**The Effect of Palmar Hyperhidrosis to Smartphone Usage in Metro Manila**

Project Documentation Submitted

to the Faculty of School of

Computing and Information Technologies

of

Asia Pacific College

In Fulfillment of the Requirements for the subject

Introduction to Systems and Design for CS

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Table of Contents

[Abstract 2](#_Toc479445015)

[List of Figures, List of Tables, List of Notations 3](#_Toc479445016)

[I. Introduction 3](#_Toc479445017)

[1.1. Project Context 4](#_Toc479445018)

[1.1.1. The Challenges 4](#_Toc479445019)

[1.1.2. The Opportunity 4](#_Toc479445020)

[1.1.3. Purpose and Description 4](#_Toc479445021)

[1.1.4. Background of the Problem 4](#_Toc479445022)

[1.2. Objectives 7](#_Toc479445023)

[1.3. Scope and Limitation 7](#_Toc479445024)

[II. Literature Review 8](#_Toc479445025)

[2.1. Palmar Hyperhidrosis 8](#_Toc479445027)

[2.2. Smartphone Usage 8](#_Toc479445028)

[III. Technical Background 11](#_Toc479445029)

[3.1. Theoretical Framework 11](#_Toc479445033)

[3.1.1. Access Control 11](#_Toc479445034)

[3.1.2. Biometric Authentication 11](#_Toc479445035)

[3.1.3. Juels and Sudans Fuzzy Vault Scheme 13](#_Toc479445036)

[3.1.4. Capacitive Scanner 13](#_Toc479445037)

[3.2. Conceptual Framework 14](#_Toc479445038)

[3.3. Definition of Terms 14](#_Toc479445039)

[IV. Design and Methodology 15](#_Toc479445040)

[4.1. Nature of Study 15](#_Toc479445042)

[4.2. Sampling Technique 15](#_Toc479445043)

[4.3. Population and Sample 15](#_Toc479445044)

[4.4. Research Instruments 15](#_Toc479445045)

[4.5. Gathering Procedures 16](#_Toc479445046)

[4.6. Data analysis 16](#_Toc479445047)

[V. Appendices 18](#_Toc479445048)

[5.1. Bibliography 18](#_Toc479445050)

[5.2. Evaluation Tool or Test Document 19](#_Toc479445051)

[5.2.1. Hyperhidrosis Scale 19](#_Toc479445052)

Abstract

More than 5% of the world's population (approximately 367 Million people) are affected by hyperhidrosis. Hyperhidrosis is a condition where a person experiences excessive and uncontrollable sweating. Most smartphones have capacitive touch screens, on top of that, in order to register "touches", a circuit has to be completed through conductive means. Fingers are conductive and so is sweat, therefore, sweat droplets can register touches in the smartphone, making it difficult for a palmar hyperhidrosis patient to register accurate "touches" in his smart phone. This study aims to study the human computer interaction between smartphone and palmar hyperhidrosis patient. The proponents will investigate and propose a solution for smartphone manufacturers on the problems and struggles encountered by a palmar hyperhidrosis patient when using the touch sensitive display and fingerprint authentication features of his smartphone.

List of Figures, List of Tables, List of Notations

[Figure 1 Biometric Authentication Process 13](https://asiapacificcollege-my.sharepoint.com/personal/mpjimenez_student_apc_edu_ph/Documents/INTSDEV/Biometrics-CSFormat.docx#_Toc479542703)

[Figure 2 Capacitive Scanner Technology 14](https://asiapacificcollege-my.sharepoint.com/personal/mpjimenez_student_apc_edu_ph/Documents/INTSDEV/Biometrics-CSFormat.docx#_Toc479542704)

[Figure 3 Biometric Authentication Process 15](https://asiapacificcollege-my.sharepoint.com/personal/mpjimenez_student_apc_edu_ph/Documents/INTSDEV/Biometrics-CSFormat.docx#_Toc479542705)

1. Introduction
   1. Project Context
      1. The Challenges

Current fingerprint authentication or touch sensitive display enabled smartphones in the market has low responsivity rate under damp situations, for that reason, it lessened the satisfaction of users with palmar hyperhidrosis when using their smartphones.

* + 1. The Opportunity

This research can help smartphone manufacturers on improving their devices satisfying customers affected with palmar hyperhidrosis.

