Personalized Persuasive Messaging System for Reducing Patient's Dissatisfaction with Prolonged Waiting Times

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Abstract. Long waiting time required before a patient sees a doctor is one of the major problems faced by many hospitals especially those in the developing countries. According to recent study, 97% of patients are frustrated by wait times at the doctor's office. However, patient's perceived wait times is often longer than the actual wait times because idle time tends to feel longer. As a result, it has been shown that perceptions regarding waiting time predicts overall patient satisfaction, but actual waiting times do not. Therefore, this paper discusses how persuasive technology can be used to reduce the overall dissatisfaction often associated with long wait times to see a doctor by reducing patient's perceived wait times. We present a persuasive messaging system based on the fingerprint technology and mobile phones. The persuasive messaging system is based on three persuasion principles aimed at reducing perceived waiting time, reducing overall dissatisfaction, and persuading patients against leaving the hospital without seeing a doctor: (1) Set a clear expectation; (2) Explain the wait time; and (3) Provide regular updates. Decreased perceived waiting times should ultimately lead to increased patient satisfaction and better patient.

Keywords: Persuasive technology. Patients' behaviour. Waiting cost. Optimal

1 Introduction

One of the major problems faced by the healthcare system in the developing countries today is the overcrowding nature of hospitals, which leads to delay in medical consultation and long waiting time. A recent study has shown that 97% of patients are frustrated by wait times at the doctor's office. There are three major factors contributing to this problem. The first is the difference between the number of patients demanding for medical attention daily and the available capacity to meet the demand. The second factor has to do with the high number of patients that are visiting the hospital daily without prior appointments and, as a result, have to wait for a longer time than expected to receive medical attention. The third is the disparity between the actual wait times and patient's perceived wait times. Patients' often perceive their

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wait times longer than their actual wait times because idle time tends to feel longer. "Stress management theory suggests that people under physical and/or emotional stress tend to feel any wait to be longer than usual" [1]. As a result, it has been shown that perceptions regarding waiting time predicts overall patient satisfaction, but actual waiting times do no [2].

Lengthy waiting times can affect patients by creating low compliance with the doctor's recommendations, deterioration, and dissatisfaction with their care [3]. Fernandes et al. [4] found out that prolonged waiting time had caused a substantial number of patients to leave outpatient departments without medical attention. Similarly, it has been shown that anxiety and stress due to long, unexpected or uninformed wait periods can lead to an increased health risk for patients [5].

Thus, there is need for an intervention for reducing patients' perceived waiting time and motivating them to wait longer than the initially scheduled time to see their doctors for medical attention, as failure to see a doctor could lead to costlier health implications for patients, especially those that really need timely medical attention. It is this urgent need that informed our intervention. However, this research is not aimed at increasing the capacity of the hospital which will ultimately reduce the overall congestion and waiting time; rather, we argue that a contributory factor to patients' dissatisfaction is inadequate information. Patients are often left in the dark regarding their expected waiting time. This makes them feel forgotten and having to wait indefinitely. This often leads to dissatisfaction and patients leaving the hospital without medical attention.

Therefore, this paper discusses how persuasive technology can be used to reduce the overall dissatisfaction often associated with long wait times to see a doctor by reducing patient's perceived wait times. We present a persuasive messaging system based on the fingerprint technology and mobile phones. The persuasive messaging system is based on three persuasion principles aimed at reducing perceived waiting time, reducing overall dissatisfaction, and persuading patients against leaving the hospital without seeing a doctor: (1) Set a clear expectation; (2) Explain the wait time; and (3) Provide regular updates.

The persuasive messaging system is based on fingerprint technology and mobile phones, which can be used to authenticate patients and capture their arrival and departure time. Based on this information, tailored messages can be sent to the patients' mobile phones to inform them about their expected waiting time, update them on the waiting time, and persuade them to keep waiting to see a doctor if their estimated waiting time is prolonged [6, 7].

