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Project Title: Can an interactive software solution improve user attitudes towards food-related routines that affect the quantity of consumer food waste?

Name: ARCHIE YARR

Programme: BSc COMPUTING

Matriculation Number: S1821533

Project Supervisor: Dr. DAWN CARMICHAEL

Second Marker: Dr. Lisa Liu

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"Except where explicitly stated, all work in this report, including the appendices, is my own original work and has not been submitted elsewhere in fulfilment of the requirement of this or any other award"

Signed by Student: ____Archie Yarr_____ Date: _____22/04/2022_____

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2 Abstract

Consumer food waste is the term given to food that is wasted by the consumer or at the consumer level of production. There are a set of food-related routines that can reduce the amount of waste a consumer creates if positive attitudes are held towards these routines.

This report aims to ascertain whether an interactive software solution would be able to aid in creating more positive attitudes towards these routines. There is evidence and research showing software solutions have a positive impact on other societal issues. However, there is a lack of research regarding consumer food waste. This study aims to fill that gap and provide a reference point for further work

To answer this question a custom software solution was developed and tested by a group of users. The user group had initial attitudes measured through a survey and their final attitudes were measured after two weeks of using the software solution.

This study found that after the testing period the user group had a more positive attitude to their food-related routines. However, no conclusive statement could be made as to how much of this change was due to the software solution. Rather the study states that it is highly likely that the software solution played some part in this positive shift.

These findings do not create an immediately actionable base of research within the field; however, they do provide a reference for further work to improve upon the studies user test and apply more time and resources to investigating this question.

3 Introduction

3.1 Background

Food waste is a global and multifaceted societal issue with roughly one-third of the food produced worldwide being lost or wasted annually, around 1.3 billion tonnes (UN Environment Programme, 2013). The United Kingdom contributes the most of any EU country. Of the UK's waste, approximately 60% of this number is created at the consumer level (Lazell, 2016).

There is a large contribution from the consumer in nations such as the United Kingdom, however, this is inversed in lower-income countries with a large amount of waste coming from agriculture and processing stages of production (Stancu, 2016). Focussing on the consumer's waste and why it occurs, we see consumers' choices being influenced by their attitude towards a behaviour, as described by the Theory of Planned behaviour (Ryan, 2016).

The fact that food waste is consumer-led would be less of a complex issue if their high levels of waste were not contradictory to their claimed attitudes towards the issue, with 82% of respondents to a survey by WRAP (a charity dedicated to increasing the efficiency of resource usage) expressing concern and want to take personal responsibility regarding the issue (Roberts, M. and WRAP, 2020). This shows that the group responsible for the majority of food waste (consumers) wishes to reduce their contribution to the issue.

The main driver of consumer food waste behaviours and attitudes is ineffective, or a lack of, effective food-related routines. These routines include shopping, leftover reuse, and planning, thus providing one possible explanation for the disparity between claimed consumer intentions and consumer actions. (Stancu, 2016)

Software applications can have a positive effect on user attitudes and their subsequent actions in a wide range of scenarios, prominently mental and physical health (B. Ainsworth, 2017) (Roy Darioshi, 2021). There is a wealth of research within these fields due to the popularity of health and fitness applications within certain demographics.

Many of the behavioural science techniques implemented in these applications stem from the Theory of Planned Behaviour (Antezana, 2020). Techniques routed in this theory have shown success in other areas when implemented in a software scenario. They have also shown success concerning food-related routines outside of a software scenario. (Werf, 2019)

There is a lack of research as to whether the use of a software application can influence user attitudes and behaviours regarding their food waste. Utilising features shown to be effective in other areas of software (health, fitness) and methodologies used in and outside of software (Theory of Planned Behaviour) in an interactive software solution will allow an investigation to fill this hole in research. An investigation and survey of user attitudes and behaviours before, during, and after the use of such an application will provide valuable insight into how effective an interactive software solution may be in impacting the users' attitudes and behaviours towards their food-related routines.

3.2 Project Outline

Shifting the attitudes and behaviours of consumers to their food-related routines will reduce the amount of food waste generated in consumer households. While this is only a portion of consumer food waste this is a progression that can be made at an individual level, which consumers have shown a desire to do. (Roberts, M. and WRAP, 2020)

It has been shown that user attitudes and behaviours can be influenced using software and that the Theory of Planned Behaviour, often utilised in software, has had success outside of a software application in influencing consumer attitudes and behaviour towards food waste. Ascertaining whether implementing a software application utilising this theory could have a positive impact on the issue will contribute greatly to assisting consumers in making positive changes.

Through the implementation of an interactive software solution consumer attitudes to food-related routines will be monitored. Using the data collected from users during a test period, whether user attitudes have improved, stagnated, or worsened will be discussed and conclusions drawn from this discussion.

3.3 Headline Objectives and Research Question: "Can an interactive software solution improve user attitudes towards food-related routines that affect the quantity of consumer food waste?"

Defining the Problem-

1) Define food waste and establish that consumers create food waste. Show that it is an issue that needs addressing.
2) Establish that consumers waste food due to ineffective food-related routines.

Objectives one and two will show that there is a necessity to research and later solve the issue of consumer food waste, they will detail how users waste food allowing conclusions to be drawn in later objectives about various solutions that could affect consumer attitudes and behaviour. Objectives one and two have been touched on in section 3.1 and will be evidenced in the literature review.

Defining and Hypothesising the Solution-

3) Establish that software can influence user attitudes.
4) Identify how these techniques can be applied to this specific use case in an effective manner.
5) Identify the technologies required to implement the software.

Objectives three to five will involve research of literature and technology. The correct methods and technologies to create an effective software application will be researched and presented, an in-depth study of the useful technologies will ensure that the application can provide an answer to the research question.

Developing the Hypothesised Solution-

6) Develop a suitable prototype using the technology and techniques identified
7) Test the prototype with a suitable test case and sample user group

Objectives six and seven involve a waterfall development process to implement the proposals of the previous objectives alongside a testing and survey process. User surveys will be used to enhance the development process alongside answering the research question. The testing and survey process will determine technical quality alongside the effectiveness of the application in improving the user's attitudes towards their food-related routines.

Discussing and Reporting the Outcome of the Research

8) Analyse group test results and user data to identify how effective the software product is.
9) Report and discuss the findings of the research.

Objectives eight and nine will gather all relevant user surveys and display the findings for review. Through analysis of the user survey data, conclusions will be drawn on whether the application was successful in improving user attitudes toward their food-related routines. Finally, the reasons for the software solution's effectiveness or ineffectiveness will be discussed and areas that require future work or show opportunities for expansion and improvement will be presented.

4 Literature Review and Technology Assessment

The literature review aims to establish and evidence:

- That consumer food waste is an issue that should be addressed
- That consumer food waste is impacted by consumers' attitudes to their food-related routines (shopping skills, planning skills, household skills, and leftover reuse)
- That the use of software has a complex relationship with changing user attitudes
- That there is not enough research to decisively state that a software solution can improve consumer attitudes toward their food-related routines.

4.1 Literature Review

4.1.1 Identifying the Scale of Consumer Food Waste and its Impact

Consumer food waste is a significant contributor to the expansive issue of food waste. Specifically in the United Kingdom consumers account for approximately 60% of the total food waste created by the nation, with the largest contribution of any EU nation this is a significant and unnecessary wastage (Lazell, 2016).

Consumer food waste has a plethora of negative impacts on society. Food waste at earlier stages of the production process has impacts including environmental damage due to landfills (Salomone, 2016) and exacerbation of hunger and food allocation issues (800 million people suffering from chronic hunger annually (Theda Godecke, 2018) and 25,000 dying daily (Holmes, n.d.)).

As it is further on in the production process consumer food waste also carries the burden of having travelled ‘upstream’ through this resource-heavy production process utilising animal life, water, and environmental resources in large quantities. At the consumer level, value-added is highest including plastics and effort alongside the previously stated resources. (H. K. Jeswani, 2020)

4.1.2 Highlighting the Driving Factors Behind Consumer Attitudes and Behaviours Towards Food Waste

Consumers claim to have a negative view of creating food waste, yet have been shown by the resource utilisation charity WRAP to contribute greatly to the negative impact of the issue of food waste (Roberts, M. and WRAP, 2020). Consumer behaviour is not entirely dictated by consumer attitudes and desires, but also external factors and internal factors not consciously influenced by the consumer. Factors such as food-related routines and a consumer’s education and perception of food-related routines also have an impact on decisions made by the consumer. In “Determinants of consumer food waste behaviour: Two routes to food waste” it was found that food-related routines were a main driving factor of food waste in a demographic of 18-74-year-old Danes. When food-related routines were included in models of consumer food waste behaviour, routines were found to be as important predictors of food waste as behavioural and moral norms. These routines included household skills, planning skills, shopping skills, and leftover reuse. (Stancu, 2016).

A meta-analysis of peer-reviewed articles on consumer household food waste, “Food waste matters- A systematic review of household food waste practices and their policy implications” also found a link between poor food-related practices/routines and food

waste, further supporting Stancu's findings that user attitudes and behaviours regarding food-related routines have a significant impact on consumer food waste. (Schanes, 2018)

Food waste created by the consumer in the United Kingdom is a significant contributor to what is a widespread and impactful issue. Much of this waste stems from poor consumer attitudes and behaviour towards food-related routines. Therefore, an improvement in the consumers' attitudes and behaviours toward food-related routines is likely to have a positive impact on the issue of consumer food waste.

When discussing the role of the consumer in food waste it is also important to recognise that the consumer is not a 'sovereign' and there is a shared responsibility between retailers and consumers in their waste (Welch, 2021). Welch supports Stancu's findings that the consumer does play a significant role in their waste and does not seek to ignore that fact. However, Welch's conclusions claim that any solutions aimed at addressing consumer attitudes and behaviours must be seen in the wider systemic context of the production process.

Considering this perspective and the evidence given this study aims to address consumers' attitudes, but it is acknowledged that this is one factor within a complex systemic issue that cannot be dealt with if the issue is 'individualised'.

4.1.3 Evidence Surrounding Software influencing Consumer Behaviour and Attitudes

Persuading consumers to change habits and routines that are beneficial to themselves and wider society through software applications has become increasingly popular with the growth in internet and smartphone usage. Most prominently, lifestyle and health applications have attempted to utilise aspects of behavioural science to create positive habits and routines in users' daily lives (Antezana, 2020). Lifestyle and health applications are most commonly used by young people therefore the utilisation and effectiveness of behavioural science delivered through software applications cannot be asserted based solely on the success of these applications.

In academic studies, software applications have had a positive effect on creating habits in consumers. B. Ainsworth discusses the impact of a digital intervention with 8993 users of the PRIMIT website attempting to create a positive change in self-reported hand washing routines. The study shows an improvement in self-reported handwashing after using the website across all demographics who took part (B. Ainsworth, 2017). This consistency across demographics is significant as it shows that if a software application receives consumer uptake, implementing interventions and other aspects of behavioural science are likely to have wide demographic success across the consumer base.

Consumer decision-making processes are another factor that can be influenced through software applications, allowing for more intelligent decisions to be made by consumers by exposing them to biases, a phenomenon that could create a desirable outcome for consumer attitudes and behaviours towards food-related routines (the ethics of exploiting consumer bias, even for a positive outcome for the consumer, is beyond the scope of this paper). In recent years utilising behavioural science and user psychology within software applications to create desired outcomes has been practised by technology companies,

examples of this can be seen in Google, ProQuest, MobilEye, and Waze, four popular software products. (Darioshi, 2021)

In contrast to the evidence given by Ainsworth and Darioshi, Wang found that in a study of how user attitudes can be swayed by social media, there are certain thresholds and limitations to influencing user attitudes with software. Wang found that the test group resisted changing their attitudes. Even when presented with irrefutable facts on social media, only certain forms of information delivery had any effect at all on the test group (Wang, 2021). This contrast shows a need for software's ability to influence users to be addressed in specific topic contexts and not taken as a general rule. Software can influence user attitudes in fitness and health contexts but as shown by Wang, this does not mean that this is easily replicable or replicable at all.

Having discussed how software applications can influence user behaviour and attitudes, it is now important to expand on how, if at all, software solutions have been used to improve users' attitudes and behaviours towards food-related routines.

4.1.4 A Lack of Definitive Research linking food waste, behavioural science, and software solutions

There is a wide range of published research on the topic of consumer food waste, so much so that meta-analysis and summary articles have been produced to show trends in research and their findings (Schanes, 2018). Similarly, there are a plethora of proposed solutions to the issue involving behavioural science and software solutions. For example, government-sponsored advertisement and education campaigns that utilise social proof and interventions have been run with varying degrees of success internationally (Schneeman, 2020). Similarly, private entities have attempted to intervene with food-related routines using software applications that draw from certain aspects of behavioural science and the theory of planned behaviour, such as a smartphone app that allows consumers to monitor the contents of their fridge remotely (Lazell, 2016).

Although there has been in-depth and varied research discussing these separate issues and the proposed solutions that stem from them, there has been little research discussing the efficacy of a software solution that emphasises an approach based on a strong use of consumer behavioural science to create positive attitudes from consumers towards their food-related routines. It has not been widely discussed in a peer-reviewed format whether the combination of these techniques would create a positive response from consumers toward food-related routines.

4.2 Technology Review

The technology review chapter will give detail about the software tools that the study will utilise during the lifecycle of the project and how they are useful in the project context.

Discovery Phase

During the requirements/discovery phase, the study utilised the prototyping/ wireframing tool Figma to create low-fi designs to gain feedback from user testing/surveys.

Design Phase

During the design phase, Draw.io (a diagramming tool) was used to generate UML diagrams to build a more detailed picture of how the software solution will be implemented.

Development Phase

The research utilised the Android Studio development environment alongside the programming language Kotlin to carry out the implementation phase of the development cycle. Based on the nature of the application being developed the Repository design pattern was implemented using the previously mentioned technologies.

Deployment Phase

To deploy the software solution Android Studios testing features were used to download the application on Android devices. The following user test was anonymised and analysed using Survey Monkey a free survey software tool.

4.2.1 User Experience Prototyping/Wireframing Tools

User experience (UX) prototyping tools such as Axure or Figma are software packages created for the use of professionals who work within IT fields such as software development, web development, or user experience design. They allow interactive 'surface level' prototypes and wireframes to be created with relatively low-time investments from users. These prototypes can be presented to stakeholders and sample groups to further the development process cheaply and efficiently at early development stages where incrementation and design changes are rapid and plentiful.

UX tools will be of significant importance in this scenario due to the nature of the primary research method and its objectives. UX practices and therefore associated tools have become an industry-standard during the development process of software products, (Kashfi, 2017) to adhere to effective UX practices the utilisation of prototyping tools is vital, more significantly so when resources are a limiting factor on productivity. Significantly for the specific research goals of this project effective use of UX theory will impact the quality of the product produced by the primary research method and therefore the accuracy of the answer to the proposed research question.

Having highlighted several advantages of UX prototyping tools, any disadvantages must be considered. The most significant disadvantage is the ease at which project scope can creep during the requirements analysis phase. As creating prototypes is made more efficient by UX tools, responding to user activity and feedback during this phase can tempt development teams to create more and more complex prototypes as they discuss issues with users. To

mitigate this a strong definition of the project scope must be understood by users and developers as the project proceeds (Aravindakshan, 2017).

UX prototyping tools will be a vital technology for the success of the project, providing a resource and cost-efficient tool to base further work on will streamline a typically resource-heavy stage of development.

4.2.2 Draw.io

Draw.io is a free-to-use online web application that provides a variety of chart, graphing, and diagram functionality, users access a plethora of drag and drop diagram elements alongside editing tools for formatting. Draw.io allows files to be exported in an array of formats aiding ease of use, it is an intuitive and extremely easy to learn package that contains an enormous library of elements and styles. Importantly for this project, it has a varied UML package allowing for clear and technical UML diagrams to be created and iterated upon with ease. The benefit of using draw.io over traditional UML tools is its ease of use, low barrier for entry, and ability to export files in a variety of file formats.

Having discussed the importance of using appropriate tools during the design phase, using appropriate technology during the implementation phase is as, if not more, important to a project's success.

4.2.3 Android Studio

Android Studio is an integrated development environment (IDE, a software program that provides tools and capabilities to perform tasks such as code writing, compiling, and automated testing (W. Snipes, 2015)) based on the IntelliJ IDE. Android Studio provides a unified environment where developers can build apps for devices running the Android operating system such as mobile phones, tablets, Android TV, and wearable devices.

As a development environment Android Studio provides excellent code editing and testing functionality, greatly reducing the amount of repetitive work carried out. Creating layouts and UI is simplified greatly in Android Studio. The tool offers a layer of abstraction that streamlines the process of creating a UI, repeatedly typing boilerplate XML code is instead implemented using a drag and drop interface.

Most importantly Android Studio provides an efficient and streamlined way to deploy applications created inside the IDE. Using an emulator ("a computer system that is designed to behave in the same way as a different system" (Cambridge Dictionary, 2022)) or a physical Android device, developers can deploy their applications onto the device for testing and usage by users. In the context of this project, an interactive software solution will be deployed to an android device to provide to users for testing in an uncontrolled environment. This streamlines the deployment process greatly eliminating the need for a WIFI connection (web application) or approval process from an app store (IOS or traditionally deployed android application). This will allow for a more accessible user testing process not limited by location, network status, or external servers.

Additionally, Android studio is supported by a large team of community and professional developers creating, updating, and refining an enormous library of documentation and predetermined code for use by developers. This means that developers can perform

commonly implemented and sometimes extremely complex tasks with ease, allowing development to be focused on the areas that are unique to the specific implementation. Android Studio supports the use of an array of programming languages including Java and Kotlin.

4.3 Kotlin

Kotlin is a programming language designed to work with IntelliJ and aimed specifically at improving java when being used to create android applications. Kotlin is designed to work everywhere that java works and aids developers in creating simpler, more effective, and less boilerplate (code repeated in many places with little to no variation (Zaveri, 2018)) heavy code. In 2017 Kotlin was announced as an official language for Android Development. Kotlin offers a plethora of benefits over using Java, most importantly for this study, the ability to use Coroutines allows for more efficient data handling and UI interaction (BLAKIT IT Solution, 2018). Kotlin Coroutines are centred around suspending functions, a suspended function is a piece of programming logic that is given the ability to 'suspend' the execution of a coroutine at any point and then return control to the coroutine once the suspended function has completed its work (Leiva, 2022). Simply, Kotlin Coroutines work like threads (the path that is taken through the code while an application is executed) but with almost no limit on how many coroutines you can run on each thread.

As a result of the powerful additions and improvements that Kotlin has made over Java the code is more readable and concise, improving the overall experience of coding a Kotlin project, and greatly reducing the cognitive load of writing and debugging code.

As can be seen below Kotlin is growing in use, likely driven by its recognition as an official language for Android:

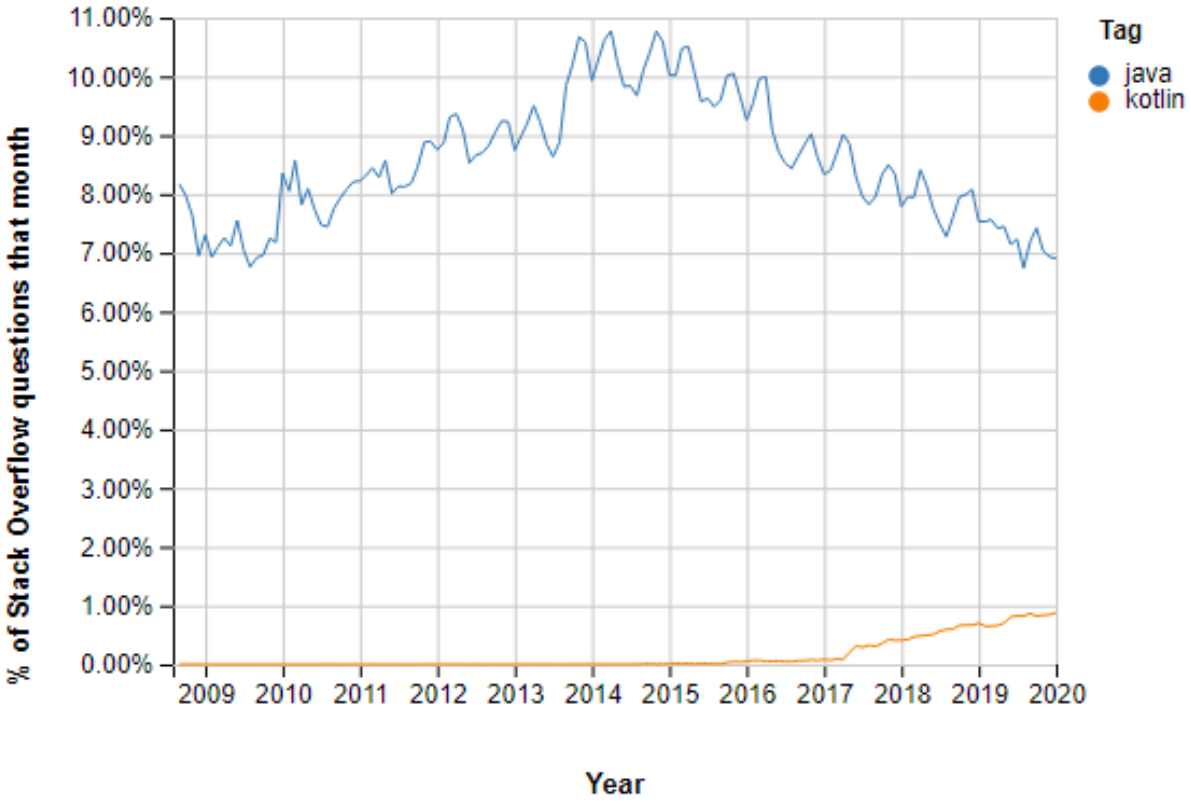

Figure 1: Java V Kotlin, Stack Overflow

However, java has a much larger community and decades of incremental improvement. In contrast, Kotlin is a young language with a much smaller, although dedicated, community. (Hartman, 2022)

Kotlin's benefits are felt greatly in designing and implementing the data structure of an application. However, if the language is not put to use effectively with an appropriate design pattern the additional functionality of Kotlin is wasted.

4.3.1 The Repository Design Pattern

A design pattern is a description given for a mature solution for a common and particular design problem. It is not a code package that can be applied to certain issues rather it is an empty framework that a developer can structure their code around (Coplien, 2003). A design pattern can be applied individually or in tandem with one or more patterns, a developer will assess how a pattern or patterns could help solve their problem and utilise or adapt the pattern for their solution.

The repository design pattern communicates between the domain and data layers of an application, acting like an in-memory domain object collection. Client objects create queries declaratively and pass them to the repository for satisfaction/completion. Objects can be added and removed from the Repository as with any collection of objects, the appropriate code within the Repository will carry out the appropriate operations behind the scenes,

outside the 'view' of the domain layers of the application (cubet, 2022). This is illustrated below:

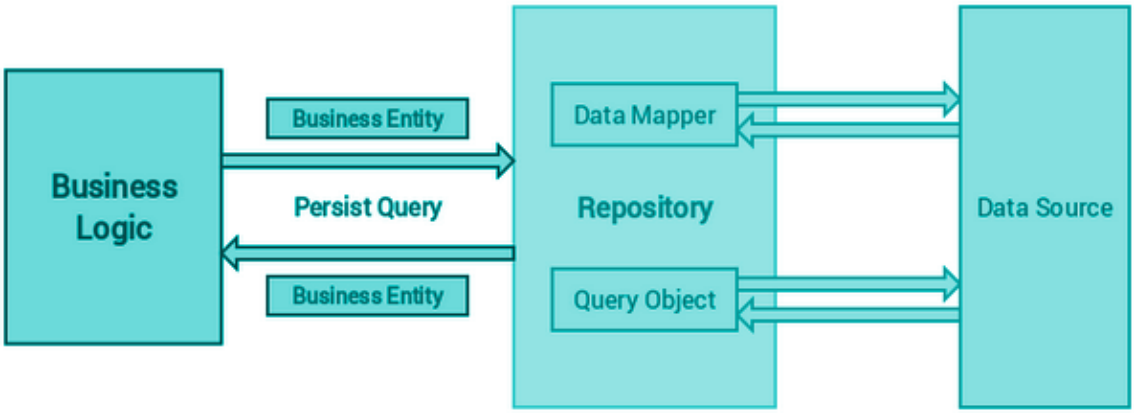

Figure 2: Repository Design Pattern Diagram

In simpler terms the Repository acts as a container for data access logic, separating the details of data access from the business logic. This means that the business logic has access to the data within the data object without knowledge of the data objects underlying architecture. There are many benefits to this (Kumar, 2015):

- Aids Separation of Concerns
  - Architecture is flexible
  - The two separated layers can be edited without having to modify the repository
- Aids Testing
  - Less duplicated code
  - Can test separated layers individually

In the context of this application, the benefits of this pattern will be fully utilised. Based on the results of the requirements and design phases any potential software solution would involve heavy interaction between the Business logic of the application and the Data Source. For effective technical testing and debugging to take place the separation of concerns and testing benefits would be vital to project success.

