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**TIMELYNE: An OCR based Expiry Date Tracking system**

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1. Abstract

It is safe to say that all consumer items are perishable, whether in a matter of day or even if they last for years, they all carry an expiry date. The world today is extremely fast paced and usually there is always something that needs one’s primary attention, hence it is easy to forget ‘less important’ details such as the best before of the face cream one uses every morning or the jam that sits in the fridge. There are systems and solutions in place to halt this issue; to avoid using items that have exceeded their best before date or unfit for consumption and to avoid wastage of consumer items. Present applications are less likely to be used by the average consumer due to certain limitations they pose in terms of being convenient for daily use. This report highlights and describes the artefact designed and developed to address these inconveniences and give the consumer a reliable application solution to ensure maintenance of their items. The report explores the features and functionalities of the application in detail and the research and reasoning behind the development of the system. The report also explores the outcome of the development and explores the benefits, recommendations and future work for the application and its users. The report highlights the success of the artefact and how it achieves its aims and objectives.

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1. Table of Contents

[1.0 Introduction 9](#_Toc51629812)

[1.1 Background of Project 9](#_Toc51629813)

[1.2 Project Aim and objectives 11](#_Toc51629814)

[1.3 Description of Artefact 12](#_Toc51629815)

[1.4 Development of the artefact 13](#_Toc51629816)

[1.5 Structure of the Thesis 15](#_Toc51629817)

[2.0 Literature Review 17](#_Toc51629818)

[2.1 Introduction 17](#_Toc51629819)

[2.2 Waste products and Disposal wastage due to expiry 18](#_Toc51629820)

[2.3 Existing Expiry date tracking systems 19](#_Toc51629821)

[2.3.1 Cloud based Architecture of a Smart Expiry System with IOT Device 19](#_Toc51629822)

[2.3.2 Mobile Application for Medicine Expiry Date Detection 19](#_Toc51629823)

[2.3.3 Other General Expiry tracking mobile Applications from play store 20](#_Toc51629824)

[2.4 [OCR] Optical Character Recognition 21](#_Toc51629825)

[2.4.1 OCR used Existing System 23](#_Toc51629826)

[2.4.2 OCR used Other Mobile Applications 24](#_Toc51629827)

[2.5 Barcode system and available Barcode system 24](#_Toc51629828)

[2.5.1 The concept of the available systems and how it works 25](#_Toc51629829)

[2.6 Conclusion 26](#_Toc51629830)

[3.0 Methodology 27](#_Toc51629831)

[3.1 Planning and Analysis 28](#_Toc51629832)

[3.2 Requirement Gathering 30](#_Toc51629833)

[3.3 Design and Implementation 32](#_Toc51629834)

[4.0 Results and Discussion 35](#_Toc51629835)

[4.1 Functions 36](#_Toc51629836)

[4.2 Accuracy and Reliability of the System 38](#_Toc51629837)

[4.3 Conclusion 39](#_Toc51629838)

[5.0 Evaluation and Testing 39](#_Toc51629839)

[5.1 Evaluation 40](#_Toc51629840)

[5.2 Testing 47](#_Toc51629841)

[5.2.1 Test Cases for Registration and Log In 47](#_Toc51629842)

[5.2.2 Test Cases for Search Products 49](#_Toc51629843)

[5.2.3 Test Cases for Add Product (Manually) 50](#_Toc51629844)

[5.2.4 Test Cases for Add Product (Automatically) 52](#_Toc51629846)

[5.2.5 Test Cases for Update Product 58](#_Toc51629847)

[5.2.6 Test Cases for Delete Product 59](#_Toc51629848)

[5.2.7 Test Cases for Each Navigation Menu Bar Fragments 60](#_Toc51629849)

[5.2.8 Test Cases for Add Category 62](#_Toc51629850)

[5.2.9 Test Cases for Update Category Name, Prior Notify Date, Save and Delete Category 63](#_Toc51629851)

[5.2.10 Test Cases for Support 65](#_Toc51629852)

[5.2.11 Test Cases for Notification 66](#_Toc51629853)

[5.2.12 Test Cases for Logout 66](#_Toc51629854)

[6.0 Conclusion 67](#_Toc51629855)

[6.1 Overview of the project background 67](#_Toc51629856)

[6.2 Benefits of the system 69](#_Toc51629857)

[6.3 Limitations of the system 69](#_Toc51629858)

[7.0 Recommendations 70](#_Toc51629859)

[8.0 References 71](#_Toc51629860)

1. List of Figures

Figure 4: Architecture of cloud Based Expiry system…………………………………………….70

Figure 5: Structure of Medicine Expiry Date Tracking system………………………………….70

Figure 6: Architecture of OCR (Dhiman, 2013)…………………………………………….……74

Figure 6: What is your gender …………………………………………………………..……….75

Figure 7: Food or other product wastages………………………………………………..………75

Figure 8: Types of products waste more …………………………………………………...…….76

Figure 9: Solution to prevent wastage……………………………………………………….…..76

Figure 10: Developing an android application help to track of the expiry date………..…….….76

Figure 11: Problems found in existing system………………………………………………..….77

Figure 12: What age category are you……………………………………………………..…….77

Figure 13: Use case diagram………………………………………………………………..…….32

Figure 14: Work breakdown structure ………………………………………………….….…….78

Figure 15: Use of expiry date tracking system………………………………………….….…….40

Figure 16: Using expiry date tracking system regularly………………………………….………41

Figure 17: Quality of the TIMELYNE……………………………………………………..…….42

Figure 18: Understand ability of the TIMELYNE…………………………………………..……43

Figure 19: Features of TIMELYNE…………………………………………………………...….43

Figure 20: What ease the use of TIMELYNE…………………………………………………….44

Figure 21: Use TIMELYNE in long run………………………………………………………….45

Figure 22: Recommend TIMELYNE…………………………………………………………….45

Figure 23: Registration details……………………………………………………………………47

Figure 24: Login with user details………………………………………………………………..48

Figure 25: Searching…………………………………………………………………………….49

Figure 26: Add product manually………………………………………………………………...50

Figure 27: Expiry Date capture – OCR………………………………………………....……….52

Figure 28: Product name capture – barcode (Add product manually)…………………….……...53

Figure 29: Image capture…………………………………………………………………….…...54

Figure 30: Insert category, description and save (Add product automatically)………………….56

Figure 31: Update product……………………………………………………………………….58

Figure 32: Delete product ……………………………………………………………………….59

Figure 33: Navigation menu drawer……………………………………………………………...61

Figure 34: Test case 10 – Add category ………………………………………………………….62

Figure 35: Update category name, prior notify date, save and delete ………………….…………63

Figure 36: Support……………………………………………………………………….……….64

Figure 37: Notification……………………………………………………………………...….65

Figure 38: Feedback questionnaire …………………………..…….…………………………….80

Figure 39: Feedback questionnaire……………………………………………………………….81

Figure 40: Feedback questionnaire……………………………………………………………….82

Figure 41: Poster…………………………………………………………………………………83

1. List of Tables

[Table 1: Keywords And Abbreviations 8](#_Toc51634572)

[Table 2: Application comparison table 21](#_Toc51634573)

[Table 3: Phases of OCR (Islam, Islam and Noor, 2016) 72](#_Toc51634574)

[Table 4: Test Case 1 - Registration with User Details 31](#_Toc51634572)

[Table 5: Registration with User Details 45](#_Toc51634573)

[Table 6: Login with our Details 46](#_Toc51634573)

[Table 7: Searching 48](#_Toc51634574)

[Table 8: Add product (Manually) 49](#_Toc51634572)

[Table 9: Expiry Date Capture - OCR 50](#_Toc51634573)

[Table 10: Product Name Capture – Barcode 52](#_Toc51634573)

[Table 11: Image Capture 53](#_Toc51634574)

[Table 12: Insert category, Description and Save 54](#_Toc51634572)

[Table 13: Update product 56](#_Toc51634573)

[Table 14: Delete Product 57](#_Toc51634573)

[Table 15: Each navigation menu bar fragment 59](#_Toc51634574)

[Table 16: Add category 60](#_Toc51634572)

[Table 17: Update category name, prior notify date, save and delete category 62](#_Toc51634573)

[Table 18: Support 63](#_Toc51634573)

[Table 19: Notification 64](#_Toc51634574)

1. Keywords and AbBreviations

|  |  |
| --- | --- |
| Keyword or Abbreviation | Meaning |
| OCR | Optical Character Recognition |
| FAO | Food and Agriculture Organization of United Nation |
| CMC | Colombo Municipal Council |
| UML | Unified Modelling Language |
| NRDC | National Resource Defence Council |
| API | Application Programming Interface |
| ISBN | International Standard Book Number |
| DB | Database |
| OS | Operating System |
| GUI | Graphical User Interface |
| IOT | Internet of Things |
| QR | Quick Response |
| URL | Uniform Resource Locator |
| WBS | Work Breakdown Structure |

Table 1: Keywords And Abbreviations

# Introduction

This part of the thesis will entail the entire background of the project and analytical thinking for the implementation and development of the concerned framework. This further comprises the aims and objectives and emphasize the features of the proposed system. At last, the section explains the layout of the subsequent divisions in the thesis report.

## Background of Project

Since the world is made up of both living and non-living, it has now become complex in nature for living beings. Nowadays, humans always eventually evolve with the advancement of technology to make their hectic life easier. With their busy schedules, it is very challenging for people to remember things appropriately. Food is known to be an essential survival necessity for living beings, they can survive when the significant "food" necessity has been accomplished. And yet household waste that is resulted as a negative effect of packaged food still seems to be extremely unusual in the world. One of the issues that mostly contribute directly to this economic downturn is consumer negligence or inattentiveness about the relevant expiry date for food products as it is impossible to remember exactly the expiry dates of all the products.

In having a thorough understanding of this major problem, technology can probably be personalized to address this problem by tracking the "Expiry Date" through an architectural framework to notify consumers of the impending expiration. With the introduction of the application for product expiry date tracking system for android devices, the people in the existing generation were tremendously served. And that is why the necessity to introduce a mobile application for tracking the expiry date should take place in the technology field.

Besides that, it is taken into account that the application could be utilized on a wide range of products such as fabrics, medicine, cosmetics, and stationary appliances that would otherwise inevitably create severe side effects for the health by using after the expiry date. Thus, the software further verifies public health and safety. It is important to remember that sometimes a global threat like the one discussed above can be effectively and efficiently managed with an application that can be seamlessly integrated and powered around the globe, without any difficulties involved, and appears to have the potential to escalate quickly.

Most of the existing tracking systems are based on manual data inputs even though it is a software application and has incurred a cost of using them, but it is noteworthy that connectivity to fully automated and free software solutions for human time and cost management by such an expiry tracking application is an important requirement for all consumers in this existing technically sophisticated generation. The necessity for free and completely automated connectivity to these systems is due to the statistical fact which can be massively control the household waste. And can result for the prevention of dumping of household waste post to expiration and prevent causing an economic downturn.

Exploratory study into the existing expiry date tracking system has shown that consumers haven't really been impressed and inadequacy of the options that consumers ought, to keep track of the expiry date at its ease, as such trash appears to rise rapidly and contributes to an unsustainable world situation. Therefore, some innovations had to be performed to fulfil the needs of the consumer by assisting the users in the scenario of waste control. The developers have attempted to establish several methods to provide users with what they prefer, the technological tools used to maintain the standard and convenience in using the application are; OCR (optical character recognition) and the barcode scanning into a simple android application, with viable categorization of products for a variety of products. It will also be available free of charge to users, in contrast to the existing applications.

Food that exceed the normal expiry date tends to unavoidably fall into the group of household waste and continues in enhancing its statistics for annual assessment. According to the Food and Agriculture Organization of United Nation (FAO) in Sri Lanka mentions that a study of food waste performed, reflects that 63.5 percentage of the food materials granted by the Colombo Municipal Council (CMC) is to be waste of food material in 2016 (FAO in Sri Lanka | Food and Agriculture Organization of the United Nations, 2020). Equivalent incidents were reported around the world as in countries such as Turkey, where two thirds (2/3) of the population are involved in the wastage of food. (FAO in Sri Lanka | Food and Agriculture Organization of the United Nations, 2020).

Moreover, America estimates that its internal food wastage tends to happen within a wide range of sectors, such as farming, post-harvesting, processing, distribution and retailing in households and finally disposal (Gunders, 2012). This demands careful consideration from the downturn to mitigate further gigantic highly unstable wastage.

Within a specific short time span the development had to be accomplished effectively and efficiently in a way that it would spread through the consumers as a best solution with unique features that other system lack. Including the special tools, functions and structures used to design to best fit the necessity of users.

## Project Aim and objectives

The aims and objectives of the developed project are interacted with supply chain wastage, in particular food wastage. Perhaps it concentrates on safeguarding consumers from using expired products and mitigating the dangers that could cause to health.

Aim:

* To develop an application with the unique feature (OCR) Optical Character Recognition and the Bar code technologies to scan and keep track of product expiration dates to make the project more user friendly and functional.

Objectives:

* To highlight the limitations of existing systems and develop a solution that other existing systems could not provide for the beneficial to the users.
* To develop an application with Optical Character Recognition and Barcode technology that will make the data input process convenient for the user.
* To design and develop an android application with user friendly User Interface to allow users to categorize/manage their product expiries.
* To alert the consumer periodically before the very date of expiration.
* To evaluate the applications and methods of expiry tracking.

## Description of Artefact

The proposed system can apparently be classified as an expiry date tracking system based on OCR and barcode called "TIMELYNE" This is entirely a mobile application developed based on the Android version 4.0 or above with 1GB ram or above and also with 2 GB secondary storage. This application requires registration to enjoy the benefits of all the features the system offers. The specifications are highlighted in the section below.

This tracking system enables users to add product, edit or delete product details. The (OCR) Optical Character Recognition and the barcode can be used to capture the expiry date and the product name and other details automatically by scanning. This can be done manually either automatically as per needed. Also categorize the products as desired and set notification alerts before the product expires, and can edit the notification date according to how the user intend. Apparently, the user is given the facility to gain any customer support regarding and circumstances they face through the support option withheld. Adhering to fewer limitations, this system allows consumers to easily track the expiry date using these unique features.

Prior to the registration, any user can go through and understand the benefits and features of the developed system.

On registration, the user has the ability to enjoy the following functional actions;

* Can add, view and delete product details as needed.
* Allows to categorize the products as required.
* Can create, update and delete the category if essential.
* Provides the facility to set/ edit time for prior alert notification category wise.
* Allows to scan the product name through barcode.
* Facilitates to read the product expiry date through the OCR.
* Enables to track the expiry date in real time.
* Notifies and alert the users on the incoming expires of the products in prior to prevent expiry.

## Development of the artefact

After an extensive research into the technology field, the concept for the artefact was snatched. As a developer, enabling users with the use of advanced technology at the current situation was crucial, hence the concept of "TIMELYNE," compiled with OCR and barcode scanner, an android-based expiry date tracking mobile application was developed through the Agile Scrum methodology.

Once the project was confirmed, the succeeding task was to construct a project framework to ensure that the next few phases of the project will be accomplished in a manner that validates its implementation. Formulating a Work Breakdown Structure and Gantt chart empowered to allocate the activities that required to be fulfilled within the rigid time frame. The data acquired from the investigation intended to allow major changes that has to be made. It laid the groundwork for the selection of the most appropriate tools and technologies, interpreting all the functional and non-functional requirements, algorithms and frameworks necessary to accomplish the project goals.

The aspect was accompanied by a project proposal which address the general concept of what the artefact would include. Concerning the approval of the project proposal, an extensive investigation was carried out on the; Wastage products and Disposals wastage due to Expiry, Existing Expiry date tracking system, Mobile Application for Medicine Expiry Date Detection, Other General Expiry tracking mobile application from play store and further about Optical Character Recognition (OCR) and about barcode scanner.

In order to recognize how the artefact should be developed precisely and what kind of functions and features it should include in order to be a productive project at the end as all the consumers expect.

As to the constraints on date labels in consumer products, it has been discovered that a knowledge and understanding of the expiration date technology needs to be established within the user in order to significantly reduce the trash caused due to the expiration. The development of the system preceded the agile sprint methodology since it was thought that it would greatly influence the system’s development and enhance the proposed changes across each sprint on demand.

Since the existing systems were handled with manual input data, most of the time it appeared to be inadequate for the users to enter it manually rather than just automatically doing it. And therefore, it was mandated to an advancement in the system. In this context, if the common end users check the label erroneously or do not acknowledge the notification of the label, then there is a chance of false output such as false expiry date entered, hence that could lead to an inaccurate expiry tracking process. Due to such problems the developed system uses an OCR and barcode to recognize the best before dates and the product details including the name just by scanning the code according to customer engagement. The user receives expiration particulars of the relevant products without interruption. Thus, a fire-based, OCR-based mobile application was developed to track the expiry date. It has 1 primary participant: and that is just the user. Since this application is based on an OCR, the camera captures the expiry date, the application includes the description of the goods to be addressed to the consumer, can upload an image for easy navigation. The notification can be scheduled for a periodical alert as in a week prior or as demanded so that it helps to organize and minimize the wastage post to the expiration of the product.

Another significant feature is directly linked to the developed software is that it enables with the visual date. This is available on dairy, drink and cosmetic labels. In such products, the consumer can rapidly and efficiently enter or capture an image of the dates specified in the system on the OCR, the date of first use can influence the user about its expiration once the period of time has been vigilantly configured.

Moreover, the system facilitates the consumer to categorize the product such as food, fabric, medicine, stationery, cosmetics and leads to health issues when consumed expired, it can be further categorized as diary, vegetables, dry rations, fruits and meat etc.

It took approximately seven to eight months of time span to design and develop the system. Upon the implementation of all the sprints. Therefore, of the entire application’s, integration testing was carried out to ensure that the application runs as smoothly as possible according to its approved way. The outcomes of this testing are being used to determine the exact project acceptance proportion as a whole. In order to respond, testing was carried out with a limited number of users to gain feedback on the application's functions.

## Structure of the Thesis

This section describes the topics ordered hierarchically to disclose a productive flow of the thesis content.

1. Introduction

2. Literature and Review

3. Methodology

4. Results and Discussion

5. Testing and Evaluation

6. Conclusion

A summary of the project development, key characteristics of the project, primary functions, aims and objectives, and explanation of the artefact are shown in the Introduction chapter of the thesis to help the readers gain a sound understanding of the thesis report.

Chapters on literature and review, it further gives a general overview of the market research and literature review process the framework. Hence, it evolves the phases of the existing system's research and analysis compared to the accepted framework.

