's economic struggles.
- Safety first: These are respondents who said that as long as the illegal electricity was being used in a way that did not endanger anyone then there was no need to bother.
- Ignorance: These are people who did not know where to report, or what to do, or the reward for reporting.
- Relationship: These valued their relationship with those around so they did not want to make enemies.
- Self-preservation: These felt that if they reported others, they too would be reported.
- No reward: These felt there was no benefit from reducing electricity theft.
- Hopeless: These felt it was useless to take any action.

We match these reasons to appropriate persuasion techniques basing on PSD [18] as shown in Table 1 below:

Table 1. Appropriate persuasive techniques

Reason	Corresponding technique	PSD dimension
Individualism, safety first, financial empathy	Tailoring of information- through localisation and visualisation	Primary task support
Relationship, self-preservation, hopeless	Notification	Dialogue support, social support
Ignorance	Reduction	Primary task support
No reward, utility	Rewards	Dialogue support
Ignorance	Suggestion	Dialogue support
Hopeless	Praise	Dialogue support

Tailoring

Information about the economic impact of electricity theft is normally provided in Newspaper publications and television media as the total non-technical losses (NTLs) and financial loss incurred by the company. This information can be localized, such that electricity users in the same area are periodically provided with figures of NTLs within their area. In this way it would appeal to the consumers.

Additionally information of deaths, fires, and other electricity theft related accidents is reported once in a while in newspapers and eventually forgotten. This information can be represented on a map, showing the locality of user.

Lastly, through mass media campaigns, electricity consumers are informed that they bear the financial burden of for electricity theft through the tariff. However this information is not clearly quantified and presented to consumers. Data visualization can be used to communicate the economic burden of electricity theft to consumers.

Notification

Consumers ought to receive a notification whenever someone in their neighborhood participates in fighting electricity theft. This would increase willingness to participate since according to the social proof theory, "individuals are more likely to engage in behaviours which they perceive others are also engage in" [19].

Reduction

People normally report electricity theft by calling on a toll free line and they are asked for details. The process could be made simpler by providing a template or form on a website or mobile application. This template would guide a person reporting on what information to provide, as well, as provide an option for uploading a picture of the case so that one does not have to input a lot of information.

Suggestion

Suggestion should be used to remind people to report electricity theft. This could be done when electricity theft in an area increases or when an accident occurs due to electricity theft.

Praise and Rewards
When a user reports any case, they could be praised by the technology. IT should also provide a mechanism for rewarding users when they provide information.

4.4 Step 4: Selection of Technology

We propose to use a mobile phone application because mobile phones enable citizen participation in governance and are useful in awareness campaigns [20]. We specifically recommend smart phones because they provide the necessary platform for display of graphics. They also make it possible to personalize features. Data visualization can easily be achieved on a mobile application. For example, after a user purchases prepaid electricity on their mobile application, then a bar chart can be used to show how much money paid is for power and what that for power theft. Lastly, the mobile application would also make reporting electricity theft anonymous such that people are not bothered about being found out by the community as snitches.

4.5 Step 5: Requirements Specification

Documenting requirements as a formal requirements specification is part of requirements engineering [21]. It is important for requirements management. It should take place after requirements analysis and modeling. While this step is missing in Fogg's original process, we include it in this modified process to ensure quality and traceability of requirements.

4.6 Step 6: Design Basing on Similar/Successful Technologies

Fogg's process does not explicitly have a design step, however steps 5 and 6 provide guidelines on how to design. We combined them into our sixth step. If relevant design patterns for corresponding technology and features are available they may be used.

In this study the process of design is ongoing. So far we are basing on the utility's mobile application for communicating to users to design the look and feel of the interface.

Steps 7 and 8 remain the same as in original process.

5 Discussion

Different people respond differently to differing persuasion techniques. If an inappropriate technique is used, the technology may be counterproductive [22]. Methods of how to select persuasive techniques from the available ones proposed by Fogg and PSD are scanty [23]. We relied on results from the previously mentioned study [3]. This empirical approach to proposing persuasive techniques is common in persuasive technologies development. For example, Kulyk *et al.* [24] used focus group discussions to propose persuasion strategies for an application for young adults used, while Mubin [25] used a survey to propose persuasion techniques to design of an electronic health book for Sri Lankan children.

The selected persuasive features basing on primary support, social support and dialogue support dimensions. Dialogue and social support are critical features for Ugandans being a largely collective culture [26].

Information concerning the impact of electricity theft to electricity consumers in Kampala is broadcasted on radio and Television once in a while. People do not appreciate the impact of electricity theft to their day-to-day lives and with time forget about it. This we overcome by information tailoring. Tailoring is a highly used technique in persuasive system design [18]. Tailoring ensures that information meets the "potential needs, interests, personality, usage context, of users" [12]. It can be achieved through various techniques including, data visualisation, localisation and contextualisation. Data visualisation makes it easier to process information and to make decisions [27]. Foth *et al.* [28] used Google maps to achieve real time visualisation of blood donations to motivate youth to donate blood, while [29] developed an application that visualises crime on a map. Our aim is to do the same for electricity theft reduction.

Lastly, ethical considerations are crucial in persuasive technology design. We followed Berdichevsky and Neuenschwander's "golden rule": "creators of a persuasive technology should never seek to persuade anyone of something they themselves would not consent to be persuaded of" [30]. To the best of our comprehension the intended outcome of this technology is ethical. However, the actual outcome can only be validated after users interact with it.

6 Conclusion

In this paper we have proposed persuasive features of a persuasive technology to change the negative attitude electricity consumers in Kampala have towards curbing electricity theft. These features, namely; tailoring, reduction, notification, rewards, praise and suggestion, were proposed basing on a modification of Fogg's eight steps of persuasion technology design. A mobile application is the selected technology as it is suitable for implementing these features. As further work we will design, develop, and evaluate the proposed mobile application.

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