4.3.2 Survey Monkey

Survey monkey is a software service for carrying out surveys with a participant group. It features the ability to share the survey with a chosen audience and then analyse the results using data visualisation. In the context of this research, it will be used mainly to anonymise the responses from the user group to minimise any issues of bias or data protection.

5 Execution

The execution chapter discusses and details what a development type project is and how this structure was applied in the context of this project.

Detail is given on each phase of the development process beginning with the requirements and design phases. The requirements and design phases establish what functionality is required and the use of a focus group and brainstorming to determine this. Secondly, the implementation phase describes how an android application was used to achieve the functionality and elaborates on how the technologies were utilised to ensure success, with an evaluative discussion highlighting navigation shortcomings and a validation error. Finally, the deployment phase discusses the process of deploying the application to an android phone and utilising a user test. Data was collected from a user group before using the application and then after two weeks of consistent usage. The usefulness and relevance of this data are also established.

5.1 The Structure of a Development Type Project

A development-type project was the primary research method used for this study. This method is constructed of three major phases. Firstly, a software implementation is developed using an established development process, usually of two kinds:

- Incremental: An incremental development cycle is an approach that divides the development process into fully working sections known as increments.
- Iterative: An iterative development cycle involves creating a feature and releasing it in its most bare initial form, then adding to or amending the feature based on feedback from project stakeholders. (Agility.IM, 2022)

Secondly, the testing/evaluation phase is undertaken, this involves carrying out unit testing to ensure that the features of the software solution function on a technical level and there are no syntax or logic errors, if the application passes this level of testing it is ready for user testing. User testing is used to create a dataset that can be reviewed in the final phase of the project, the evaluation/conclusions phase. User testing may involve carrying out workshops in a controlled environment or allowing users to test the application in an uncontrolled environment and then surveying the user's reported attitudes after some time.

The evaluation/conclusions phase involves an analysis of the user testing carried out in the previous phase, evaluations are made, and conclusions are drawn from them. These conclusions will be used to answer the research question.

5.1.1 Why a Develop and Test Type Project?

The development type project is the most appropriate approach to answering the research question because of the inherent properties of the approach, alongside the different avenues that can be explored based on the initial research.

Firstly, developing a unique software application through the lens of answering the research question allows for a specific use case to be explored. Therefore, tailored, and detailed conclusions can be drawn from the testing phase.

Secondly, the testing phase of a development-type project allows for a wide variety of data gathering techniques to be implemented, from uncontrolled user testing, and controlled workshops to metadata analysis there is a wide scope for differing tests.

Finally, a development-type approach creates a lasting and unique software application in a specific research area. This fragment provides a tangible starting point for any new research in the area thus expanding the research topic not only through its findings but also the research method itself. As a by-product of this new usages for technologies used in the development process may be discovered, also expanding the research base outside of the research conclusions.

5.2 The Development Process

It was decided that an incremental development process would be used to develop the software application. The popular waterfall method was chosen. As touched on in 5.1 incremental development methodologies, and by extension, the waterfall method involves completing stages of the development in their entirety before moving on to the next phase of the process:

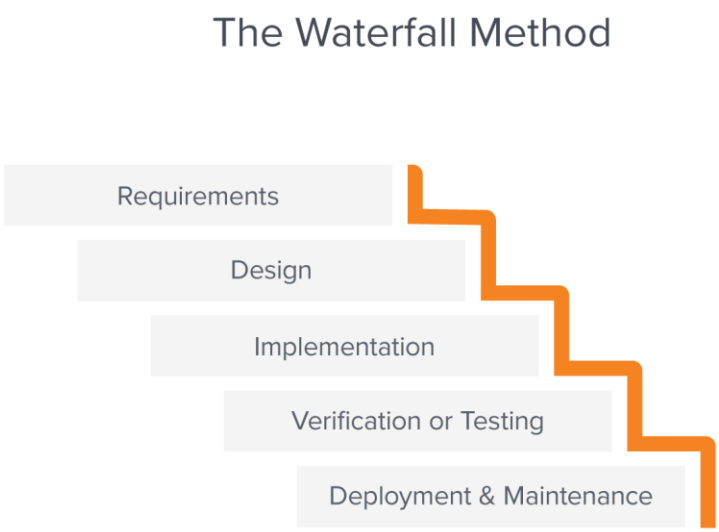

Figure 3: The Waterfall Process

Requirements

The requirements phase of the waterfall method depends on the developer being able to gather all of the requirements up front before the design and implementation begin. Requirements gathering will involve stakeholder consultation and in the context of this project consulting potential users, secondary research, and similar applications that operate in a different area. The requirements phase will lead to the functionality the design and implementation phases create.

Design

The design phase involves the developer creating a technical solution to the problems discussed in the requirements phase. The design phase will describe how the developer will implement the features that the application will contain.

Implementation

The implementation phase involves the actual coding of the application by the developer. The developer codes based on the design documentation and will carry out technical testing in this phase, debugging as the code is written is common. Often the implementation phase discovers errors in the design and requires returning to this phase.

Testing

Final unit testing is deployed to determine how effectively the implementation has met the specification once the implementation phase has reached completion. Testing is carried out and if any errors occur the implementation phase is returned to, and the process is repeated until the solution meets the testing requirements. (Adobe Experience Cloud, 2022)

Deployment

Finally, the deployment phase is begun once the testing phase has reached a satisfactory conclusion, the deployment phase involves releasing the software application to users or customers. In the context of this project, it will involve deploying the completed application to an android device for users to test over a period of time.

Why an Incremental Approach?

It was decided that an incremental design method would be used over an iterative approach as the incremental approach fit more appropriately with the style of project that is being undertaken. While there are many benefits (early functional prototypes, easier changes to project scope etc) to an iterative approach this project would not have been able to make full use of them, while still suffering the disadvantages (difficult to define end date, resource intensive).

An iterative approach relies on rapid deployment of basic coded prototypes, it was felt that the implementation phase would make up a significant portion of the development cycle therefore iterating through this phase would increase the time constraint beyond acceptable limits. However, the benefits of iterating within a phase were not ignored, during the requirements and design phase especially, several iterations of concepts would be created based on user feedback.

5.2.1 Requirements and Design Phases

5.2.1.1 Initial brainstorming and requirements gathering

Based on the findings of the literature review a set of initial attitudes and behaviours that the application will target was decided on. These would be the user's household skills, planning skills, shopping skills, and leftover reuse. Considering these skills, a feature set was brainstormed intending to target aspects of each area in one cohesive application (original paper documentation is available in appendix 10.1).

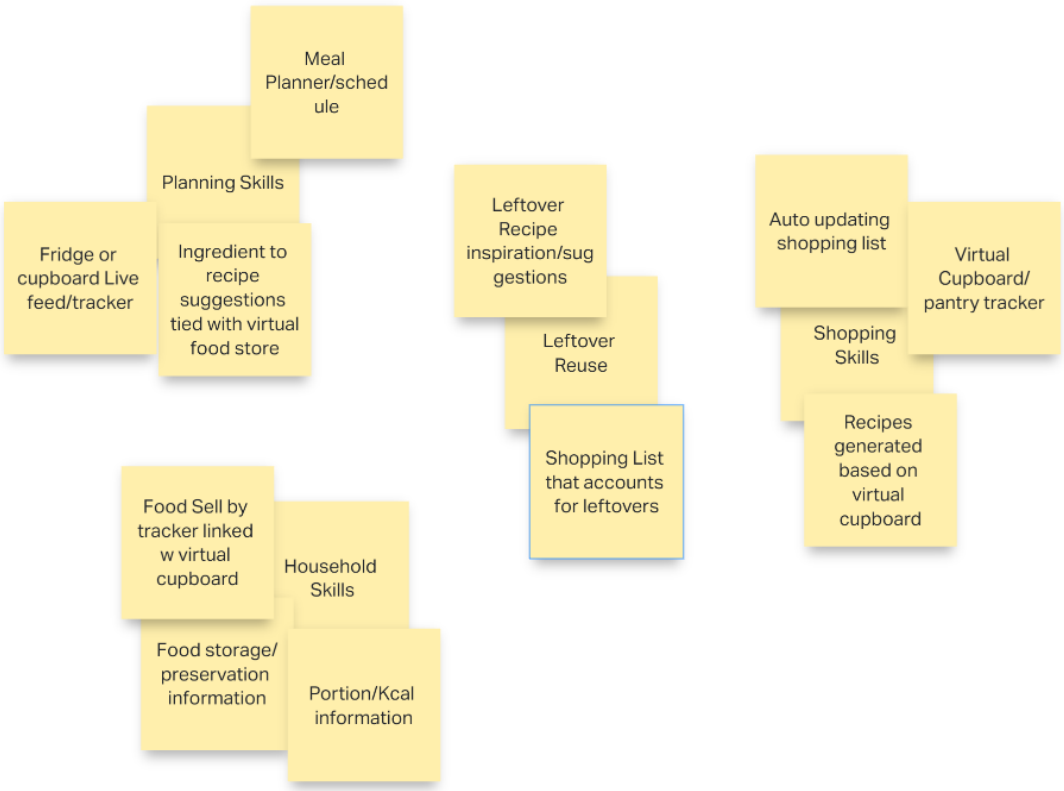

Figure 4: Digitised representation of Initial Brainstorming

Based on the features envisioned in this process the feature set was narrowed down to a short list of combined features that could be implemented as an application with a coherent user journey.

Figure 5: Digitised representation of short list 1

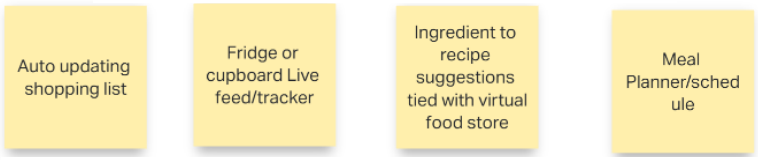

Figure 6: Digitised representation of short list 2

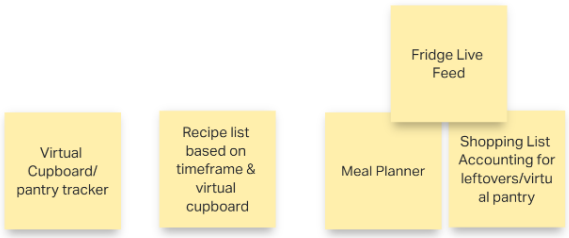

Figure 7: Digitised representation of short list 3

Finally, comparisons were made with 'competing' applications that have had success in other areas in changing user attitudes as mentioned in the literature review. Applications of particular influence were MyFitnessPal, NoWaste, and Strava:

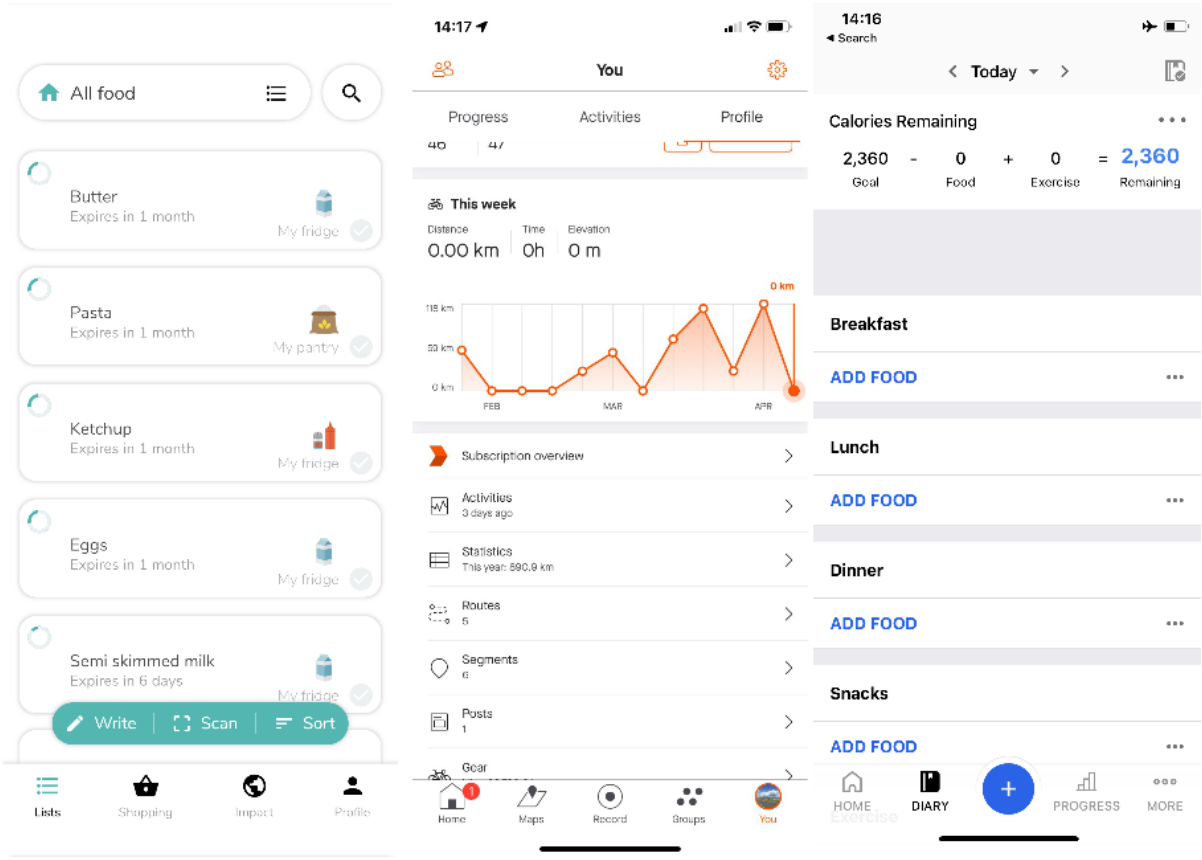

Figure 8: From Left to Right, examples of; NoWaste, Strava, MyFitnessPal

The application's layouts, features, and navigation structure were noted by the developer and would be called upon as a reference point during the rest of the design process.

5.2.1.2 Initial Design Process and Documentation

Having decided on an initial feature set the UML process was started with a use case diagram created to provide a high-level view of the application:

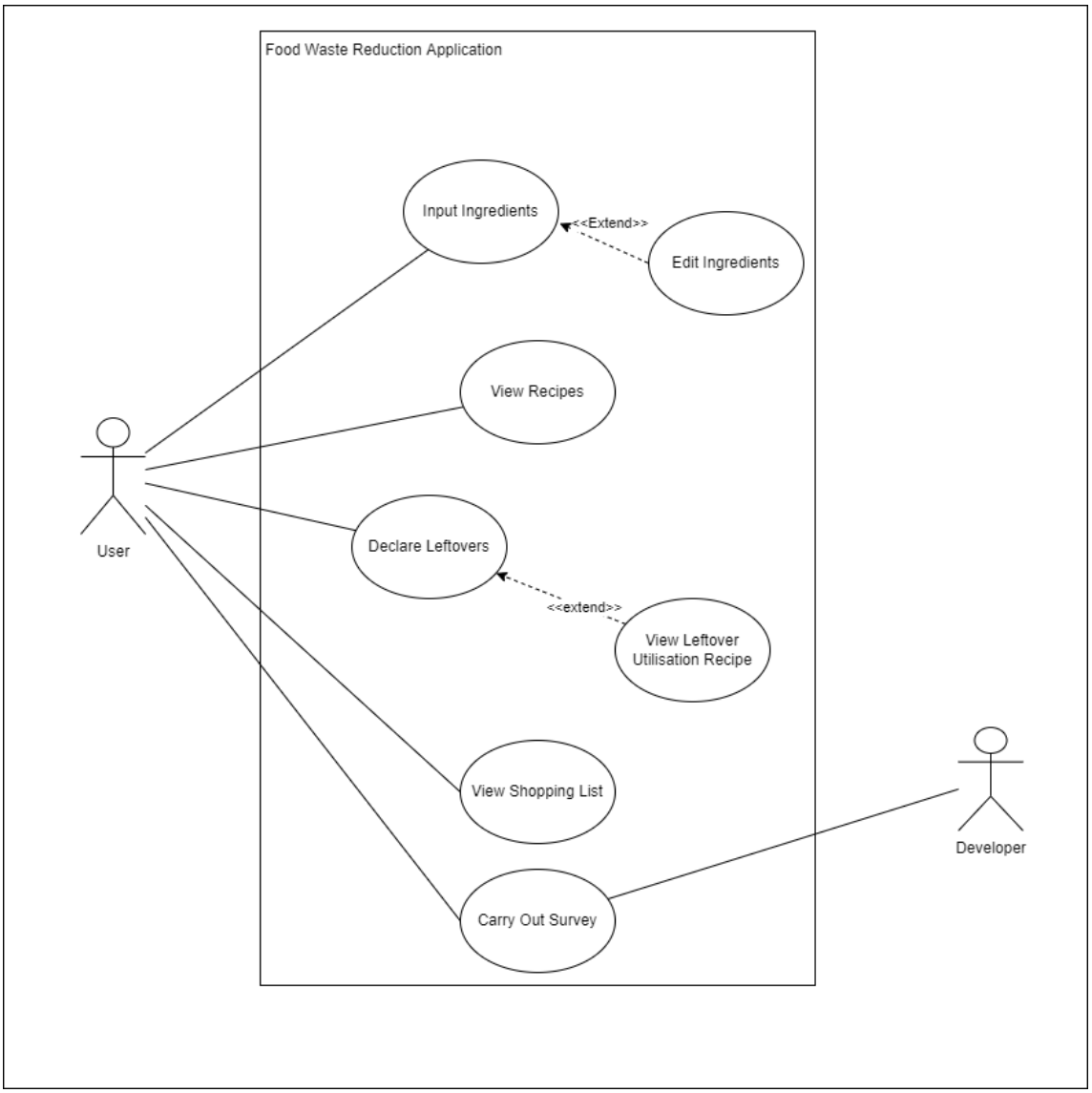

Figure 9: Initial Use Case Diagram

Further initial UML documentation is available in the appendices section in appendix 10.2.

This use case visualises the initial feature set. The feature set involved allowing users to track their food stores at home by capturing images of their shopping receipts and generating a list of recipes that would utilise those ingredients. If the user had leftovers after cooking the recipe list, they could input these into the app, this would then generate a leftover recipe and a shopping list that would correct their last batch of ingredients to reduce leftovers.

Having now defined the applications initial feature set and preparing to move into the design phase of the development process, a focus group session was carried out. Using basic

wireframes (available in the link at the top of appendix 10.2), brainstorming documents and an explanation of the purpose of the application, vital feedback was gained from potential users as to what features they felt would have the greatest impact on their attitudes and behaviours. The most impactful feedback that drove significant changes to the current state of the design was:

- Ease of Use is a major priority
- They use their phones for the majority of their digital time
- The initial layout was unprofessional and not up to the standards the group was used to
- The feature set is invasive and demanding (requires a big commitment from the user)
- The group would use an app that has less functionality but is easier to use over an app that has more features but is awkward or difficult

5.2.1.3 Final Design Process and Documentation

Based on this feedback the feature set was pared back to focus primarily on the routines that potential users felt could be most impacted by the application and empower them most to make positive changes to their attitudes to those routines. This meant focusing on targeting the Shopping and Planning routines with simple and intuitive features.

Importantly user feedback showed that a mobile application would be the most effective way to improve their habits, as most users spent the majority of their digital time on a mobile phone rather than a non-mobile device. This is supported by secondary research from Statista that showed users in leading markets spending over 80% of their digital minutes on a mobile device. (Statista, 2020)

Based on these findings a final design of the use case and attached UML was created:

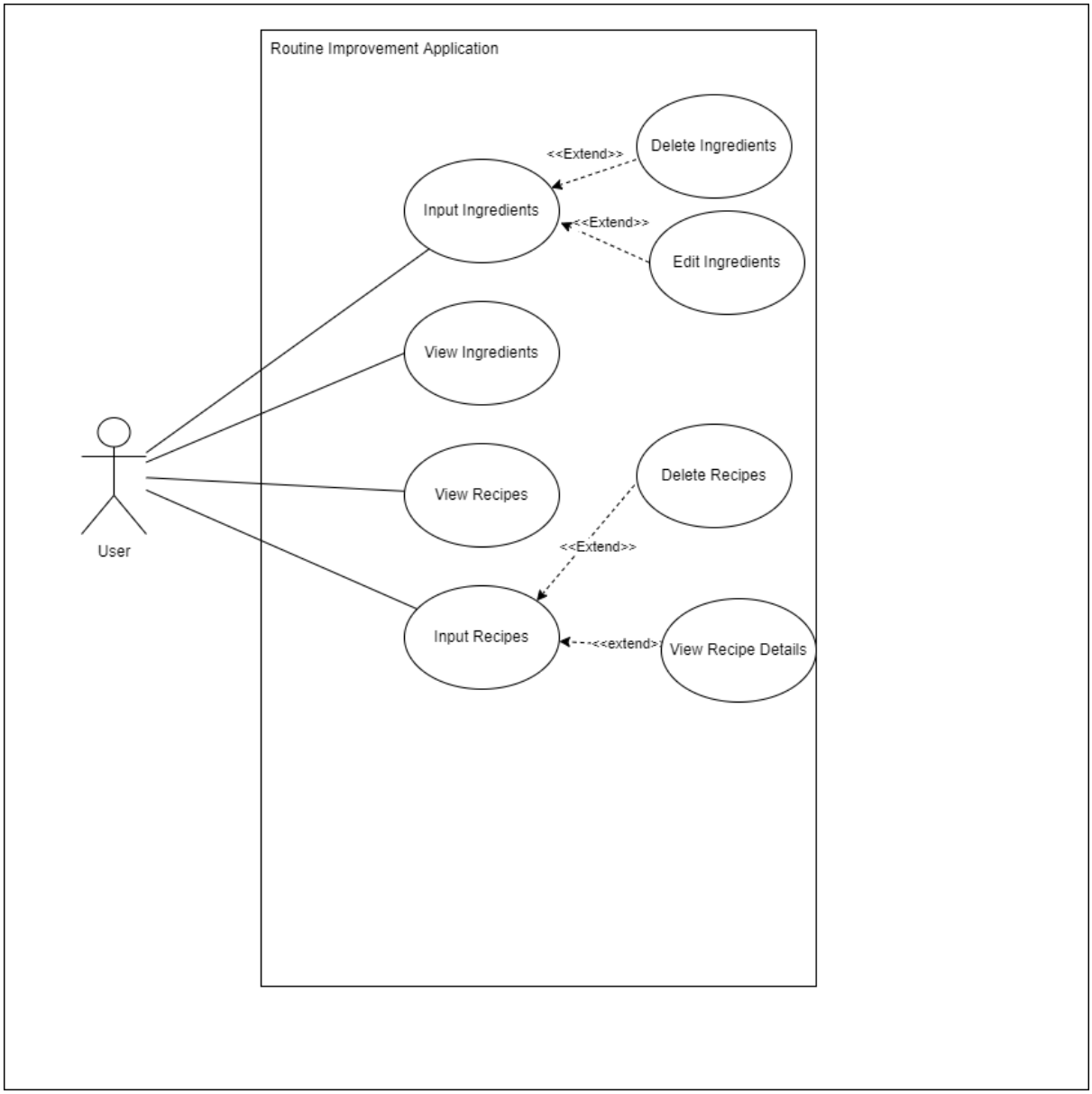

Figure 10: Final Use Case Diagram

Further finalised UML documentation is available at appendix 10.3 and complete user feedback and notes from the focus group is available in the appendices section at appendix 10.4.