Methodology chapter, it Identifies the methodology utilized in developing this system. Since the project is assigned for seven to eight months, it was able to successfully complete the artefact with short sprints. In sequence to that the planning process, requirement and gathering procedures are discussed, and the design and implementation phase along with the UML diagrams that are linked to the project. Also, the other tools utilized in the development phase are also discussed.

Results and Discussion, this section outlines the ultimate result in each step, with the support of the attachments, and discusses in depth the efficiency, strength and weakness throughout the implementation and development phase of the assigned project.

When heading to the Evaluation and Testing part, it explains the testing and the evaluation procedure of the proposed application as well as with the test cases needed, to accurately estimate the success of the development.

At last the project's conclusion declares the thesis summary, emphasizing the development's disadvantages and advantages. It also states the future works and suggestions to be done in future in relation to the proposed system in order to improve the efficiency to a further extent.

# Literature Review

## 2.1 Introduction

The literature review section in the thesis report targets at rigorous analysing and evaluation of the esteemed published articles by professionals from their own relevant arenas. That very same study will assist in determining the entire area and the technologies associated with the field. This also appears to support the proposed framework with the relevant documentation for the system's functional and non - functional requirement and the limitations of the existing system. The study facilitates in stating the system potential benefit and significance.

A few reference publications within the literature review were examined and analysed just before the system was developed, yet it probably contributed to further discussion of the significance and necessity of the functionalities within the developed system.

The Literature contexts in this section was originated from browsing through the IEEE Xplore database, Swinburne Library Search and Google Scholar database and perhaps notably the paper research was limited to last eight years to ensure the reliability and quality of the articles referenced for the purpose of the system development. It encompasses published reports, papers and a detailed review of the existing expiry date tracking system and all of the other appropriate Technologies existing.

Essential papers, reports and articles from each of the following topics have been referenced and then coordinated to classify the most significant literature elements for the topic and those elements will be reviewed rigorously in the subsequent sections to describe and illustrate the requirement for the framework proposed.

**The topics listed in research are as follows:**

* 2.1.1 Waste products and Disposal wastage due to Expiry
* 2.1.2 Existing Expiry date tracking system
* 2.1.3 Optical Character Recognition
  + OCR used Existing Tracking system
  + OCR used other mobile application
* 2.1.4 Barcode systems and Available Barcode systems

## 2.2 Waste products and Disposal wastage due to expiry

As the essential need to survive is termed as food and yet food wastage created due to expired products are realized globally as an extreme issue. This issue was encountered due to several minor irresponsibility of the humans. As that made an impact on their managing capacity it led to misestimate of the food, inappropriate storage, misunderstanding of the needs, unnecessarily massive quantities purchased, poor planning and carelessness of the product expiry date. This has been the reason for building space for the products to be expired and disposed even before consuming them without the user’s knowledge itself. And it forbids the consumer in using them because that could lead to severe health problems afterwards. This problem created the need for a mobile application to be developed to prevent such occurrences.

Thus, considering more about dumping away food because of expiration. A research conducted by the United States National Resource Defence Council (NRDC) has confirmed that 40% of food is disposed in all household in the United States annually. It costs $218 billion every year to produce, for carriage, process and for disposing (Leib et al., 2016). Widely held economic value has certainly been degenerated as an impact of food wastage. Moreover, every household in the U.S. junkyards 25 percent of the food bought prior to consumption itself, and if the U.S. curtails food wastage by 5 percent, which would be sufficient to supply a projected 4 million people (Gunders, 2012). When denoting to researched documents it has exposed that food wastage in developing countries is considerably less in relation to developed countries.

Consequently, the developed mobile application would prevent from wasting food and supplementary expiable products, which would encourage us to keep track of the expiry dates of the food and alert the user once the product is nearby to expire.

## 2.3 Existing Expiry date tracking systems

### 2.3.1 Cloud based Architecture of a Smart Expiry System with IOT Device

This is a novel cloud-based smart expiry system which is formed to direct notification to the user's mobile phone through internet from the device (IOT) that has been previously pinned to the refrigerator (Tareq Hasen, 2018). Such notification alerts the consumer regarding the goods that are closer to expiry. Accordingly, the user is able to retain accounts of it and implement appropriate actions. This platform also offers personalized smart-expiry card for the consumer to swipe it into the device's (IOT) checkout operator affixed in the refrigerator. The counter administrator sends the expiry information recorded in the counter to the cloud database, then the user's smartphone expects to obtain the necessary data from the cloud-based database and then mobile app is prepared to receive notification alerts in relation the products expiry details. In the event the user may not have the smart-expiry card in store with them as shown in Figure 1. Then as a substitute option the user can easily scan the Quick Response (QR) code previously printed on the back side of the receipt and then subsequently for scanning the QR code the consumer will generate all the data on his/her mobile application including all the product expiry information. Hence, this platform does show up such resolutions to keep track of the product's expiry date to lessen wastage.

### 2.3.2 Mobile Application for Medicine Expiry Date Detection

It is very obvious that consuming of the expired medicines especially can badly affect the user and it could lead to severe health constraints such as; destruction of a person’s health, long term and short term side effects also has chance of causing to death. Realizing the expiry date of a medication is therefore critical. Thus, this mobile application is established to keep track of the medicine’s expiry date to avoid such circumstances. Nearly all the products have their unique barcode numbers, and the barcode can classify only a limited necessary data such as the name and price of the products from already warehoused in supermarket systems or pharmacies. This application has been developed using an emerging Quick Response (QR) code scanning technology it consist of two-dimensional (2D) encoded barcode matrix structure composed of black grids organized on a white background because then users can use the smartphone camera to scan a QR code to quickly identify medicine details (Figure 2), which would include the expiry as well (Ramalingam, Puviarasi and Afiqah Binti Zakaria, 2018).

So if the bar code is destroyed when the labels and other tags are scratched off or squashed then the users will not be able to scan and detect the QR code over the use of the smartphone camera. However, since this system actually offers such viable alternative ways to keep track of the product's expiry date to prevent wastage?

### 2.3.3 Other General Expiry tracking mobile Applications from play store

Most of the existing applications are bound with manual data input and not precisely attractive for the users and certain software are incorporated to track the expiry date only. So therefore the users considered those as a constraint and restricted the usage from those applications as those were not helpful as expected for keeping track of the Expiry Date of the products. Yet there have been presently no reliable applications that have really incorporated an OCR-based product expiry tracking application. Nearly every other application are with equivalent aims and objectives to prevent product wastage and allow consumers save resources. For example, Expiry Wiz (Expiry WIz, 2020), BeepScan (BEEP-Barcode Scanner Expiry Date, 2020), Best Before (BestBefore, 2020) and so forth.

These are some of the similar specifications found in most of the expiry date tracking applications:

* Unlimited number of products that items can be tracked.
* Categorize items into groups as needed.
* Maintain your own groups of items.
* Product images can be attached for quick navigation purpose.
* Expiry notifications and alerts can be set.
* Create/restore backups in order to safeguard your data.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Available Application | Expiry Wizz | BeepScan | Medicine Expiry Tracking System | Cloud-Based Smart Expiry System | Proposed System |
| Track Expiry | Yes | Yes | Yes | Yes | Yes |
| Expiry Alerts | Yes | Yes | Yes | No | Yes |
| Item Grouping | No | Yes | No | No | Yes |
| Feed Product Details | Manually | Barcode | QR Code | Manually | Barcode |
| Feed Expiry Details | Manually | Manually | QR code | Manually | OCR |
| Application Cost | Free | Free | Paid | Paid | Free |
| Scope of People/Used By | Everyone | Everyone | Only Industries | Only Industries | Everyone |

Table 2: Application comparison table

## 2.4 [OCR] Optical Character Recognition

Ever since the OCR was not popularly been used due to the obvious technical limitations in the industry. Even though it was actually built and introduced to the field years back, presently after conducting a little deep research over it for several years, finally now it has been popping up in the field. The use of OCR has indeed managed to reach a standard level and with existing advanced technologies, it’s been a while since on the digital market. Previously, OCR based techniques were designed only for computers however most of the OCR applications are modern world environment based. The smart phones seem to be very innovative nowadays, and therefore the mobile applications invented with OCR and other advance technologies are playing a dominant role in the digital market currently.

Optical Character Recognition (OCR) is a software that changes written text, printed text and images in to the digital format, so that only a system can examine it. The electronic devices are capable of understanding only the digital language and not the analogue text or characters from an image as the human brain. OCR is comprised of extremely extensive series of languages, fonts and styles that text can be sometimes be written in the image along with complex language guidelines. Then as a solution to such issues numerous alternative methods have been utilized to diagnose the limitations such as; language processing, image processing and pattern recognition etc. (RAO, 2016).

Extensive OCR phases, such as acquisition, pre - processing, segmentation, extraction of features, classification, and post-processing (Table 2). Using a sequence of these phases, a suitable and well-organized OCR system with relatively low opportunity of triggering mistakes during processing can indeed be developed.

There are several Optical Character Recognition Engines accessible such as (Tesseract, Transym, Nuance, Dual-OCR, Chronoscan, Microsoft Azure, and etc), the OCR engines can be featured. Hence deciding of an OCR engine is based on the anticipated performance and the system that is to be developed. Besides, only limited number of the OCR engines are available on open source and free.

The system that has been established is a mobile application which was developed in an android platform. Thus further, these are just the few main optical character recognition engines designed exclusively for android with tesseract and the following engines available are such as; Tesseract OCR, Tess-Two, Android OCR, Openalpr-Android, ONYX, etc (Android Store | OCR Engines, 2020).

Tesseract OCR symbolizes as an open source engine. This package consists an OCR engine – libtesseract and a tesseract command line program. Tesseract 4 adds an entire new OCR-based neural net (LSTM) which is concerned on line recognition. But that also supports the legacy Tesseract OCR of Tesseract 3 engine that functions by distinguishing the character patterns. Tesseract has a Unicode support (UTF-8) and can detect over 100 languages. And it also supports numerous output setups such as hOCR (HTML), TSV, PDF, etc. Tesseract can be trained to recognize other characters, symbols or languages (tesseract, 2020).

The architecture of the Tesseract OCR is comprised of 4 steps as shown in Figure 4 and define below;

1. Adaptive thresholding- this stage utilizes the Otsu’s method to convert the image to binary that can be understood by the computer.
2. Analysis of connected components - this actually recognize the blocks of text within the document.
3. Finding lines and words- the orderings of each line are recognized and text will be segmented into words using space.
4. Recognize word is performed in two pass operation. In the 1st pass, the word recognition happens using the static classifier. And will be passed to an adaptive classifier. The 2nd pass runs through the entire page and classify the new words which are not realized in the pass one (Nair 2016).

### 2.4.1 OCR used Existing System

Abbyy Fine Reader [Fine Scanner Pro] –

The consumer is divided into three classes of consumers, and this version is completely paid. This helps to change the scanned documents to the format of MSoffice, PDF, or any other format. Abbyy FineReader can convert data structure to batches, it can stand up to 192 languages without break or complications. This application is fairly well recommended for the digitalization of accounts in the OCR field, (for&nbsp;Windows, 2020). And the mobile version of this scanner is named as FineScanner Pro (by Abbyy) which has mutual features as the Abbyy FinerReader, this application can however scan any other kind of comprehensible document and convert it into PDF or any other necessary format (‎FineScanner PRO-PDF Scanner, 2020).

Adobe Acrobat Pro DC-

- This is an application charged on monthly subscription and for two users. This application could even access to documents from any destination, irrespective of which device has been used and it continues to maintain the integration and modified features such as comments and feedbacks and scanning the documents, the scanned files can be corrected or altered etc. This can also completely monitor the shared PDFs, and expects to receive an email with a link to the shared PDF without complicated attachments. (Adobe Acrobat DC | Adobe Document Cloud, 2020).

### 2.4.2 OCR used Other Mobile Applications

MS Office Lens - Free mobile application, but in accessing to the application it requires a Microsoft account. This software enables users to share files, save images locally, print etc. It is capable of managing OCR in a digital set-up on a JPEG format file. This structure functions with the synchronization of OneDrive and Microsoft Word, so a Microsoft account was mandated by the user. The procedure of this system is to save the taken image from the mobile to OneDrive as a.docx file and then to computerize the document when the file is opened in Microsoft Word. OfficeLens has four main scanning options which included Business Card, Documents, Whiteboard and Photo.

For example; files can be saved as PDF, OneNote, PowerPoint, or can be shared to Outlook or any other emails (Get Office Lens - Microsoft Store, 2020).

## 2.5 Barcode system and available Barcode system

Smart phones are now incorporating with new innovative types of features, such as capturing pictures and trying to film movies using inserted camera devices, and the innovation is highly reliant on the device technology. Likewise, embedded camera devices could be used as advanced interfaces for data input, such as semantic character recognition and syntax recognition.

Such as European Article Number or EAN Barcode (1D barcode) and QR coding (2D barcode) uses the smart phone which actually enables symbol acknowledgment with the camera devices and both coding symbols have been led to greatly access telephone network services to sight the URLs or characters of those addresses.

2D barcodes in mobile apps have already obtained the audience's attention for different reasons. Initially, as the camera phone snaps generally 2D images and snaps 2D barcode images straight. Apart from previous laser-based 1D barcode scanners, which demands hardware alteration, it could be used as a 2D barcode scanner, and barcodes could even be clicked straight from a mobile camera device. It used limited technology devices rather than manual entry through keyboard (Seo and Park, 2016). It is crucially significant that 2D codes have considerable speed that enables a system skilled of integrating the real world of publishing on the Internet with the cyber world. In specific, the most primary attribute of 2D barcodes is to allow access to digital information about advertised goods and services in print media.

It is that approach was intended in contrast to the current mobile architecture which integrates an fixed camera and a processor for application. That approach used the spiral scanning technique to analyse significant horizontal black and white bars for 1D barcodes, and to discovery of the code area by sensing the four corners of the 2D barcode (Ohbuchi, 2012).

Steps of the processing a barcode: -

1. Grasp the source image via an embedded camera.

2. Process the image-The code is identified and analysed from the captured source image and the image analysed throughout this step is created in the code as a standardized size and binary image area.

3. Decode the code - the system, the code transmitted in the previous steps will be decoded and the decoded code will be produced for the application software.

4. Display the result – The application displays the decoded outcome.

## 2.5.1 The concept of the available systems and how it works

Market Station Vendor machines – These devices are constructed in small size and shapes with a touchscreen interface on them, that can be installed anywhere in public places such as bus stands, train stations, public markets, malls, etc. The target audience could therefore easily obtain the desired product from the vendor's machine without using cash (Mostafa, 2015). For an example, Many, travellers does not hold cash in hand nowadays due to the extreme modern technology advancement that makes them feel easier and more efficient to carry cash, so just by touching the vending machine screen to choose the sort of product (e.g. drinks), the product category (e.g. Hot or Cool) then choose the product he wanted (e.g. Coca-Cola) and at the last the machine will pop a the payment method by providing a Barcode or QR code, Accordingly, by scanning the code via the smartphone by using third party payment implementation that renders the payment online via a debit card or credit card (The Barcode Reader Embedded in Vending Machine via MDB Protocol-Barcode Scanner, QR Code Reader, OEM Barcode Scanner, Barcode Scan Engines, 2020). Such as the above situation, internet-based purchases could be carefully done by capturing the QR code presented on the website (payment page), which is easy and convenient than inputting the number of the card or completing out the form.

Mobile QR code & Barcode Scanner – This implementation is merely built with QR & Barcode scanning technology that has the ability to scan barcode and QR code of any product certainly by indicating the camera in this system that will begin for scanning mechanically. It is not necessary to press any buttons or click on the screen, it will automatically alter the label focus and conveniently read the label, and offer the user with the necessary information. They can scan and read this all type of QR and Barcode, including text, URL, ISBN products, contact, calendar, email, location, Wi-Fi and many more other formats. This system also can use QR or Barcode to scan a coupons or coupon codes to get discounts (Gamma Play Games and Apps for Android and iOS, 2020).

## 2.6 Conclusion

The rapid increase in wastage globally is due to product expiry, and it contributed to a disposal minimizing, automated, flexible and user-friendly framework. The system, as per the study, has fulfilled the user requirement to a level that consumers are still willing to look for a more enhanced form for easier use. These systems modernized the technical field and provided several remedies to the consumers. The literature review made it possible to develop the launched system in a more appealing and user-friendly way by combining the key features required by the users.

Assorted approaches to minimize waste have been implemented. One such mechanism is by keeping track of its expiry dates to allow customers use products while it is still useable. There are several technological solutions for tackling with this problem. Existing smartphone applications that attempt to solve this problem by providing functionalities of expiry date tracking system, mostly provide alerts to inform consumers of oncoming expiries.

The awareness obtained from the literature has authorized an advanced version of the system in a user friendly and flexible platform to be established to serve the consumers. The established expiry date tracker is a system based on the OCR and barcode reader to improve user enhancements when inputting data.

The literature highlights system design in order to create easy techniques of data input through OCR and barcode, classifying and grouping items as required, facilitating easy navigation images as per customer preferences. The primary and secondary research conducted, which confirms the system would be a potential achievement, can encourage every feature of the system.

# Methodology

This thesis's methodology section discusses the strategies introduced to tackle with the project, including the development methodology planned upon. Furthermore, how data and information were collected and evaluated is also mentioned in the section. In this section, the tools needed to accurately develop the artefact would also incorporate.

Selecting which methodology would be flawless for the selected project to be developed vitally, therefore, it can take over the entire project's performance. The use of Agile Scrum methodology has now been finalized in spite of the fact that the application is centred in a direct connection with its users, flexibility and mainly by focusing in the need of the project, this methodology would be advantageous to the project ((Kataria, Shrivas, Shukla and Hemlata, 2017)). The methodology enables for analysis of the requirements at the beginning of each sprint which aided small necessary changes and thus, reliability could be maintained and required adjustments could be made during the testing phase. Agile scrum methodology has three characteristics.

Agile scrum methodology characteristics

* Quality preserved – at each development sprint it has verified whether this meets the set standards.
* Flexibility – No restriction on artefact implementation, system modifications can be made whenever required.
* Time limit-As the proposal seems to be massive, methodological sprints makes sure that they are accomplished within a set time period.
* High user interaction- while development can be tested after each sprint, feedback from real users can be included in the implementation.

## 3.1 Planning and Analysis

System planning constitutes the backbone for a successful project. Each system requires a way to implement and create it. The planning phase was pursued with a detailed review into the innovations necessary in the field of information technology. The concept for the artefact was snagged following an intensive analysis of different records and articles in the form of online articles, books and reports.