* + 1. Purpose and Description

This research serves as a reference for smartphone manufacturers for them to improve their products and widen the scope of their satisfied customers. Catering people with or without the medical condition palmar hyperhidrosis, the researchers aim to know the different solutions that smartphone manufacturers can implement to enhance the user experience of those who have palmar hyperhidrosis when using smartphones.

* + 1. Background of the Problem

Smartphones are hand held devices that functions like a computer. They can receive and make calls, create and receive messages. Also, these smartphones have the capability to connect to the internet, making them capable of downloading and running 3rd party apps (downloaded from digital distribution platforms such as Google Play and App Store). Smartphones were first introduced in 1999 by the Japanese company NTT DoCoMo and became widespread a year after. A lot of firms have been competing in the Smartphone Industry and the competition never stops, for every year, new features and innovations are being introduced.

Touch screen based smartphones has been constantly developing throughout the years and has proven reliability. This technology is a type of visual display, it enables the users to interact with an electronic device by touch. Touch screen technology also opened new possibilities for the security aspects of smartphones.

Last year, 2016, new features came up such as fingerprint authentication, and water and dust resistance. Fingerprint authentication revolutionized security, while water and dust resistance dramatically enhanced durability. Fingerprint authentication is a type of biometric authentication where the user registers his fingerprint in his smartphone. It can be used in the future to easily unlock his device, the registered fingerprint can also unlock certain applications and may be used to verify virtual transactions.

The fingerprint authentication functions through storing a photograph of how the user’s fingerprint looks. Though when the user’s finger is wet, the sensor can’t match the current authentication to the stored fingerprint. This situation usually occurs when the user’s hand is sweaty.

Sweating is the natural mechanism of the human body to regulate temperature, but when sweating is more than usual in hands, feet, armpits, etc., it is called hyperhidrosis. Hyperhidrosis is the excessive and uncontrollable sweating in certain parts of the body, derived from the prefix hyper meaning excessive, and hidrosis which is synonymous to sweating. Hyperhidrosis is a physical saddle that can reduce the quality of life physiologically, emotionally, and socially (Vary, 2015). It is also sometimes called as “The Silent Handicap” (Swartling, et al., 2011). Hyperhidrosis has two types, generalized or localized. Generalized hyperhidrosis or secondary hyperhidrosis is the overall abnormal sweating of the body, while localized hyperhidrosis or primary hyperhidrosis only exists in specific parts of the body such as hands, feet, armpits, etc. There are two types of primary hyperhidrosis namely focal hyperhidrosis or gustatory hyperhidrosis. Primary hyperhidrosis is the abnormal sweating of a specific body part, for example, palmoplantar hyperhidrosis (sweating of the hands and feet). On the other hand, gustatory hyperhidrosis is induced upon consuming certain food items.

According to Erika S. Poole, human-computer interaction refers to the “interdisciplinary area of research and practice, drawing upon intellectual traditions of several disciplines including human factors, computer science, information systems, psychology, sociology, and visual design” (Poole, 2013). Human-computer interaction researches and practices has been focused on user-centered design, creating and optimizing technologies to improve the relationship between user and device (Poole, 2013). User centered design helps state the product’s usability, usefulness, and its fit into daily lives (Poole, 2013).

Several smartphones on the market up to this date is equipped with several durability features, such as water resistance and water proofing. But unfortunately, some water-proof or water-resistant smartphones doesn’t work well under damp or wet situations, this caught the researcher’s attention. The researchers wanted to study the effects of the medical condition palmar hyperhidrosis to the user experience when using smart phones with touch-sensitive display and fingerprint authentication, and to create solutions on how to reduce or solve the problems encountered by these individuals.

* 1. Objectives

This research aims to study the user experience of people with palmar hyperhidrosis when using their smartphones. It is to inform the general public about the user experience of those with palmar hyperhidrosis and their smartphones, so that they may use it to increase and make considerations when interacting with people with palmar hyperhidrosis. Thus, the objectives are...

1. to summarize the effects of the medical condition palmar hyperhidrosis on the UX when using their smartphones touch sensitive display and fingerprint authentication; and

2. to help smartphone manufacturers to look for ways on how they would broaden their satisfied market by knowing the complaints and statements from people with palmar hyperhidrosis.

* 1. Scope and Limitation

The study focuses on the effects of the medical condition palmar hyperhidrosis as a factor on the UX of palmar hyperhidrosis-affected individuals residing in Metro Manila when using their smartphones. Also, this study will not focus on the main medical condition palmar hyperhidrosis, but may contain a few medical terms related to the condition.