In summary the final increment of the design would allow users to log ingredients and food stored in their home and create a bank of recipes that they preferred to cook. When shopping or planning a shop users can reference their ingredients and determine what recipes will make use of ingredients stored at home.

5.2.2 Implementation Phase

5.2.2.1 Technologies Justification

When beginning the implementation phase a set of technologies were chosen to ensure a successful implementation process. The first technology that was decided on was the development environment, Android Studio was chosen to fill this role. Android Studio is based on the popular development environment IntelliJ and provides a wide array of functionality that assist in the implementation and deployment phases of the project, this includes 'quality of life' features such as text autocomplete and plugins that can generate layouts, format code, and increase legibility.

As mentioned in the technology review the most important factor in choosing Android Studio was the emulator and ability to deploy applications created in the studio directly to an Android Device. This simplified the deployment process to a time efficient exercise where a QR code is scanned, and the user can use the application on a mobile device.

As the software solution was going to be a mobile application a development studio that allowed a seamless implementation and deployment phase to a mobile device was an excellent resource for this project.

The second decision was which programming language would be most appropriate for the software solution. Android Studio offers a selection of languages and the most immediately suited languages appeared to be Java and Kotlin. Based on previous experience with Java it was the initial choice. An early prototype of the navigation structure was created in Java (code available in the appropriate remote repo in appendix 10.5) but upon researching how to implement the data structure it was decided that Kotlin would be a better fit for the software solution.

Kotlin is a comparatively young programming language that was created to improve upon Java and provide functionality it was missing. The deciding factor between the two was Kotlin's Coroutines which delegates most of the functionality of Asynchronous or non-blocking programming to libraries (Kotlin, 2022), functionality that Java lacks.

Finally, choosing an appropriate design pattern to structure the implementation around was moved on. The largest considerations were the separation of concerns, a simple and maintainable data structure, and testable code.

As the implementation would come to centre around heavy interaction between the data structure and the interface aspects of the applications the Dao and repository patterns were both considered. When comparing the two it was felt that the repository would offer more flexibility as a higher-level concept and encouraging domain-driven design, it would be a more 'legible' structure to implement.

After considering and defining what technologies would be utilised the implementation phase could begin in earnest with the construction of a navigation structure.

5.2.2.2 The Navigation and UI Structure

Android studio provided an efficient way of forming a navigation hierarchy and UI layout. The 'Navigation graph' was used to quickly create and visualise the basic navigation structure that the application would utilise:

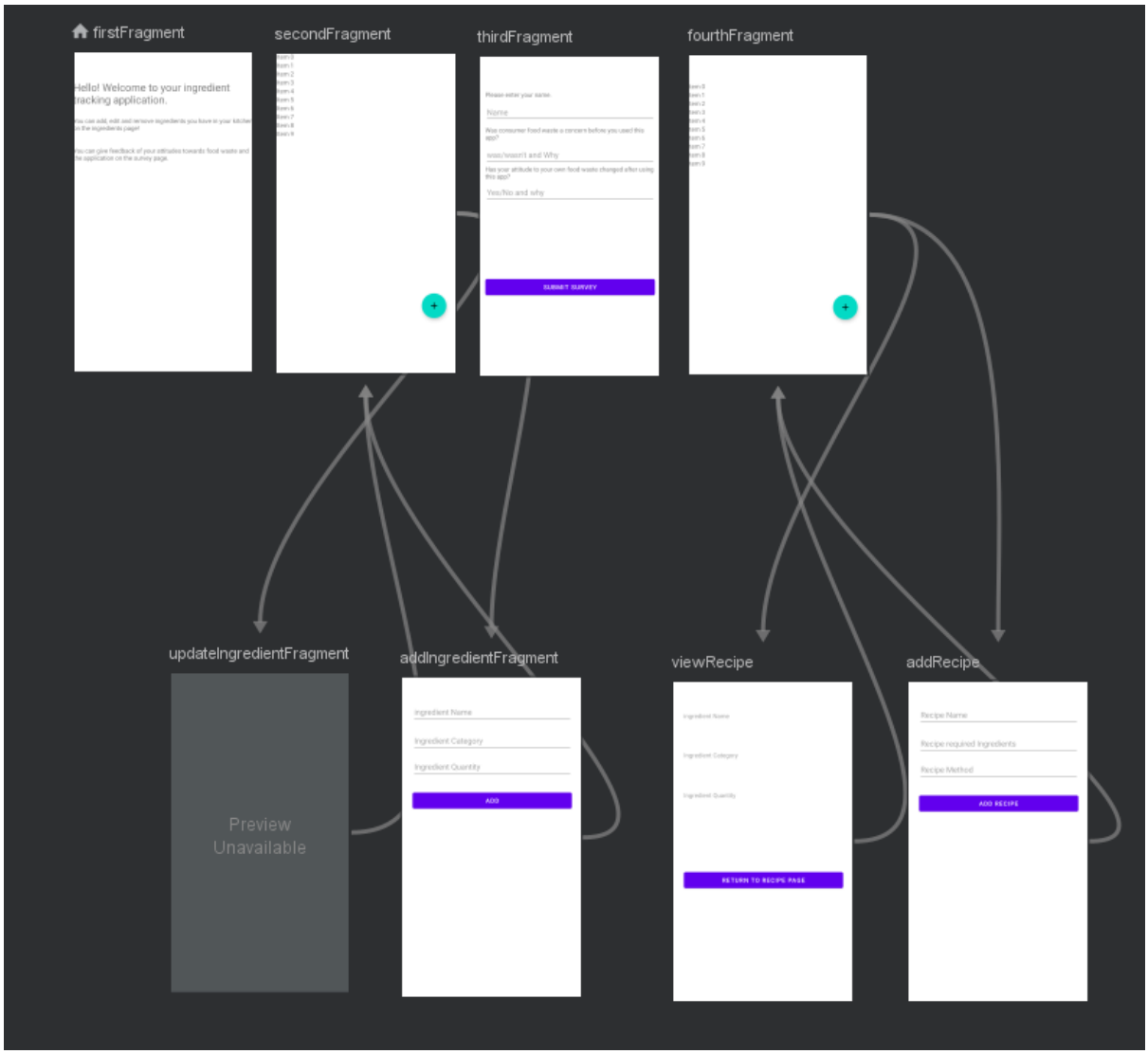

Figure 11: Navigation Graph Visualisation

The navigation graph displays all of the 'fragments' ("a reusable portion of your app's UI" (Android, 2022)) within the application, each fragment has an attached layout and class, and handles its own inputs and passes them to different layers of the application for handling.

The fragment setup is designed by Android to function with other navigation elements including the BottomNavigationView which was used to handle traversal between fragments. The BottomNavigationView is an Android class that handles navigation between top level fragments, in this case the first through fourth fragments.

Utilising Android Studios classes for navigation rather than a custom class allowed for more efficient implementation and for the application to be consistent with standard UI practices.

Alongside the Navigation classes (BottomNavigationView, Navhost and NavController) that the application utilised the RecyclerView class also played an important role in forming the UI and displaying data read from the data layer through the repository structure:

```
val view = inflater.inflate(R.layout.fragment_second, container, attachToRoot: false)
//Recycler View (display users input ingredients)
val adapter = ListAdapter()
val recyclerView = view.recyclerview
recyclerView.adapter = adapter
recyclerView.layoutManager = LinearLayoutManager(requireContext())
```

Figure 12: Recycler view being utilised in the SecondFragment Class

The above code snippet from the SecondFragment Class displays how the use of the predefined navigation and recycler view classes is used to 'inflate' (instantiate the XML elements of the layout file) the layout and populate it through the usage of the custom adapter class and other internal methods.

Having now created the navigation framework implementing the data structure was the next step, thus implementing the functionality that the UI enabled. Similar to the navigation structure the data structure was greatly improved through the use of Android Classes.

5.2.2.3 The Data Structure

SQLite (a lighter form of SQL developed for mobile applications) has native support on Android and was deemed to be able to meet the relatively simple database requirements of the software solution.

To implement SQLite more effectively within an android application, Android provides an Object Relational Mapping library (ORM, a layer between the programming language and the database that acts as data-access code) that improves readability and testing as the code that the ORM produces is well tested.

The ORM for SQLite in Android Studio is known as ROOM and provides important functionality that formed the structure of the applications data persistence:

```
@Entity(tableName = "ingredient_table")
data class Ingredient(
    @PrimaryKey(autoGenerate = true)
    val id: Int,
    val ingredientName: String,
    val ingredientCategory: String,
    val ingredientQuantity: Int
        ): Parcelable
```

Figure 13: @Entity Example

“@Entity” allows the developer to define a database table and “@Primary key” defines the table's primary key.

```
@Dao
interface IngredientDao {

    @Insert(onConflict = OnConflictStrategy.IGNORE)
    suspend fun addIngredient(ingredient: Ingredient)

    @Update
    suspend fun updateIngredient(ingredient: Ingredient)

    @Delete
    suspend fun deleteIngredient(ingredient: Ingredient)

    @Query( value: "DELETE FROM ingredient_table")
    suspend fun deleteAllIngredients()



        @Query( value: "SELECT * FROM ingredient_table ORDER BY id ASC")
    fun readAllData(): LiveData<List<Ingredient>>
```

Figure 14: @Dao Example

“@Dao” provides an API for reading and writing data, the dao is where database interactions or queries are defined. When the project is compiled, Room generates an implementation of the class which is referenced by a database. (Android, 2022)

```
@Database(entities = [Ingredient :: class], version = 1, exportSchema = false)
abstract class IngredientDatabase: RoomDatabase() {

    abstract fun ingredientDao(): IngredientDao

    companion object {
        @Volatile
        private var INSTANCE: IngredientDatabase? = null
```

Figure 15: @Database example

“@Database” declares the database as an extension of room database allowing it to be accessed through the Dao.

The image below visualises how the navigation and data structures interact through the repository pattern. It encapsulates how all of the technologies used in the implementation operate together to achieve the functionality:

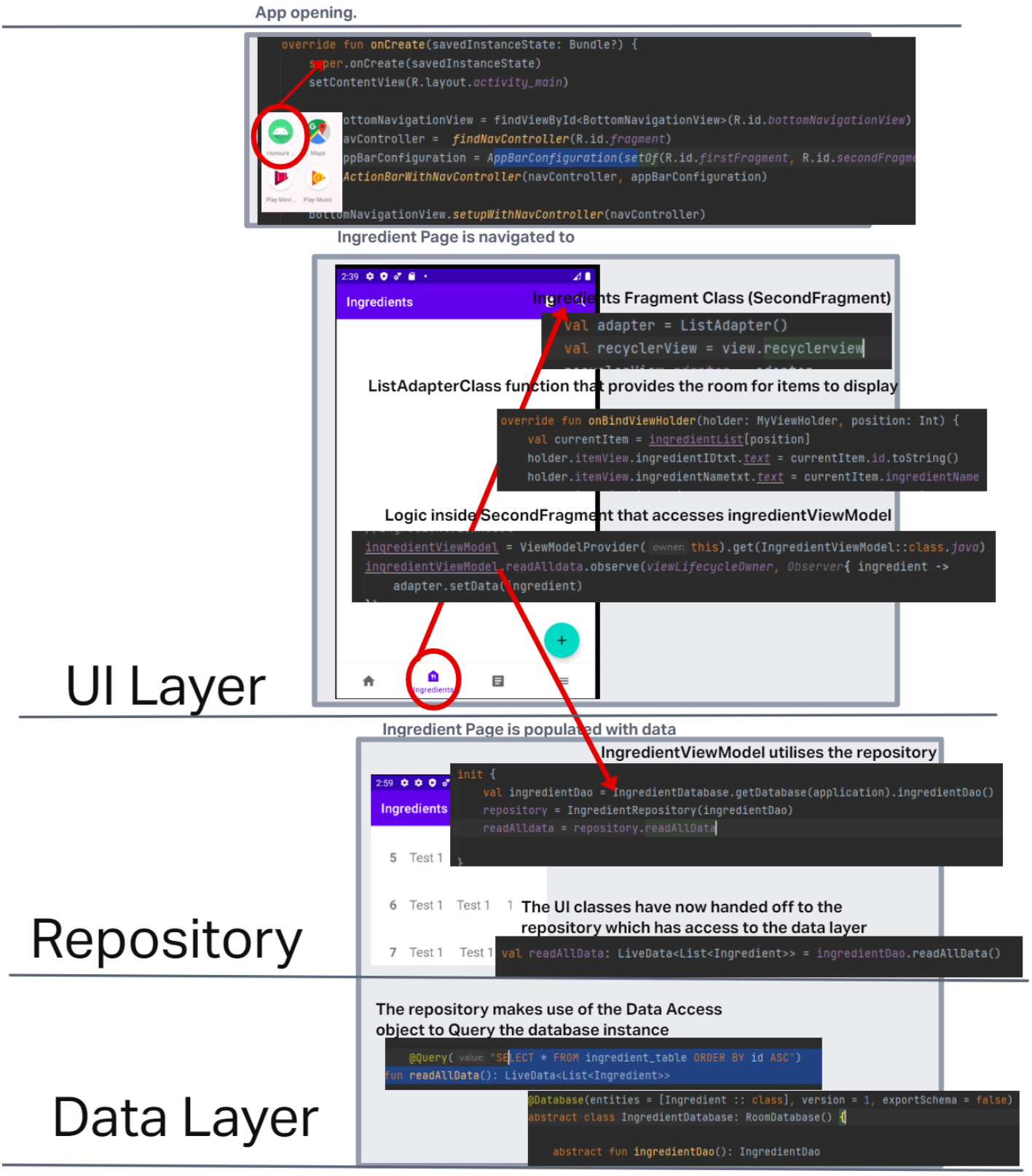

Figure 16: Implementation example

This example shows how the repository, UI, and data structures interact to display a user's saved ingredients.

5.2.2.4 Functionality Assessment

Based on the goals set out in the design phase the final implementation of the software solution was successful. All of the functionality set out was achieved, however, there were some minor shortcomings in the execution of the application that will have impacted the user experience. Firstly, when navigating to a lower level of the navigation structure the back arrow implemented in the top left of each fragment did not operate correctly, this was negated with an external return button on some pages, but it hinders the flow of a user's journey through the application. Secondly, there was an issue with the Kotlin packages that hindered the search function from filtering results, diminishing the user experience and causing the user to scroll. Finally, the validation for the ingredient quantity can cause an application crash on occasion.

While these errors do not stop the functionality of the application in its entirety, they do hinder the overall user experience and would not be allowed to be deployed in a business application. However, as the central feature set was not heavily impacted it was felt that these errors would not sway a happily participating user from making use of the functionality of the application.

5.2.2.5 The Deployment Phase

Having finalised the implementation phase deployment was the next step. The main work of the deployment phase would be capturing user feedback before and after using the application and ensuring the users can spend an appropriate amount of time with the application.

To do this the users would need to either have or be given an android phone with a version of the software solution installed. This was done using android studios remote debugging tool, an alternative to the usual emulator that can be used:

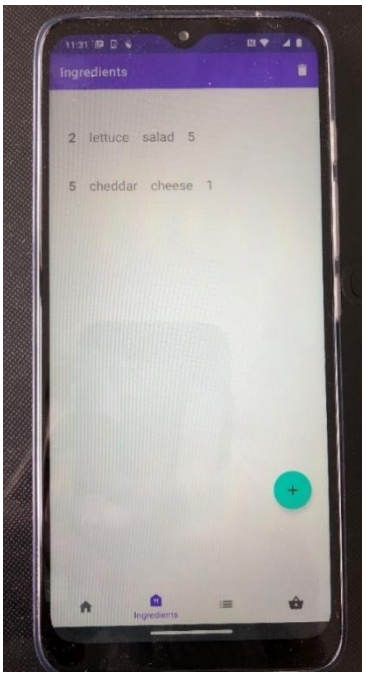

Figure 17: Deployment to a device

Above is an example of an android phone running the software solution after accessing the developer settings and scanning a QR code generated by Android Studio.

5.2.3 User Testing and Survey

After establishing the constraints on deploying the software solution to an Android Device the next step was taken to establish a group of users to carry out an extended test of the application.

This process would involve providing the user group (and by extension their household) access to the application for two weeks for use in their everyday lives, asking them to report their initial attitudes towards their shopping and planning routines, and then consulting them after the testing period on the same attitudes.

The data gained from this test will define the initial attitudes of the user toward their food-related routines. The impact the software solution has had will be determined by the response of the user to the survey carried out after having access to the application for two weeks.

The results of the two surveys will be compared and contrasted and conclusions are drawn based on that.

5.2.4 What are the logistics and constraints of this method?

Due to the nature of the deployment method the scale and scope of the test are restricted by several factors. Most significantly, this method is constrained by the way the software solution is deployed to the device, this method requires that the target device is on the same WIFI network as a computer running android studio with the software solutions source code when initially deploying. Secondly, the fact that the software solution only runs on Android limits the scope of testing and required at times the tester be provided with an Android device to use. Lastly, this method was restricted to the researcher's network due to the (relative) complexity of installing the software solution and the time that would be required to carry out the testing. This may also have restricted the demographic scope of the test, however, as discussed in chapter 4.1.3 this is likely not a factor that would skew or bias the results of the test in a significant way. This will be discussed further in chapter 6.

The results of the deployment phase are discussed and elaborated on in the next chapter.

6 Results Evaluation and Discussion

This chapter presents, discusses, and makes initial conclusions regarding the results of the user test.

A set of targeted and open-ended questions from the initial and final surveys are presented which showed a generally positive shift within the user group after taking part in the surveys. The initial conclusion made is that it may not be possible to conclude concretely that this shift was entirely due to the use of the software solution.

6.1 Presentation of results

Through the surveys carried out during the deployment phase of the project the user group's attitudes were surveyed before using the application and then after using the application for two weeks.

The initial and final survey questions can be found in the links in appendix 10.6

The initial survey results can be found in appendix 10.7

The final survey results can be found in appendix 10.8

The surveys built up a picture of the user group's general attitudes to food waste and their food-related routines. In the initial survey, ten questions were asked with some more general questions and several questions structured to gain specific insight into their attitude to their shopping and planning routines (the routines the software solution aimed to address).

When designing the question list for the final survey the priority was to identify if the user group's attitudes to their shopping and planning routines had changed, and if they had, in what way. The approach taken to this was to ask a range of similar or identical questions as the first survey, alongside some additional open-ended questions for the users.

The questions that a direct comparison can be drawn from are listed in the table below:

Table 1: Survey Key Question Comparison

Initial Survey Question	Initial Survey Answer statistics	Final Survey Answer Statistics
Question 3- "When you are deciding what to buy what is your starting point?"	70% state it is the meals they want to eat, 30% state it is the ingredients they have at home.	71.43% state it is the meals they want to eat, 28.57% state it is the ingredients they have at home, 57.14% added a comment saying both
Question 5- "What is important to you when buying food"	80% response to making sure I have all the ingredients for meals I want to cook, 40% responses for what needs used up at home.	80% response to making sure I have all the ingredients for meals I want to cook, 80% response for what needs used up at home.
Question 6- "Which of these statements are true about you?"	80% responses to I often forgot to buy all the ingredients I need. 60% of responses buying more food than they use. 20% of responses to buying just the right amount of food	80% of responses felt they forgot to buy all the ingredients they need. 50% of responses buying more food than they use. 30% of responses to buying just the right amount of food
Question 7(Question 8 in the final survey)- "Would you like to do any of the following?"	90% of responses showed that they wished to save money on food shopping. Nearly 56% wished to reduce their food waste	60% of responses showed that they wished to save money on food shopping. Nearly 60% wished to reduce their food waste

Question three aims to find a starting point for how much a user considers using up their ingredients that are stored at home, as the application assists them in tracking this and aims to make this a more significant consideration. The initial survey found that while the user group did consider using the ingredients they had at home, 70% of the group prioritised the meals over utilising the ingredients stored at home. In the final survey the overwhelming majority (71.43%) still felt that the meals they want to eat were the main priority when shopping, however, the comments box showed a majority consensus that the group now considered both.

Question five aims to identify the most important factors for a user's shopping routines. In the initial survey, this question supports the findings from question three that the user

group prioritised the meals they would like to eat when shopping (80% response to making sure I have all the ingredients for meals I want to cook). Only half as many responses (40%) were logged for the “what needs used up at home” response, again showing a similar ratio as question three. The relevant change in the final survey was that the number of selections for the “what needs used up at home” option doubled since the first survey, indicating a positive change in the group's routines.

Question six attempts to identify the wider scope of a user’s attitudes to their shopping and planning routines. In the initial survey, there were 80% responses to the “felt they forgot to buy all the ingredients they need” option, followed by 60% of responses to “buying more food than they use”. This shows that the user group felt a shortcoming in both their planning and shopping routines.

In the final survey question, six showed some minor changes when compared with the initial survey, there was a 10% decrease in users reporting that they bought more food than they use and a 10% increase in users reporting that they buy just the right amount of food. These changes are indicative of users now having a more ‘aware’ or waste-conscious attitude to their food-related routines.

In the initial survey, question seven was used to discern the group's desire to make positive changes, to which they showed an overwhelmingly positive response. When asked again (question 8 in the final survey) the group showed a 4% increase in those wishing to reduce their food waste and a 30% decrease in wishing to save money. This could be due to an increased awareness of the impact of their waste on their budget. The decrease in a wish to reduce spending could be due to more efficient shopping. There is not enough evidence here to draw a firm conclusion.

In the final survey, question seven was instead used to ask if any of the group’s answers to question six had changed since using the first survey. It showed a slight majority identifying a positive shift since using the application, this is interesting as it shows a potential disconnect in how the group viewed the changes in their actions compared to how they viewed their attitude to their routines that drive these actions. This is highlighted in the open-ended question nine in the final survey:

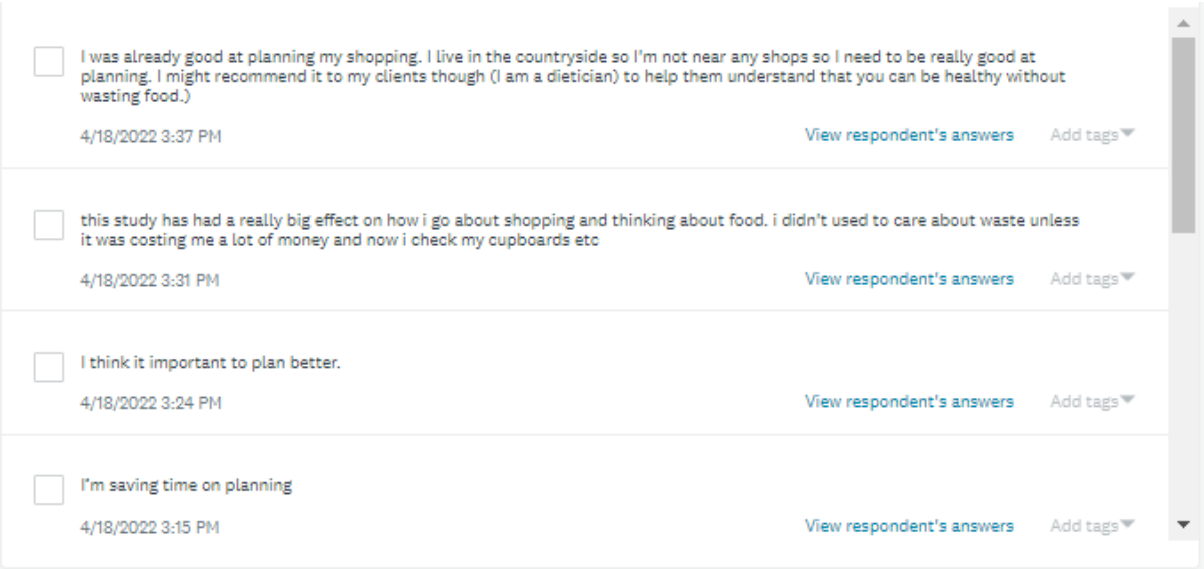

Figure 18:Question 9 Answers

The answers to question nine show a clear consensus in the group that their self-reported attitudes to their food and shopping routines have changed in a positive sense during the test period, due to the software solution.