Afterward, it was inspected if the chosen topic was attainable. The underlying problem discovered was having to sort out the topic. Digitalization is evolving day by day and reintroducing an improvement in the system software was absolutely important. And hence, it was essential to investigate numerous different subjects that led to the identification of several topics, almost all of the research topics would have been much more powerful and it would be completed within the time frame, while the others would not face that much of the hurdles in handling it.

While there were different opportunities of which part of development the artefact would concentrate on, an advanced automated efficient system requirement was satisfied. Since the existing systems had so many restrictions, it contributed to the formation of a mobile tracking application system based on android version. More such research prompted to an advancement of the system by involving the OCR and barcode scanner with time. OCR was witnessed that it could draw a huge impact on the users positively as it has the ability to capture the expiry date automatically without the need to enter it manually.

The development of the project proposal accompanied with this precise understanding with a brief explanation of the artefact, certainly stated goals and objectives for the system and viable methodology was used to accomplish the work.

Concerning the acceptance of the project proposal, it was essential to conduct extensive development research and to obtain all the considerable requirements besides project design and development in order to fulfil the needs of the system's intended audience. And the tools that would appropriately suit the nature of the project has to be selected, and it was finalized to use the android studio IDE.

Effective time management throughout the construction process of the project was a major factor to be encountered. As mentioned in the review Agile scrum methodology was used to design the application. Therefore, time allocation was built for each development stage. Planning should be held out taking into account the importance of each task, and time allocation should be accurate, using the methodology and within seven to eight months to effectively and efficiently finish the project. Work Breakdown structure was determined initially to simplify the major tasks. Gantt diagram shows (Figure 5 & 6 – Gantt chart), all the details regarding the task to be performed, the time allocated to the task. As the huge work load was split into small sub parts to make the work much simpler and that was done in 3 sprints.

In the planning stage of the project every necessary step and the significant decisions in relation to the features to be adapted by the system, tools and technologies, methodology and the model of the project, scenario and the aims and objectives to be achieved was crucially paid attention to finalize accordingly with the help of research works performed.

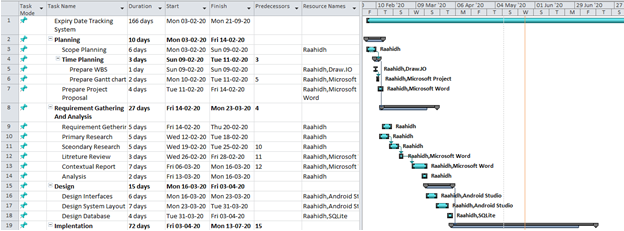


Figure 4: Gantt Chart

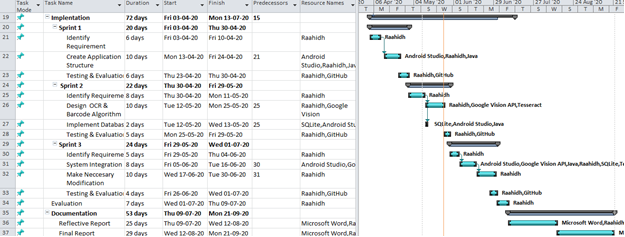


Figure 5: Gantt hart

## 3.2 Requirement Gathering

Requirement collection is a phase of knowing the requirements of the intended audience by conducting market research. Significant and contributory research was mandated during the requirement and gathering procedure to discover the adequacy of the topic. A consumer assessment was conducted, and researched papers have been used for this project work.

Literature review and market survey on existing platforms were the main approach for information gathering. The IEEE Xplore database, the Swinburne Library Search and the Google Scholar database were just some relevant and reliable sources used for literature review. Taking into account the most recent years of articles in the last eight years and gather details to preserve a qualitative up to date research area and to explore highly regarded information and specifications required through the application, the system has integrated the most suggested and crucial functions. The expectations for this system and the further improvements to be made could be verified in later part.

During the process of finding relevant study materials for the research, the following keywords were found;

* Food and other wastages
* Expiry date tracking system
* OCR
* Technology in wastage control
* Barcode

Throughout this investigation, the most relevant articles and documents were recognized and, once each article that has been collected, it was then browsed to confirm the relevancy to the topic in order to make sure that the finest data collected has been used to rationalize the development of the proposed artefact.

To ensure that the production meets the target audience's demands, a questionnaire was submitted to potential system consumers to spot out the limitations of the current system and also to fully comprehend what alterations or features target audiences needed in an expiry tracking system (market survey attached in (Appendix B)). The feedback to this market survey was able to make sure that the necessary functions are added to this system.

The functional requirement and non-functional requirement for the proposed system is shown the following table below.

|  |  |
| --- | --- |
| **Functional Requirements** | **Non-Functional Requirements** |
| Ability to insert, view and delete product details | Capable of handling many users simultaneously |
| Ability to categorize the products | The accuracy and reliability of information present in the system |
| Ability to read the product name through Barcode | Scalable with the growth of users |
| Ability to read the product expiry through OCR | Ability to maintain and update the system |
| Ability to track the expiry date | Ability to use by all the levels of users |
| Ability to notify and alert the users of incoming expires |  |

Table 4: Functional and Non Functional Requirements

## 3.3 Design and Implementation

To guarantee the effective implementation of the system the design of the application holds a vital position. The awareness of the application’s purpose will be contingent on making an effective design. The designing stage of the project represents all UML schema that are highly grounded on the determined necessity for the application. These UML diagrams, including the use case diagrams, are additionally deliberated below in order to entirely realize the application and how it operates, supporting in the real implementation of the system. (Figure 2: use case diagram).

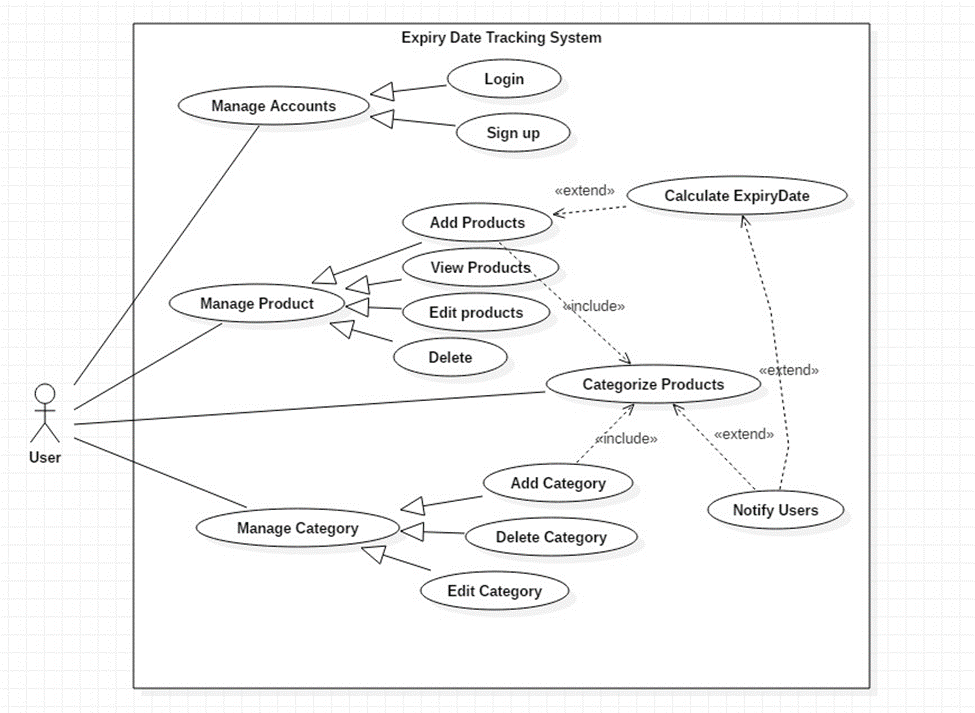


Figure 13: Use Case Diagram

Use case diagrams to help to confirm that the appropriate framework is created by searching for the specifications demanded from the consumer's point of view. It makes it easier by splitting down the software by merely relying on its key functions only (Elenburg). As shown in (Figure 2: Use Case Diagram), the application has only one participant; the user itself. Users are required to register to an account and then login. The users are bound with ample amount of access to the features in the application that is built with, the user is given the ability to manage the account, product and manage the category. In the scenario of managing the product the users, are allowed to create/add, view, edit and delete the product details as per the requirement, commonly in managing the category also allows to create, edit, and delete the category. Whilst the user manages the products and category, they can calculate the expiry date of the product through OCR and set notification alerts for consumer’s easiness. Thus, all of the above-mentioned features are accessible after the user login to the system through registering to an account.

If the proposed system ought to be implemented, it is essential to establish a design. The tool used for the designing of this project was Android Studio IDE by using the java programming language. According to the research, the tracking application deemed necessary to be more user-friendly and enable automatic data input in ease rather than manual, and this formed framework satisfied the user requirements as well as being an adaptable framework that tends to make adjustments anytime the system requires.

The proposed system was subsequently approved and integration of the OCR-based application had to commence. As it was initially decided to utilize a local SQLITE database, the researcher was just not aware with the SQLITE database as well as login and other constraints were found. As a result, few disadvantages in the local database were experienced mainly such as; the data (log in details) does not get saved to access easily from anywhere and any device and the user had to enter the credentials every time they log in, this in a way restricted the access to the software from other devices conveniently. Therefore, it was encountered to be unlikely to succeed thus, it was finally agreed to create a complete fire-based database since it was capable of reducing problems confronted before. A firebase database will indeed support cloud data backup as well as login can be easily integrated through firebase authentication, the cloud base database can be accessible from anywhere and from any device.

Designing includes case diagrams to be used with the UML to illustrate how the system performs. Following the design of the system, the development of the system was carried out in three stages according to the WBS as shown in (Appendix C).

The first sprint focused on the design of the fundamental UIs that paved the way to the foundation of the expiry date tracking system. Following this, it was decided to implement the OCR and Barcode framework. Apart from WBS, it was challenging throughout the development to join in OCR even it deprived of full implementation of the functions within the system concerning the decision on the framework, the WBS claims that the database was applied with the help of google Firebase. This enables convenience and comfort and flexibility in operation.

Following this step, the OCR and Barcode was implemented in the system to scan the expiry date automatically and other product details through barcode scanning according to the framework approved on. As per the research conducted, all the components were incorporated after the finalization of the phase.

The selected tools and technologies to build the system are listed below;

* Microsoft Word: this was used to create all documents throughout the project period.
* Android Studio IDE
* Java programming Language
* Cloud Firebase Database: was used to store all of the mobile application data as the database storage
* Firebase Authentication: was used to create user accounts and authentication function of them
* Firebase Storage: was used to store the actual images that are abundant throughout the application
* Draw.io

At the later part of each sprint, appropriate testing was conducted in for each module, integration of all of the other elements, extensive testing and evaluation was done in order to ensure the system's accuracy and consistency.

# Results and Discussion

This part of the thesis provides the respective overall system functionalities with the aid of reference and diagrams for better understanding. Moreover, it also clearly demonstrates the reliability, accuracy and strength and weakness, the operational problems experienced during the development phase and how these barriers were technically fixed to achieve the aim and objectives established at the start, along with the user requirements, in order to create a successful system that fulfils the requirement.

The main purpose of this chapter was to provide a detailed analysis into all of the project's features and functionality while portraying each one's significance. And mainly for understanding the “TIMELYNE’’ expiry date tracking system for top to bottom.

Mainly, the TIMELYNE’s interface was structured to take into account the absence of features that users require to minimize waste and other constraints that other systems encounter. As a result, each software was developed incredibly interesting and in an interacting approach to develop the rate of flexibility and efficiency.

It was found that most of the user requirements was to minimize their time spent on such technology aid and get the maximum benefit that the digital world would offer. And yet there are solutions found as to tackle with their practical issues even though they are not brought into practical test much. Hence through the research conducted it was able show such wonderful solutions back into the industry to serve the users at its best. In the same, OCR feature was popping up with a fascinating feature that all the users would get attracted to. Therefore it was then decided to build this system integrating the OCR feature. That allows to scan the expiry date automatically without the need for manual input.

## Functions

Once the application is installed the initial details to be entered is the LOGIN details in the login screen to use the features of the application further. Then, once the initialize process is completed it will start to authenticate the details entered to verify the user when the log in button is clicked. As the system is developed using a Firebase a Firebase authentication takes place. As soon as the user logs in the user will be redirected to the main page. The user is then given permission to access to all the feature or functions provided by the application.

If the user is not already registered, it is important to REGISTER entering the appropriate details/ using an email to login. After the sign-up page is displayed once you click the sign-up option in the login page, it is possible to get registered by clicking on the CREATE ACCOUNT option. Then the new user will be registered whilst the Firebase authentication is processing, hence, through the successful registration of the new user, the details will be stored in the cloud store in the firebase database.

The user is able to search for any product that is already been added for tracking purpose for any editing, deleting or any other alterations the user wants to make. Once the menu bar is clicked a fragments of categories that were added will appear. Hence if the user requires to search for a product they can click on the desired category fragment then all the products will be viewed under that navigation menu drawer, for this function to continue further the user is bound to click on the search icon on the navigation bar at the top of the screen in the application so that it will be easy for the user to search for the required product faster. Whilst the user type the letters of the product, every products in that category starting with those letter will be suggested. Also there is an option called “ALL” in the category fragments, basically that option views all the products added for tracking irrespective to the categories. By clicking on the search icon, a search bar will appear. There, by entering the product name, the barcode manually or by scanning, the user can search for the product exactly that they wants to check through.

Selecting the “Add Product Button” on the bottom of the main page, will then direct the user to the OCR scanner to scan the expiry date automatically of the product and then in order to capture product name automatically the barcode scanner will be opened after the OCR is read, next the camera will open to capture the product image. If necessary it is also possible to enter the details or barcode manually by clicking on the manual option at the beginning on the add product button click. A select category option will be displayed with the already added category list, if necessary, it is possible to add/ edit a new category from the menu option “Add or Edit category”. Once the select category list pop ups the user is supposed to select the respective category. Further an additional description to the added product can also be entered in the description field.

The user can personalize the categories as per requirement. For this purpose there is an option developed in the menu bar named “Add or Edit category” by clicking on it the user can Add or Edit category name. Consequently by clicking on the Add option in the Add or Edit category in the screen that appears a new category name can be added. Also, when u tap on the uncategorized or categorized name list, a list of options as change category name, edit notification date, and delete category options are available. For the user convenience to personalize it as they are comfortable with.

There is a support option created for usefulness of the users to get any support regarding anything faced upon the application. Or any complains also could be made. The support option is incorporated in the menu options. Once the user click on the support option the user will be directed to the email in your smart phone, there a screen will be displayed with a subject and message box. The user is supposed to enter the subject and message they wish to deliver.

## 4.2 Accuracy and Reliability of the System

The accuracy and reliability of TIMELYNE is decided by determining if it meets its objectives and achieves its aim. The application, upon evaluation should produce the expected results and should work as expected.

The application should be evaluated in accordance to its purpose and whether this purpose is met, and the users are able to achieve the purpose of using it. TIMELYNE is an expiry tracking application and it needs to ensure that throughout the application it is designed to serve that purpose and allows its users to track and maintain their products/items. The accuracy of the application refers to the accuracy of the output it generates, i.e. for instance if notifications are generated at the expected intervals specified by the user.

The application needs to be further evaluated to see if its functionality works as expected. The application needs to be able to maintain a realistic reliability rate. TIMELYNE measures a 70% success rate for its OCR and Barcode reading functionality. The success rate depends on camera input, lighting conditions and clarity of the values on the item.

## 4.3 Conclusion

As certainly discussed in the section above, "TIMELYNE" is an application for expiry date tracking that is registered with multiple features and functions for the user to seamlessly decrease and handle household waste in this current hectic lifestyle.

The functions and features are formulated in the system plays a significant role to the system's aims and objectives. Each of them has been formed with serious contemplation on how this all would perhaps best support the framework to work efficiently, as well as the consumers who use it.

The system's functionalities are really so adaptable and user-friendly, attempting to develop it as simple as anybody with little or no expert knowledge can connect to it.

# Evaluation and Testing

This section of the thesis concentrates on system assessment as queries. The content will underline the system testing to verify that the system operates seamlessly among the users.

This section will highlight the testing and feedback acquired from users who have accessed the system. While the last step in SDLC testing the software was indeed a crucial accomplishment which discloses the software's success or failure amongst all the work and dedication. And perhaps the effectiveness of the system is demonstrated to guarantee that it is established in line with the specification standards. The finalized aspect of the project will be tested with unit testing at each sprint, after that integration testing just after reaching the end of the system components, then the final acceptance testing will be performed out by the intended audience after the final sprint.

## 5.1 Evaluation

Along with the test that composed of numerous responses, a response questionnaire was administered to each person (Appendix D) to submit in order to gain their opinion.

This is yet another aspect of the phrase of implementation and the framework will be evaluated at every implementation sprint. This process is to ensure adherence with the necessary requirements as well as the system has been developed as an error-free system. Since Evaluation is indeed the process of estimating whether the project is a successful attempt. Thus, the proposed application specifically deals with consumers’ acceptance, it was suitable to analyze the market survey on existing systems with their functionality as well as inadequacies in order to determine the features that have not been established by the current systems and the features that the community needs to see in an innovative one.

The market research conclusions empowered the developers to discover the exact involvement of a large number of targeted audiences in the proposed application.

Market analysis conducted to assess the significance of an expiry date tracking system, and the demand for the proposed system was highly beneficial. It aimed to determine what people are expecting in the implementation, and what the current systems have certainly lack.

Based on the current study results in this survey, it's indeed obvious that a crucial number of participants are focused with the preventive measures of waste and food wastage seems to be the most impacted among the wasted expiry products. It is also clear from the research that the software framework is of excellent benefit to people and would find it very favourable.

Since everyone wants to engage in their daily life with smart mobile phones. It represents a strong concept of what improvements are expected from participants in existing mobile applications. A significant majority of respondents assume that manually entering data into the system takes more time and pressures them to utilize a system that is not user-friendly, since the system proposed is fully automated, neither of the information will have to be manually provided into the application, which makes a significant contribution to almost every other disadvantages discovered by the participants in the study.

