MSc Computer Science

Project Report

Ubiquitous Consumer Inventory Management System For Waste Prevention

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Contents

1 Introduction

1.1 Abstract

What the project is about in regards to the proposal. The problem i am trying to solve. Over production food. Tackeling the core, If the consumers stop over purchasing the supermarkets will stop over producing.

1.2 Structure of the report

Present the reader with an overview of each chapter.

1.3 Development Methodology

UML and agile. And the reasons why this is a productive methodology. Version control for documentation and history.

2 Background & Analysis

This section presents the problem and the intent for the project supported by the analysis of currently available processes.

2.1 Motivation

The intention of the system is to aid the reduction in food waste created by households. Below highlight the motivation for the project and the cause of waste.

2.1.1 Environment

Globally food waste has exceeded to two billion tonnes annually. Spoiling food emits methane, a particularly harmful greenhouse gas contributing to the warming of the earth's surface and threatening the echo-system. Due to human activity methane gas being released into the atmosphere has increased two and a half folds since the industrial revolution. Further more, resources used during the rearing and plantation process for the produce, as well as the use of packaging and transportation all contribute to the detrimental effect on our environment. Local councils are continuously pressured to fuel more funds into waste management recourses, landfill sites are overflowing and space to accommodate the waste is fast diminishing.

In the United Kingdom alone consumers and households are responsible for at least seven million tonnes of waste, whilst in comparison the retailers contribute a mere two hundred and twenty five thousand tonnes. Although the reported figures implicate the household as the largest culprit, retailers are in fact the catalyst force behind the mass generation of waste. Frequent buy-one-get-one-free and multi-buy discounts hosted by retailers contribute largely to the problem. Competition for market share is fierce between the retailers and goods must always be available at a lower price than that of their neighbours. Farmers and other producers alike are pressured to over produce to accommodate for a sudden rise in demand or to simply cover the risk of a potentially bad harvest. But when the sales forecast is not met or the harvest is overly fruitful, supermarkets will routinely deduct the price of food nearing expiration as a method of damage control for their investment.

Consumers are enticed by the attractive offer of a free item after purchasing two, and encouraged to over purchase food that they do not need and will most likely not consume before the use-by-date. Thus, waste that was originally created by the retailers is pushed down the chain, residing with the consumers. This aggressive sales strategy not only causes monetary waste to the individual but also engineers the blind participation in driving up demands in goods, in turn encouraging the overproduction of food.

2.1.2 Public Health

In addition to the environmental damage, there are growing concerns over the public health risks the bargains offers bring. Over purchasing of food can encourage excessive consumption. Discounted foods usually come with a shorter use-by-date, meaning over a shorter span of time an individual must consume more than necessary in order for their investment to be justified. This side effect is detrimental to the health and well being of the public as the national statistics report for the United Kingdom has unveiled. Obesity rates in male adults have increased 13.2% and 7.4% for female adults since 1993. These figures are rising every year and the World Health Organisation (WHO) has predicted that by 2030 74% of male adults and 64% of female adults will be obese if precautionary measures are not implemented.

2.1.3 Aiding the modern lifestyle

The final problem is simply human errors. We purchase produce with the good intention of consuming them. But as the demands of our fast paced modern life-style take priority, we often forget all about the existence of what we stocked and inadvertently let our stock expire until it is no longer fit for consumption. Expiry dates for different produces vary, and keeping track of all dates is a near impossible task by relying on human memory alone. A popular study carried out in by George Armitage Miller, a prominent figure in the field of cognitive psychology discovered that the number of objects an average human can hold in working memory is seven, give or take two. With this limited capacity is no surprise that once the fridge door is closed, it is inevitable that some of the produce is destined for the waste bin.

Many homes are made up of multiple inhabitants. Errors such as double purchasing due to lack of communication is a common occurrence. If two occupiers notice an item is low on stock at different times they may both set out to replace the item, resulting in duplicate items being purchased and increasing the risk of waste occurring.

2.2 Current Waste Reduction Methods

Governments and organisations have implemented various measures to tackle the rising figures in waste. Below describe the techniques used and the strengths and weaknesses that each possess.

2.2.1 Manual Labour

Such efforts include manual labour by distributing flyers aimed to inform and educate individuals if the implications of waste. Engaging with commu-

nities by setting up stalls and public demonstrations to raise awareness has been a favourable method for generating interest. This form of engagement is inspirational and informative but an expensive operation; sustaining the interest of the community is tough and effects are short lived.

2.2.2 Anaerobic Digestion

Waste management organisations such as Biffa and the retail giant Sainsbury's have collaborated to recycle food waste using anaerobic digestion. By utilising the gases produced from the waste they are able to generate power to sustain the running of retail stores. Anaerobic digestion creates a circular process where the waste produced by the retailers is pumped back into the production line to fuel the very instrument creating the problem. This method has been questioned as to whether it is a true solution as the resources used throughout the process also leave a carbon footprint.

2.2.3 Smart Fridge

Smart fridges were introduced in the early 2000's as a home inventory management system. Designed to be integrated with our every day lives and to monitor the inhabitants investment. The user inputs the product on either an embedded screen or mobile device. The fridge was designed to keep track and inform the owner if items are running low on stock and support the automatic replenishment of goods. The primary hindrance to sales of this product is largely attributed to cost and lack of infrastructure.

2.2.4 Nano Technology

Most recently, Nano technology has been used to monitor the stages of decomposition in foods. A small gel like cube emits a colour corresponding to a particular stage of decomposition and visually representing the shelf life of the product. Nano technology is able to remove the need for printed sell-by-dates but it still requires the inhabitants to actively open the fridge door, view, process and memorise the colours of the tags for various products.