6.2 Evaluation of Results

Through the comparisons drawn between the two surveys, it was felt that the user group showed a shift in a more positive direction concerning their shopping and planning routines. The shifts in direction were, at times, minor with some questions seeing improvements of less than 10% , however others showed a doubling in positive responses.

The open-ended 'reflective' questions support a positive shift in the users' attitudes to their routines, however, the responses to these questions were more diverse and did not paint as clear a picture as the comparisons that could be made between the more focussed questions.

When considering the comparison between the two surveys and what the open-ended questions of the final survey signal, it could be stated that they support a positive shift in the user group's attitudes to their shopping and planning routines. This means that after two weeks of partaking in this user test the group now has a more positive, i.e. improved, attitude to their routines, although it does not show conclusively that the software solution was the direct cause.

This conclusion was arrived at due to the consistency in the group's answers to the surveys as a whole. There were, however incremental, positive shifts in almost every question area and the group shared similar opinions towards a more conscientious approach to food waste.

7 Legal, Social, Ethical, and Professional Issues

7.1 Legal

When undertaking this project, the main concern regarding legal issues was the data protection act. While the data collected during this survey was not personally identifiable or sensitive it was felt that it was good practice to treat all data given by participants as if it fell under these legal constraints.

All of the data collected throughout the study was completely anonymised either manually or through the use of SurveyMonkey (an online survey software). The participants were told how their data will be used and good practice was followed. Only relevant data was kept, it was held securely on a private password-protected device and no data was held for longer than needed.

7.2 Social

The social impact of this project is central to its purpose. Consumer food waste is a negative phenomenon and attempting to understand how this can be reduced through the use of software solutions is of benefit to society.

This project aims to contribute to the current research pool and expand the current knowledge base. This will allow interested parties who may be acting to tackle food waste to inform themselves and consider the benefits of applying a software solution to the issue.

7.3 Ethical

To ensure ethical practices in surveying the test group the CASRO Code of Standards and Ethics for Survey Research was used. This code has 4 basic principles, “(1) willing participants; (2) informed about the survey’s intentions and how their personal information and survey responses will be used and protected; (3) sufficiently satisfied with the survey experience; and (4) willing to participate again in survey research” (Gideon, 2012). These codes ensure that participants are consenting, and leave satisfied with the experience. While these codes are created specifically for surveys these principles were applied to the focus group session carried out during the project.

The research question and software solution aim to change the attitudes and, as a by-product, the behaviour of users. To influence users ethically how the user receives information must be considered.

To put this in proper context an example of a user making a choice will be given. In an ethical process, the user is first made aware of a choice (changing an attitude), they then interpret this choice, evaluate it, make their choice (will I change the attitude? Will I not change the attitude?), and lastly, execute this choice (Yeates, 2010). This process means that the user evaluates and executes their choice based on the information they have been provided. For the user to remain in a position where they have consented to the choice and are in control of the decision they were presented with a clear and as unbiased as possible explanation of the context surrounding their decision (Noggle, 2020). This research explains

fully to the user the impact of their decision and any potential drawbacks in that decision, thus ensuring consent. The user will be satisfied with their decision as they have been fully informed.

It could be argued that it is not a necessary effort to ensure the ethical influence of the user in this case as the end goal of the product would be deemed by most to be a positive and ethical goal. However, the researcher believes that users who have made consensual and informed decisions will increase the effectiveness of the research and have a more positive experience taking part.

7.4 Professional

Several aspects of the project were reflected upon. More specifically it was felt there was room for improvement in the implementation and deployment phases of the project.

Regarding the implementation phase of the project, it was felt that taking an initial prototype to a focus group would have yielded interesting insights and possibly a more effective software solution. In hindsight implementing user sessions to collect usage data could also have created some insightful data.

Regarding the deployment phase, it would have been beneficial to work with a much larger sample size over a longer period. Deploying to an app store and engaging a test group that way would have allowed for a more detailed set of conclusions to be drawn, especially in tandem with app usage data.

It was also considered if an incremental method was indeed the correct approach over an iterative development process. On reflection, having completed the project work, there were many aspects of an iterative process that could have been beneficial such as conversations with stakeholders. However, the regimentation and fixed schedule of a waterfall project was overall the correct decision and was vital to project success.

8 Conclusions and Future Work

This chapter aims to summarise the work done throughout the project and share the study's conclusions. After considering the data gathered throughout the project it was shown that the user group's attitudes to their food-related routines had improved. However, a concrete conclusion about the software solution's impact on this could not be drawn. This chapter goes on to discuss the limitations of the user group the study had access to and the more detailed and resourced research that could improve on the conclusions given in this report.

8.1 Project recap

The research aims to answer whether an interactive software solution can improve user attitudes towards food-related routines that affect the quantity of consumer food waste. This was to be answered by a user test carried out with a software solution developed for the study.

The project work was executed using an adapted waterfall development process, with the deployment phase modified to include a two-week user test. The application feature set was created with the input of a focus group and deployed to an Android device.

The user group was given a survey to fill out at the beginning of the deployment test, before using the application, and then re-surveyed at the end of the two-week testing period. There were no stipulations on the users and the test was carried out in an uncontrolled environment to simulate how a commercially released software product may be treated.

The results of the survey were presented in chapter 6 and conclusions will be drawn from them in the following subsection.

8.2 Final Conclusions

In chapter 6.2 it was indicated that there had been a positive shift toward the users' food-related routines. The user test process gathered information about the users' attitudes and their self-reported attitudes. It showed a trend in the group of small improvements in their routines over the test period.

Users now considered the ingredients they had at home to a greater extent, there was a 10% increase in users buying the correct amount of food and the group reported that they felt their attitude toward their routines had improved due to the software solution.

The questions asked in the survey enquired about aspects of the routines that were directly impacted by features of the software solution (question 2 is a definitive example of this), and the users' attitudes in these regards improved generally. However, users also felt that their attitudes changed in ways that were not directly impacted by the features of the application. For example, users reported that they didn't pay as much regard to how healthy their shopping was, and they were conflicted about cost.

It could not be claimed that these changes were caused by the use of the software solution, and it cast doubt on the attitudes that appeared to be impacted by the solution.

When this is contextualised within the research question ("Can an interactive software solution improve user attitudes towards food-related routines that affect the quantity of

consumer food waste?"), the user test does not provide the definitive answer to the question that the study would have liked. It is not possible to definitively state that the software solution drove all of the positive changes that the user test reported. It is possible that just participating in the test may have impacted the user group. However, considering the general positive shift of user attitudes, it is highly likely that a software solution would have a positive impact on user attitudes to food-related routines.

This research does support Stancu's findings that an improvement or perceived improvement in food-related routines will reduce a consumer's self-reported food waste (Stancu, 2016) reinforcing the basis for this study and further research. Wang and, conversely, Ainsworth's findings are also of significance to this study's conclusions, because this study has shown that influencing user attitudes using software is a context-dependent and complex issue.

This research does not provide a definitive or immediately actionable answer for use within the field. What it provides is a point of reference for further research and shows that with a more technical and resourced study a definitive answer could be found.

8.3 Project Limitations

When looking back at the work completed for this project and the data gathering process several areas could have been improved. These areas would have created a more useful data set allowing for more concrete and defined conclusions to be drawn.

During the development process, certain aspects of the application were limited by the researcher's knowledge/experience (e.g., the user experience being hindered by minor errors) of the process and of the complexities of developing an 'of industry standard' piece of software.

The central issue with the data gathering process was a lack of resources available for the study. The sample size of the user testing group was limited by the availability of Android devices, as the users often had to be provided with a device this meant only one or two users could carry out the usage term at once. Had the researcher been able to provide more devices, a larger number of users could have been tested at once, therefore, putting less stress on the time constraints of the project. Secondly, as the user group was restricted to a small network the possibility exists that this could have biased (consciously or subconsciously) the user group's answers.

In hindsight separating the user group in a 'placebo' style test could have eliminated much of the ambiguity in the user test. For example, providing one half of the group with the software application and the other with some simple resources or knowledge of the study would have provided the study with a basis to claim which changes came directly from the use of the software solution and which did not. While this form of testing was prohibited by the already small sample size it is felt this is an excellent opportunity for future work.

8.4 Future Work

Drawing on the limitations subchapter it shows there is a great deal of future work that could address these issues and provide a comprehensive answer to the research question.

Carrying out a similar study with access to a full development team with industry experience and expertise would develop a much more representative software solution possibly widening the scope for greater impact on the user group.

A more refined user test would also provide impact. Drawing from the conclusions of this report a similar study that can focus directly on the user's interactions with the application could give clear and definitive answers. This would be greatly assisted through a more experienced development team as user sessions could be implemented (user accounts), data and usage tracking, and a more in-depth data gathering process directly from the software solution.

More broadly it would be interesting to see other food-related routines approached in-depth with different types of software solutions. There are various ways a software solution could attempt to influence a user's attitudes toward their food-related routines from a 'helper' or 'planner' style application as was created in this study to a virtual assistant or a video and information application.

9 References

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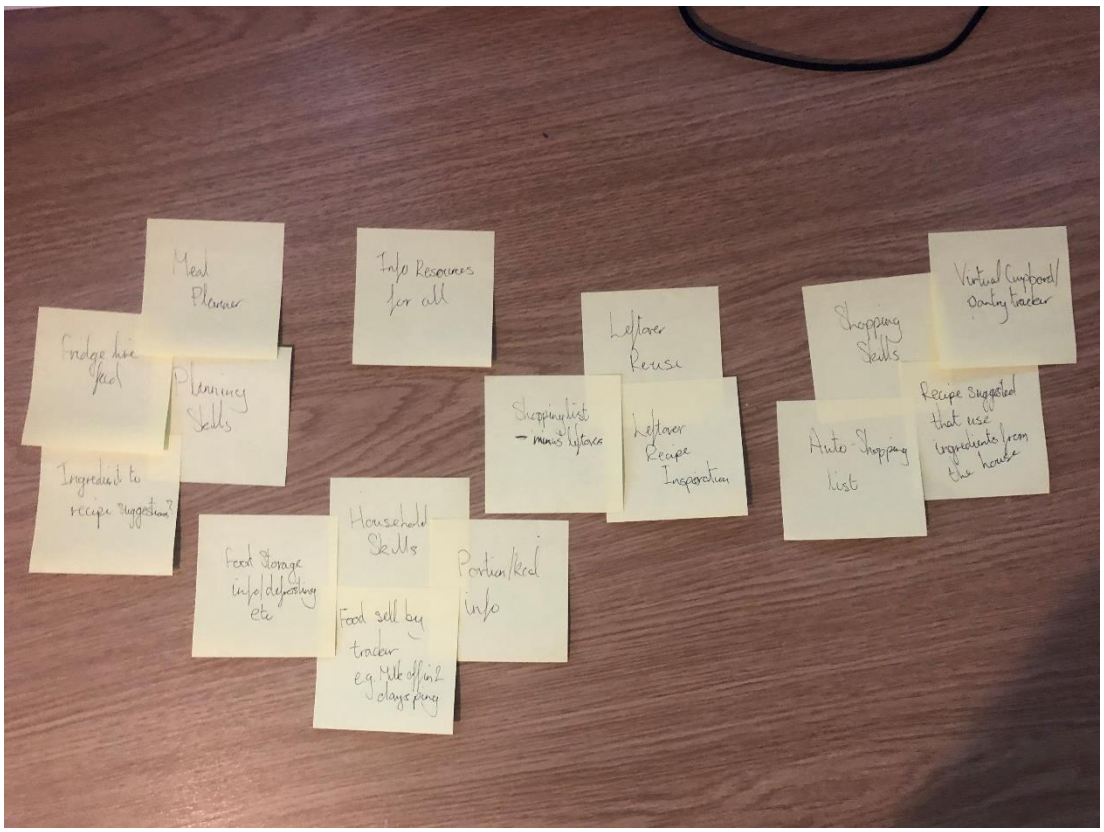
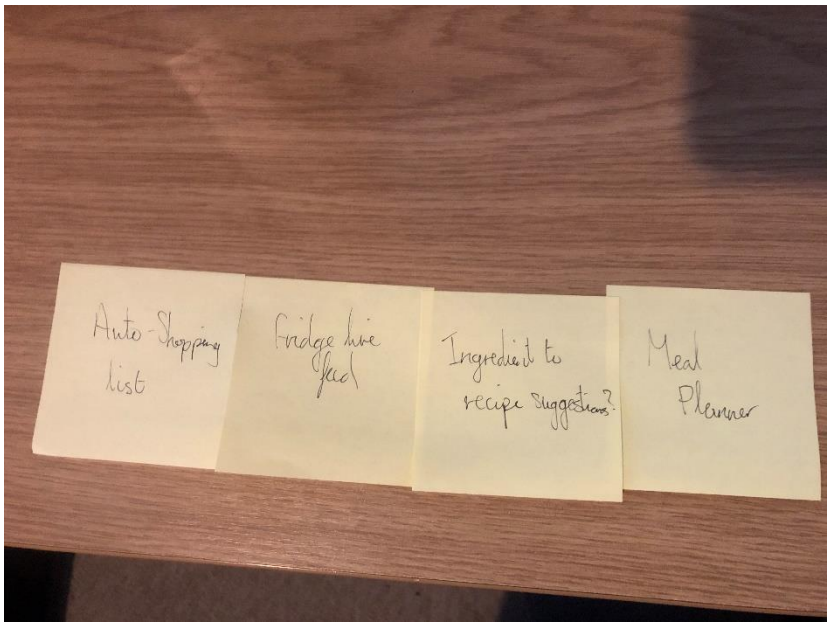
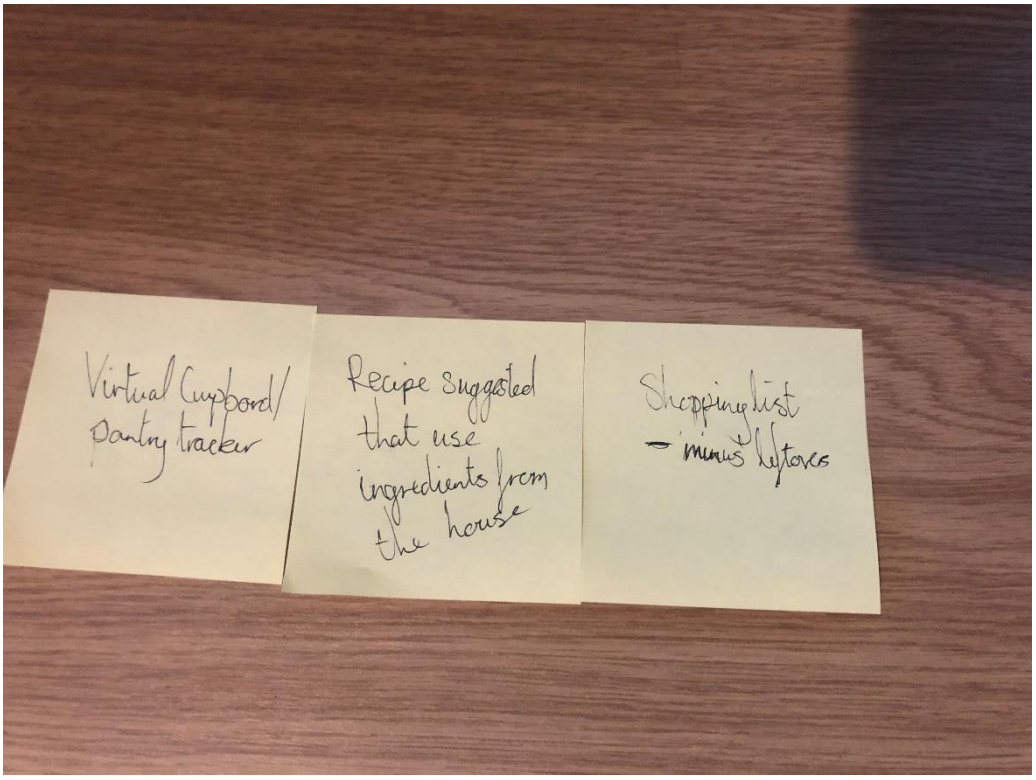
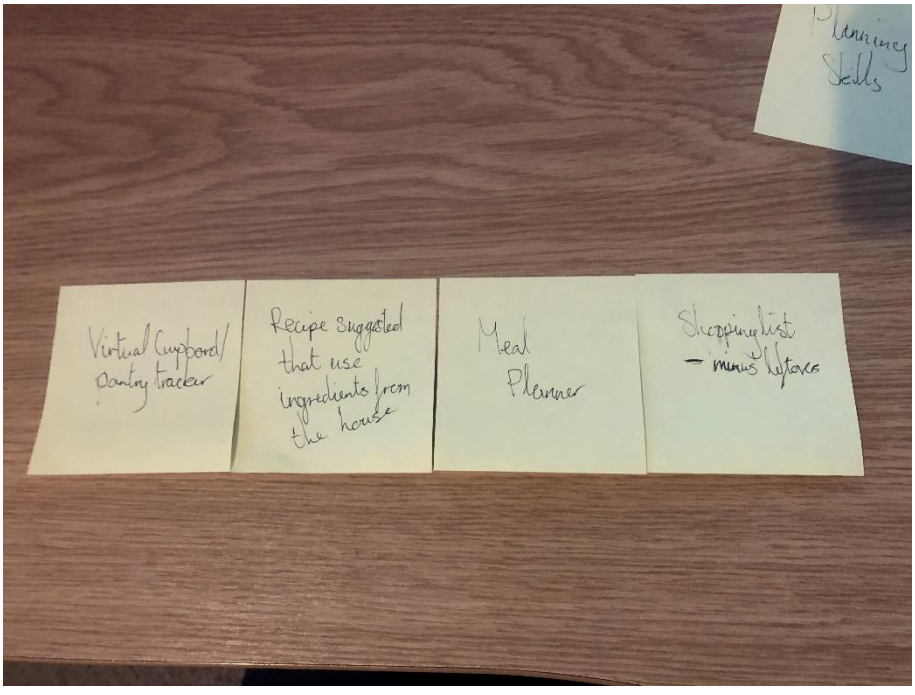
10 Appendices

10.1 Initial Feature Brainstorming Session and Shortlists






Virtual Cupboard/ pantry tracker
Recipe Suggested that use ingredients from the house
Shopping list - minus leftovers


Virtual Cupboard/ pantry tracker
Recipe Suggested that use ingredients from the house
Meal Planner
Shopping list - minus leftovers

10.2 Initial Feature Proposal Activity Diagrams and Use Case Forms

Basic Low-Fi wireframes

https://www.figma.com/file/Iq5acKuJNk92zquopkyyzu/Honours-Application?node-id=0%3A1

Use Case Forms

Use Case Name	Input Ingredients
Description	The user is prompted to capture an image of their latest shopping trip or manually enter a list of ingredients they would like assistance with. Once the user has inputted their ingredients using either method the ingredients are added to the applications/user's virtual cupboard.
Actors	User
Pre-Conditions	The user must have a copy of the application downloaded, be logged in and have consented to the appropriate data usage agreements
Trigger	The user selects the update cupboards option
Main Flow of Events	1. User selects "add ingredients to cupboard" 2. User selects "capture receipt" [A1] 3. User photographs receipt and confirms selection [A2] 4. Ingredients are added to the user's cupboard
Alternative Flow of Events	A1. User does not wish to input ingredients using a receipt. User selects manual input and types in their ingredients. Move to step 4 A2. User does not want to confirm the ingredients and wishes to make a change. Use case ends
Post-Condition	The user has a populated cupboard.

Use Case Name	View Recipes
Description	The user selects the recipes area of the application. They are able to view a list of recipes available based on the virtual cupboard. The user can sort and filter the recipes based on various factors. E.g. the user can order the recipes by average expiry date of ingredients in order to use fresh ingredients first.
Actors	User
Pre-Conditions	The user has a locally installed version of the application and a cupboard with several ingredients stored.
Trigger	The user selects the view recipes option
Main Flow of Events	1. The user selects to view recipes generated for their cupboard [A1] 2. The user wishes to see all recipes possible. [A2][A3] 3. The user views all possible recipes based on their available ingredients. [A4]

Alternative Flow of Events	A1. There are no available ingredients in the user's cupboard so a recipe cannot be generated. The user receives an appropriate error message. Use case ends A2. The user wishes to sort by recipe complexity and selects the appropriate sorting option. The recipes are displayed by recipe complexity. Use case ends. A3. The user wishes to see a week of meals (3 meals per day) available with their ingredients. The user selects the appropriate filtering option. The week of recipes are displayed. Use Case ends. A4. The user wishes to only see Italian cuisine in order of complexity. The user selects the appropriate sorting and filtering options. Italian recipes in order of complexity are displayed. Use Case Ends
Post-Condition	The user has viewed the requested recipes in their designated specification.

Use Case Name	Declare Leftovers
Description	The user is able to notify the application if they have any ingredients leftover from the previous shopping term. The user can select leftovers from their cupboard or manually input anything that may not be stored in the application.
Actors	User
Pre-Conditions	The user must have a locally installed version of the application and a registered account. There is no need for any previous ingredients or cupboard data to exist.
Trigger	The user must select the leftovers area of the application.
Main Flow of Events	1. The user selects the leftover option [A1] 2. The user selects 'What are my leftovers?' 3. The user inputs the details and quantity of leftovers in their cupboard by selecting ingredients from their virtual cupboard. [A2] 4. Confirm selections
Alternative Flow of Events	A1. The user has no leftovers to declare. The user selects to exit the area. Use case ends. A2. The user wishes to declare leftovers not registered in their cupboard. The user selects the input with text option. The user inputs the leftovers they wish to add. Use case ends.
Post-Condition	The users declared leftovers are saved to their account.