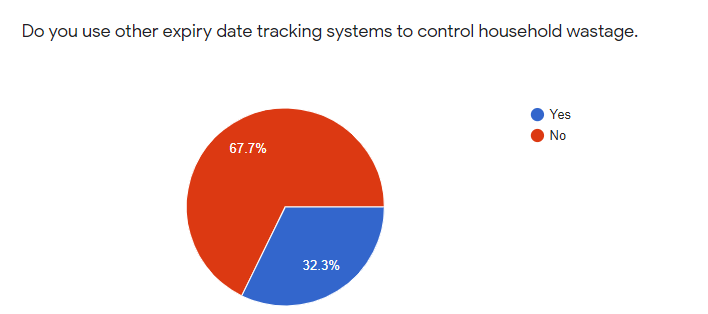
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Figure 15: Use of expiry date tracking system

The evaluation results obtained through an online questionnaire to find out the user’s response over the expiry date tracking system depicts that 67.7% of the response has not experienced any kind of an expiry date tracking system where as only 32.3% out of the respondents has practiced such software for their household waste management purposes, (as shown above in the figure: 15)

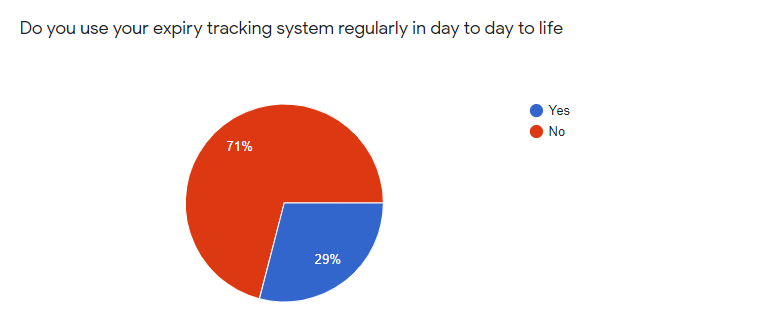
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Figure 16: Using expiry day tracking system regularly

It was clearly exposed that people are not much evolving with the trending technologies as the majority of the respondents with 71% does not utilize an expiry tracking system in their day to day life due to unawareness or other technical issues and however, 29% of them are habitually using such expiry tracking system those who are updated with the evolution in the technology. (As shown in the above figure: 16)

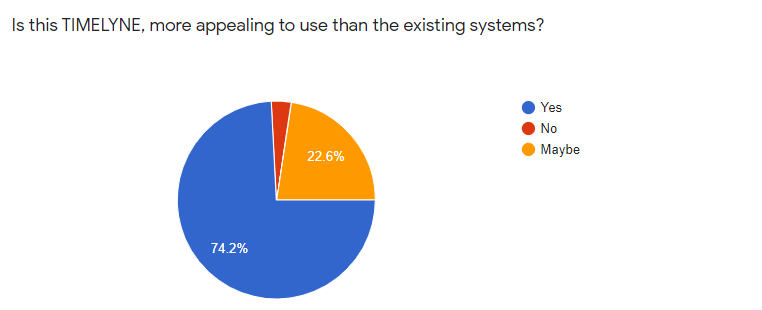
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Figure 17: Quality of the TIMELYNE

As the testers tested on this developed system “TIMELYNE” experiencing it practically the unique features and functions integrated in the system. And according to the questionnaires submitted by them it was realized that the majority more than 50% accepts that TIMELYN application is more appealing/ attractive in contrast to the existing expiry tracking application whilst a small count of testers less than 50% has responded without a clear mind as a middle choice. And less than 5% has negatively respond. Meanwhile the TIMELYN provides an unique feature OCR reader it has overwhelmingly facilitated the users to scan the expiry automatically as the users expected and was it not available in the existing systems. This is witnessed in the (above figure: 17).

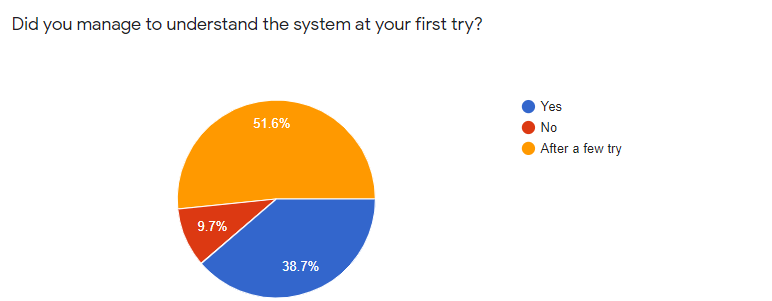
****

Figure 18: Understand ability of the TIMELYNE

As the system was a new scenario for most of the testers they happened to understand the overall system after a few try as illustrated in the figure with 51.6% and 38.7% understood at their first try itself however, less than 10% could not comprehend at once. This describes that how simple and conveniently the system has developed, even for the new users to understand entirely in just few tries. (This is illustrated in the figure: 18)

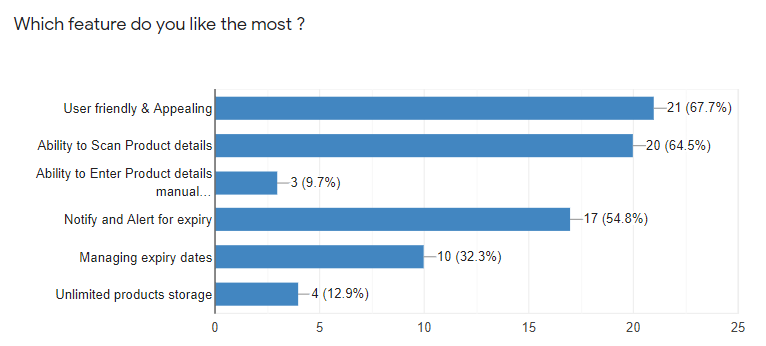
****

Figure 19: Features of TIMELYNE

Almost all the features provided by the TIMELYNE has been accepted and appreciated by the testers, as it is proved in the bar chart above. The key features incorporated in the system are user friendly and appealing and scanning the product details automatically, in accordance to that, the users also have been tremendously facilitated through the key features. It can be seen that user friendly and appealing, scan product details, and notifying and alert the user in regard to the expiry of the product has gained more than 50% positive feedback on each. In addition to that other functions are also accepted among the users. (Shown in figure 19)

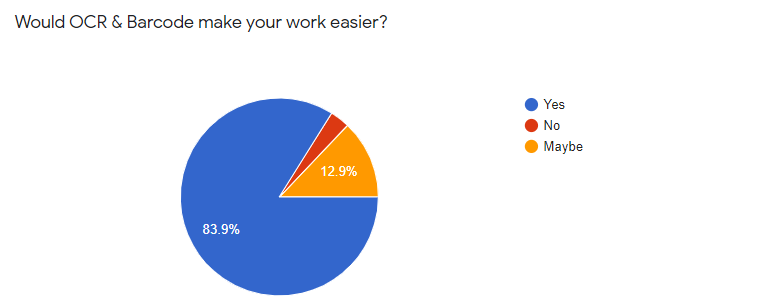
****

Figure 20: What ease the use of TIMELYNE

The major tool/feature integrated in this system is OCR and Barcode. It is great that people has understood the significance of the OCR and Barcode as it can be witnessed in the response given, a greater percentage nearly 83.9% admits that they makes the work much easier especially in inputting the data related to the product such as; expiry date through OCR and product name using barcode automatically rather than the manual method. (Shown in figure 20)

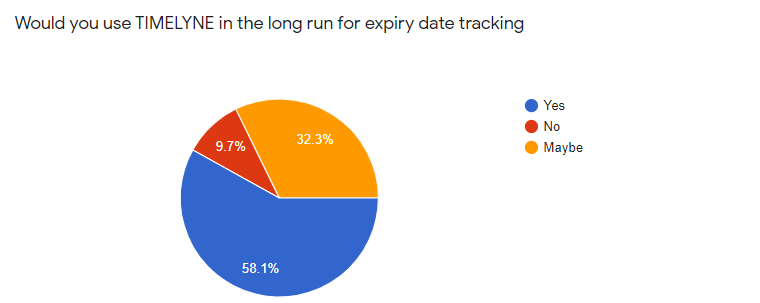
****

Figure 21: Use TIMELYNE in long run

After all, a question was raised among the users whether they would use TIMELYNE in the long run for expiry date tracking purpose, and the users enthusiastically responded as “yes” over 50% of the responses, they would recommend the system as it provides additional demanded facilities by the users. (As shown in the above figure: 21)

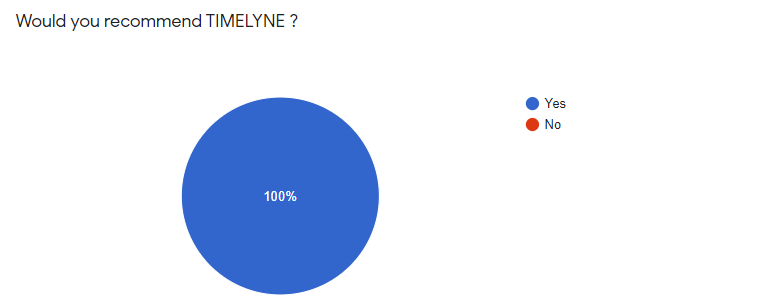
****

Figure 22: Recommend TIMELYNE

As the final question it was raised among the user whether they would recommend the TIMELYNE application, and it was 100% proven that it comprise of all the capacity to a make an positive impact on the user’s day to day life by tracking the expiry date lead to a wastage control environment. (As shown in the above figure: 22)

## 5.2 Testing

### 5.2.1 Test Cases for Registration and Log In

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number:** 1 | | | | | |
| **Name:** Registration with User Details | | | | | |
| **Precondition:** The user has navigated to the registration page | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 1.1 | Insert valid details for registration | Name: Bruce Lee  Email: [brucelee@gmail.com](mailto:brucelee@gmail.com)  Password:  Bruce1234 | Successfully registered and directed to the login page | Directed to the Login page and Display “Successfully Registered” | Pass |
| 1.2 | Insert invalid email | Name: Bruce Lee  Email:  Bruce  Password: Bruce1234 | Display invalid email message | Display “Invalid Email” | Pass |
| 1.3 | Insert invalid password | Email: [brucelee@gmail.com](mailto:brucelee@gmail.com)  Password: 1234 | Display invalid password message | Display “Invalid password” | Pass |
| 1.4 | Insert null values for the registration form | Null inputs | Display empty fields | Display “Empty Field”  (Figure 5.1) | Pass |

Table 5: Test Case 1 - Registration with User Details

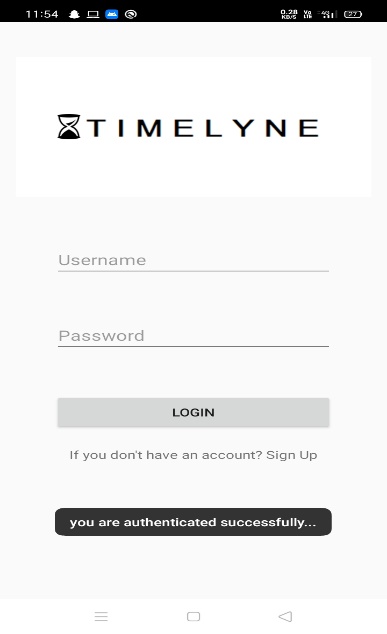
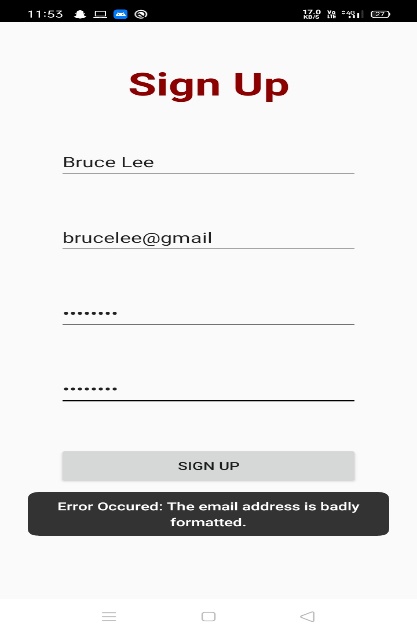
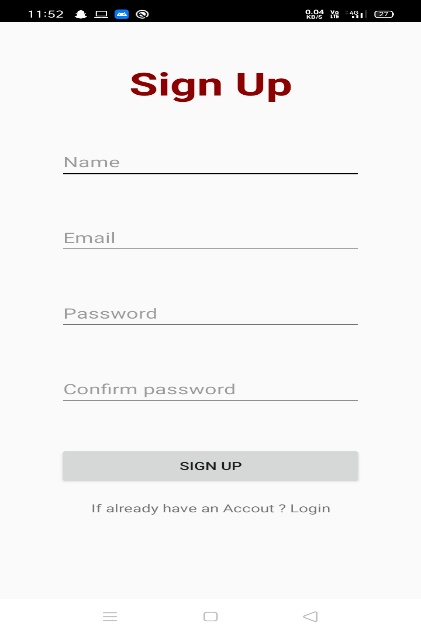


Figure 23: Registration Details

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 2** | | | | | |
| **Name:** Login with User Details | | | | | |
| **Precondition:** The user to have registered an account in the system | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 2.1 | Insert valid login details | Email: [brucelee@gmail.com](mailto:brucelee@gmail.com)  Password:  bruce1234 | Login successfully | Successfully logged in | Pass |
| 2.2 | insert invalid email | Email: bruce  Password: bruce1234 | Display invalid email message | Display “Invalid Email”  (Figure 5.2) | Pass |
| 2.3 | insert invalid password | Email: brucelee@gmail.com  Password: 1234 | Display invalid password message | Display “Invalid Password” | Pass |
| 2.4 | Login with null values | Null input | Display empty fields | Display “Empty Field” | Pass |

Table 6: Test Case 2 - Login with User Details

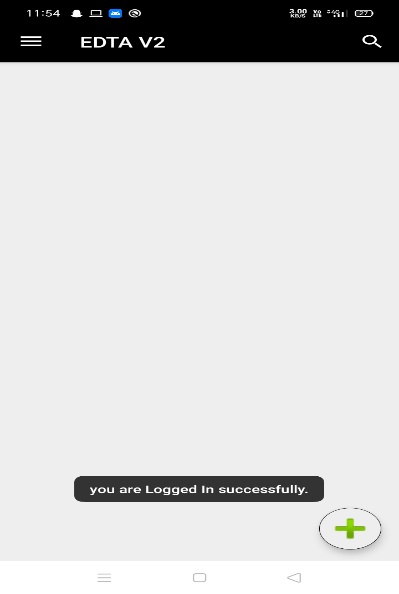
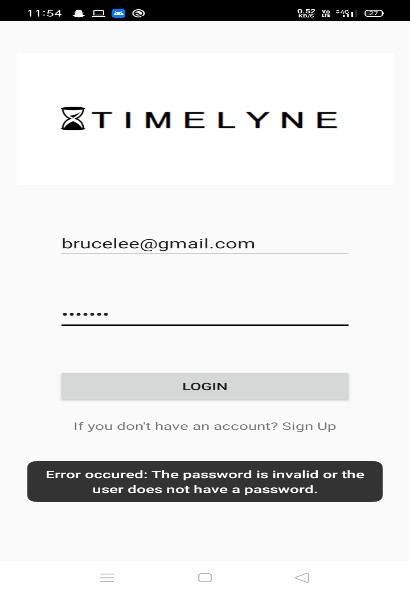
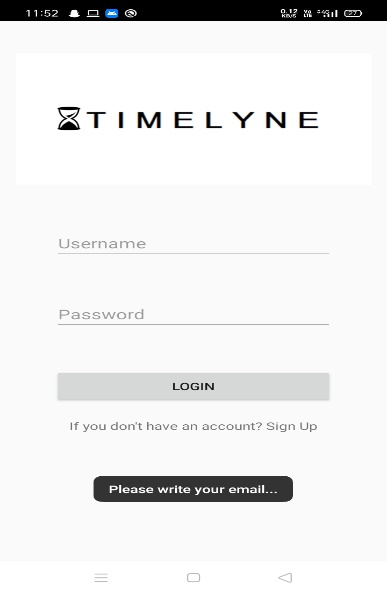


Figure 24: Login with User Details

### 5.2.2 Test Cases for Search Products

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 3** | | | | | |
| **Name:** Search Products | | | | | |
| **Precondition:** The user has to be logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 3.1 | Search for products using valid name | Search key: “Chocolate” | Display all products which includes name “Chocolate” | Displays all available products searched with the name | Pass |
| 3.2 | Search for product using search key | Search key: “Choc” | Display all products which includes the letters “Choc” | Displays all the products searched with the first letters  (Figure 5.3) | Pass |
| 3.3 | Search for product using invalid search key | Search key: “Cholate” or “Milk Chocolate” | Display invalid search message | Displays “Invalid Search”  (Figure 5.4) | Pass |
| 3.4 | Search for product using invalid name | Search key : “Coco” | Display invalid search message | Displays “Invalid Search” | Pass |

Table 7: Test Case 3 – Searching

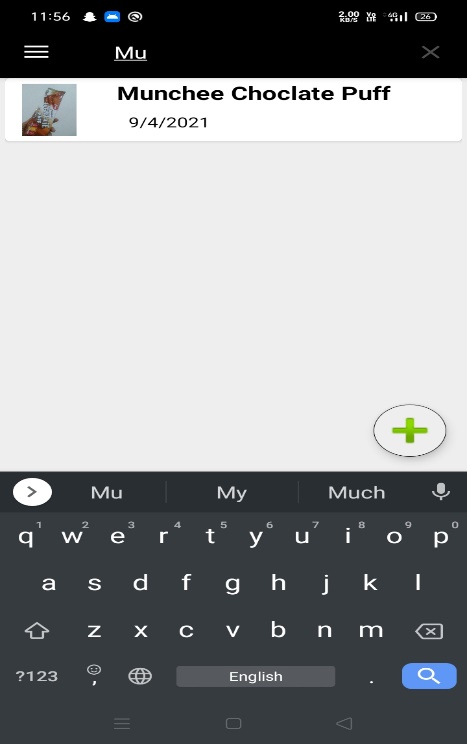
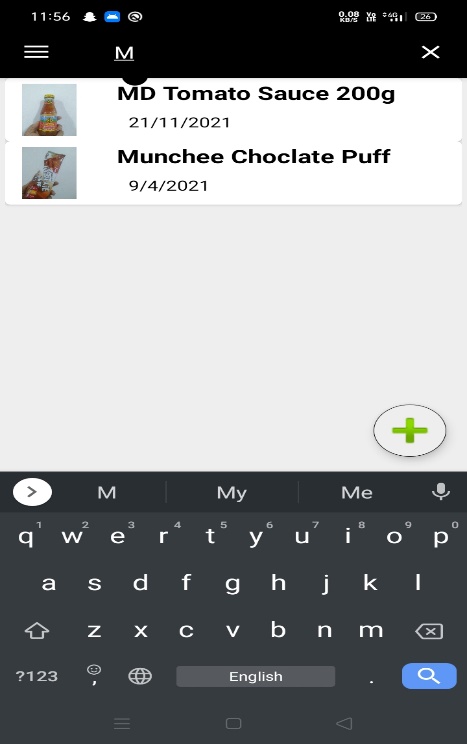
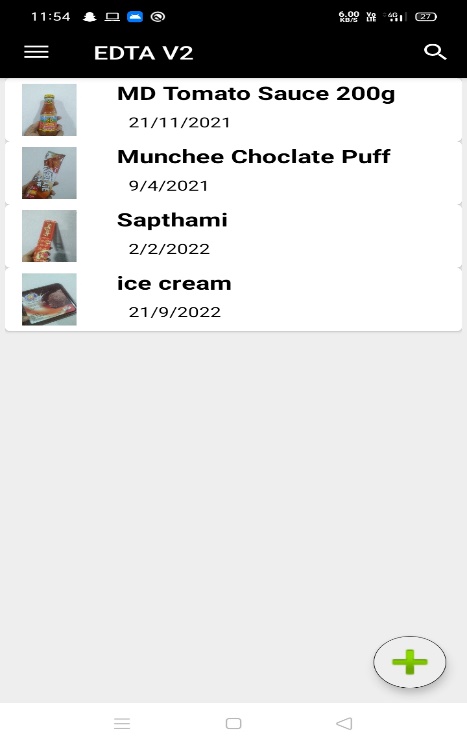