2.2.5 Mobile Application

Mobile phone applications have been created by charity-funded organisations such as Love Food Hate Waste. This application informs the user of the recommended portion to discourage over purchasing. Other features include recipe recommendations and a shopping list creator and inventory manager. Apps such Love Food Hate Waste and other product login applications all suffer from the same bottleneck, that act of having to manually punch in the product details. This arduous process dissuades many, and the application is soon discarded. Some applications have implemented barcode scanning

using the phones camera but if the barcode is damaged in the slightest it is rendered unreadable.

2.2.6 Radio Frequency Identification

Radio frequency identification (RFID) has been utilised in the food supply chain for many years for inventory tracking. Recently Dutch researchers have developed sensor enabled tag, the tag monitors atmospherical changes in the environment the produce is exposed to during transit. By analysing the data collected with the Pasteur sensor tag an estimate shelf life for the produce is generated thus reducing the likelihood of waste occurring. Currently this technology is only available for large-scale shipments and used only to protect the transportation between producers to retailers.

2.3 Proposed Solution

In the past the British government has intervened in attempts to reduce the production of waste. Officials pressured retailers to abolish the multi-buy offers but the suggestion was met with reluctance. Instead a compromise was met and the revised promotions allowed the consumers a wider variety of products to choose from. It is evident from this that persuading retailers to prioritise the reduction of waste over the potential increase in revenue is an up hill battle. The multi-buy marketing strategy has proven successful in increasing market share and responsible trading can easily be overlooked in favour of this.

For this reason the proposed solution is not to try to persuade the retailer to change their practice but the consumer. By equipping the consumer with an application that will monitor the contents of their fridge over stocking can be avoided and avoid the temptation of the seemingly attractive offers. Driven by the incentive of monetary savings, the system intends to encourage the user to stop excessive purchasing, as a side effect this intends to prevent the generation of waste occurring at the consumer level. Theoretically creating an up stream ripple effect that will keep the waste at bay with the retailers, forcing the termination of over production.

2.3.1 System Overview

2.4 Automated Identification

For the fridge or application to be able to manage and monitor inventory, registration of a product is a vital. As mentioned in the previous chapter, the primary draw back of existing systems is the lack of automation in the registration process.

Convincing the consumer to change habitual behaviour such as restocking the fridge is difficult and will be met with resistance unless the newer

process yields better results than the current. Thus the user having to either manually punch in the product name, or having to scan each item with a barcode reader before the restocking process can be completed is unappealing and discourages the user from using the technology.

2.4.1 Current Item Level Product Identification Methods

Current methods of item level identification predominantly use barcodes. Barcodes are have been prevalent since the 199999 and have been used to identify items for years. These codes are made up of a of a binary number that uniquely identify a collection of items. The registration process requires a laser to scan the code and nothing must obstructs the line of sight between the code ad the laser. The smallest scratch or dirt can render the code unreadable. Barcodes hold very little data.

2.4.2 RFID Item Level Product Identification

2.5 Ubiquitous

2.6 Requirements Definition Report

A requirement definition report is provided to support the development of the new system. Here the requirements are organised into categories following the UML recommended presentation as described in the book, ?System Analysis and Design with UML? by Tegarden and Wixom. (Suggestion was taken from the Information Systems module as part of the MSc Computer Science.)

2.6.1 Non-Functional Requirements

Operational Requirements

- The mobile element system should be able to operate in an Android environment.
- The system should be portable and accessible from a mobile phone.
- The system should persist and read data from the database.
- The system should scan and register RFID tags.

Performance Requirements

- The user interface must constantly be active.
- The system should be available for use 24 hours per day, 365 days per year.

- Any communication between the clients and the server must not exceed 5 seconds.
- The system should be durable and preserve data integrity.

Security Requirements

- Only authorised users can use the system.
- Users may only see the content of the subscribed fridge.

2.6.2 Functional Requirements

Multi-user Support

- Any user should be able to join an existing fridge by entering the unique code provided to the primary owner of the fridge.

Information Viewing

- User should be able to view a list of their stocked items.
- User should be able to view the expiry date of the items with ease.
- User should be able to see the quantity for each item.
- User should be notified when an item is added to their inventory.
- Users may only see the content of the subscribed fridge.

User Registration

- Users should be able to login to the system.
- User should be able to logout by pressing the logout button.

2.7 Technology Analysis

2.7.1 Mobile Platforms

Why i chose android over iOS

2.7.2 Java

Android Java and JavaEE compare and discuss. Scalaroid? IAndroid studio inteliJ like IDE.

2.7.3 RFID

Currently used in xyz, provide examples. Different classifications.

2.7.4 Cloud Services

Getting rid of the burden of server maintenace.

Google and Amazon Web Services A bit of history

2.7.5 NoSQL vs Relational

3 Design

3.1 Design Strategy

Activity diagrams Sequence diagram

3.2 Architecture Design

Describes hardware software and network infrastructure.

3.3 Interface Design

How the user will navigate through the application. Navigation methods such as buttons and settings.

3.4 Database and File specification

Defines exactly what date is being stored and where they will be stored.

3.4.1 NoSQL Database

DynamoDB is a NoSQL key, value store distributed database designed by Amazon. The original motivation behind this was to cope with the massive amounts of data Amazon produces. The primary principal for DynamoDB is high availability, with data being replicated across multiple nodes if a node eliminating the single point of failure. Heartbeat signals are sent to the.

3.4.2 Internal Device Storage

3.5 Program Design

This defines the programs that need to be written and exactly what each program will do.

3.5.1 Delay Tolerant Networking

3.5.2 Distributed Authentication & Access Control

3.5.3 Multi-platform Consistency

$This may for the conclusion or implementation.$Security:

5.1 Unit test and mocking

5.2 Integration Test

6 Review and Conclusion

6.1 Security Concerns

look at link from George.