1. Literature Review
2. 1. Palmar Hyperhidrosis

Hyperhidrosis signifies the excessive secretion of the sweat glands (Harth, Gieler, Kusnir, & Tausk, 2008). This medical condition is not rare, it’s just that a few are only aware of this. Even though sweating is the natural mechanism of the human body to regulate temperature (mainly to prevent overheating), hyperhidrosis patients still sweat even if they are in a cool place or resting (The New York Times, 2013). Hyperhidrosis can be categorized into three levels, mild, moderate, and severe. Sweat droplets are not visible in mild hyperhidrosis, while sweat droplets are completely visible in severe hyperhidrosis (Hölzle, 2002).

The primary cause of palmar hyperhidrosis is still unknown, but some states that 65% of their patients inherited it from their family blood line (Wolosker, et al., 2010). Also, another study states that palmar hyperhidrosis is caused by an overactive sympathetic nerve, these nerves are located in the spinal cord which controls the sweat reaction.

Hyperhidrosis dramatically reduces the quality of life. Frustration in handling everyday activities, depression, embarrassment and unhappiness are one of the frequent reports made by Palmar hyperhidrosis patients. In a US survey, one-third of the patients reported that the sweat in their hands was barely tolerable as it interferes with their daily lives (myVMC, 2015).

* 1. Smartphone Usage

Human-Computer Interaction, or HCI, is an area of research that contains several disciplines such as human factors, computer science, information system, psychology, sociology, and visual design (Erika Poole, 2013). Researches on Human-Computer Interaction focuses on creating technology that would fit to the needs and daily life of a person who utilize them. Basically, HCI focuses on designing technologies for humans in order to make their lives easier, this may also be called user-centered design. User-centered design is a design philosophy wherein users and their needs are a big factor throughout the design of a certain technology.

HCI with smartphones is a trend that is growing rapidly as time passes and technology improves. There are three main impacts of HCI to smartphones: smartphones and society, smartphones and the economy, and smartphones and culture (Jonathan Crawly, 2015). According to Crawley, smartphones have changed the way humans interact with each other in a social level, affecting the social skills of humans. Also, smartphones allowed easier communication with a push of a button. In short, smartphones have changed the way people interact with each other socially.

In order to outstand, smartphone corporations innovate their products. Although they give new features to their products, questions still arise whether some of these newly applied features are going to be used by the consumers. The best example for this scenario is Samsung’s Galaxy S4’s rumored new features. Which was assumed as an eye scrolling technology that lets the user scroll through their smartphones with just the use of their eyes, but instead it had only Smart Scroll and Smart Pause. Smart Scroll lets you scroll without even touching the screen though a combination of facial recognition and tilt, while Smart Pause, on the other hand, pauses things like videos whenever your head moves not towards the screen, and once you are back, the video continues (Versace, C. 2013).

All in all, palmar hyperhidrosis-affected individuals really takes a toll from the condition they are affected with, this medical condition not only affects them physically, but also socially and mentally. These individuals are affected physically as their sweat glands on their palms secretes sweat abnormally. Socially, as they get frustrated and awkward shaking hands, or high-fiving other people, basically interacting with other people using their hands. Mentally, as these individuals experience the daily frustrations in doing their daily activities due to their condition. Holding or grasping things can be really difficult for them, smart phones are hand held devices, and most of the recent finishes these smart phones have are glass finishes, making it really slippery to hold when wet.

1. Technical Background

4. 1. Theoretical Framework
      1. Access Control

Access Control is the ability of one place or resource to limit access through different media, such as PINs, passwords, biometric scans, etc. Access control runs on comparing data from the database with the current input, scanning for a pair that matches the current input. Access control works at different levels in a system. Access control working at the Application level is based on the users roles, some features are available to higher level roles, and are restricted to those below them. Applications can be written on top of middleware, access control working at the Middleware level is ensures a certain process, usually used in database management systems. Middleware uses facilities provided by the operating system, access control working at the operating system level provides basic security for files and ports. Lastly, the operating system heavily relies on the hardware, access control working at the hardware level controls the memory addresses a process can access (Anderson, 2001).

* + 1. Biometric Authentication

Biometric authentication is the process in which physical characteristics are used to validate identity, making it hard to fake and tamper as these attributes are unique to one person only. Physiological characteristics are used in order to authenticate access such as Fingerprints, Palm prints, DNA, iris recognition, etc. The wide use of biometric authentication in the community heavily increased the level of security one device or facility has.