Figure 25: Searching

### 5.2.3 Test Cases for Add Product (Manually)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 4** | | | | | |
| **Name:** Add product (Manually) | | | | | |
| **Precondition:** The user has to be logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 4.1 | Insert valid image & product details | Image: Capture image  Other Fields:  Name, Expiry date, Category, Description  Click Save: Yes | Display product details & image uploaded | Displays ”Uploaded Product” & “Uploaded Image” message | Pass |
| 4.2 | Insert valid product details only | Image: Null  Other Fields :  Name, Expiry date, Category, Description  Click Save: Yes | Display image required to upload | Displays ”Image Not Captured” message | Pass |
| 4.3 | Insert valid image only | Image: Capture image  Other Fields : Null  Click Save: Yes | Display empty fields | Displays ”Empty Fields” message for each fields separately | Pass |
| 4.4 | Insert null value | Image: Null  Other Fields : Null  Click Save: Yes | Display field are empty | Displays ”Fields Are Empty” message | Pass |

Table 8: Test Case 4 - Add product (Manually)

## C:\Users\Raahidh\AppData\Local\Microsoft\Windows\INetCache\Content.Word\WhatsApp Image 2020-09-22 at 12.39.57 AM (1).jpegC:\Users\Raahidh\AppData\Local\Microsoft\Windows\INetCache\Content.Word\WhatsApp Image 2020-09-22 at 12.39.57 AM.JPEG

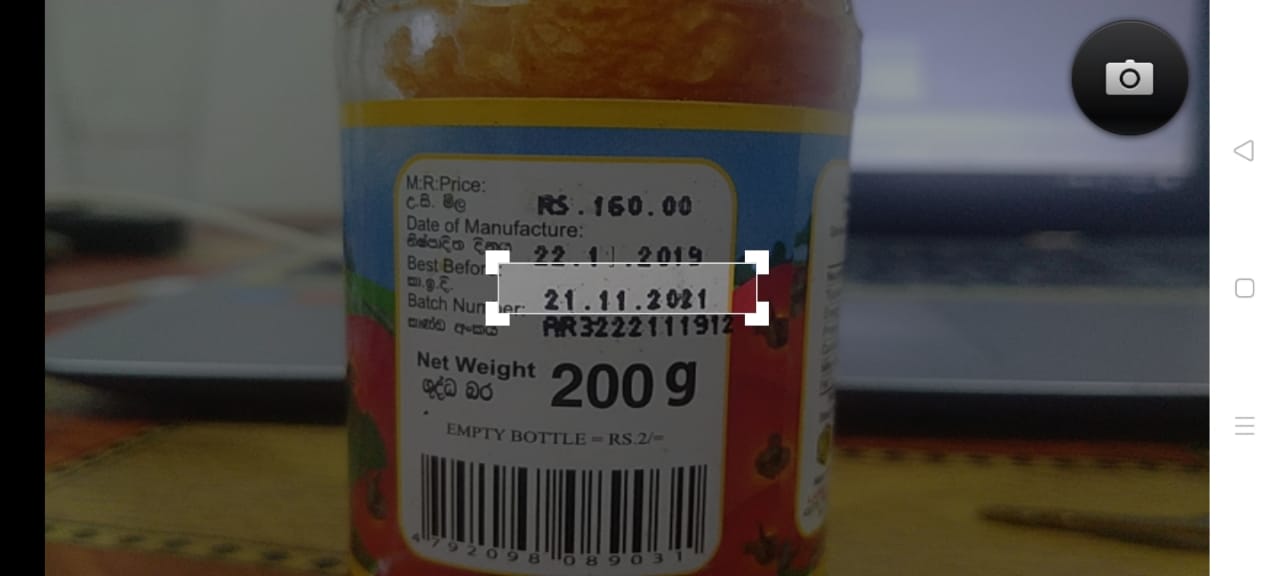
Figure 26: Add product (Manually)

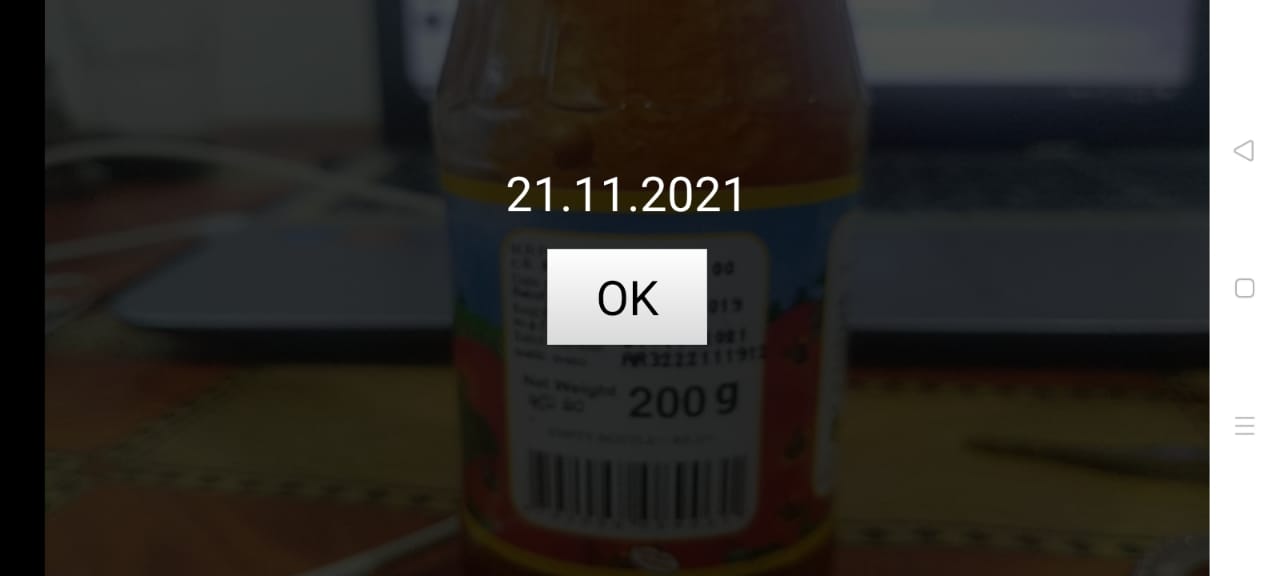
### 5.2.4 Test Cases for Add Product (Automatically)

**Expiry Date Capture - OCR**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 5** | | | | | |
| **Name:** Expiry Date Capture – OCR (Add product automatically) | | | | | |
| **Precondition:** The user has to be logged in and navigate to floating add button | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 5.1 | Capture valid expiry date | Capture OCR: Focus and captured the expiry date clearly  Click Ok: Yes | Display the expiry date taken from OCR | Display Captured OCR and on click ok, appears in the expire date field in Add Item Page | Pass |
| 5.2 | Capture unclear expiry date | Capture OCR: Focus and captured the expiry date (unclear) | Display OCR Failed | Displays”OCR failed. Please try again” message | Pass |

Table 9: Test Case 5 – Expiry Date Capture - OCR





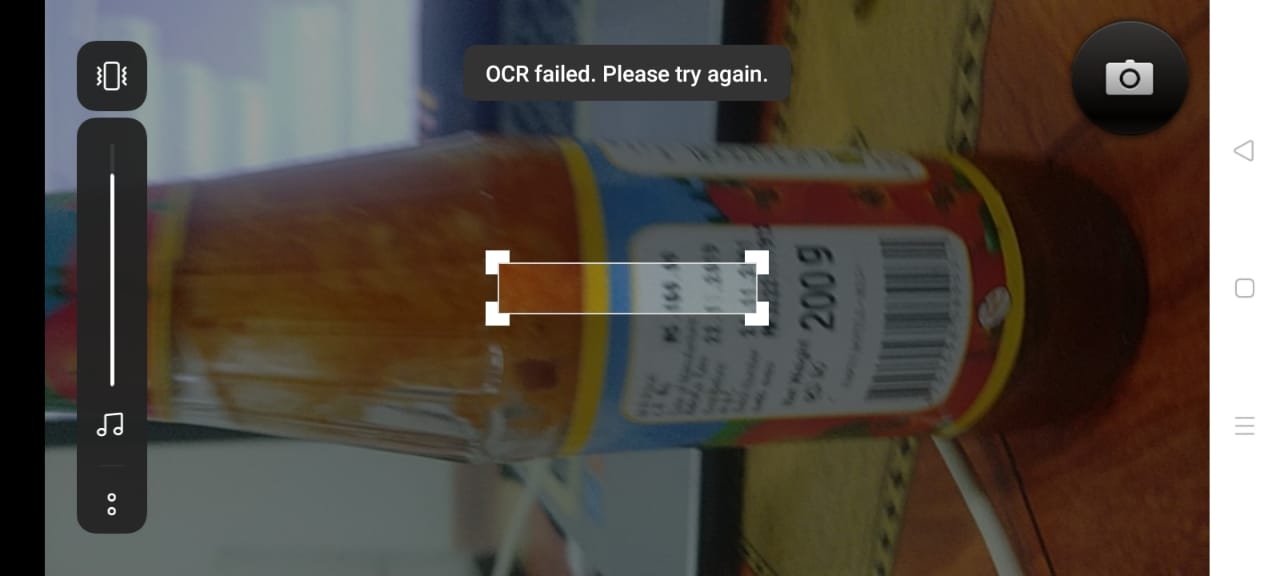


Figure 27: Expiry Date Capture - OCR

**Product Name Capture - Barcode**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 6** | | | | | |
| **Name:** Product Name Capture – Barcode (Add product automatically) | | | | | |
| **Precondition:** The user has to be logged in and navigate to floating add button | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 6.1 | Capture valid Barcode | Capture Barcode: Captured Barcode clearly  Click Finish: Yes | Barcode number taken from Captured Barcode and get the product name through API | Display Captured Barcode number and product name in Add Item Page | Pass |
| 6.2 | Capture valid Barcode | Capture Barcode: Captured Barcode clearly  Click Scan Again: Yes | Allow to Recapture Barcode | Redirected to the Capture Barcode page | Pass |
| 6.3 | Capture Invalid Product Barcode | Capture Barcode: non expiable product barcode | Display alert to user not expiry product | Display Barcode Number in the in the Add Item Page | Fail |
| 6.4 | Capture Non Barcode | Capture Barcode: Non Barcode | Until the correct Barcode enter, waiting ready to capture | Wait in the same page till barcode been captured | Pass |

Table 10: Test Case 6 – Product Name Capture – Barcode (Add product automatically)

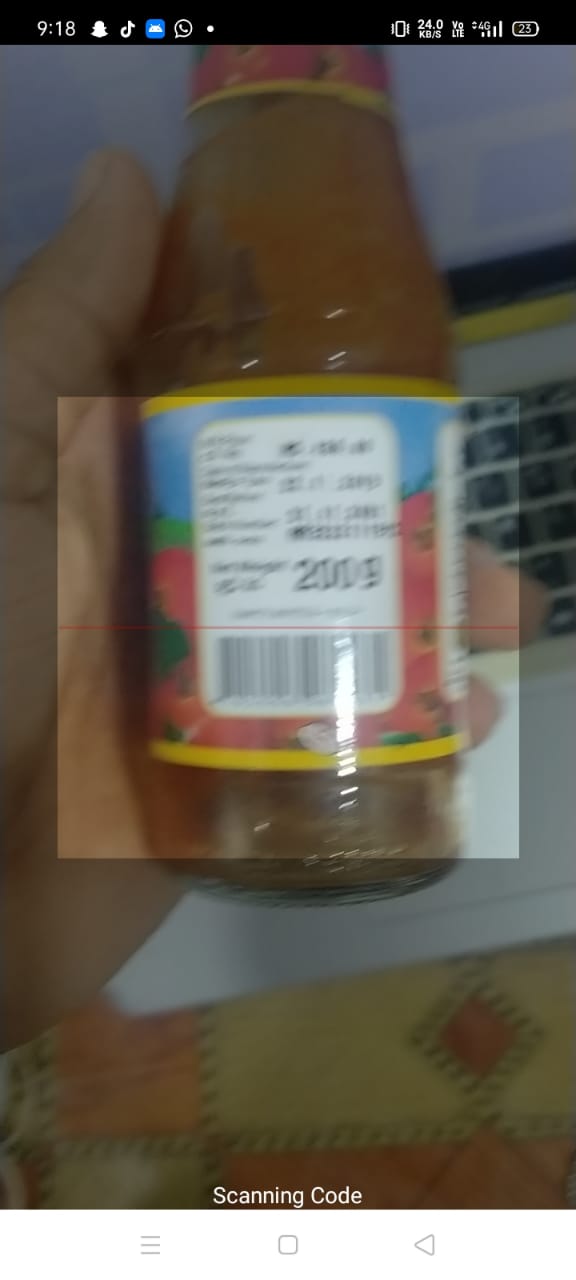
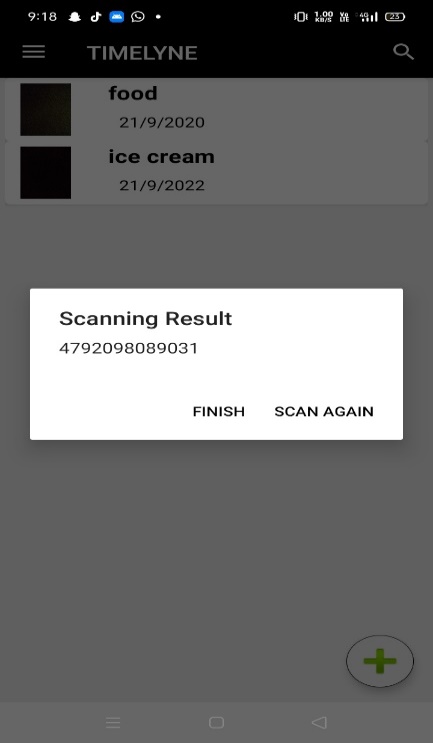


Figure 28: Product Name Capture – Barcode (Add product automatically)

**Product Image Capture - Camera**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 7** | | | | | |
| **Name:** Support | | | | | |
| **Precondition:** The user has to navigate to the logout page after logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 7.1 | Capture the product image | Click Capture Button: Yes | Direct to the Item Details Pahe | Direct to the Item Details Page | Pass |

Table 11: Test Case 13 – : Image Capture

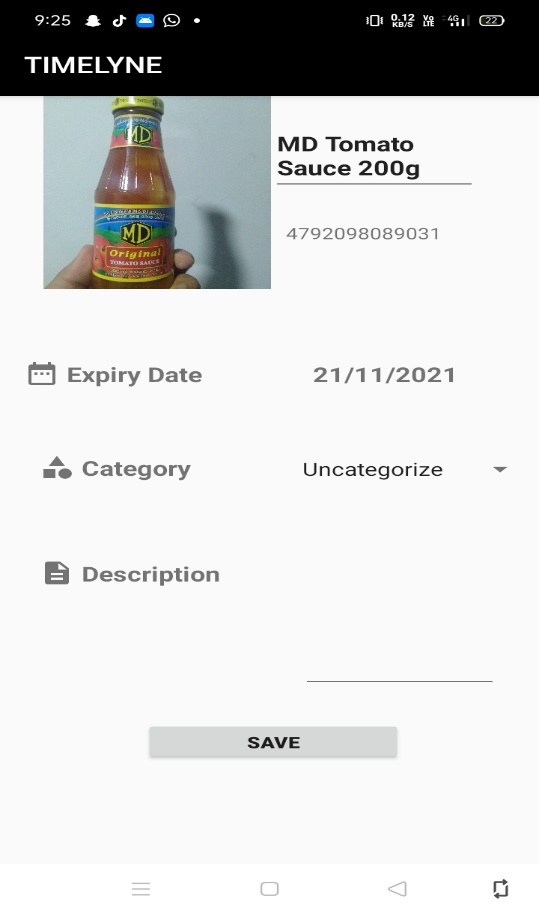


Figure 29: Image Capture

**Insert Category, Description and Save**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 8** | | | | | |
| **Name:** Insert category, Description and Save (Add product automatically) | | | | | |
| **Precondition:** The user has to be logged in and navigate to floating add button | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 8.1 | Insert Image, Category and Description | Image: Product Image  Category: Cosmetics  Description: New Hair Cream…  Click Save: Yes | Display product details & image uploaded | Displays ”Item Uploaded” & “Image Is Uploaded” message | Pass |
| 8.2 | Insert Image, Category and Description | Image: Product Image  Category: Uncategorized  Description: New Hair Cream…  Click Save: Yes | Display product details & image uploaded | Displays ”Item Uploaded” & “Image Is Uploaded” message | Pass |
| 8.3 | Insert null value | Fields : Null  Click Save: Yes | Display field are empty | Displays ”Fields Are Empty” message | Pass |

Table 12: Test Case 7 – : Insert category, Description and Save (Add product automatically)

