6COSC006W - Final Year Project Report

Contactless Voucher

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# Declaration

# Abstract

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# Introduction

This chapter aims to give an overview of the context of this project, the problem is trying to resolve and the objectives.

## Problem statement

Nowadays there are many ways a retailer can reward the most loyal customers. There are loyalty schemes almost for everything, from the coffee shops to flights. The more money you spend with a company more likely they are going to offer you special discounts because it is easier and more convenient for the business (Jovancic, 2019).

The current most common type of loyalty schemes available in restaurant such as Starbucks, Pizza Hut, Domino’s require the customer to register online on their service and then download a mobile application (DevTeam.Space, 2020). Sometimes is the cashier that enables the digital stamp or other times is the record of the purchase in the customer account. Other smaller food restaurants usually have a classic paper card where the cashier can make a stamp on it. The cards are usually made with empty icons that can be filled with the stamp to represent the accumulation of number of purchase made.

Image sources:  https://www.tradeprint.co.uk/dam/jcr:a3f81a33-30e6-43c7-a798-6a9fdbf89a9b/comp_loyaltycard_170620_0187.jpg

https://www.thesun.co.uk/wp-content/uploads/2017/04/nero1.png



Figure 1. Paper loyalty card and loyalty Mobile App

In the example above (Figure 1.) on the left there is an example of paper loyalty card and on the right a mobile loyalty app. The concept is similar but the way it works is completely different because one is physical and other one is digital.

This project purpose is to enable something in between the two existing solutions by using the NFC (Near Field Communication) technology. Also known as contactless, this technology is now available in most of the devices in the world and it is becoming more popular.



Figure 2. Monthly contactless transaction in the UK from June 2016 to October 2019

This technology is mostly used for payments with a small amount of money involved because it does not require any type of validation. The lack of validation makes the card more vulnerable to fraud (loveMoney, 2019), but that is a reasonable compromise for fast payments.

Moreover, in terms of ethic and ecologic point of view, this project has the potential to save the waste of plastic and paper by avoiding the demand of printed paper cards and plastic cards that “[…] have actually been the most requested gift in America” (Long, 2015).

## Aim and Objectives

The overall purpose is to create a Web App that uses the Web-NFC experimental feature on Google Chrome browser on mobile (Bhaumik, et al., 2020) and allows both customer and retailer to manage their loyalty experience the way they want.

The main scope is to allow the customer an easy way to collect stamps or points without the need of a mobile application. For the retailer the advantage is a system where the loyalty experience is not restrict to a proof a purchase, but it could a number of visits throughout a month or maybe an interaction with a new product in the store. With the use of NFC tag the retailer is also able to reuse the same piece of technology without investing into more complex machinery.

To achieve the desired goal, I will need to complete this list of objectives:

* Gain in-depth understanding on NFC capabilities
* Research NFC security known issues and always be aware on related news
* Develop a prototype to use as demo for stakeholders
* Constantly receive feedback from different sources to gain a wider perspective of the project
* Source control to make sure there is trace of the work done in case of work lost or not working as expected
* Time tracking and documentation of the work done for the project
* Deployment of the project on a stable environment such a cloud service
* Implement an algorithm that compress the small amount of data
* Work with an external API that can send a digital voucher to the customer

Moreover, I would like to achieve some additional features (in descending order of importance):

1. Creation of own images and logos
2. Customisation of the interface per type of user
3. Gamification of the user experience

# Background

This section introduces the literature of the project, a comparison of similar or relevant applications for the same customer reward. In addition, a discussion on the possible approaches for the intended solution is included.

## Literature survey

Within the following sections the literature review will be uncovered to give an insight of the aspects of the NFC. Starting from the beginning of this technology and its original creator to the technical differentiation of the modern world. It is important to be aware of the modern enhancement and what are the future capabilities.

### The history and physics behind

A Russian physicist and inventor called Léon Theremin (also known as Lev Sergeyevich Termen) in 1920 developed a musical instrument, later named after himself, that can produce sounds without being touched. The theremin core principles are heterodyning and capacitance. The former is the result of a combination or mixture of two frequencies (a principle used for FM radios) and the latter is the “ability of a circuit to collect and store energy in the form of an electrical charge” (Fluke Corporation, 2020).



Figure 3. Léon Theremin playing his own invention

The electric instrument has two metal antennas, one to control the pitch and the other to control the volume. When a hand goes near to an antenna, a natural capacitor is generated, and its capacitance change based upon the distance to the hand. The circuit of the instrument takes the capacitance and set a frequency for the pitch and the volume. Then an inductor inside the instrument creates the frequency to be combined with the previous one so it can result with an interference that is hearable by the human hear (Huth, 2018).