Use Case Name	View Leftover utilisation Recipe
Description	The user has declared a selection of leftovers to the application. Utilising this list one or several recipes are suggested to the user.
Actors	User

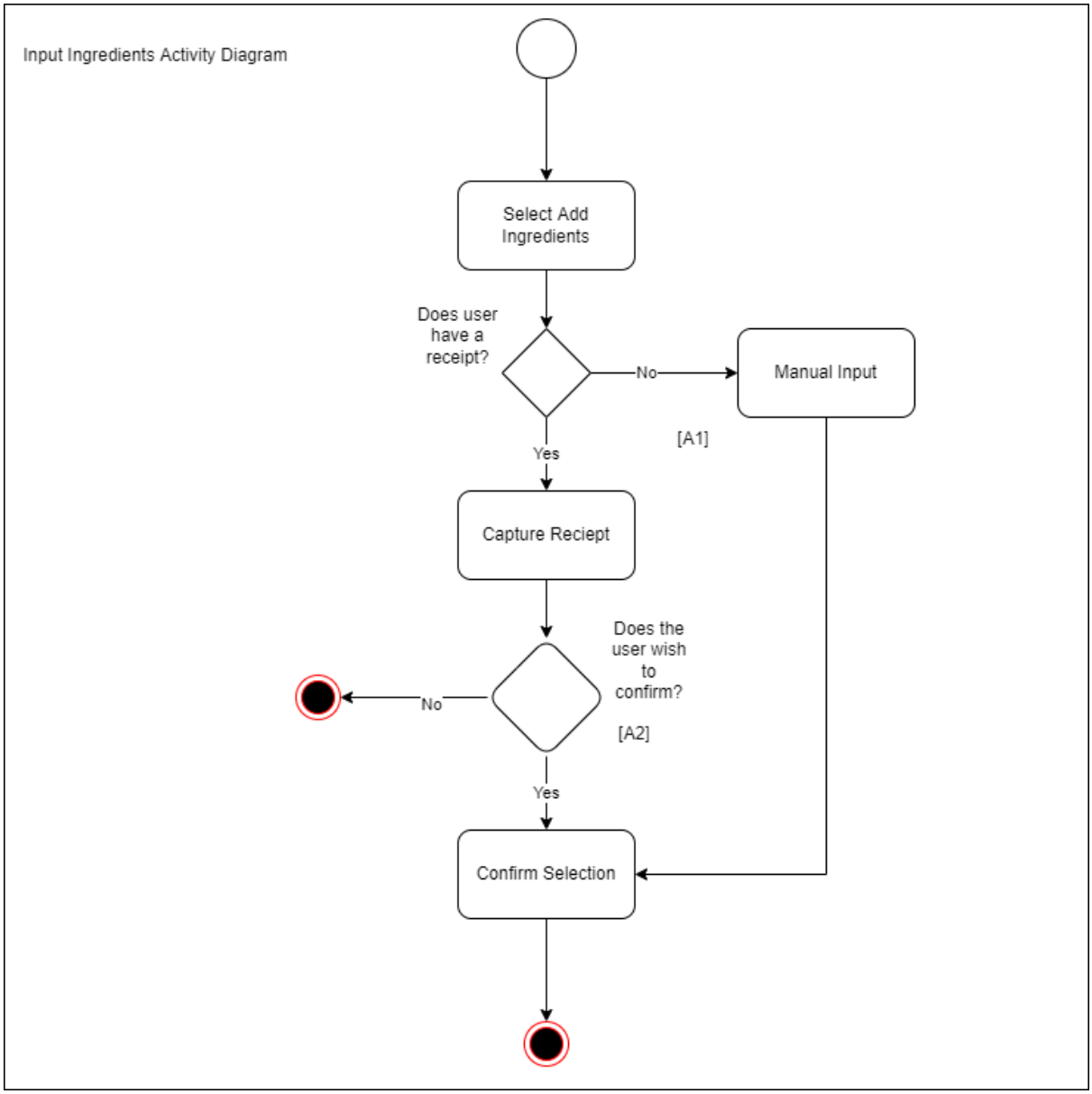
Pre-Conditions	The user must have a locally installed version of the application and a registered account, the user must have declared one or more leftover ingredient(s).
Trigger	The user is prompted to view the generated recipe(s) after declaring leftovers, to view this later the user may navigate to the recipes section.
Main Flow of Events	1. The user is prompted to view recipes they can create with their leftovers with or without a small selection of additional ingredients. [A1] 2. The user saves the recipes to their recipe selection [
Alternative Flow of Events	A1. The user does not wish to view the suggested recipes at this time. The user is informed they can be viewed for a period of time in the recipes area until they next declare leftovers. Use case ends.
Post-Condition	The user has viewed the recipe(s) generated

Use Case Name	View Shopping List
Description	The user is able to view a shopping list based on previous usage and user indicated data for a selected term. Accounting for previous terms leftovers and user inputs to the cupboard in previous terms shopping lists are generated to most closely match users reported consumption
Actors	User
Pre-Conditions	The user must have a locally installed version of the application, a cupboard history and for a more accurate list a leftover history
Trigger	The user selects the generate shopping list option
Main Flow of Events	1. The user selects to view generated shopping list 2. The shopping list is generated based on the users previous shopping and declared wastage [A1] 3. The user views the shopping list [A2] [A3] 4. The user saves the list for future reference 5. The user exits the list area
Alternative Flow of Events	A1. There is no user usage history. The user receives a message indicating a list will not be accurate until there is a history of a specified number of user inputs. Use case ends A2. The user wishes to make edits to the list. The user selects edit list. The user makes the necessary edit. Use case moves to step 4. A3. The user wishes to share the list with a co-habitant. The user utilises the share function. The user shares the list via social media, airdrop etc. Use case moves to step 5
Post-Condition	The user has a shopping list to proceed with.

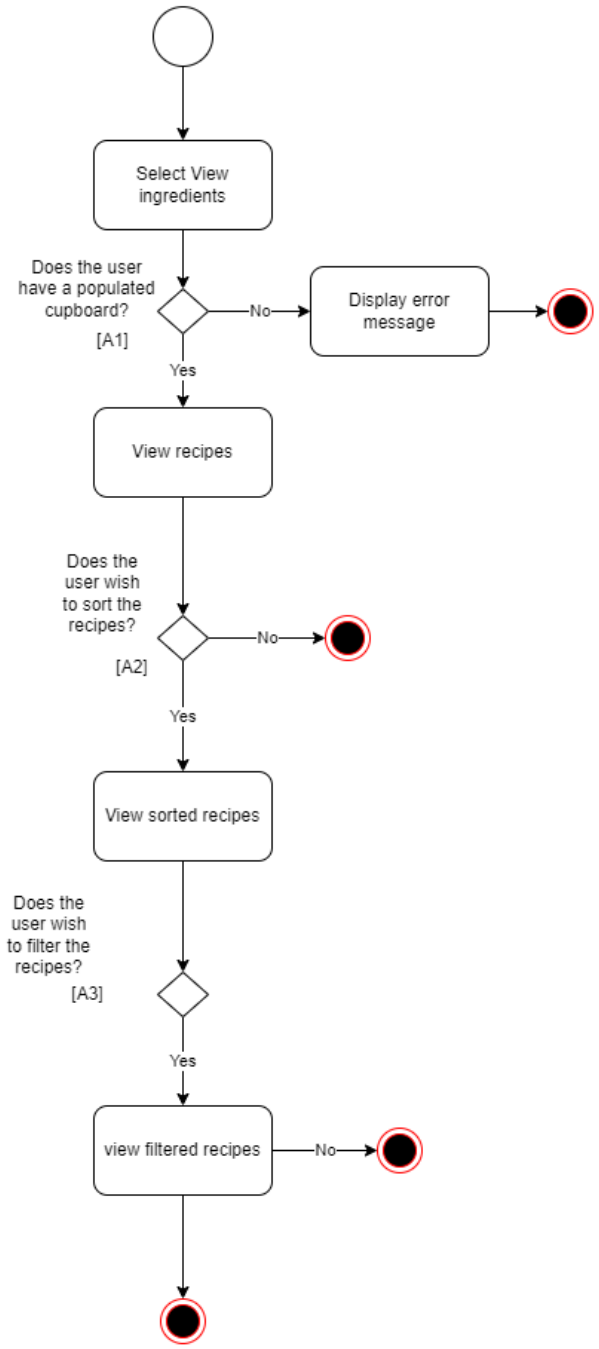
Use Case Name	Carry Out Survey
Description	At certain milestones in the user's usage of the application the user is prompted with a short survey to gauge satisfaction and improve the user experience.
Actors	User

Pre-Conditions	The user must have a locally installed version of the application and a logged in and registered account
Trigger	The user reaches a usage milestone. E.g. time in application, first waste declaration, tenth shopping list generation.
Main Flow of Events	1. User reaches usage goal 2. User receives prompt asking whether they wish to complete a survey[A1] 3. The user selects to complete the survey 4. The user answers the short list of questions and writes a comment[A2]
Alternative Flow of Events	A1. The user does not wish to complete the survey. The user selects 'never' and will not be prompted to take part in a survey again. A2. The user does not wish to leave a comment. The user exits the survey, use case ends.
Post-Condition	The user has been given the option to complete the survey

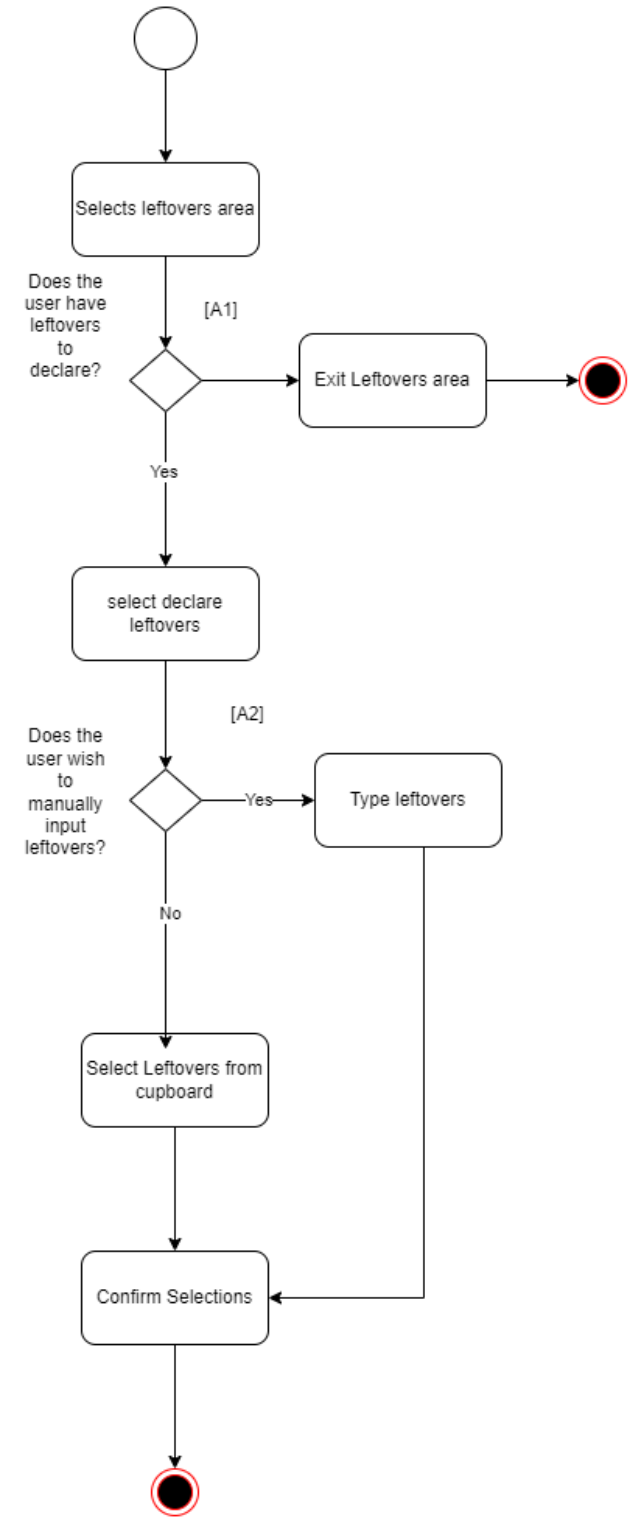
Use Case Name	Edit Ingredients
Description	If the user has Added items to their cupboard, they are able to edit quantities, dates and other variables should there be any errors in the input process.
Actors	User
Pre-Conditions	The user must have a locally installed version of the application and a logged in and registered account with a populated cupboard.
Trigger	The user selects the edit cupboard option.
Main Flow of Events	1. The user selects to edit an ingredient in their virtual cupboard. 2. The user makes the necessary changes to the item[A1] 3. The user confirms the changes and exits.[A2]
Alternative Flow of Events	A1. The user no longer wishes to make a change to that item. The user selects the correct item to make the edit. Use returns to step 1 A2. The user does not wish to make the edits they have selected. The user selects cancel changes. Use case ends
Post-Condition	The user has made any changes they wish to make.


Input Ingredients Activity Diagram
Select Add Ingredients
Does user have a receipt?
No
Manual Input
[A1]
Yes
Capture Reciept
Does the user wish to confirm?
[A2]
No
Yes
Confirm Selection

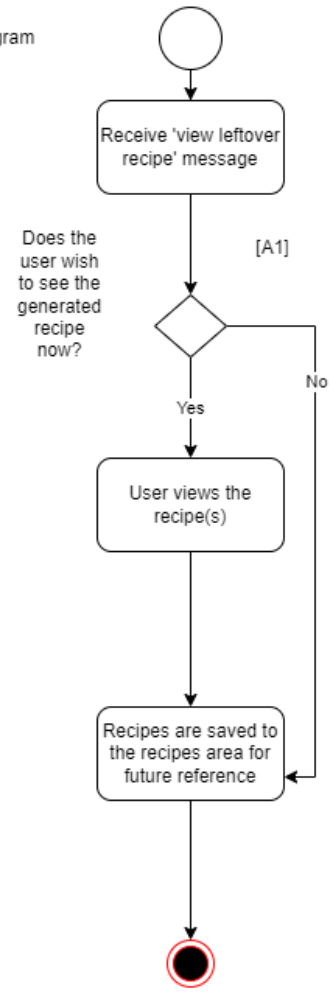
View Recipes Activity Diagram



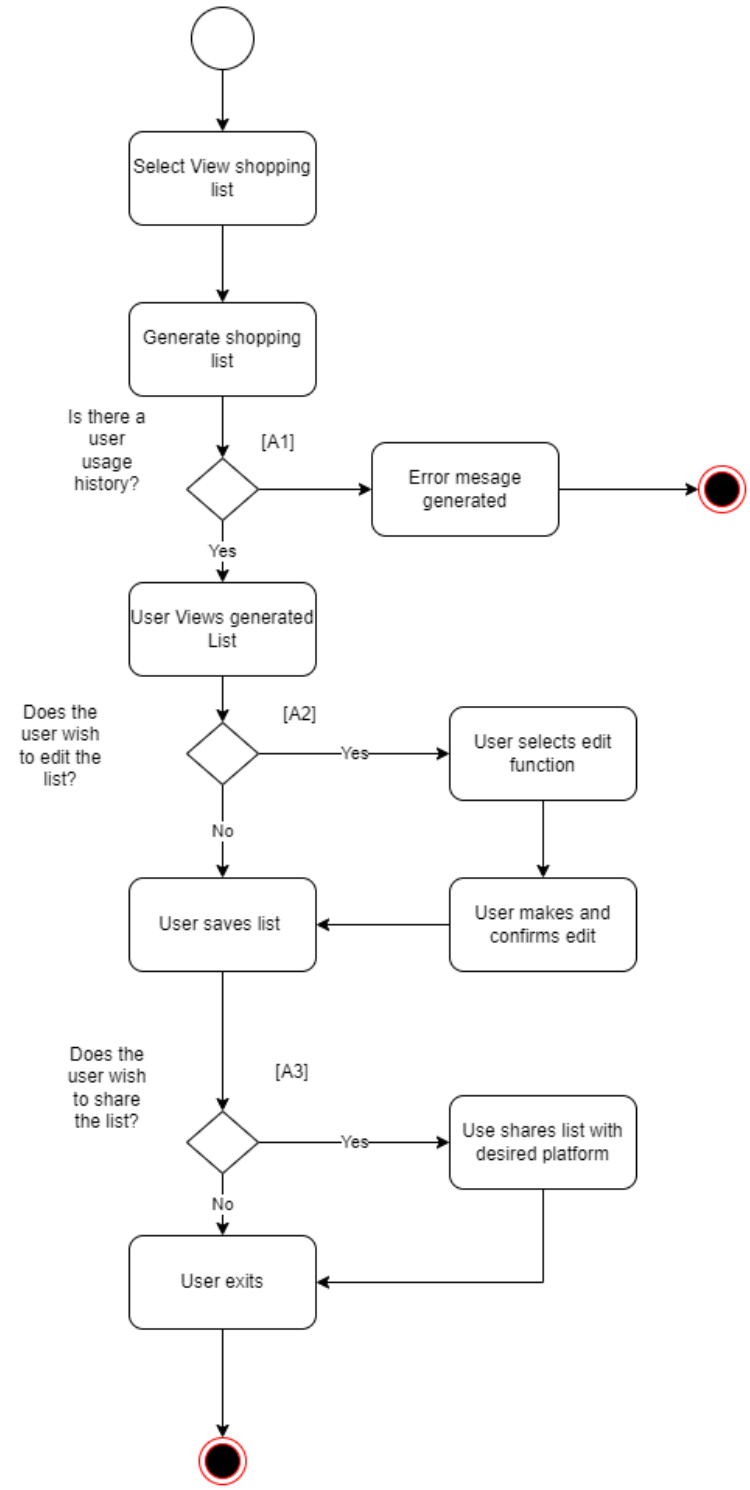
Declare Leftovers Activity Diagram

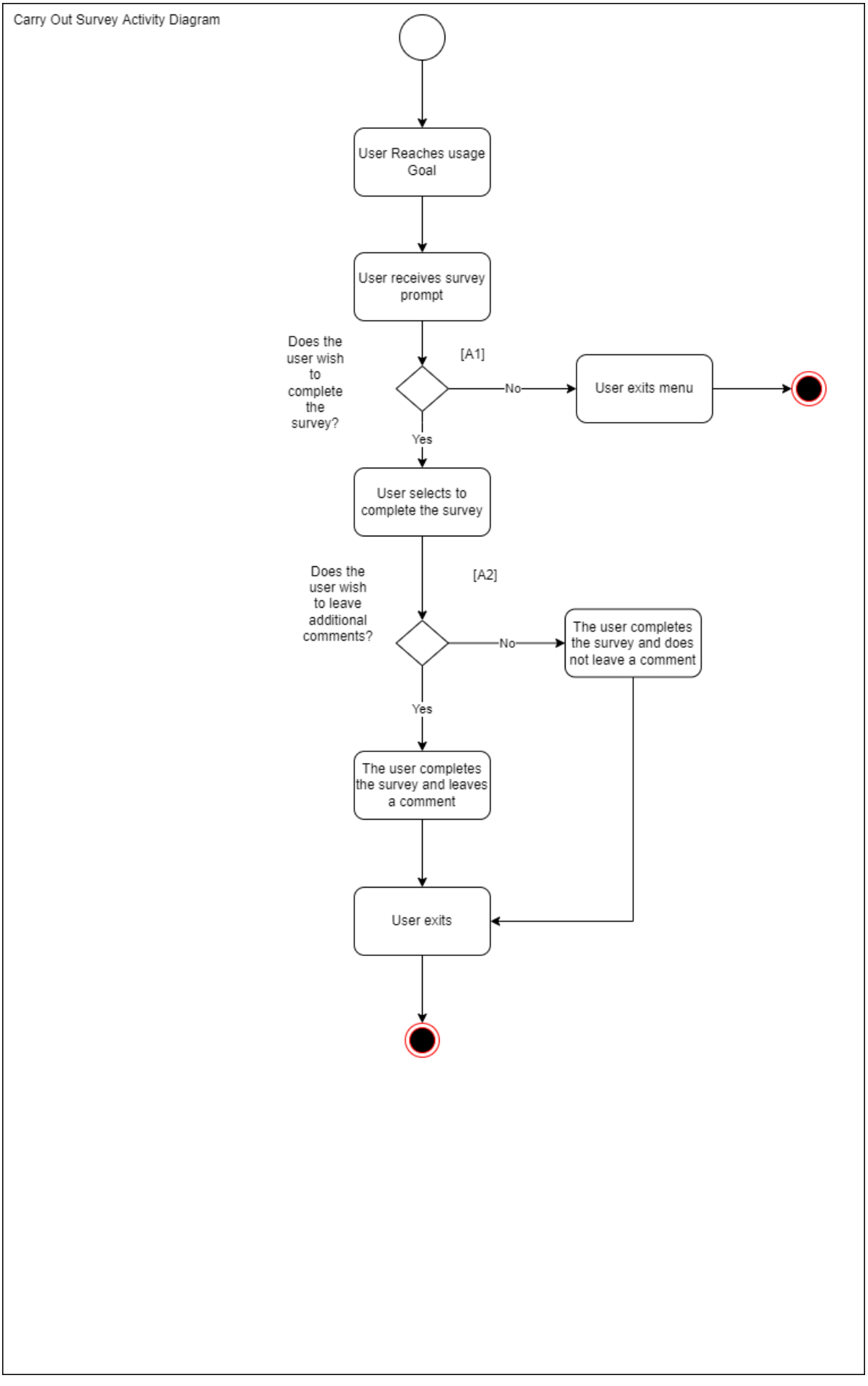


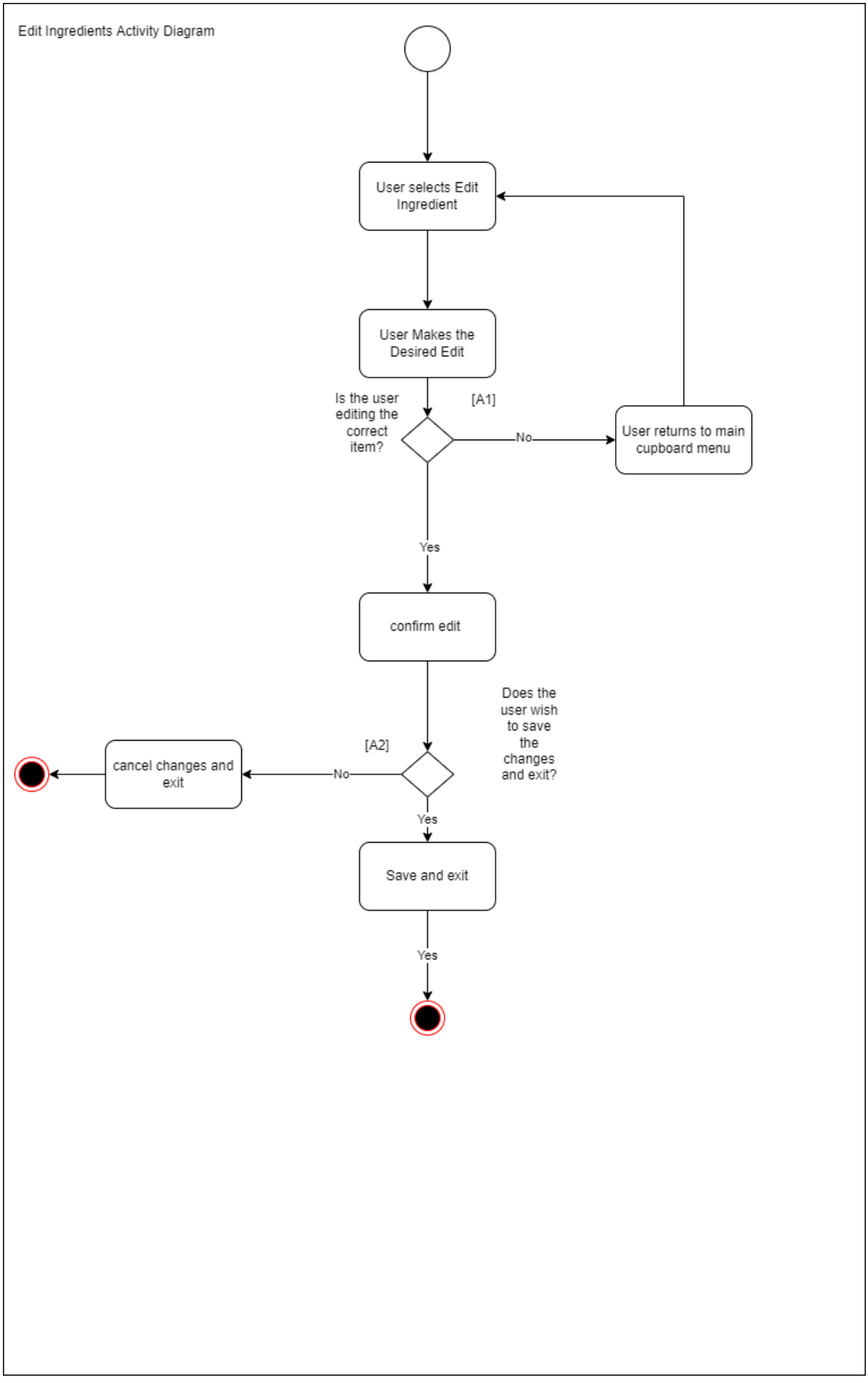
View Leftover Utilisation Recipe Activity Diagram



View Shopping List Activity Diagram




Carry Out Survey Activity Diagram
User Reaches usage Goal
User receives survey prompt
Does the user wish to complete the survey?
[A1]
No
User exits menu
Yes
User selects to complete the survey
Does the user wish to leave additional comments?
[A2]
No
The user completes the survey and does not leave a comment
Yes
The user completes the survey and leaves a comment
User exits


Edit Ingredients Activity Diagram
User selects Edit Ingredient
User Makes the Desired Edit
Is the user editing the correct item?
[A1]
No
User returns to main cupboard menu
Yes
confirm edit
Does the user wish to save the changes and exit?
[A2]
No
cancel changes and exit
Yes
Save and exit
Yes

10.3 Final Feature Proposal Activity Diagrams and Use Case Forms

Use Case Name	Input Ingredients
Description	The user is prompted to manually enter a list of ingredients they have in their cupboard or pantry/fridge at home. Once the user has entered the relevant ingredients information their ingredient is added to the list of the users currently held ingredients.
Actors	User
Pre-Conditions	The user must have a copy of the application downloaded.
Trigger	The user selects the add ingredient button
Main Flow of Events	1. User selects "add ingredients to cupboard" 2. User inputs the relevant ingredient information 3. User selects add[A1] 4. Ingredients are added to the user's cupboard
Alternative Flow of Events	A1. User does not want to confirm the ingredients and wishes to make a change. Use case ends
Post-Condition	The user has a populated cupboard.