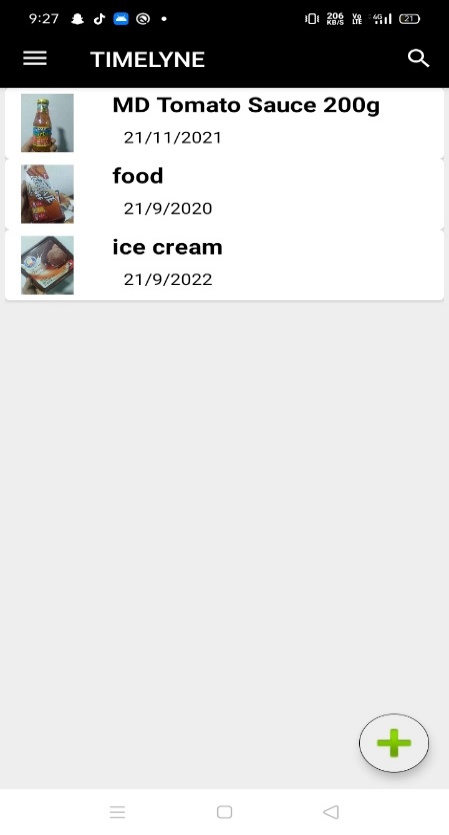
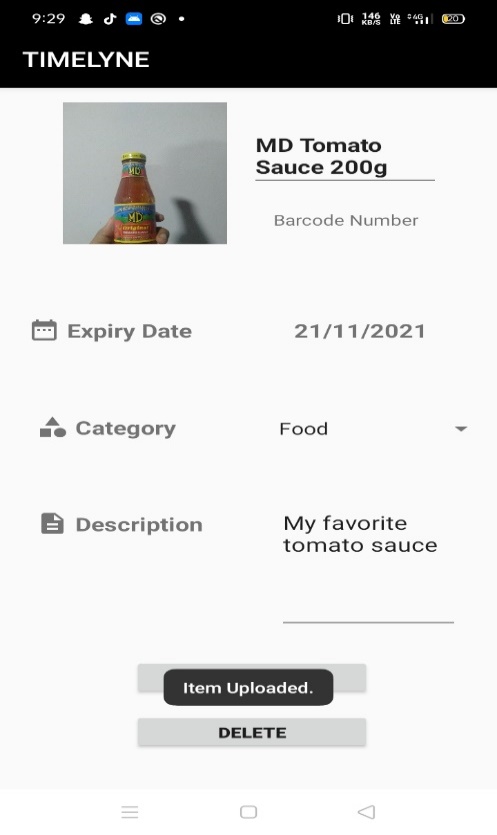
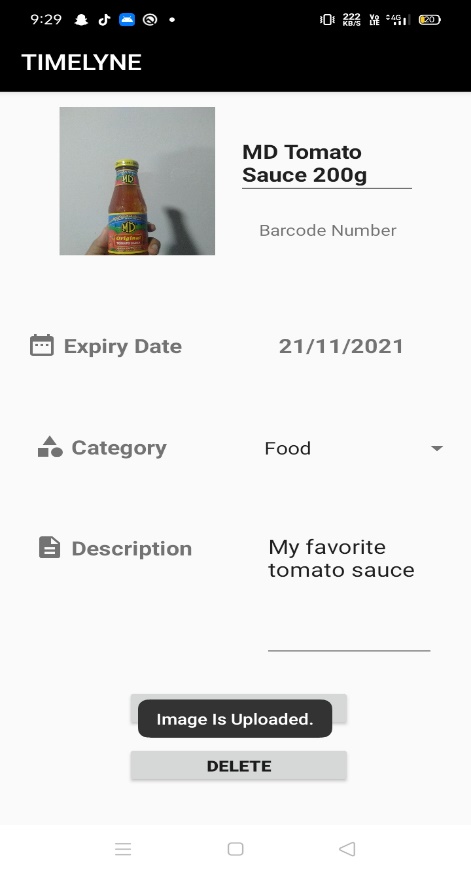
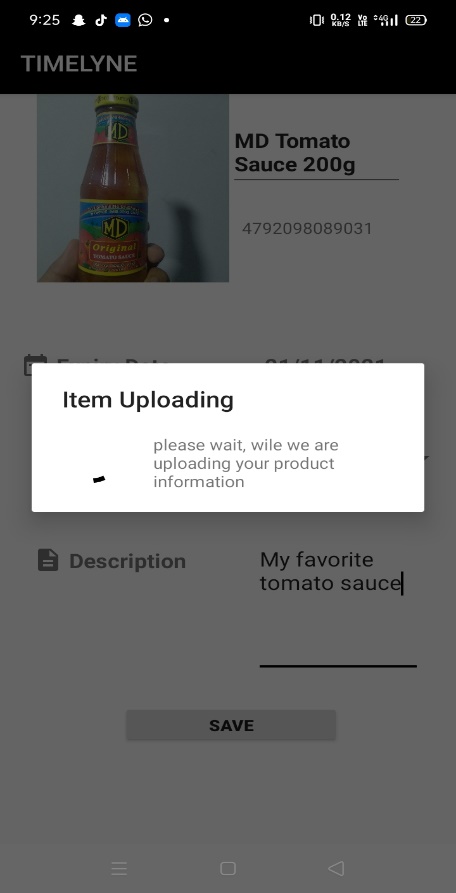
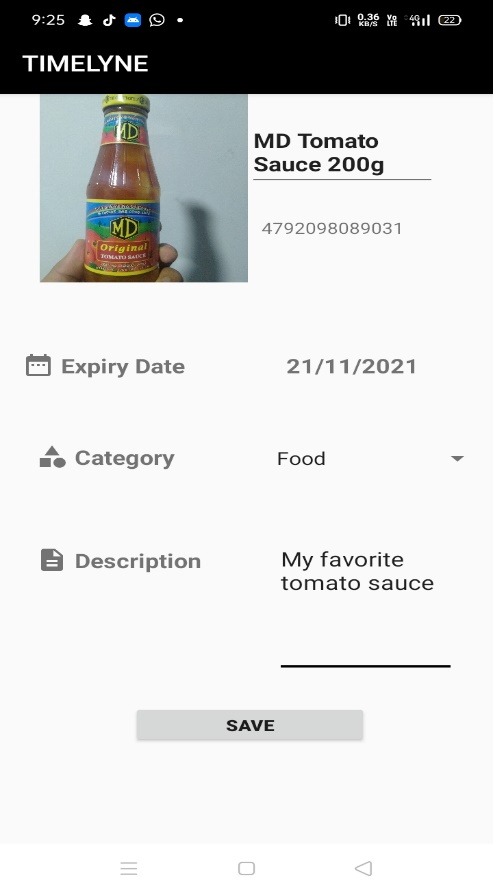
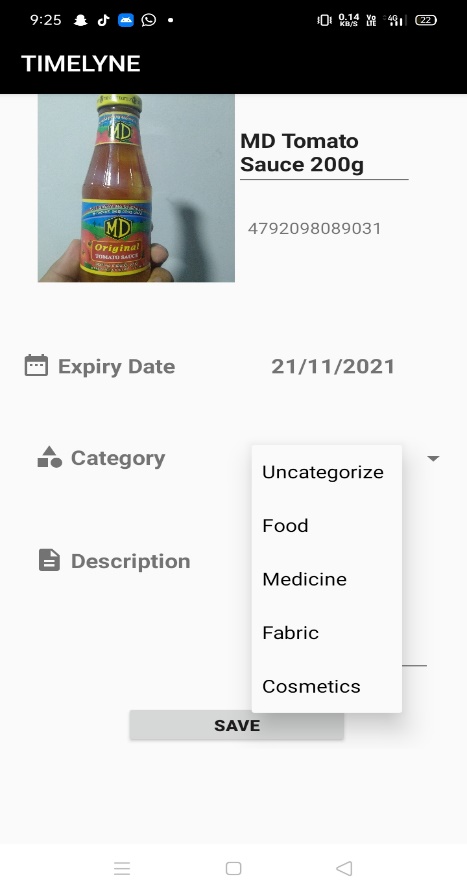


Figure 30: Insert category, Description and Save (Add product automatically)

### 5.2.5 Test Cases for Update Product

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 9** | | | | | |
| **Name:** Update product | | | | | |
| **Precondition:** The user has to be logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 9.1 | Update valid image & product details | Image: Capture image  Other Fields:  Name, Expiry date, Category, Description  Click Save: Yes | Display product details & image uploaded | Displays ”Item Uploaded” & “Image Is Uploaded” message | Pass |
| 9.2 | Change valid product details only | Image: Null  Other Fields :  Name, Expiry date, Category, Description  Click Save: Yes | Display image required to upload | Displays ”Image Not Captured” message | Pass |
| 9.3 | Change valid image only | Image: Capture image  Other Fields : Null  Click Save: Yes | Display empty fields | Displays ”Empty Fields” message for each fields separately | Pass |
| 9.4 | Change null value | Image: Null  Other Fields : Null  Click Save: Yes | Display field are empty | Displays ”Fields Are Empty” message | Pass |

Table 13: Test Case 8 – : Update product

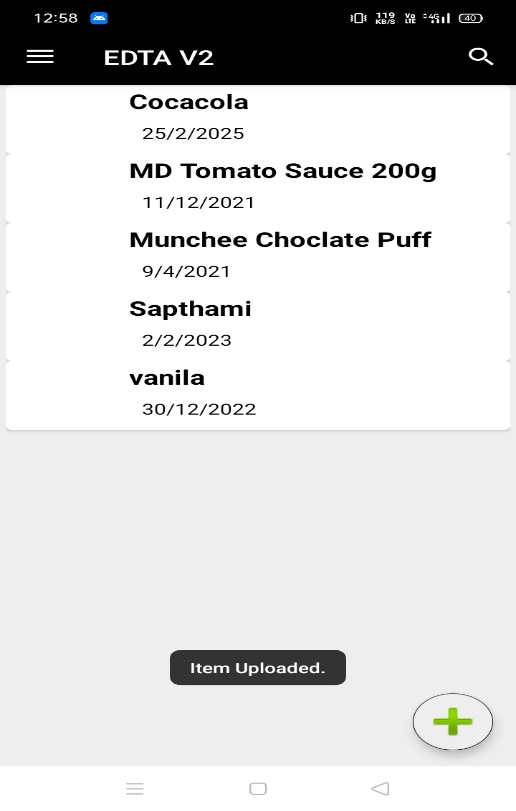
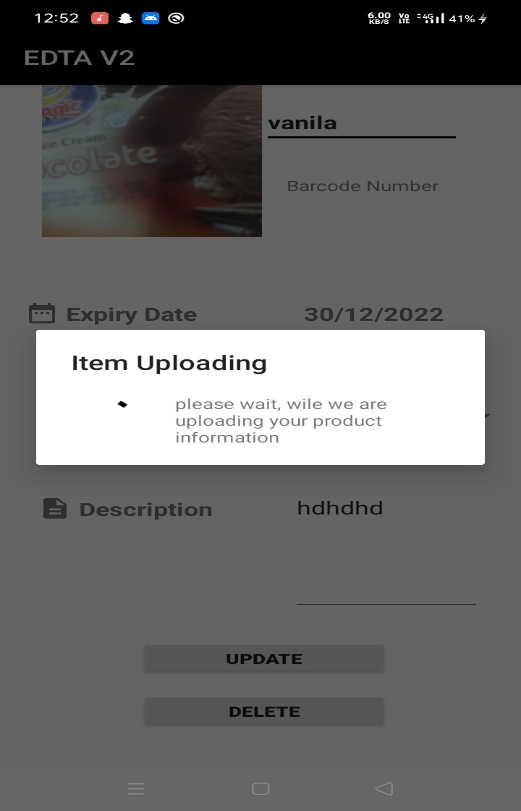


Figure 31: Update Product

### 5.2.6 Test Cases for Delete Product

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 10** | | | | | |
| **Name:** Delete | | | | | |
| **Precondition:** The user has to navigate to product details page | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 10.1 | Delete Product | Click Delete: Ok | Display Product Deleted | Display “Product Details Deleted” | Pass |
| 10.2 | Delete Product | Click Delete: Cancel | Display Product Details Page | Redirect to Product Details Page | Pass |

Table 14: Delete Product

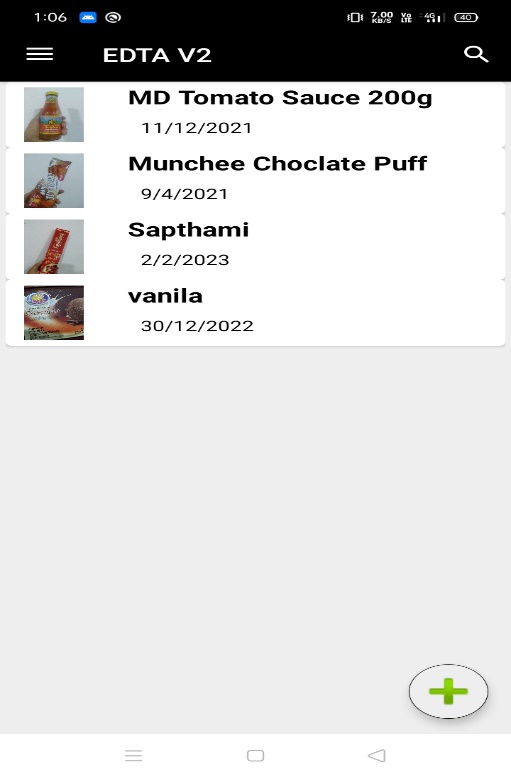
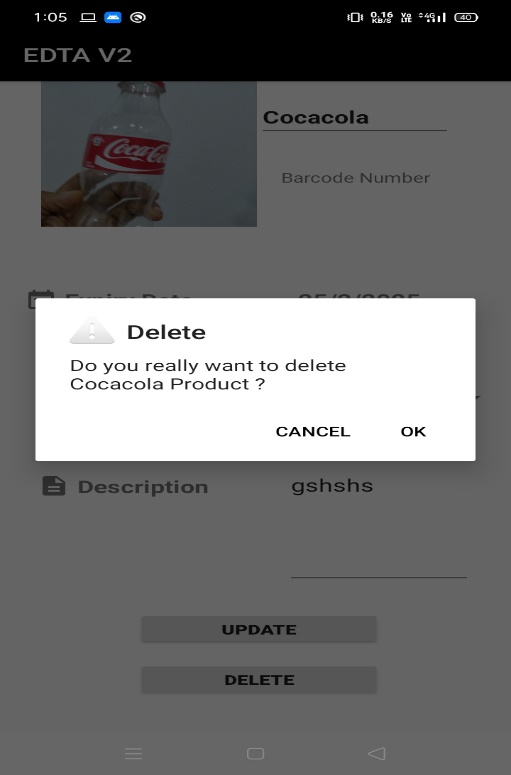


Figure 32: Delete Product

### 5.2.7 Test Cases for Each Navigation Menu Bar Fragments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 11** | | | | | |
| **Name:** Each navigation menu bar fragment | | | | | |
| **Precondition:** The user has to be logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 11.1 | Select Navigation Menu bar | Click the “All” category | Display all the all category products in the main page | Redirect to the main page with the all category products displayed | Pass |
| 11.2 | Select Navigation Menu bar | Click the “Food” category | Display all the food category products in the main page | Redirect to the main page with the Food category products displayed | Pass |
| 11.3 | Select Navigation Menu bar | Click the “Medicine” category | Display all the medicine category products in the main page | Redirect to the main page with the medicine category products displayed | Pass |
| 11.4 | Select Navigation Menu bar | Click the “Fabric” category | Display all the fabric category products in the main page | Redirect to the main page with the fabric category products displayed | Pass |
| 11.5 | Select Navigation Menu bar | Click the “Cosmetic” category | Display all the cosmetic category products in the main page | Redirect to the main page with the cosmetic category products displayed | Pass |
| 11.6 | Select Navigation Menu bar | Click the Add or Edit Category | Display to the Add or Edit Category Page | Redirect to the Add or Edit Category Page | Pass |
| 11.7 | Select Navigation Menu bar | Click the Support | Display to Support page | Redirect to the Support page | Pass |
| 11.8 | Select Navigation Menu bar | Click the Logout | Display to the Login page | Redirect to Login page | Pass |
| 11.9 | Select Navigation Menu bar | Click the Back button | Display main page | Redirect to the main page | Pass |

Table 15: Test Case 9 – Each navigation menu bar fragment

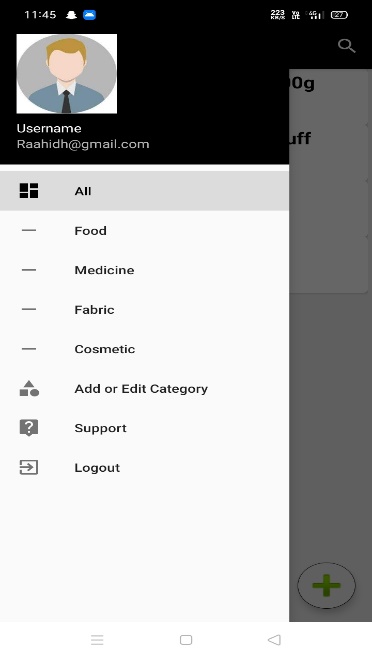


Figure 33: Navigation menu drawer

### 5.2.8 Test Cases for Add Category

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 12** | | | | | |
| **Name:** Add category | | | | | |
| **Precondition:** The user has to navigate to the Add & Edit Category page after logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 12.1 | Insert valid category name | Category Name: “Cosmetic”  Click Add: Yes | Display category name changed | Displays ” Category Name changed” message | Pass |