Later, in 1945 the World War II finally came to an end. On the 4th August in Moscow a group of boys from the Young Pioneer Organization of the Soviet Union went to the American embassy to give a present as a symbol of friendship between the two countries. Averell Harriman, the United States ambassador at that time, took the great wooden ornament as an important gesture and hung it on the wall of his office. They probably have checked every side of it to make sure it was not going to cause any harm like a Trojan horse, but nobody found anything alarming (Harford, 2019).



Figure 4. The present given to the US ambassador and the hidden device location

Eventually it was found that the gift was an innovative creation from Theremin commissioned by his government to spy the conversation of the ambassador. It worked secretly for seven years until its discovery and gained the names “The Thing” and “The Great Seal Bug” (Harford, 2019).

The invention of Theremin consisted of a reverse concept of his musical instrument. He created a hidden circuit that had a capacitor that vibrated depending on the voice pattern. The capacitance would set the frequency representing the voice. An interference would be created when beaming a radio frequency signal to the object. This beaming would also power up and activate a response signal to broadcast out so it could be received and analysed to get the information needed (Crypto Museum, 2015).

This can be conceived as the first example of the modern RFID (radio-frequency identification) technology because of the concept and physics involved.

In fact, the underlying principle of RFID consists of electromagnetic waves and mutual inductance. The latter is a physical principle that describes how the change of current in a coil can produce an electromotive force (EMF) in an inductively coupled coil.



Figure 5. Inductive coupled coils

In the image above we can consider to be an initiator that tries to engage to a target . The mutual inductance between the two coils can be calculated by the following formula:

Being H the magnetic field strength, N the number of loops of the area A, and I the current that flows in the coil (Yang & Hancke, 2017).

### RFID (Radio-Frequency Identification)

RFID can be described as a form of wireless communication that uses the aforementioned electromagnetic principle (see 2.1.1) to uniquely identify an object (Rouse, 2007). It is purposely designed for identification because the RFID tags can hold only a small amount of data, usually around a thousand bytes or less (Igoe, et al., 2014).

There are two RFID types of communication mode: active and passive. But first of all, it is essential to define the two actors involved in the exchange: the target and the initiator. The initiator is the device that tries to read or write a tag, it generates the radio field and waits for responses from any target in the field. The target is usually the tag, that will respond with an UID (Unique Identifier Number) to the radio field (Igoe, et al., 2014). Therefore, the communications mode is considered as:

* *Active* when the target is powered independently like with a battery.
* *Passive* when the target has no power source. It usually gets the power from the radio field. Very similar to “The Great Seal Bug” (see 2.1.1).

At this point, it is worth mentioning there are various type of RFID protocol standards, usually developed by the ISO (International Standards Organisation) along with the major participants in the market. The different standards can change in terms of radio frequencies used (i.e. A lower frequency usually means a shorter read range), data format and data transfer rates (Lowry Solutions, 2014).

### NFC (Near Field Communication)

NFC, similarly to the RFID, is also a wireless communication that works on the same physics principles mentioned before (see 2.1.1). It is designed upon the RFID protocols and it is generally possible to interact with the RFID tags (e.g. ISO-14443A tags are compatible with NFC). Its main role is to enable the target and the initiator to communicate by an exchange of meaningful data. This data can be either the capabilities of each other, records or even credentials.

It is important to note that NFC targets are not limited to tags, they can be also programmable devices like smartphones. There are two communication mode exactly like in the RFID: active and passive (see 2.1.2). Moreover, there are three operating modes:

* *Reader/Writer* when a device reads data from a target and/or writes to it.
* *Card emulators* when a device acts like a RFID tag in the electromagnetic field of another NFC or RFID device.
* *Peer-to-peer* when two devices exchange data to each other.

### Key differences between RFID and NFC

### NDEF

### Web NFC

## Review of project / applications

# Requirements

# Methodology

# Design

How the project design is implemented and the tool used

UI interface

Landing page for registration

Customer scheme

Retailer settings

# Tools and implementation

## Tools

Programming languages, libraries, framework with choice justification. Razor pages

### Visual Studio MVC

### Git

### StyleCop

### Chrome Developer Tools

### Entity Framework Core

<https://docs.microsoft.com/en-us/ef/core/miscellaneous/cli/powershell>

### 6.1.6 Adobe Illustrator

## Loyalty Scheme system

### Digital card visualisation

### Web API

### Collecting the stamp

### Creating the stamp

## Deployment

### Web Application setup

### Database setup

### Visual Studio