Use Case Name	View Ingredients
Description	The user selects the ingredients area of the application. They are able to view a list of ingredients available. The user can search through the ingredients using any terms that are associated with an ingredient, including name, category, or quantity
Actors	User
Pre-Conditions	The user has a locally installed version of the application and an ingredient stored
Trigger	The user selects the view ingredients option
Main Flow of Events	1. The user selects to view ingredients [A1] 2. The user browses the ingredients list and views the different ingredients they have available. [A2]
Alternative Flow of Events	A1. There are no available ingredients in the user's cupboard, the user navigates to the add ingredient button. Use case ends A2. The user selects the search button and enters a search term, the ingredients are displayed. Use case ends
Post-Condition	The user has viewed the requested ingredients in their designated specification.

Use Case Name	Edit Ingredients
Description	If the user has Added items to their cupboard, they are able to edit quantities, dates and other variables should there be any errors in the input process.
Actors	User
Pre-Conditions	The user has a copy of the application downloaded
Trigger	The user selects the edit cupboard option.

Main Flow of Events	1. The user selects to edit an ingredient in their virtual cupboard. 2. The user makes the necessary changes to the item[A1] 3. The user confirms the changes and exits.[A2]
Alternative Flow of Events	A1. The user no longer wishes to make a change to that item. The user selects the correct item to make the edit. Use returns to step 1 A2. The user does not wish to make the edits they have selected. The user selects cancel changes. Use case ends
Post-Condition	The user has made any changes they wish to make.

Use Case Name	Delete Ingredients
Description	If the user has Added items to their cupboard, they are able to delete them from the list.
Actors	User
Pre-Conditions	The user has a copy of the application downloaded
Trigger	The user selects the delete entry option.
Main Flow of Events	1. The user selects an ingredient in their virtual cupboard. 2. The user selects the delete ingredient button 3. The user receives a confirm choice text box 4. The user selects confirm choice[A1] [A2] 5. The ingredient is deleted from the user's ingredient list/cupboard
Alternative Flow of Events	A1. The user no longer wishes to delete that item. The user selects cancel; the user selects the correct item to delete. User returns to step 1 A2. The user no longer wishes to delete any item, the user selects cancel. Use case ends
Post-Condition	The user has made any changes they wish to make.

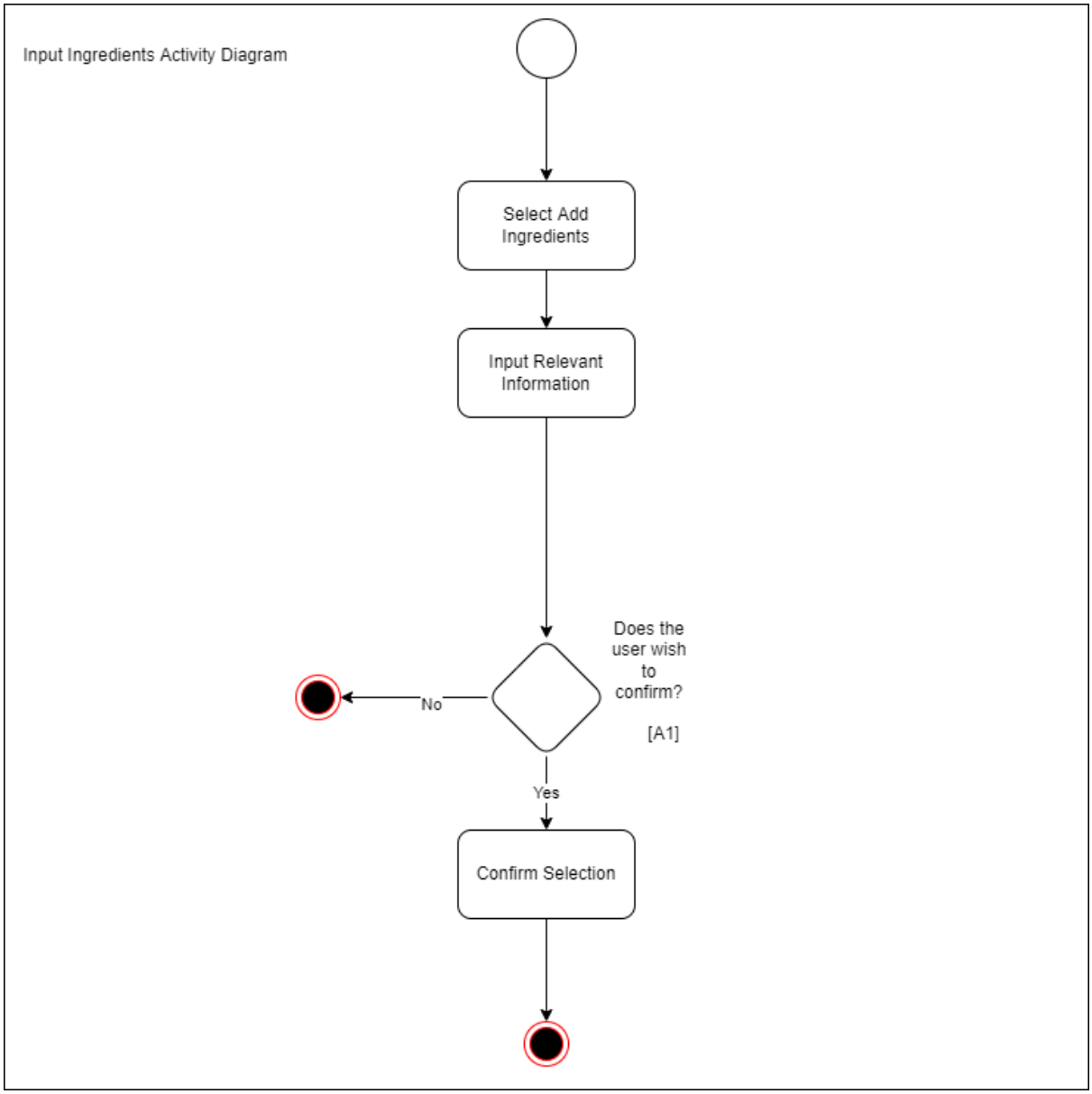
Use Case Name	View Recipes
Description	The user selects the recipes area of the application. They are able to view a list of recipes available. The user can search through the recipes using any terms that are associated with a recipe, including name, ingredients, and method
Actors	User
Pre-Conditions	The user has a locally installed version of the application and a recipe stored
Trigger	The user selects the view recipes option
Main Flow of Events	1. The user selects to view recipes. [A1] 2. The user wishes to see all recipes possible. [A2] 4. The user views all possible recipes.
Alternative Flow of Events	A1. The user does not have any recipes listed. Use Case ends A2. The user wishes to only view recipes that have carrot listed as an ingredient, they select the search button and enter their chosen search term. Appropriate results are displayed. Use case ends.
Post-Condition	The user has viewed the requested recipes in their designated specification.

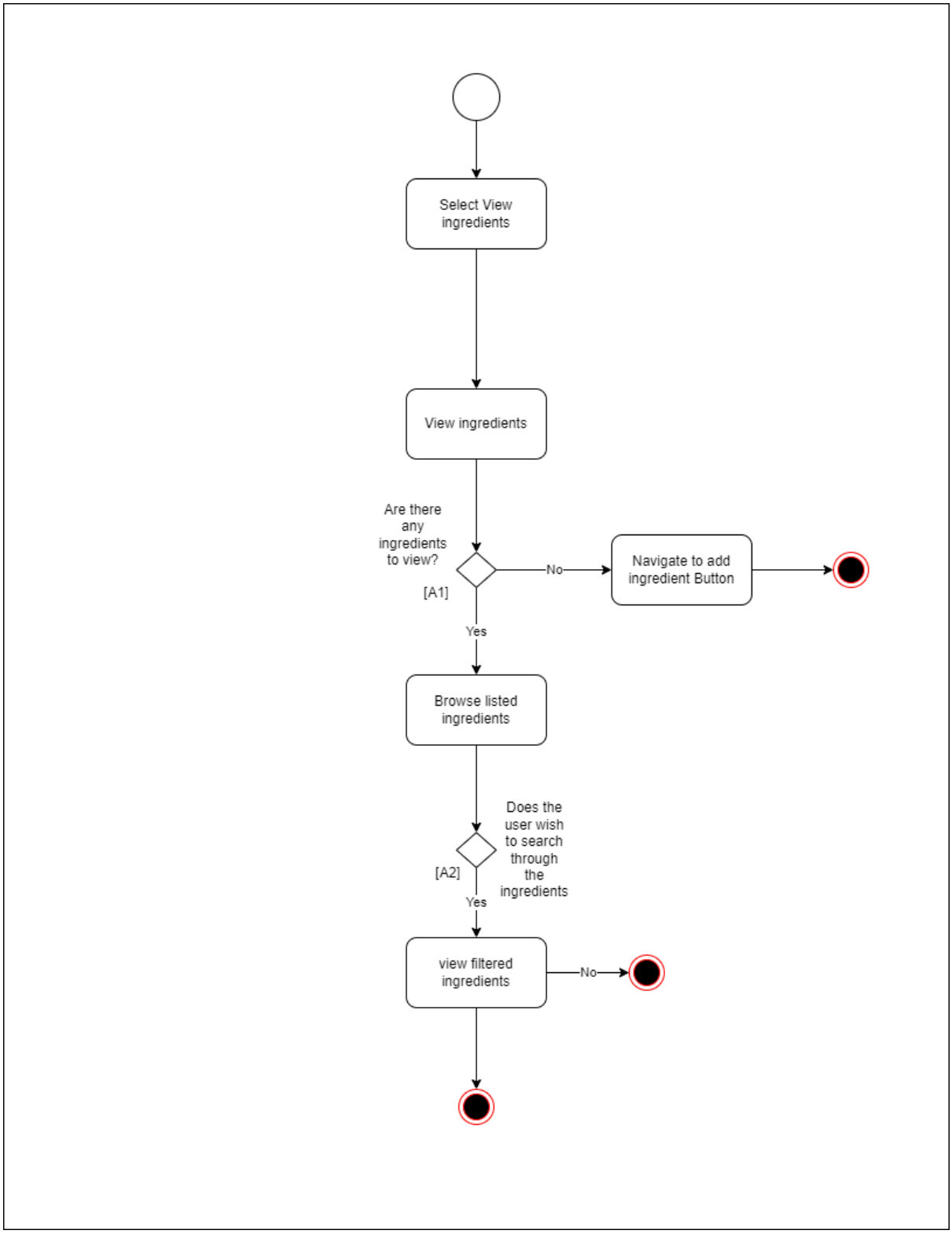
Use Case Name	Delete Recipe
Description	If the user has Added recipes to their list, they are able to delete them from the list.
Actors	User
Pre-Conditions	The user has a copy of the application downloaded
Trigger	The user selects the delete entry option.
Main Flow of Events	1. The user selects a recipe in their virtual cupboard. 2. The user selects the delete recipe button 3. The user receives a confirm choice text box 4. The user selects confirm choice[A1] [A2] 5. The recipe is deleted from the user's recipe list
Alternative Flow of Events	A1. The user no longer wishes to delete that item. The user selects cancel; the user selects the correct item to delete. User returns to step 1 A2. The user no longer wishes to delete any item, the user selects cancel. Use case ends
Post-Condition	The user has made any changes they wish to make.

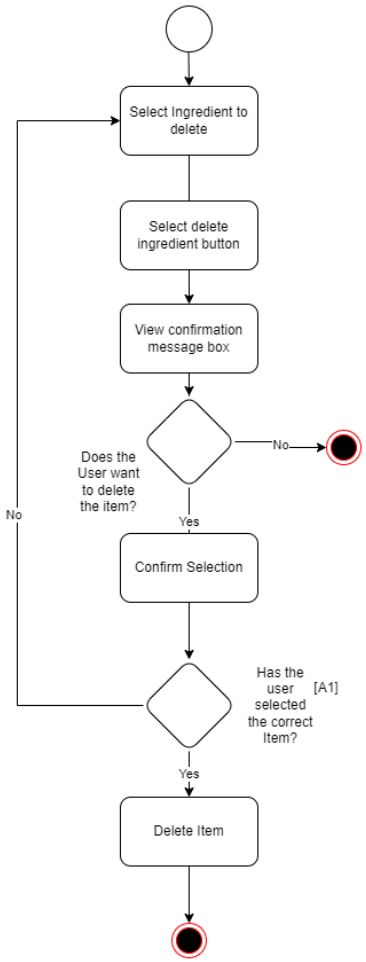
Use Case Name	Input Recipes
Description	The user is prompted to manually enter a list of recipes that they enjoy cooking or cook regularly. Once the user has entered the relevant recipe information their recipe is added to the list of the users currently held recipes.
Actors	User
Pre-Conditions	The user must have a copy of the application downloaded.

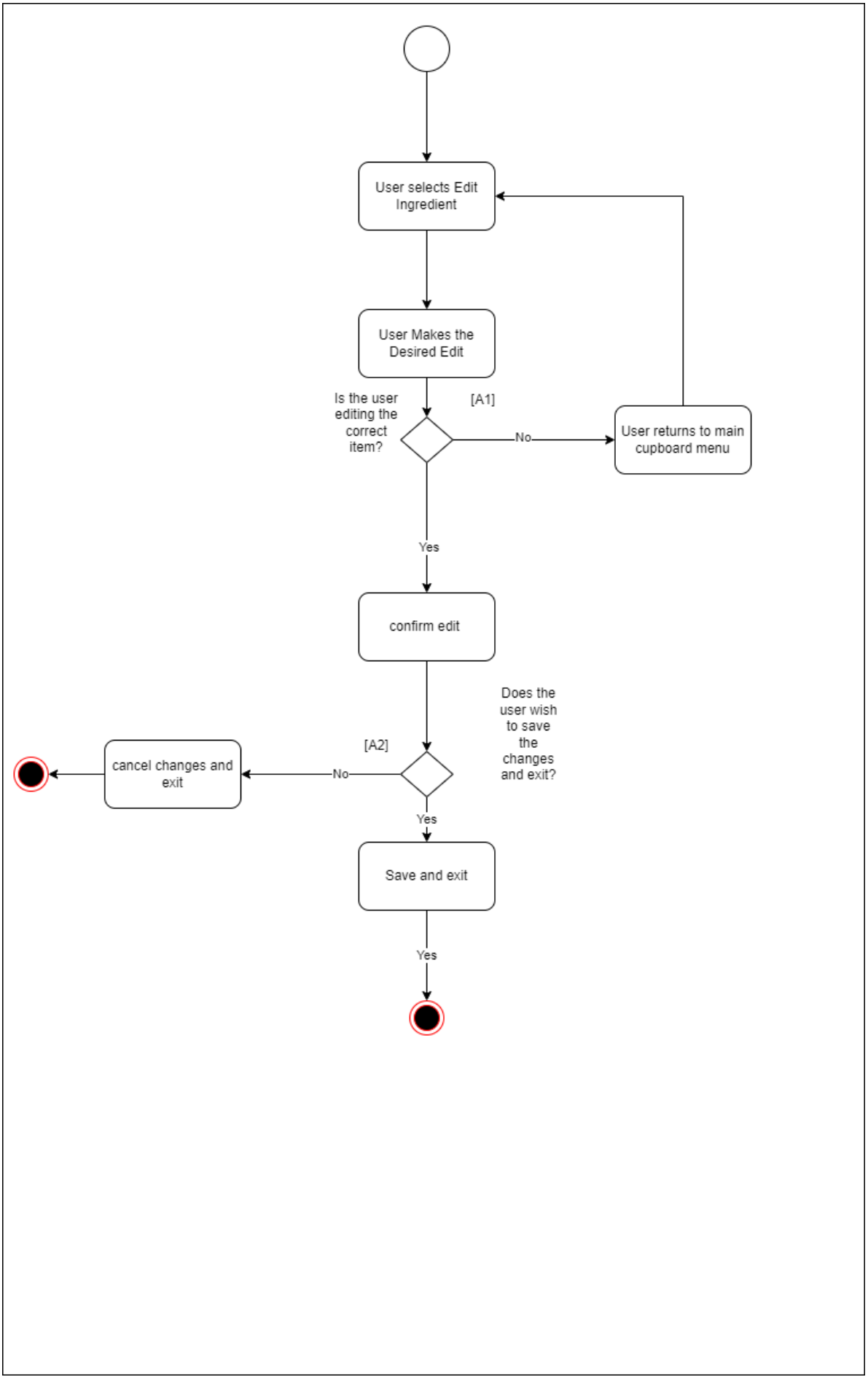
Trigger	The user selects the add recipe button
Main Flow of Events	1. User selects “add recipe to list” 2. User inputs the relevant recipe information 3. User selects add[A1] 4. recipe is added to the user’s list
Alternative Flow of Events	A1. User does not want to confirm the recipe and wishes to make a change. Use case ends
Post-Condition	The user has a populated cupboard.

Use Case Name	View Recipe Details
Description	The user selects a recipe from their list which only displays the recipe name and ID by default to ensure a clean layout. The user can now view more detailed information from the recipe detail page, such as recipe ingredients and method
Actors	User
Pre-conditions	The use has a locally installed version of the application and a recipe stored
Trigger	The user taps on an item in the list
Main Flow of Events	1. The user selects an item in the recipe list 2. The user is taken to the recipe detail page 3. The user view and scrolls through the information 4. The user selects the back button
Alternative Flow of events	N/A
Post- Conditions	The correct recipe information was displayed, and the user was returned to the recipe page when the back button was selected.

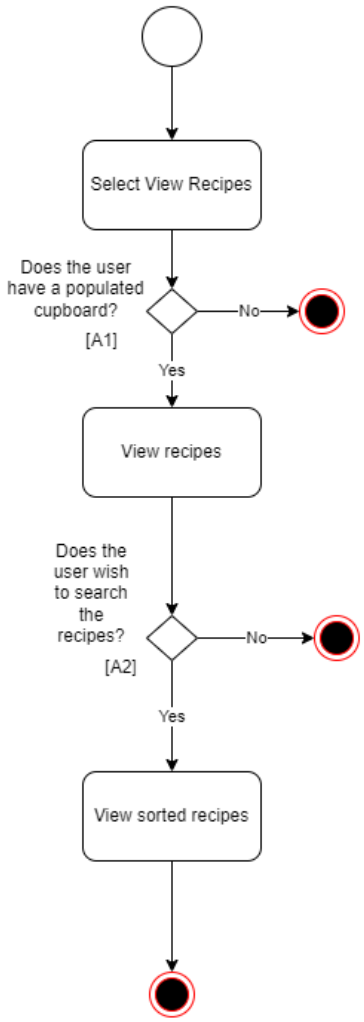

Input Ingredients Activity Diagram
Select Add Ingredients
Input Relevant Information
Does the user wish to confirm?
[A1]
No
Yes
Confirm Selection

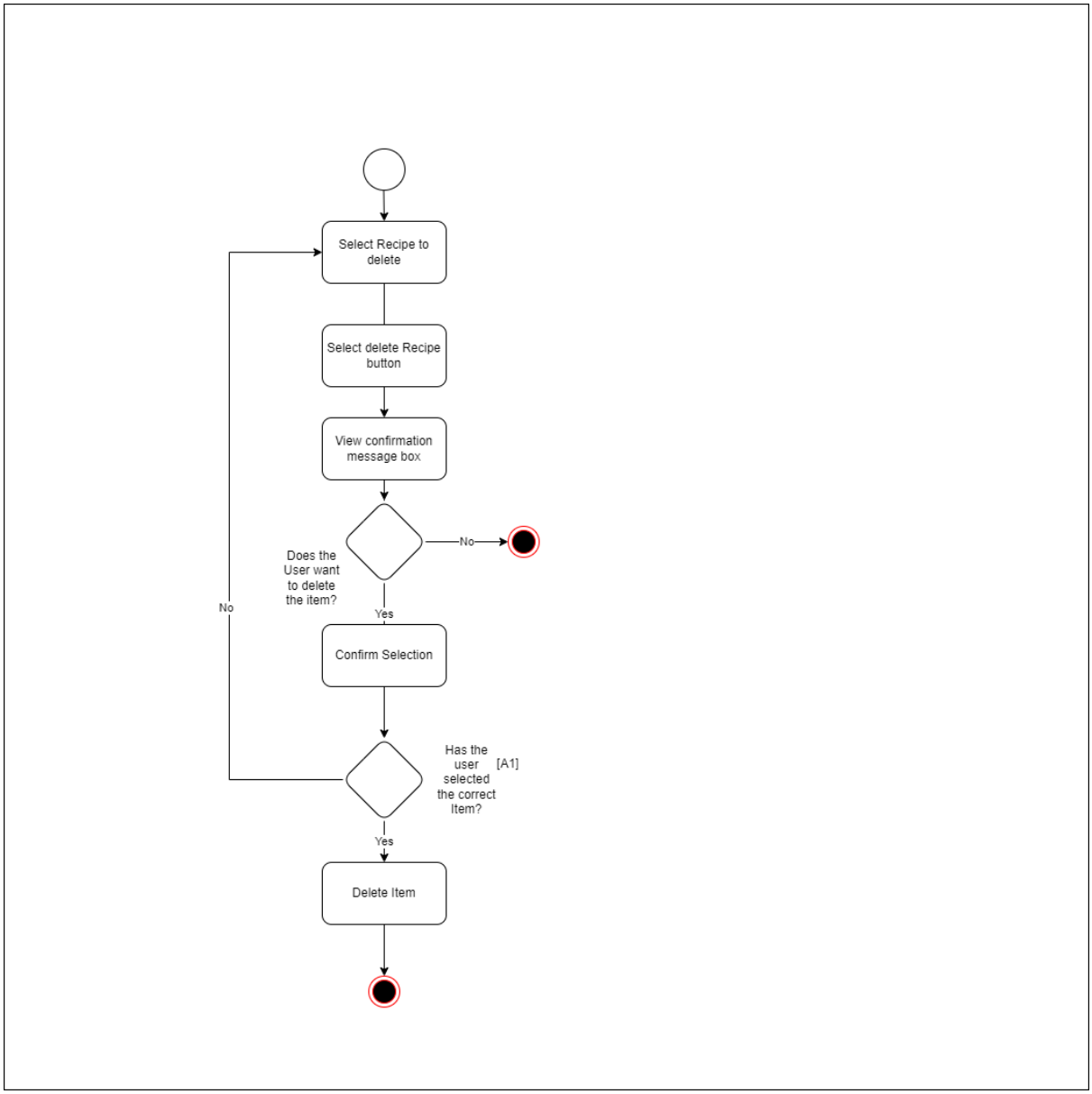

Select View ingredients
View ingredients
Are there any ingredients to view?
[A1]
No
Navigate to add ingredient Button
Yes
Browse listed ingredients
Does the user wish to search through the ingredients
[A2]
Yes
view filtered ingredients
No