Table 16: Test Case 10 – : Add category

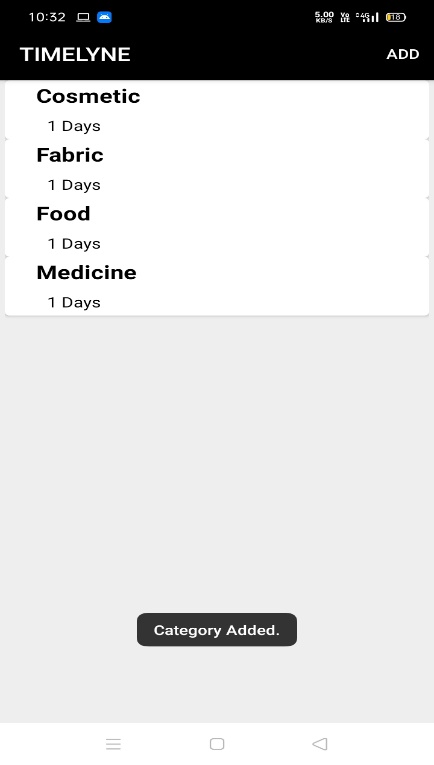
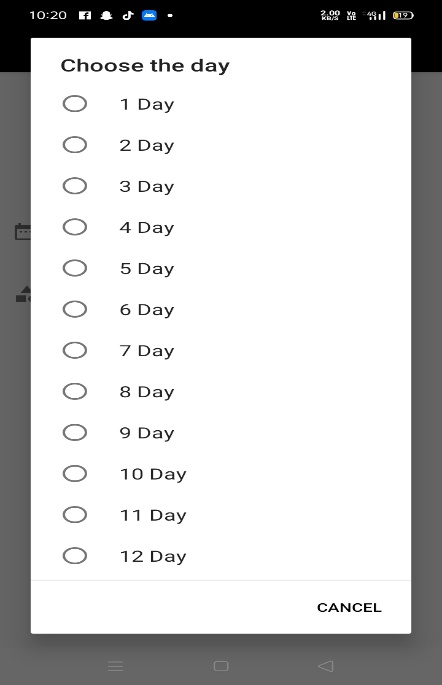


Figure 34: Test Case 10 – : Add category

### 5.2.9 Test Cases for Update Category Name, Prior Notify Date, Save and Delete Category

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 13** | | | | | |
| **Name:** Update category name, prior notify date, save and delete category | | | | | |
| **Precondition:** The user has to navigate to the Add & Edit Category page after logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 13.1 | Update the category name and desired prior notify date | Category Name: Beverages  Prior notify date:   1. days   Click Save: Yes | Display Category Details Updated | Displays ” Category Details Updated” message | Pass |
| 13.2 | Delete the category name and desired prior notify date | Click Delete: Ok | Display Category Deleted | Display “Category Details Deleted” | Pass |
| 13.3 | Delete the category name and desired prior notify date | Click Delete: Cancel | Display Update Category Page | Redirect to Update Category Page | Pass |

Table 17: Test Case 11 – : Update category name, prior notify date, save and delete category



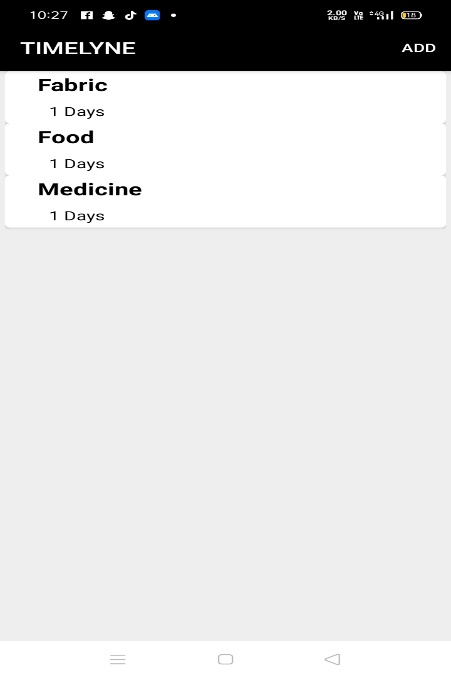
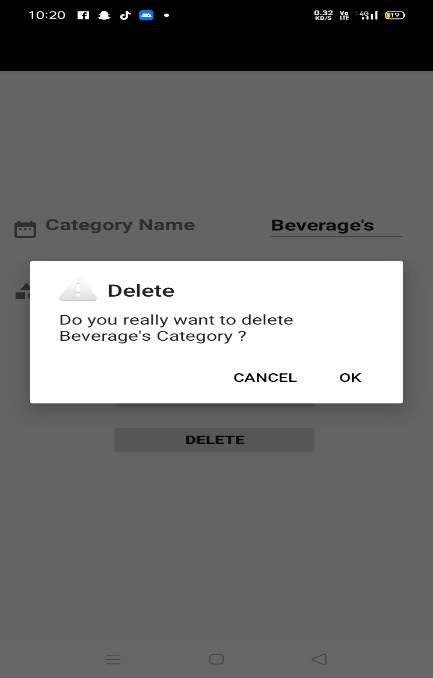
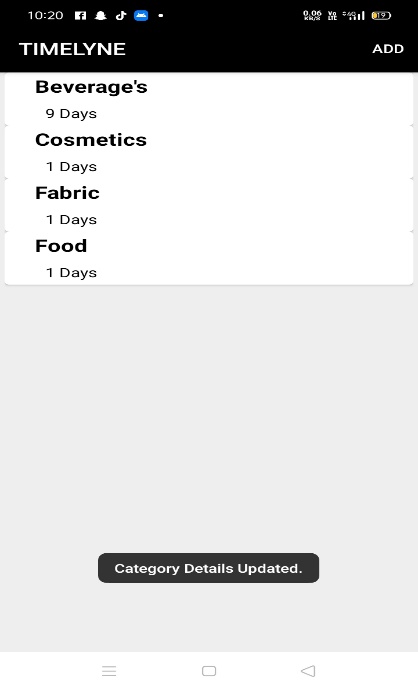


Figure 35: Update category name, prior notify date, save and delete category

### 5.2.10 Test Cases for Support

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 14** | | | | | |
| **Name:** Support | | | | | |
| **Precondition:** The user has to navigate to the Support page after logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 14.1 | Insert the subject and message | Subject: Complain  Message: I need a help  Click Send: Yes | Send email to the support team | Direct to mail application including the subject and message, then send the email | Pass |
| 14.2 | Insert null value | Subject: Null  Message: Null  Click Send: Yes | Display fields are empty | Direct to mail application with empty fields | Partial Fail |

Table 18: Test Case 12 –: Support

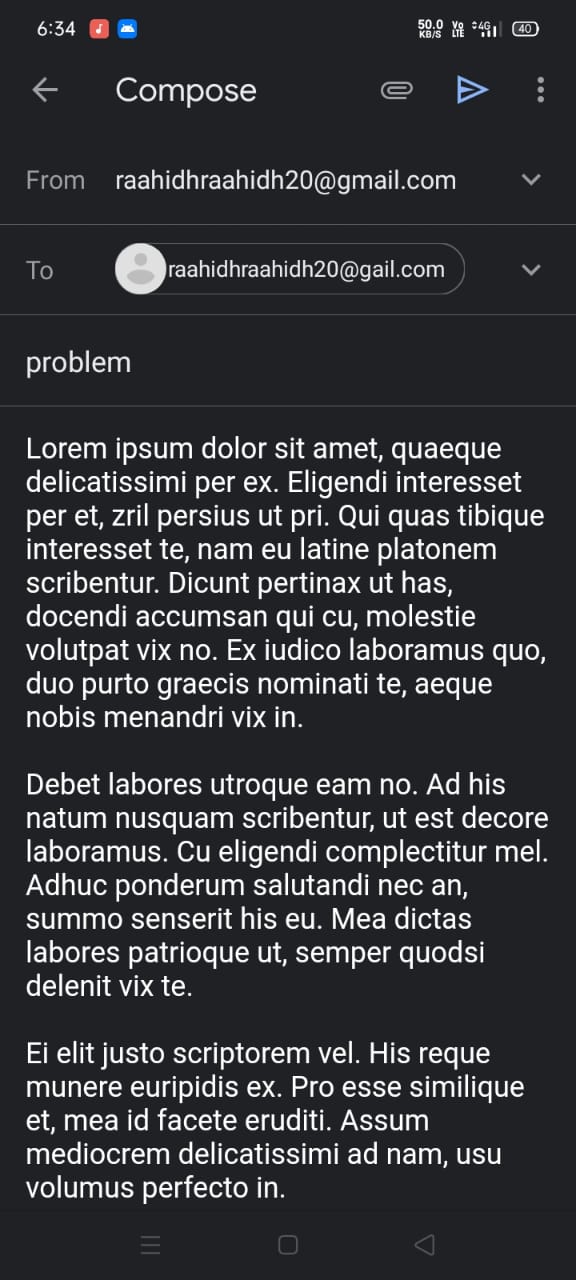
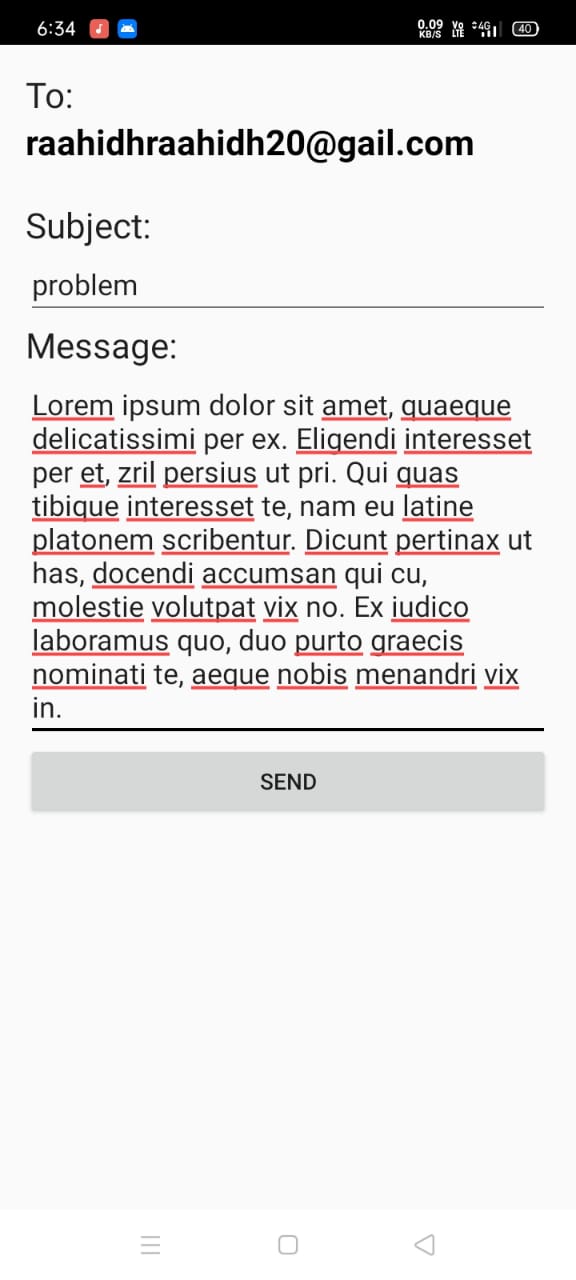
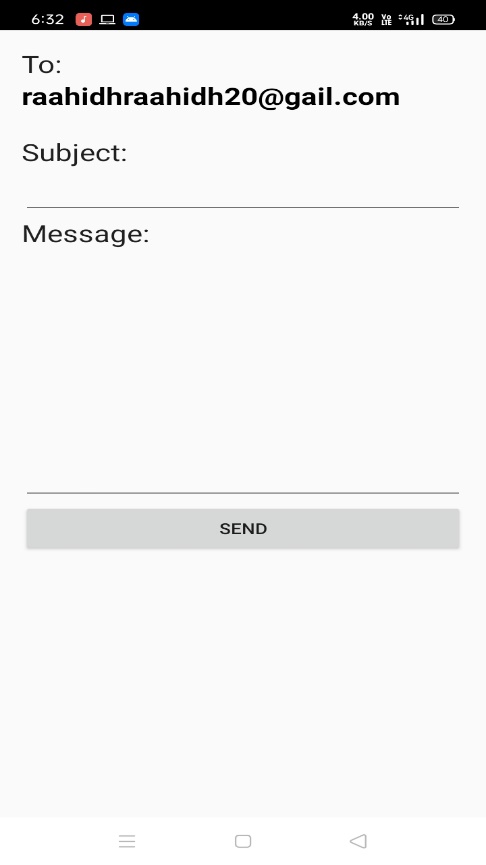


Figure 36: Support

### 5.2.11 Test Cases for Notification

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 15** | | | | | |
| **Name:** Support | | | | | |
| **Precondition:** The user has to navigate to the logout page after logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 15.1 | Expiry notify | Click on notification message | Direct to expiry product page | Direct to the item page | Pass |

Table 19: Test Case 13 – : Notification

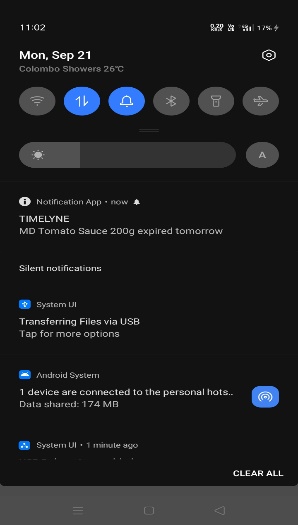


Figure 37: Notification

### 5.2.12 Test Cases for Logout

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case Number: 16** | | | | | |
| **Name:** Support | | | | | |
| **Precondition:** The user has to navigate to the logout page after logged in | | | | | |
| **No.** | **Description** | **Inputs** | **Expected Result** | **Generated Result** | **Pass/Fail** |
| 16.1 | Logout the Account | Click Logout: Yes | Logout and direct to the login page | Redirect to the Login Page | Pass |

Table 20: Test Case 13 – : Logout

# Conclusion

This very last part of the thesis envelops the entire report. It also describes the background overview, project purpose, goals and objectives, development and overall use of the system for the last time. Perhaps the platform's strengths and limitations are debated below, too.

## 6.1 Overview of the project background

As the world faces shortage of supply which cannot be resolved but can be minimized. An increased demand for food also generated in the very same way, yet the world disregards the fact that food waste often tends to increase. The unpreserved food that surpasses the best before date is categorized as food waste, hence the statistical waste line multiplies annually. Such a problem occurs because the consumer neglects or forgets the expiry date on packaged foods.

Since evolution of technology has no serious thoughts on further trying to maximize such issues. Technology can be customized thereafter to mitigate this issue by tracking the expiry date and notifying the consumer in advance of the impending expiry by designing a tracking application.

Mobile expiry date tracking system, they seek to provide consumers with technologically advanced strategies to the wastage problem they experience, and this OCR-based expiry date tracking system has become widely present among users.

Regardless of the tracking systems already implemented, the existing system does have restrictions. Therefore, it was critical to create and launch a new advanced version of this system which would fulfil all consumers in the general public and proceed to do so in the future as well.

But since basic Expiry date tracking systems provide basic features, users in this evolving environment would have never been satisfied. Consumers always glance for the simplest possible solution to any problem as such, there have been several limitations on existing tracking applications, such as manual data input only available at a premium and many more restrictions, leading to an ineffective system.

“TIMELYNE” is an expiry date tracking android mobile application, the OCR played a major role. OCR is a software that transforms the written text, printed text and images into digital form. OCR based systems are very advanced and plays a major role. Therefore, an OCR based android mobile expiry date tracking system fully on fire base database was developed in order to reduce wastage of food due to expiration of food. Fire-based database are more potential than the locally SQLITE database that was decided at the beginning, as it ease the login process convenient from any device regardless of the locally based SQLITE database.

It was assessed that the application can be used in a range of products such as; fabrics, medicines, cosmetics, stationaries that may cause expiry-related health issues. This framework obliges public health and safety with the successful handling of existential threats.

The purpose of 'TIMELYN' was to maintain standards as compared to the regular Expiry date tracking system by integrating various aspects of the other Expiry date tracking systems. At the initiation of the project these features were observed to establish a high objective for the proposed system. Also, these helped to facilitate the consumers, such as;

Features observed to establish a high objective from previous systems.

* Providing OCR based system including barcode reader to ease the data input to the users.
* Categorize the products as per user requirement.
* Include images for easy classifications.
* Receive notification alert prior to expiry and prevent expiration.

After the system has been developed, it is feasible to see that the objectives set at the commencement of the process have been finally accomplished. This demonstrates that the product may be released which fulfils the target audience demand.

The name of the framework is not a complicated system, it is a simplified system, user friendly and an effective system that helps users reduce their waste disposal problem unlike existing inefficient tracking systems.

The functionality for scanning images or product using OCR or data entry barcode, product classification as mandated, notification alerts etc.

The "TIMELYNE" system was split into phases in this whole thesis analysed and portrayed to highlight the system’s value. It was produced through careful research into the disposal of waste products due to expiry, existing expiry date trackers, OCRs and barcode systems. A detailed plan for designing and developing the proposed project was established. This contributed to the successful development of the TIMELYNE system that was able to achieve the aims and objectives and goals as scheduled. Through this system, consumers will benefit from this successful TIMELYNE system in their hectic lifestyle that tends to neglect certain issues and seek solutions.

(A concise overview of the project can be seen from the poster prepared for the project, which can be found in Appendix E).

## 6.2 Benefits of the system

* Unlimited number of products/items can be tracked.
* Organize the items into groups as needed.
* Manage your own groups of items.
* Product images can be attached for easier navigation.
* Expiry notifications and alerts can be set.
* Create/restore backups to safeguard your data.
* Available for free of charge.
* User friendly and flexible.

## 6.3 Limitations of the system

While the TIMELYNE is an amazing platform presented to the field of technology, the system may still have its limitations. These restrictions do not affect the users' tracking process, nor can the limitations be integrated as the system operates.

Developers have a duty to identify the constraints of their system and to provide quick fixes for those. Some of the limitations identified within the “TIMELYNE “system are as follows.

* Absence of overall language literacy - The system is only limited in the English language.
* Currently it is only a mobile application, which could be developed in other platforms in future
* Application is developed and the user engagement is only for android OS users, as not yet developed for IOS users.
* Restriction in application access when there is no internet connection or poor internet connection.

# Recommendations

According to the research carried out, food wastage and other products wastage are found to be massively playing a huge compact on the economy of the world as well as in the individual’s economy. As the technology evolves day by day it has been proven that they have taken possible actions technically to prevent such issues to maintain the sustainability. Already numerous systems are developed to manage this problem but still the problem continued to exist as there were so many limitations found in the existing systems. Therefore the developed system is comprised of some unique features to avoid the problems faced regarding the wastage and in a convenient way. Also for further improvements that can be made to overcome the limitations in the developed system below mentioned future works are featured. Whilst the system currently functions at its best, further enhancements can still be created.

Following recommendations for the future works can be identified;

* The framework could perhaps be enhanced by providing users with an inventory control system that really can indicate users to their regular activities appropriately.
* Features such as what to be bought, when to purchase, the actual quantity to be purchased.
* System can be incorporated with an artificial intelligence to examine the user behaviour, how the consumer manages their inventory.
* The application can be developed in IOS for Apple users.
* The user interface can be designed even more attractively to the consumers with several themes to make it look so wanted and attention-grabbing.
* For the convenience of the users a voice recognition engine to easily navigate the application also can be included.