Biometric system can be used in two modes. The first one is the identity verification which occurs when the identity of the user is already enrolled in the system (Has an ID card or login name). The biometric data that is gathered from the user is compared to the user's data that is already stored in the database. The second mode which is the Identification, or also known as search, occurs when the identity of the user is priori unknown. In this mode, the biometric data of the user is compared to all the records in the database, even though the user does not have data stored in the database. It is noticeable that the second mode is more challenging and costly (Enstitutsu).

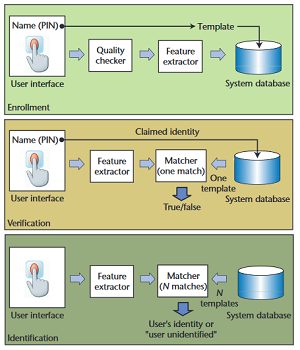
 Fingerprint scanners needs to fulfill 2 jobs, getting the image of the finger, compares the ridges and valleys of a fingerprint with existing fingerprints. Only unique characteristics are recorded and encrypted. The unique characteristics are then converted into a binary code, and is stored in a database, which are then used to validate entries.

Figure 1 Biometric Authentication Process

* + 1. Juels and Sudans Fuzzy Vault Scheme

Fuzzy Vault is an encryption scheme, stating that in order to encode an information, a key is required to decode it with ease. Its concept revolves around the idea that “A secret is encoded using a set values (the key), and can then be unlocked with another set of values if it has fairly large resemblance with set used to lock it”. The Fuzzy Vault is often used with Reed-Solomon codes also known as error-correcting codes. 2 algorithms are used in the fuzzy vault scheme, LOCK and UNLOCK.

* + 1. Capacitive Scanner

Fuzzy Capacitive scanner depicts a picture of friction ridges of a person’s finger through the use of electrical currents. Its sensors are made of semiconductor chips which have arrays of incredibly small cells and each cells of it have a couple of conductor plates protected by an insulating layer. The sensor is attached to an electrical circuit wrapped around an inverting operational amplifier which is basically an integrator. Integrators are complex semiconductor device that performs the mathematical operations.

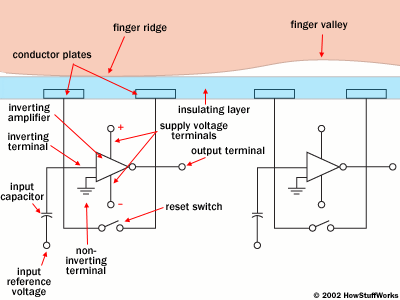
 In order to scan you must have the switch shut first in order to gain neutrality to the integrator circuit, and when it is enabled again, the processor will apply a constant charge to the integrator circuit to have the capacitors charged up. The stored electric charge of the feedback loop’s capacitator influences the voltage at the amplifier’s input which then affects the amplifier output. Afterwards, the scanner processor scrutinizes the voltage of each cell to put together a complete image of the fingerprint.

Figure 2 Capacitive Scanner Technology

* 1. Conceptual Framework

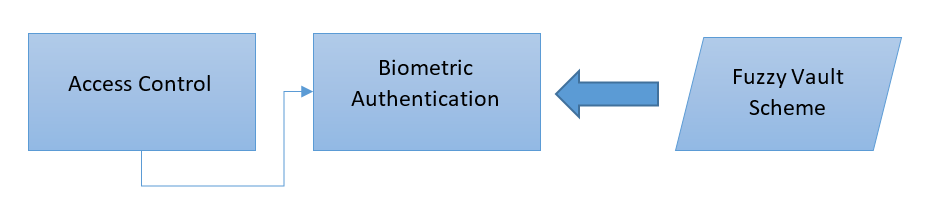
 Access Control is the limiting of entry from a certain place or resource, and one type of access control technology is biometric authentication. Biometric Authentication is the process wherein physiological attributes are used in order to validate identity. Some of the algorithms used in Biometric Authentication is the Fuzzy Vault Scheme, objects are compared and the state will only change to unlock if there are a lot of resemblance between those two objects.

Figure 3 Biometric Authentication Process

* 1. Definition of Terms
* Palmar Hyperhidrosis – a medical condition where someone has excessive and uncontrollable sweating in the hands. (Sweathelp.org).