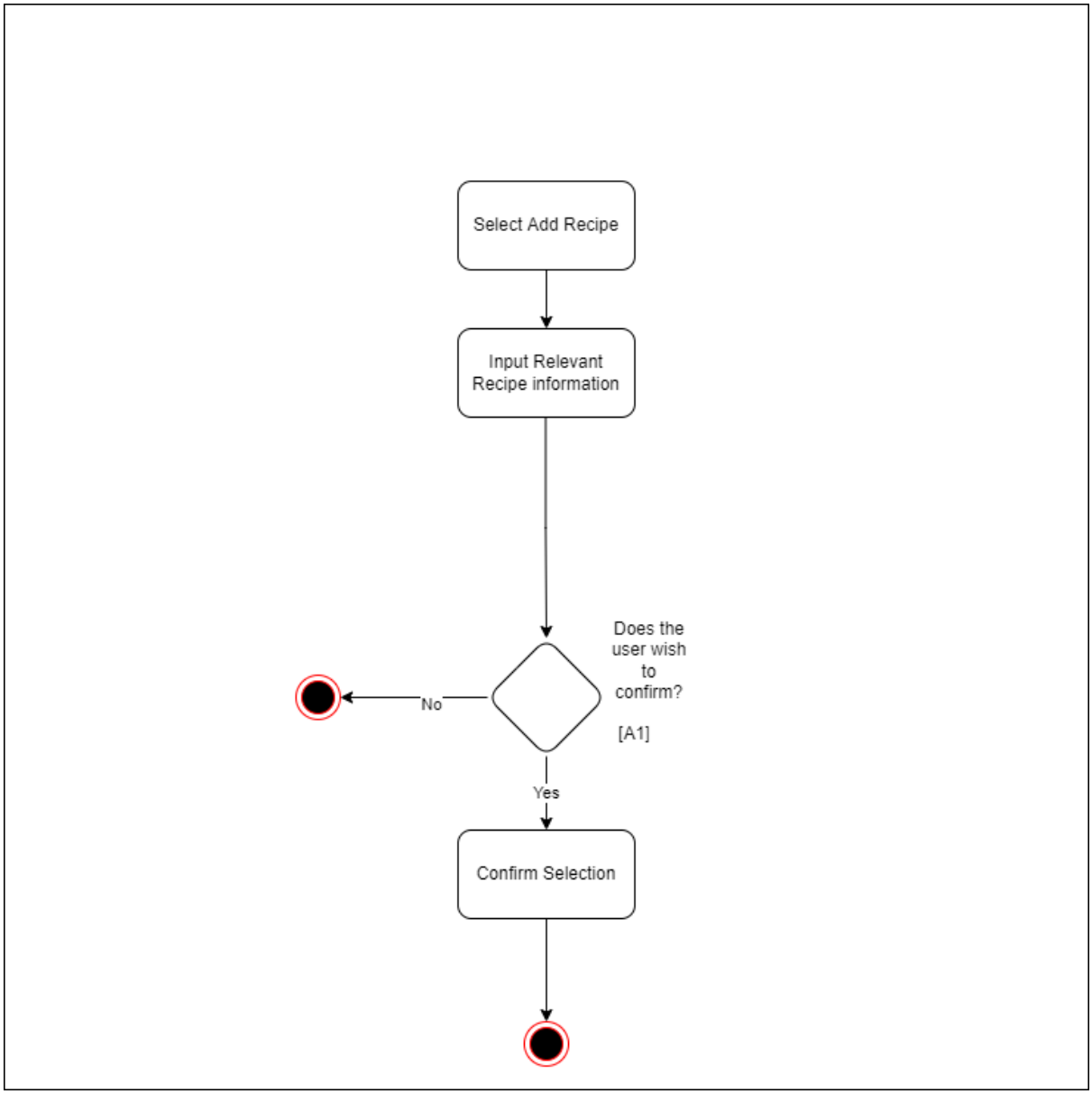

Select Ingredient to delete
Select delete ingredient button
View confirmation message box
Does the User want to delete the item?
No
Yes
Confirm Selection
Has the user selected the correct Item?
[A1]
No
Yes
Delete Item

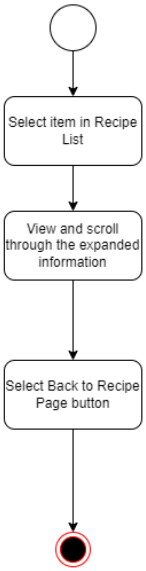

User selects Edit Ingredient
User Makes the Desired Edit
Is the user editing the correct item?
[A1]
No
User returns to main cupboard menu
Yes
confirm edit
Does the user wish to save the changes and exit?
[A2]
No
cancel changes and exit
Yes
Save and exit
Yes

View Recipes Activity Diagram




Select Recipe to delete
Select delete Recipe button
View confirmation message box
Does the User want to delete the item?
No
Yes
No
Confirm Selection
Has the user selected the correct Item?
[A1]
No
Yes
Delete Item


Select Add Recipe
Input Relevant Recipe information
Does the user wish to confirm?
[A1]
No
Yes
Confirm Selection


Select item in Recipe List
View and scroll through the expanded information
Select Back to Recipe Page button

10.4 User Focus Group Report and Meeting Notes

Initial Requirements and Design User Focus Group Report

Group Briefing

Hi, everyone. My name is Archie Yarr, I am researching whether a software solution is able to improve user attitudes to their food-related routines. I will walk you through how this focus group will work today.

Before we begin, I will run you through the information you need. I'll read it to be sure that everything is covered.

We will be analysing and discussing the software solution design proposal to see how well it would meet your needs. The session will last approximately 20 minutes. The goal of this session is to have an open conversation about what you think of the design and how it could be improved the meet the goals of the software solution

As the session continues, I'd like you to be as vocal as possible about what you think of the documentation, thinking out loud will be extremely helpful to us. If you have questions, feel free to ask us. The more conversation, and questions you bring to us the more effective this session will be.

Description of the Application

The aim of this application is to attempt to improve user attitudes towards their shopping skills, planning skills, household skills and leftover reuse. An example of this would be a user struggling to find the motivation and time to plan their meals and freeze leftovers and after a period of time using the app, they feel like this is a task they can manage and is beneficial to them.

The current design of the feature set would allow users to track their food stores at home by capturing images of their shopping receipts and generate a list of recipes that would utilise those stores entirely. If the user had leftovers after cooking the recipe list, they could input these to the app. This would then generate a leftover recipe and a shopping list that would correct their last batch of ingredients to reduce leftovers.

Here are some low-fi wireframes that give a representation of what an initial version of the application might look like.

There are also some post-it notes from a brainstorming session that helped form these wireframes and the feature set.

Questions for the group

What type of device do you use the most? E.g. PC, mac, tablet, phone

What are your initial thoughts on this feature set?

What are your initial thoughts on how it is laid out?

What features would you change if you could?

Would this be an application you'd find easy to use?

Which of your routines do you think an app could influence most (out of shopping, planning, household and leftover reuse)?

Notes based on conversation

What type of device do you use the most?

- Every single member stated that they use their phone more than any other device they own. The exception to this were members that worked on a PC or MAC felt they used those devices more than any other, however in their free time it was their phone that took most of their digital time.

What are your initial thoughts on this feature set?

- Logging the recipes by receipt is an awkward idea and would require users to keep their receipts one member remarking that they use the automated checkout when they shop which doesn't print a receipt by default, they also like that this saves paper.
- Many of the members noted that they have a specific set of recipes that they often cook at home and that they would like this integrated into the feature set somehow.
- The group felt had a generally positive view of an application like this however they felt it was a little 'invasive' and if they followed the apps lists and recipe guides, they wouldn't have any control over what they ate. If they strayed from the app, they'd have to input their shopping list again and this is an extra step.
- They also felt that it was quite a complex set of features and a little "convoluted". The consensus what that all the apps that the user group made use of consistently were focussed on what they did. E.g., one member gave the example that the only apps they use regularly are the google calendar, Facebook and Strava.

What are your initial thoughts on how it is laid out?

- One member remarked that the wireframes were not similar to any other app they use, this received a general agreement from the rest of the group. This answer led to a conversation about what changes would lead to a more consistent layout, the biggest point of concern being the home page:
    - The navigation buttons are never laid out like they are here, usually it's a bar or a menu that opens or something similar
    - What data would be displayed in the area designated for that? The group felt that it might even make them feel negative if it displayed a less than positive statistic.
    - There were no back arrows or obvious way to return to the home page.

What features would you change if you could?

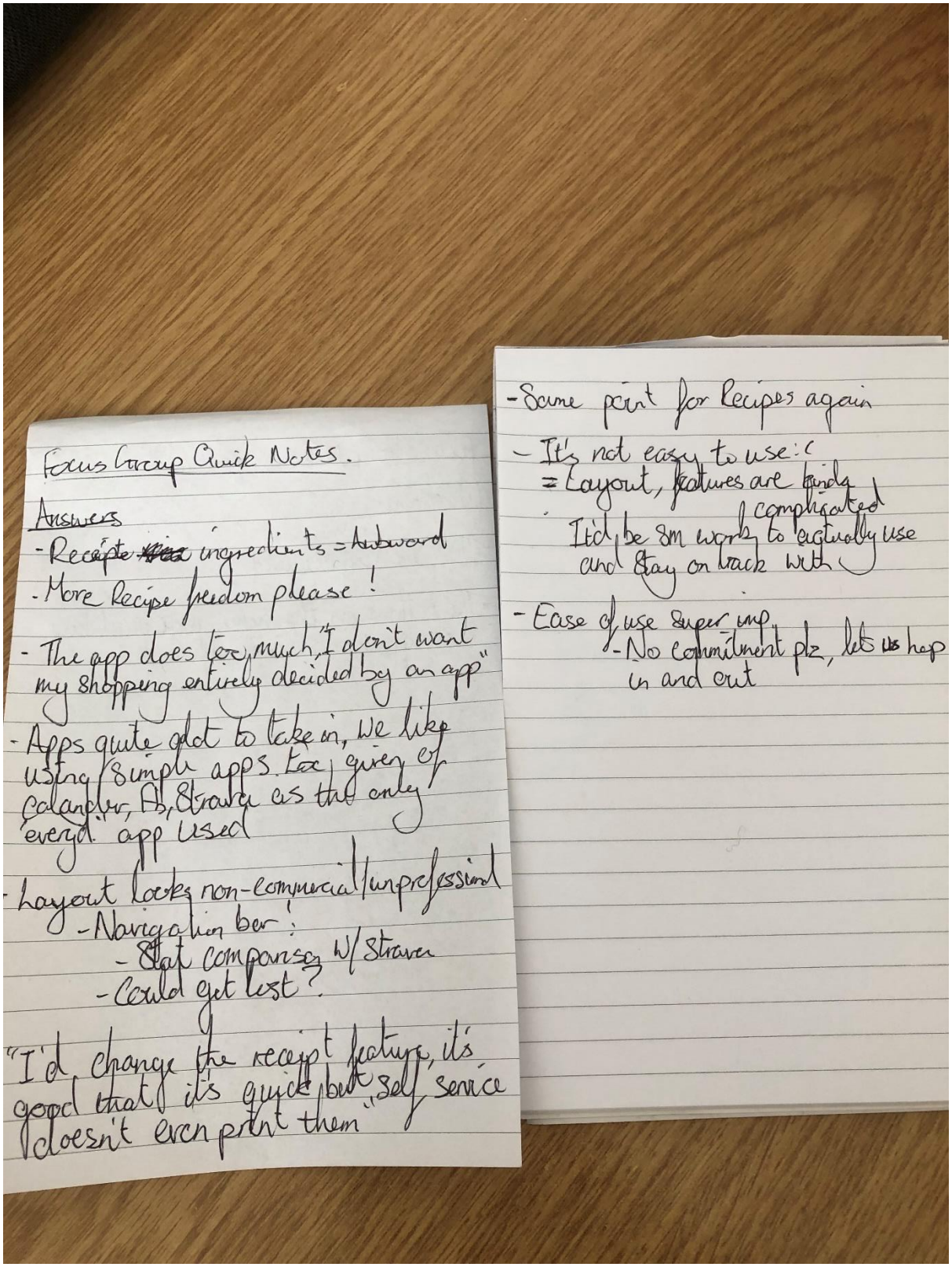
- The receipt issue was the most prevalent change here with a general consensus that it would be an inconvenience and probably not accurate, as what they have in their home on a given day is extremely unlikely to match one or two receipts.
- The recipe feature should allow input from the user but the group generally agreed that having a set of recipes generated already would be useful as inspiration.

Would this be an application you'd find easy to use?

- The response to this was generally negative. The layout was perceived to be clunky and there was criticism from the group on the feature set. While the group liked the idea of an application that helps them with their planning and shopping routines, they felt that this specific feature set was too complicated and that a simpler set of features would be easier to use, especially on a consistent basis.

What routines do you think an app/software solution could Impact the most?

- The group's main consensus is that an app might be able to get them to change their attitudes to any of their routines as they were all open to improving them, they felt that most of the features on the sticky notes could be useful/ impactful in an app. This prompted the researcher to enquire whether they thought a more focused app (1 or 2 routines) that was extremely easy to use would have more of an impact than a less focussed app (all routines) that was a little more complex.
    - The group overwhelmingly agreed that ease of use was most important to them., especially when deciding whether to stick with an application after first deciding to use it.



Focus Group Quick Notes.

Answers
- Recipe ingredients = Awkward
- More Recipe freedom please!
- The app does too much, "I don't want my shopping entirely decided by an app"
- Apps quite alot to take in, we like using simple apps. Eg, query of Calander, A5, Strava as the only everyd. app used
- layout looks non-commercial/unprofessional
  - Navigation bar:
    - Stat comparison w/ Strava
    - Could get lost?

"I'd change the receipt feature, it's good that it's quick but self service doesn't even print them"

- Same point for Recipes again
- It's not easy to use :(
  = Layout, features are kinda complicated
  It'd be sm work to actually use and stay on track with
- Ease of use super imp.
  - No commitment plz, let us hop in and out

10.5 Code Listings

Java layout Prototype https://github.com/ArchieYarr/HonoursApplicationJavaPrototype.git

Software Solution as complete https://github.com/ArchieYarr/Honours-Submission-Repo.git

10.6 Survey Question Listings

Initial Survey https://www.surveymonkey.co.uk/r/G7BNFL2

Final Survey https://www.surveymonkey.co.uk/r/ZWXYMGD

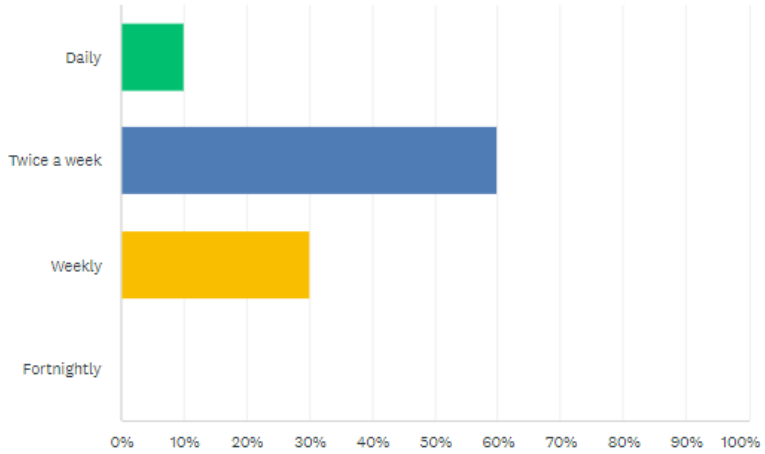
10.7 Initial Survey results

Q1

Customize Save as

How often do you shop for food?

Answered: 10 Skipped: 0

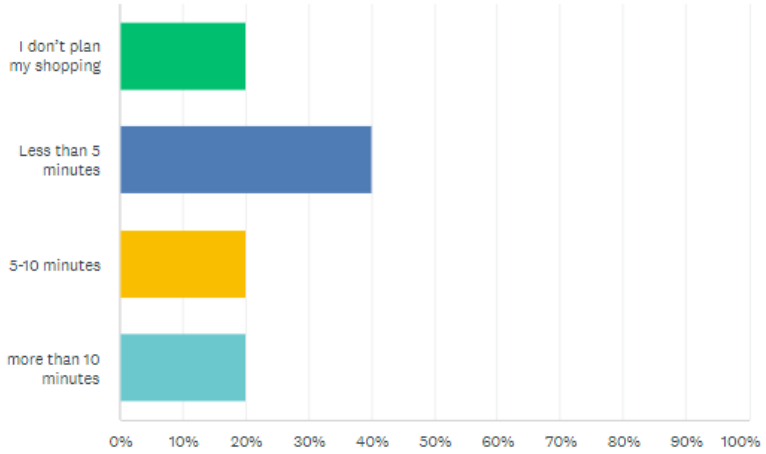


ANSWER CHOICES	RESPONSES	
Daily	10.00%	1
Twice a week	60.00%	6
Weekly	30.00%	3
Fortnightly	0.00%	0
TOTAL		10

Comments (0)

How much time do you spend planning your shopping?

Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
I don't plan my shopping	20.00%	2
Less than 5 minutes	40.00%	4
5-10 minutes	20.00%	2
more than 10 minutes	20.00%	2
TOTAL		10

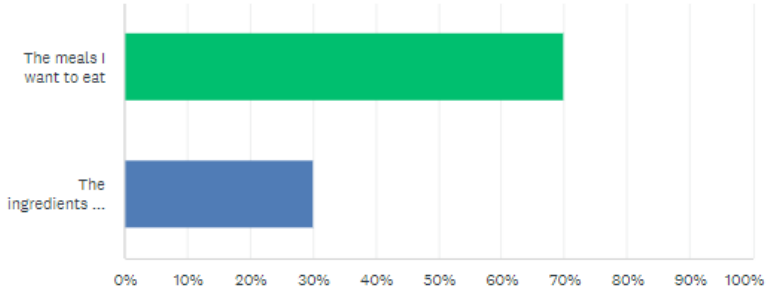
Comments (0)

Q3

Customize Save as

When you are deciding what to buy, what is your starting point?

Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
The meals I want to eat	70.00%	7
The ingredients I already have at home	30.00%	3
TOTAL		10

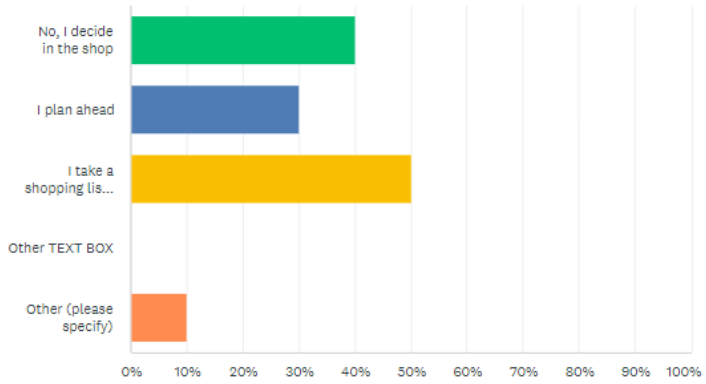
Comments (0)

Q4

Customize Save as

Do you buy groceries based on a list/plan? Tick all that apply.

Answered: 10 Skipped: 0



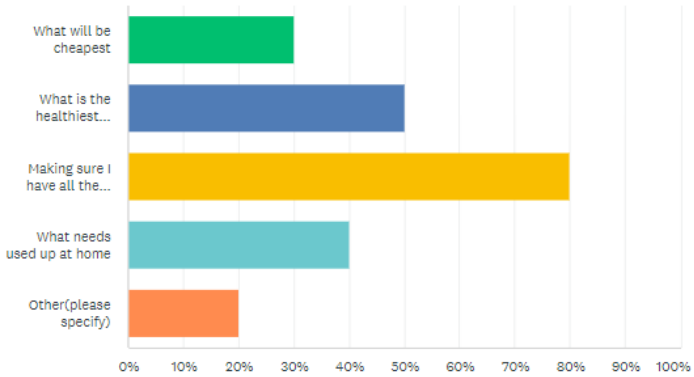
ANSWER CHOICES		RESPONSES	
No, I decide in the shop		40.00%	4
I plan ahead		30.00%	3
I take a shopping list with me		50.00%	5
Other TEXT BOX		0.00%	0
Other (please specify)	Responses	10.00%	1

Q5

Customize Save as

What is most important to you when buying food? Please select all that apply.

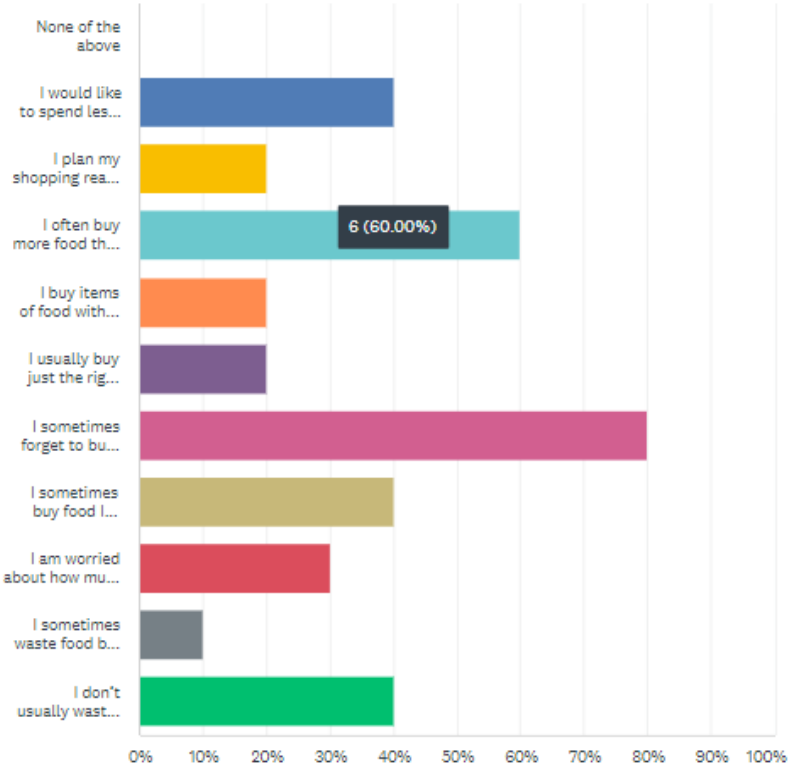
Answered: 10 Skipped: 0



ANSWER CHOICES		RESPONSES	
What will be cheapest		30.00%	3
What is the healthiest option		50.00%	5
Making sure I have all the ingredients for meals I want to cook		80.00%	8
What needs used up at home		40.00%	4
Other(please specify)	Responses	20.00%	2
Total Respondents: 10			

Which of these statements are true about you? Please tick all that apply

Answered: 10 Skipped: 0



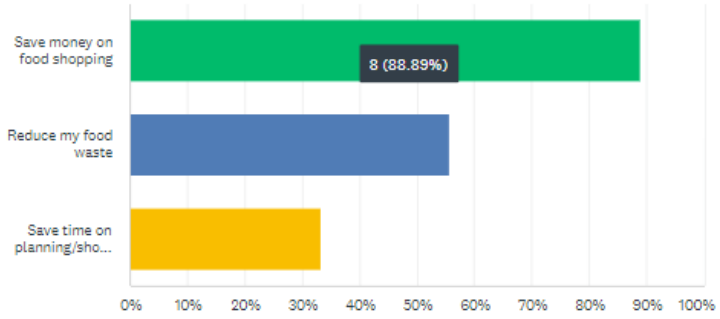
ANSWER CHOICES	RESPONSES	
None of the above	0.00%	0
I would like to spend less money on food.	40.00%	4
I plan my shopping really well.	20.00%	2
I often buy more food than I use.	60.00%	6
I buy items of food without knowing how I will use them	20.00%	2
I usually buy just the right amount of food.	20.00%	2
I sometimes forget to buy all the ingredients I need.	80.00%	8
I sometimes buy food I don't need because I have forgotten I already have it at home.	40.00%	4
I am worried about how much food I waste.	30.00%	3
I sometimes waste food but this doesn't bother me.	10.00%	1
I don't usually waste food.	40.00%	4
Total Respondents: 10		

Q7

Customize Save as

Would you like to do any of the following? Tick all that apply.