The system provides patients with personalized information about their expected wait times on arrival to the hospital, allowing them to make adequate plans on how to engage themselves or how to utilize their wait time and hence reducing the overall anxiety and frustrations often associated with waiting. Similarly, in the course of waiting, personalized messages are sent to patients updating them on their expected wait time and explaining any variation in initially estimated wait time given on their arrival. This message is particularly aimed to encourage them to keep waiting to see a doctor, especially when they have waited longer than the estimated wait time. The personalized messages are chosen based on the patients' persuasion profiles stored in a database. To evaluate the effectiveness of this system, each patient is required to fill out a questionnaire after seeing a doctor each time. The completed questionnaires are

used to determine the effect of the tailored persuasive messages sent to their mobile phones and are useful in updating patients' persuasion profiles.

We believe that the tailored persuasive messages delivered to patients would 1) reduce their overall dissatisfaction, which arises from perceived longer wait time to see a doctor in the hospital; and 2) encouraging patients to wait longer to get medical attention as may be necessary. [8, 9] Decreased perceived waiting times should ultimately lead to increased patient satisfaction and better patient.

2 Related Work

Persuasive technologies are interactive applications that are intentionally designed to motivate behaviour change [7]. In looking for a scientific approach for designing persuasive technologies, designers and researchers often turn to behaviour science that studies persuasion, most notably psychology [10, 11]. The behaviour scientists have developed many theories of attitude and behaviour change such as the transtheoritical model of behaviour change [12], the theory of planned behaviour and theories of reasoned action and its follow-up [13]. These theories have been actively used by persuasive technology researchers and designers [14] to inform their system design about user's attitude and behaviour change. Similarly, many influence strategies that can be used to motivate attitudes or behaviours change have been developed. They include the six influence strategies, *authority, consensus, consistency and commitment, scarcity, liking and reciprocity* developed by Cialdini [15, 16] and the 40 persuasive strategies developed by Fogg [7]. In this study we adopt the six strategy developed by Cialdini. The six persuasive strategies are summarized in Table 1. The six strategies have been widely employed and have been shown to be effective at motivating behaviour change [17] across multiple persuasive technology domains.

In recent times, the marketing domain is the most frequent application area for persuasive technology—for sales of products and services. However, technological developments in ubiquitous computing and ambient intelligence offers new opportunities for persuasive technology in other domains [18]. In particular, the development of new sensor technologies and algorithms that allow for context-aware computing will make it possible to infer elements of a patient's context and activity, and deliver appropriate persuasive messages at the right time when decisions are made or behaviour is executed to influence the right change [19]. Moreover, the embedding of computational power and interactive displays in our everyday environment [20] makes it feasible to provide persuasive feedback at the appropriate place where the user is likely to benefit most.

Research has shown that there is great potential in applying persuasive technologies in the health domain [19], [21], [22] to improve patients' satisfaction and behaviour. The use of interactive technology in the hospital is still in its infancy in developing countries, with available health information systems falling short in many ways with respect to meeting up with patients' demands. As a result, patients are often dissatisfied with the system. This hinders e-health adoption and diffusion in developing countries. Strategically designed persuasive technology can be applied in

this context to improve service delivery, overall patients' satisfaction and adoption of e-health systems.

Table 1. Cialdini's Persuasive Strategies (Source: Cialdini, R.B., 2001)

Principle	Description	Exploitation
Authority	People defer to experts.	Make known your expertise and use symbols that indicate authority.
Commitment and Consistency	People align with their clear commitments.	Demand for active, public, and voluntary commitments; make reference to prior commitments; start with small request, then advance with a larger request (foot-in-the-door tactic).
Social Proof	People follow the lead of similar others.	Reference to the behaviour of similar peers.
Liking	People like those who like them.	Emphasis on similarities; give genuine praise.
Reciprocity	People repay kindness.	Do favours in expectation of a return.
Scarcity	People want more of what they can have less of.	Highlight unique benefits and exclusive information; set scarce timelines and indicate limited availability.