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1. Appendix A: Litreature Review

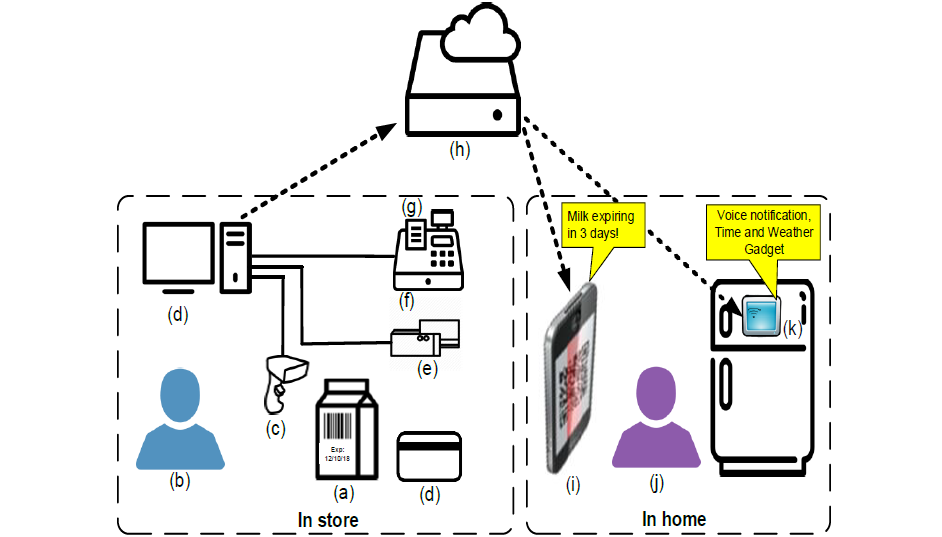


Figure 4: Architecture of Cloud Based Expiry System

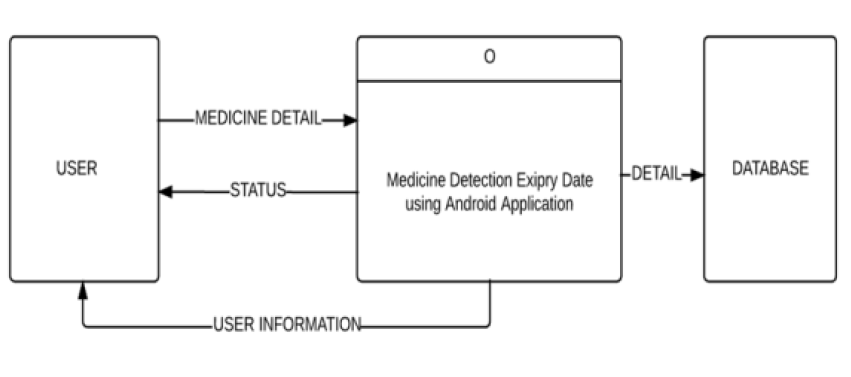
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Figure 5: Structure of Medicine Expiry Date Tracking System

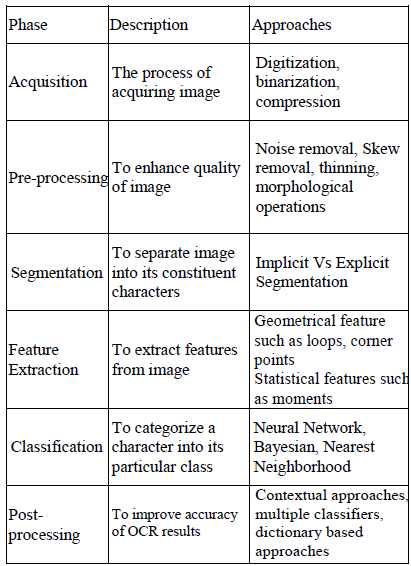


Table 3: Phases of OCR (Islam, Islam and Noor, 2016)

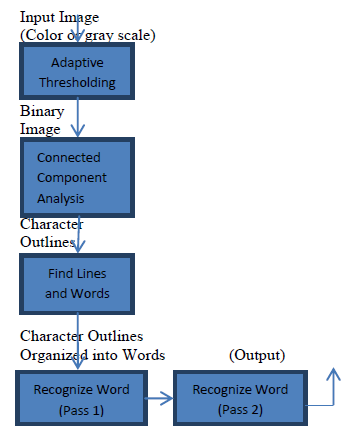


Figure 6: Architecture of OCR (Dhiman, 2013)

1. Appendix B: market research questionnaire

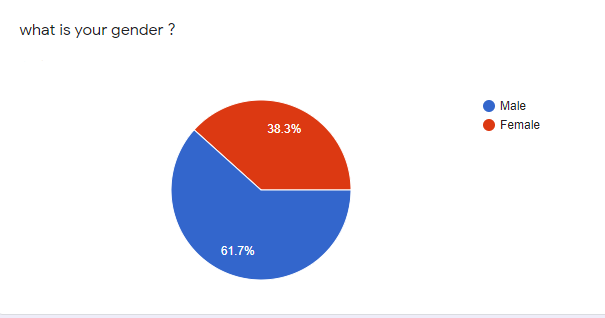


Figure 6: What is your gender?

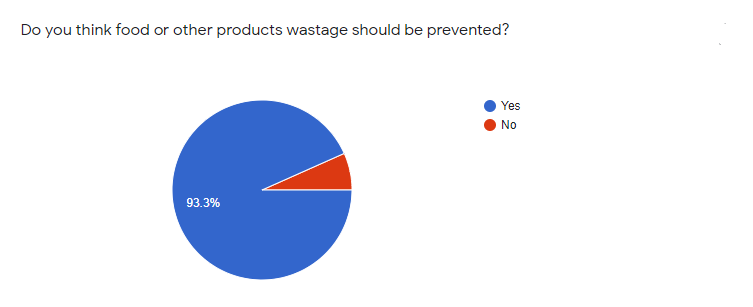


Figure 7: Food or other product wastages

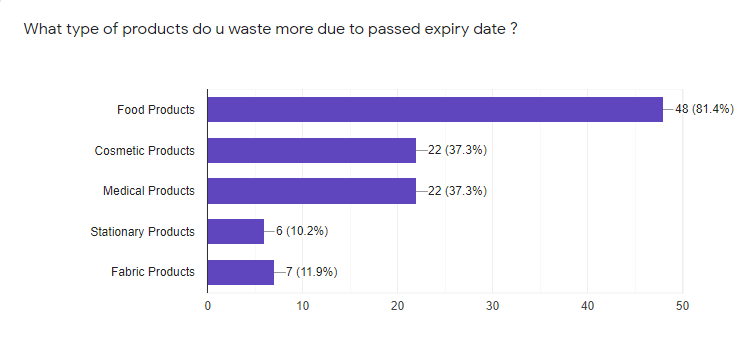


Figure 8: Type of products waste more

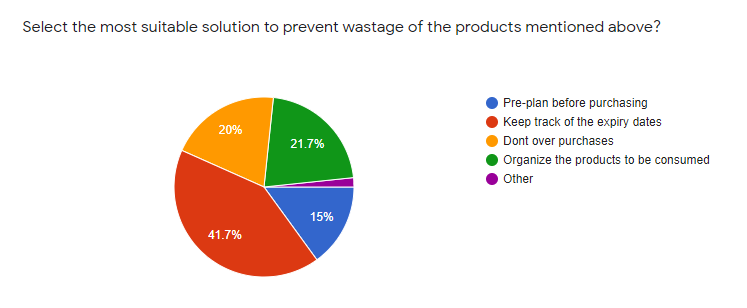


Figure 9: Solution to prevent wastage

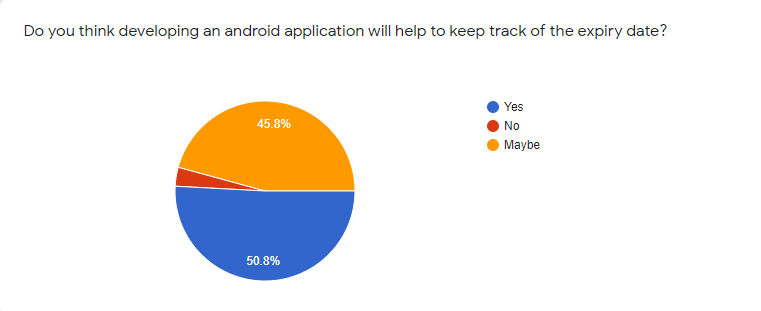


Figure 10: Developing an android applications help to track of the expiry date?

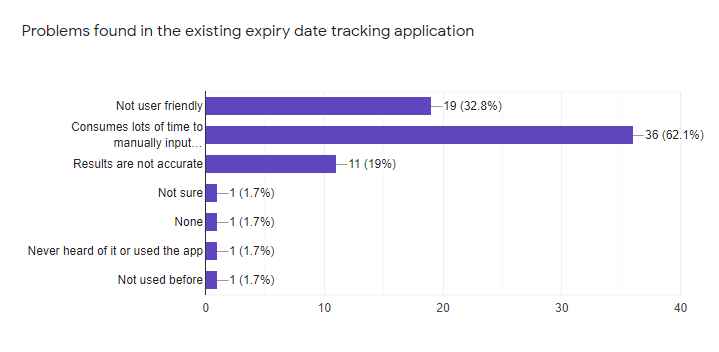


Figure 11: Problems found in existing systems

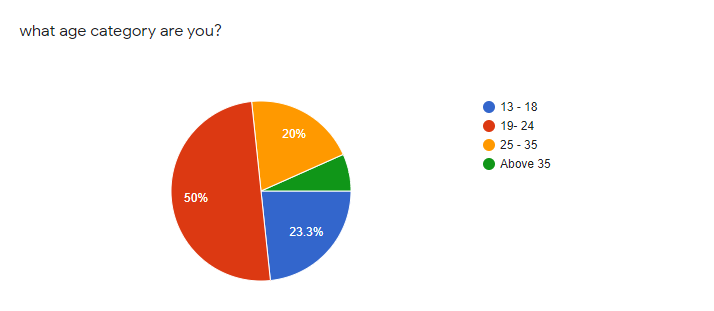


Figure 12: What age category are you?

1. APPENDIX C: Work Breakdown structure

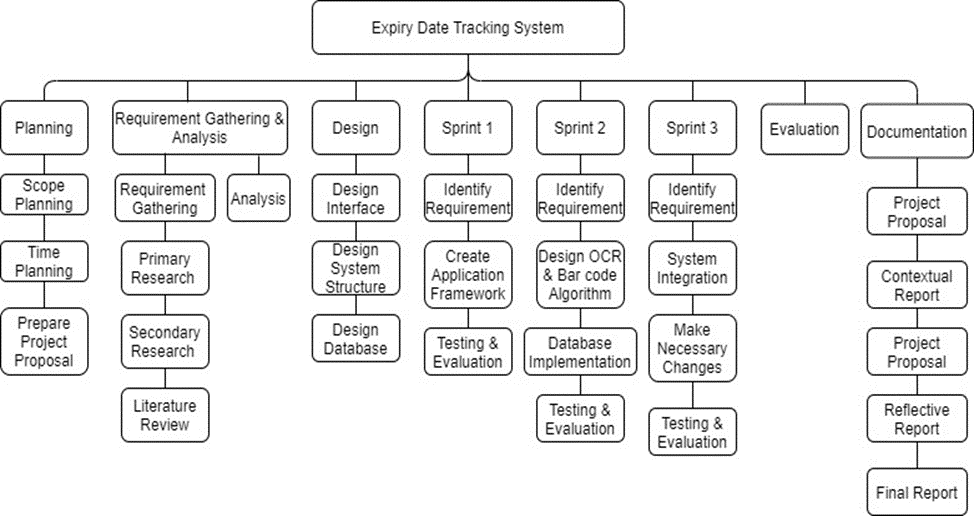


Figure 14: Work Breakdown Structure

1. APPENDIX D: FEEDBACK questionnairE

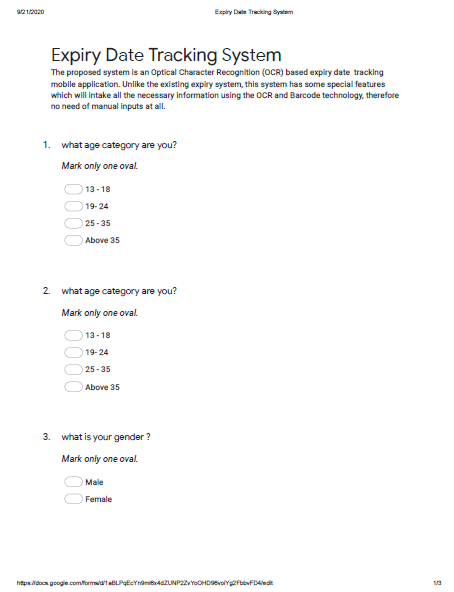


Figure 38: Feedback Questionnaire

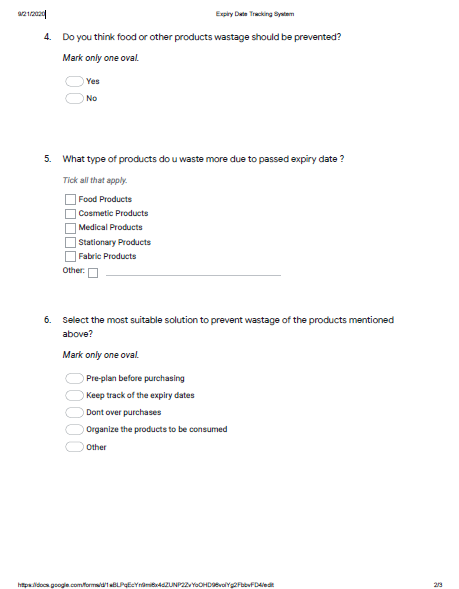


Figure 39: Feedback Questionnaire

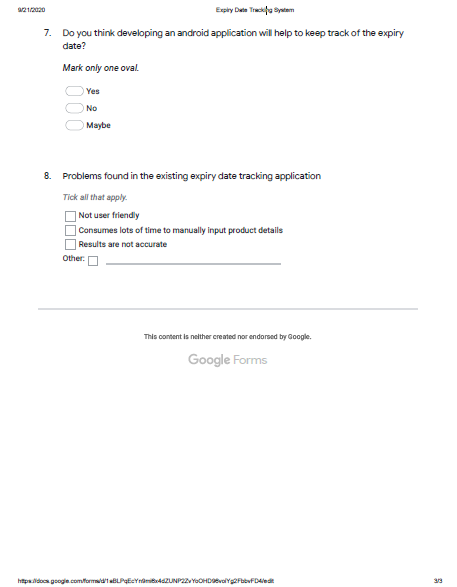


Figure 40: Feedback Questionnaire

1. APPENDIX E: Poster

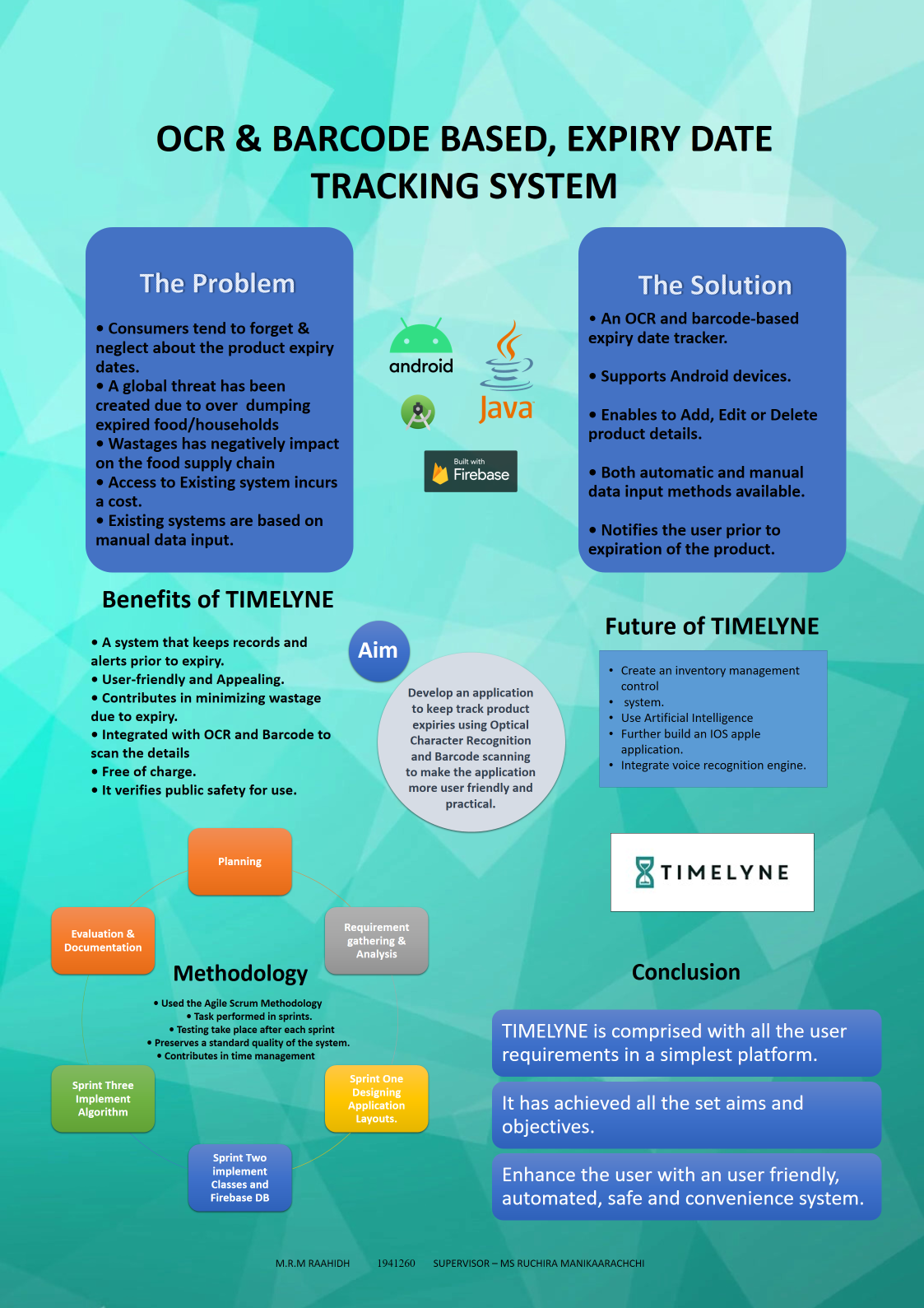


Figure 41: Poster