1. Design and Methodology
2. 1. Nature of Study

The researchers are creating a goal-oriented research, focusing on representation to understand the effects of Palmar Hyperhidrosis to the UX when using a smartphone deeply. Under goal-based research, there are two types, representation and generalization. The researchers are using representation, an in-depth understanding of a certain phenomenon, understanding how factors affect a situation, in our case, the factor is the medical condition Palmar Hyperhidrosis and the situation is the user experience when using a smartphone.

* 1. Sampling Technique

The researchers are using snowball sampling to acquire the sample of the research under discussion. This method is also known as referral sampling, which belongs to the category of non-probability sampling technique, is where research participants refer several people who qualifies to take part for a study, or directly recruits them to ease data collection. (Steven Venette, 2013).

* 1. Population and Sample

The population of interest for this study are individuals residing in Metro Manila that owns a smartphone and experiences Palmar Hyperhidrosis.

* 1. Research Instruments

The researchers are using questionnaires, semi-structured interviews, and Iodine-Starch test to gather data from the respondents. Two forms of questionnaire are used, a written and an online-based via Google Forms. The questionnaires for this study is intended to obtain information from several individuals in a short period and to quantify easily by either the researchers or through software packages. Also, semi-structured interviews will be used since they involve personal and direct contact between interviewers and interviewees. However, there are risks that the conversation might digress from the stated research aims and objective. (Gill & Johnson, 2002). For the purposes of this research, Iodine-Starch test will be used to know the rate of sweating in certain areas of their hands.

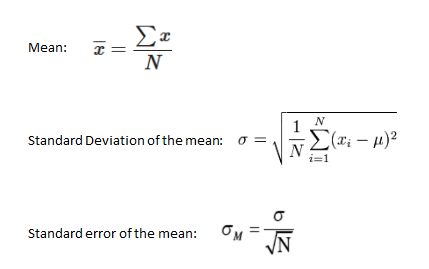
To further support the statements of this research, other materials are used such as EBSCO Host and Google Scholar for factual references.

* 1. Gathering Procedures

The researchers are providing two questionnaires to the participants, one for the diagnosis of palmar hyperhidrosis and another one for the user experience regarding their smartphone usage given their condition. The researchers are choosing a fraction to do the Iodine-Starch test to determine the severity of sweating in their hands. This procedure also enabled the researcher to conduct interview at the same time consecutively.

* 1. Data analysis

The formulas that the researchers are using are based on the study of Steven M. Keller, et al. entitled "Diagnosis of palmar hyperhidrosis via questionnaire without physical examination". Formulas that are included in the study for analyzing data are the Mean, Standard Deviation of the Mean, and the Standard Error of the Mean. Mean is to average the number of people with severe cases of Palmar Hyperhidrosis. The Standard Deviation of the mean and Standard Error of the mean are for the accuracy of the data. Standard Deviation is used to see how far the values are from one another, while the Standard Error is the standard deviation of the sampling distribution of a statistic.



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* 1. Evaluation Tool or Test Document
     1. Hyperhidrosis Scale

We are students from Asia Pacific College from the class of CN151/DF151/SS152 taking up Bachelor of Science in Computer Science and we are conducting a survey in order to support our research entitled “The Effect of Palmar Hyperhidrosis on Smartphone Usage in Metro Manila”.

Hyperhidrosis scale

Questions about distress caused by sweating of the hands.

How much distress do you experience when you:

1. Shake hands with others?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

2. Hold hands with a boyfriend/girlfriend/spouse?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

3. Writing (by hand) on paper to complete examinations,

applications or other important documents?

(None) 0 12 3 4 5 6 7 8 9 10 (worst)

4. Grasp heavy objects and/or tools?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

5. Attempt to initiate intimate contact?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

6. Turn knobs or faucets?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

7. Drive a car?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

8. Eat with forks, knives, or spoons?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

9. Wear fabric, leather or rubber gloves?

(None) 0 12 3 4 5 6 7 8 9 10 (worst)

Questions related to sweating of your feet

10. Put on socks or stockings?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

11. Walk barefoot?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

12. Wear sandals?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

13. Wear high-heel shoes?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

Questions related to sweating from areas of the body other than the hands and feet

14. Sweat from your axilla (underarms)?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

15. Sweat from other parts of the body other than hands

and axilla?

(None) 0 1 2 3 4 5 6 7 8 9 10 (worst)

If yes, where (please describe)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

©Hyperhidrosis scale, 1998. Keller, Sekons, Scher, Bookbinder, Portenoy (HYPERQUE)