3 System Overview

The work reported here is a first step toward developing persuasive technology for e-health in developing countries. We introduce an automatic persuasive messaging system with an integrated fingerprint authentication to capture the arrival and departure time of each patient that visits the hospital. We also collect information about patient's susceptibility to various persuasive strategies and patient's average waiting time to see a doctor. Using this information, tailored messages are sent to each patient's mobile on his/her expected waiting time. Subsequent messages are sent in the course of waiting to update the patients on their waiting time and explain any variation in expected waiting time and to persuade the them to keep waiting to see a doctor especially if their estimated waiting time is prolonged. Figure 1 shows the architecture of the proposed persuasive messaging system consisting of five different modules: The Enrolment, Authentication, Database, Short Message Service (SMS) and Response Module.

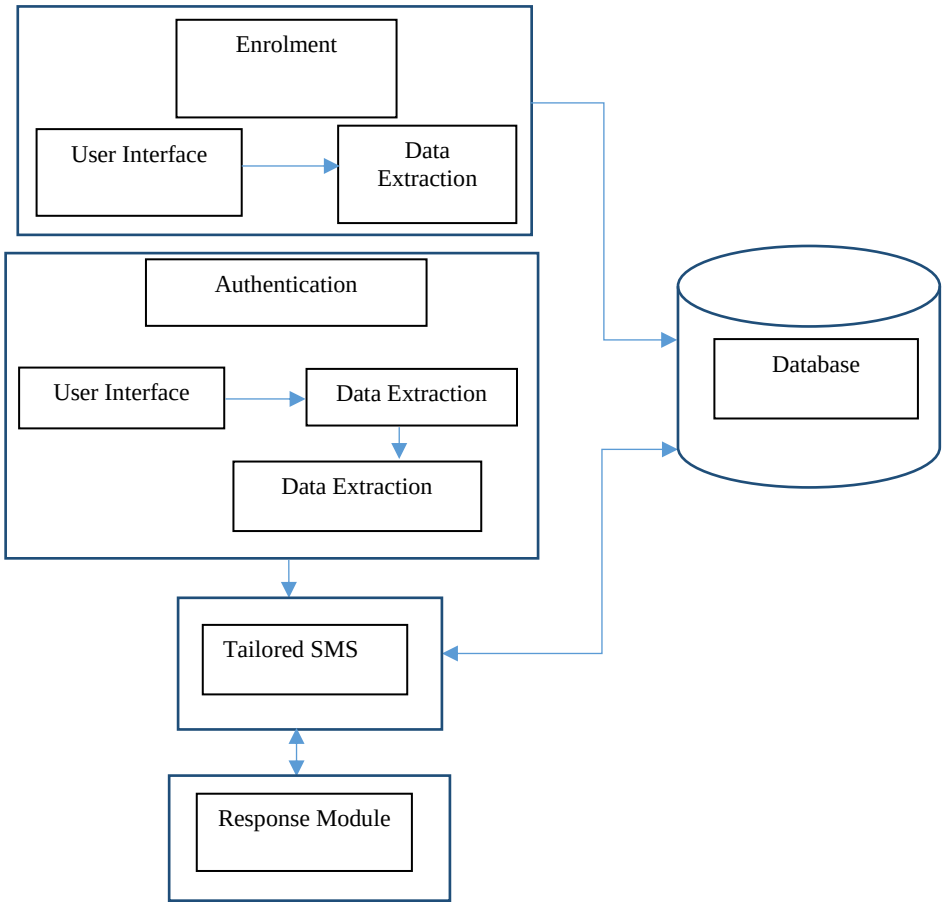

Fig. 1. Architecture of the proposed fingerprint-based attendance management system and persuasive SMS.

4 System Architecture

The architecture of the fingerprint-based persuasive text messaging system is made up of the following: Enrolment Module; Authentication Module; Database Management Module; SMS Management Module; and the Response Module.

4.1 Enrolment Module

The work of enrolment module is to capture patients' details and their fingerprints into the system database. During enrolment, the fingerprints and other bio-data of the

patient are captured and stored in a database. The patient's bio-data to be captured include: surname, other names, sex, arrival time and departure time, and phone number. After the fingerprint and the data of a patient to be enrolled are fed to the enrolment module, the extraction algorithm is used to extract the fingerprint images and the fingerprint patterns. These features are used as a unique identifier in authenticating each patient. The enrolment and registration phase is an administrative phase. The patient fingerprint as well as other bio-data is captured and stored in the database the first time a patient visits the hospital and this is done once. All data and information captured in the process of registering patients belong to this module. At the enrolment time, patients also complete a susceptibility to persuasive strategies questionnaire to determine their degree of susceptibility to various persuasion strategies [23] based of Cialdini's persuasive strategies [16].

Authentication Module

The work of the authentication module is to authenticate each patient that wants to see a doctor. The patient to be authenticated places his/her finger on the fingerprint scanner. The fingerprint image is captured and matched against the patient's biometric template stored in the system database at the time of registration in the enrolment module to authenticate patient. After a successful matching, the current time the patient arrived at the hospital and any update on the patient's profile are sent to the database.

The Database Management Module

The system database is used in storing patients' records. The database design for the system implements relational data model which is a collection of tables in which data are stored. Each record contains the patient's fingerprint, patient's bio-data, attendance history, patient's arrival and departure time, information about patient's susceptibility to various persuasive strategies also called patient's persuasion profile

SMS Management Module

Information about patient's susceptibility to various persuasive strategies is collected at the enrolment stage using the susceptibility to the six strategies questions [23]. This information about their susceptibility will be used in forming the tailoring and framing the persuasive messages. We estimated each patient's expected waiting time using the number of patients waiting to see a particular doctor and the average time taken to attend to each patient. Based on the estimated waiting time, personalized messages are sent to the patients, indicating the expected waiting time to see their doctor. However, in some cases, the waiting time may be longer than the estimated waiting time. In such cases, tailored messages are sent to the patients about the updated waiting time; explaining the reason behind any variation from the waiting time provided at initially and encouraging them to keep waiting to see a doctor. The tailored message is chosen based on the patient's persuasion profile stored in the database. Assuming there are a total of 50 patients waiting to see doctors, with an estimated average waiting time of 20 minutes, then, a tailored message will be sent to each patient with their expected waiting time to see the doctor. In cases where a

patient waits for more than 20 minutes, a tailored persuasive message is then sent to him/her to update on the waiting time and to encourage him/her to keep waiting to see a doctor [24].

After seeing a doctor, patients' fingerprints are captured to determine the average time patients spent in the hospital. Each patient also completes a survey to determine the effect of the tailored persuasive messages sent to their mobile phones. The results of the survey sheds light on the effect of the persuasive tailored messages for each patient and could be used for updating the individual patient's persuasion profile in the database [25].

Response Module

Response module is a message exchange module. A message is sent to a patient based on his/her waiting time to see a doctor. The entire system also requires the patient to respond based on his/her satisfaction with the waiting time to see a doctor. Patients respond to the system by completing a survey about their satisfaction based on waiting time to see a doctor at the point of leaving the hospital. This information from the survey is used to determine the estimated effect of the different influence principles for a specific individual and to update the patient's profile in the database.

5 Limitations

This work is limited to conscious patients and/or patients having minor illness or injuries. Unconscious patients cannot read messages with regard to time to see a doctor except patients' conveyor takes care of that.

6 Future Work

In the future, we intend to fully develop and conduct a large-scale evaluation of the system.

7 Conclusion

In this paper, we presented a fingerprint-based persuasive messaging system for reducing patient's perceived waiting time, reducing the overall dissatisfaction often associated with long waiting time in the hospital, and persuading patients against leaving the hospital without seeing a doctor. The persuasive messaging system is based on three persuasion principles: (1) Set a clear expectation; (2) Explain the wait time; and (3) Provide regular updates. The developed system monitors both patient's arrival and departure time. Using this information, the system calculates the average waiting time for each patient to see a doctor. The system can record the clock-in and clock-out time of patients in a very convenient manner using their fingerprint. It also delivers a personalized persuasive messages about the estimated waiting time before the patients see a doctor and persuade the patients to keep waiting to see a doctor if their time is prolonged. The system also assesses patients' satisfaction with the waiting time and

efficacy of the persuasive messages to reduce overall dissatisfaction that is often associated with waiting time. Decreased perceived waiting times should ultimately lead to increased patient satisfaction and better patient.

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