Answered: 9 Skipped: 1



ANSWER CHOICES	RESPONSES	
Save money on food shopping	88.89%	8
Reduce my food waste	55.56%	5
Save time on planning/shopping for food	33.33%	3
Total Respondents: 9		

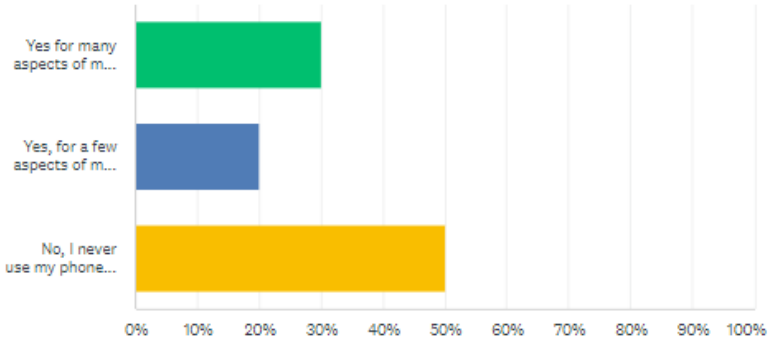
Comments (0)

Q8

Customize Save as

Do you use your smartphone to plan aspects of your life (eg calendar, notes, reminders, fitness trackers etc)

Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes for many aspects of my life	30.00%	3
Yes, for a few aspects of my life	20.00%	2
No, I never use my phone to plan aspects of my life	50.00%	5
TOTAL		**10**

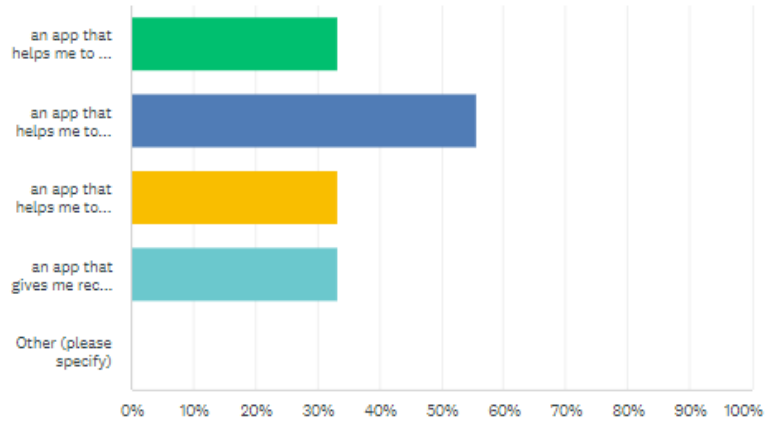
Comments (0)

Q9

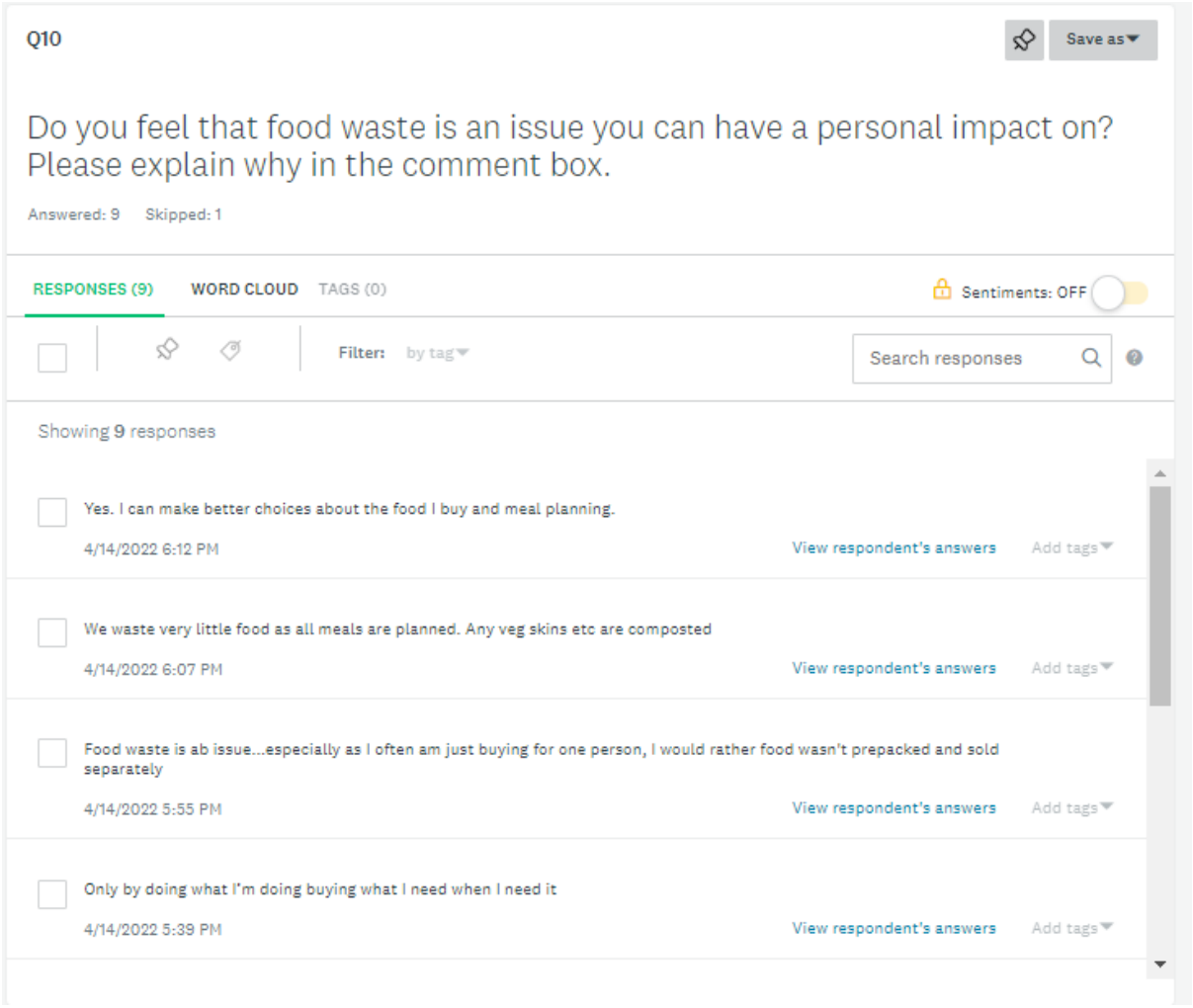
Customize Save as

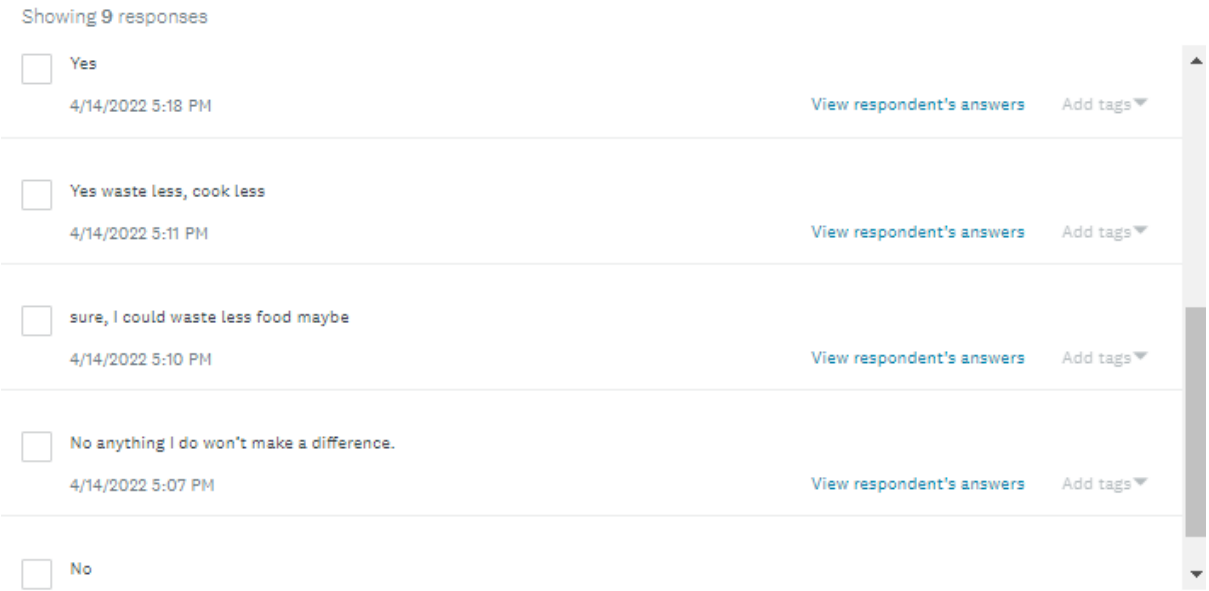
There are many apps which claim to help with meal planning and shopping. Which of the following would you find useful? Tick all that apply.

Answered: 9 Skipped: 1



ANSWER CHOICES		RESPONSES	
an app that helps me to eat more healthily		33.33%	3
an app that helps me to save money on my food shopping		55.56%	5
an app that helps me to reduce food waste		33.33%	3
an app that gives me recipe suggestions		33.33%	3
Other (please specify)	Responses	0.00%	0
Total Respondents: 9			


Q10
Save as
Do you feel that food waste is an issue you can have a personal impact on? Please explain why in the comment box.
Answered: 9 Skipped: 1
RESPONSES (9)
WORD CLOUD
TAGS (0)
Sentiments: OFF
Filter: by tag
Search responses
Showing 9 responses
Yes. I can make better choices about the food I buy and meal planning.
4/14/2022 6:12 PM
View respondent's answers
Add tags
We waste very little food as all meals are planned. Any veg skins etc are composted
4/14/2022 6:07 PM
View respondent's answers
Add tags
Food waste is ab issue...especially as I often am just buying for one person, I would rather food wasn't prepacked and sold separately
4/14/2022 5:55 PM
View respondent's answers
Add tags
Only by doing what I'm doing buying what I need when I need it
4/14/2022 5:39 PM
View respondent's answers
Add tags


Showing 9 responses
Yes
4/14/2022 5:18 PM
View respondent's answers
Add tags
Yes waste less, cook less
4/14/2022 5:11 PM
View respondent's answers
Add tags
sure, I could waste less food maybe
4/14/2022 5:10 PM
View respondent's answers
Add tags
No anything I do won't make a difference.
4/14/2022 5:07 PM
View respondent's answers
Add tags
No

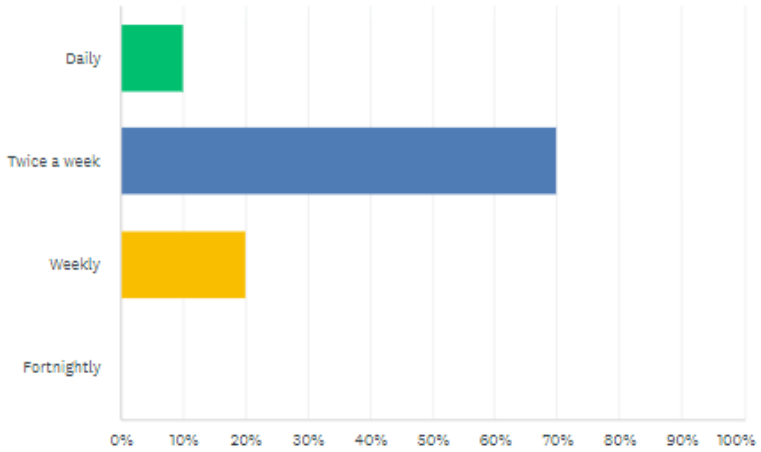
10.8 Final Survey Results

Q1

Customize Save as

How often do you shop for food?

Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
Daily	10.00%	1
Twice a week	70.00%	7
Weekly	20.00%	2
Fortnightly	0.00%	0
TOTAL		10

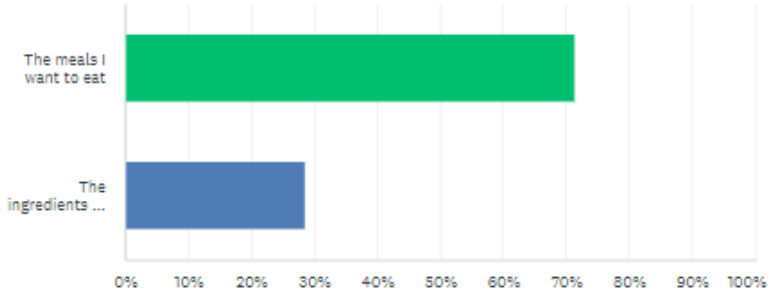
Comments (0)

Q2

Customize Save as

When you are deciding what to buy, what is your starting point?

Answered: 7 Skipped: 3



ANSWER CHOICES	RESPONSES	
The meals I want to eat	71.43%	5
The ingredients I already have at home	28.57%	2
TOTAL		7

Comments (4)

RESPONSES (4) WORD CLOUD TAGS (0) Sentiments: OFF

Add tags Filter by tag Search responses

Showing 4 responses

both
4/18/2022 3:37 PM View respondent's answers Add tags

both
4/18/2022 3:31 PM View respondent's answers Add tags

Both really but using up what I have first and foremost
4/18/2022 11:44 AM View respondent's answers Add tags

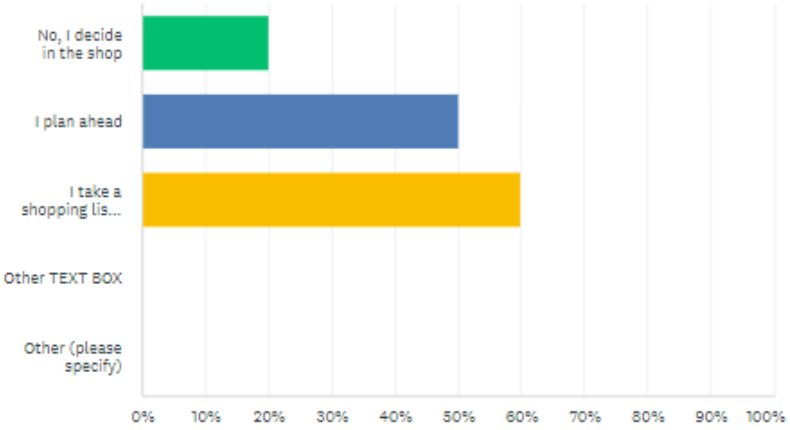
Both
4/18/2022 11:41 AM View respondent's answers Add tags

Q3

Customize Save as

Do you buy groceries based on a list/plan? Tick all that apply.

Answered: 10 Skipped: 0



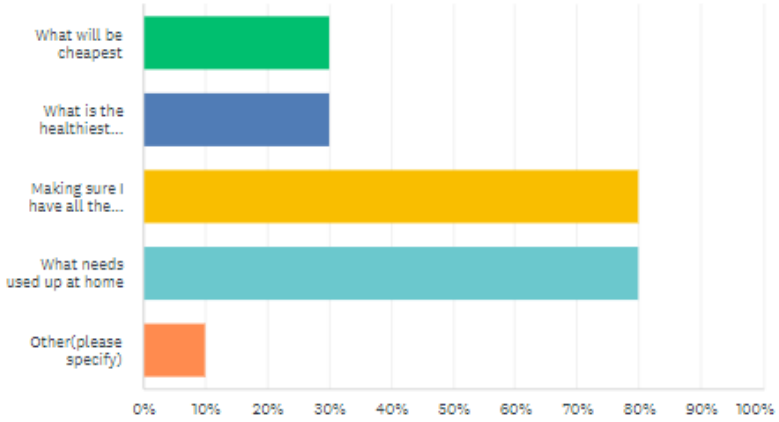
ANSWER CHOICES		RESPONSES	
No, I decide in the shop		20.00%	2
I plan ahead		50.00%	5
I take a shopping list with me		60.00%	6
Other TEXT BOX		0.00%	0
Other (please specify)	Responses	0.00%	0
Total Respondents: 10			

Q4

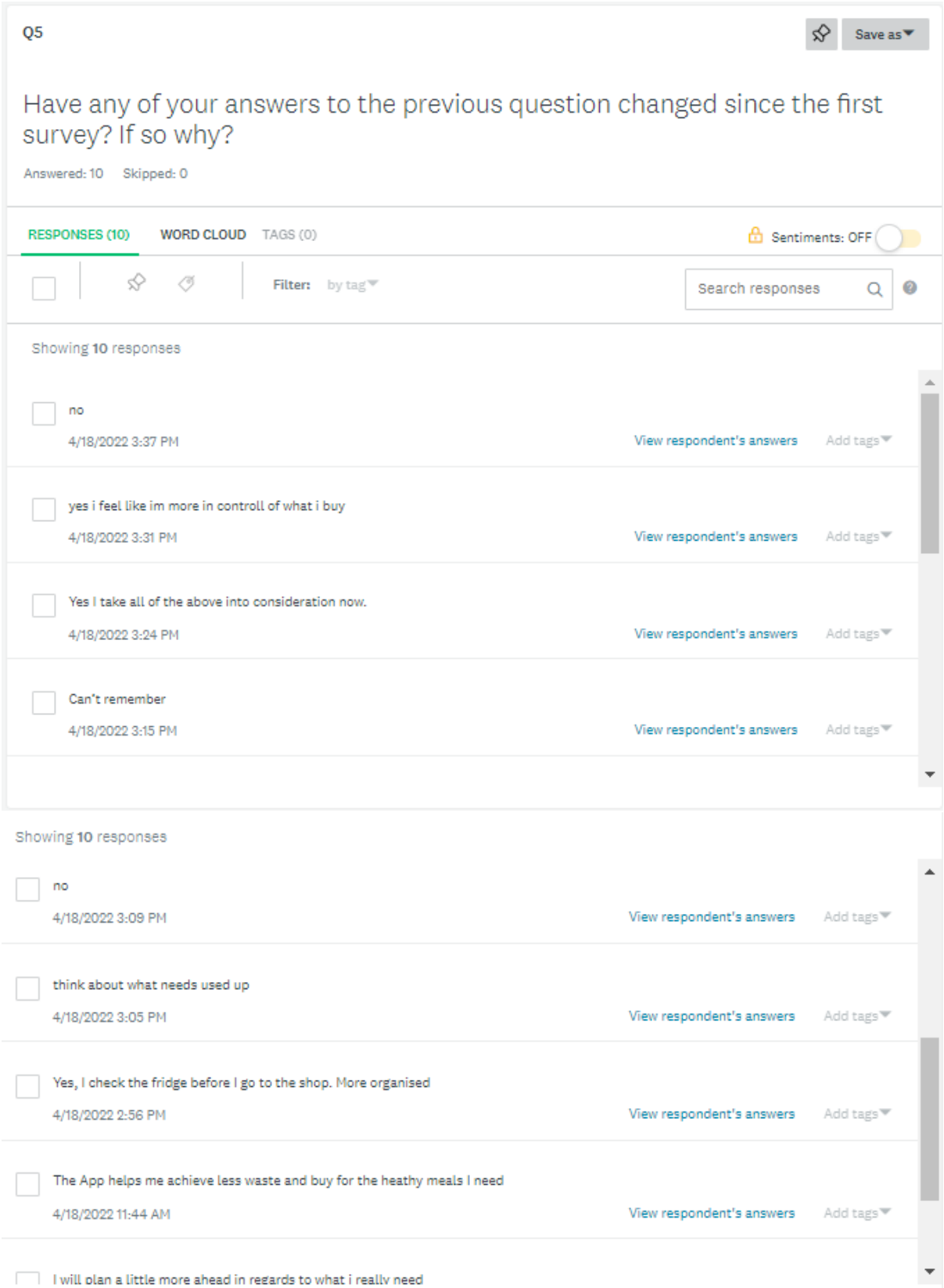
Customize Save as

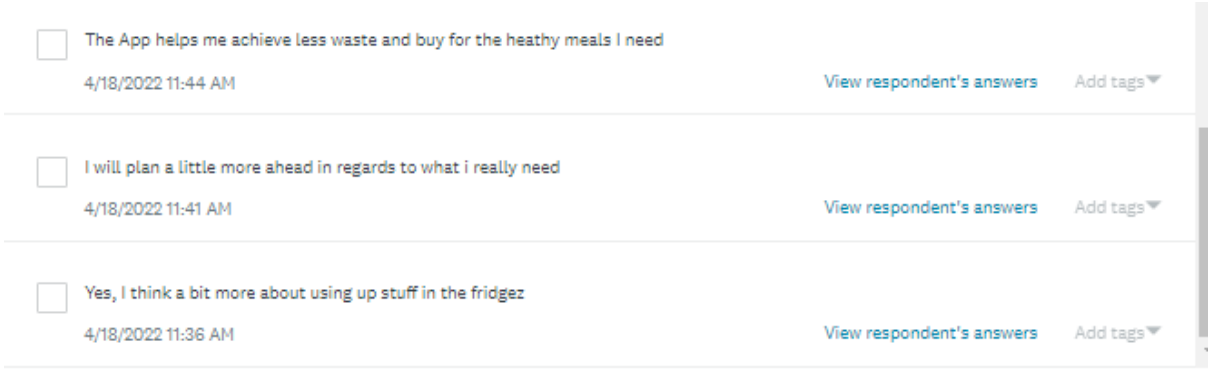
What is most important to you when buying food? Please select all that apply.

Answered: 10 Skipped: 0



ANSWER CHOICES		RESPONSES	
What will be cheapest		30.00%	3
What is the healthiest option		30.00%	3
Making sure I have all the ingredients for meals I want to cook		80.00%	8
What needs used up at home		80.00%	8
Other(please specify)	Responses	10.00%	1
Total Respondents: 10			


Q5
Save as
Have any of your answers to the previous question changed since the first survey? If so why?
Answered: 10 Skipped: 0
RESPONSES (10)
WORD CLOUD
TAGS (0)
Sentiments: OFF
Filter: by tag
Search responses
Showing 10 responses
no
4/18/2022 3:37 PM
View respondent's answers
Add tags
yes i feel like im more in controll of what i buy
4/18/2022 3:31 PM
View respondent's answers
Add tags
Yes I take all of the above into consideration now.
4/18/2022 3:24 PM
View respondent's answers
Add tags
Can't remember
4/18/2022 3:15 PM
View respondent's answers
Add tags
Showing 10 responses
no
4/18/2022 3:09 PM
View respondent's answers
Add tags
think about what needs used up
4/18/2022 3:05 PM
View respondent's answers
Add tags
Yes, I check the fridge before I go to the shop. More organised
4/18/2022 2:56 PM
View respondent's answers
Add tags
The App helps me achieve less waste and buy for the heathy meals I need
4/18/2022 11:44 AM
View respondent's answers
Add tags
I will plan a little more ahead in regards to what i really need

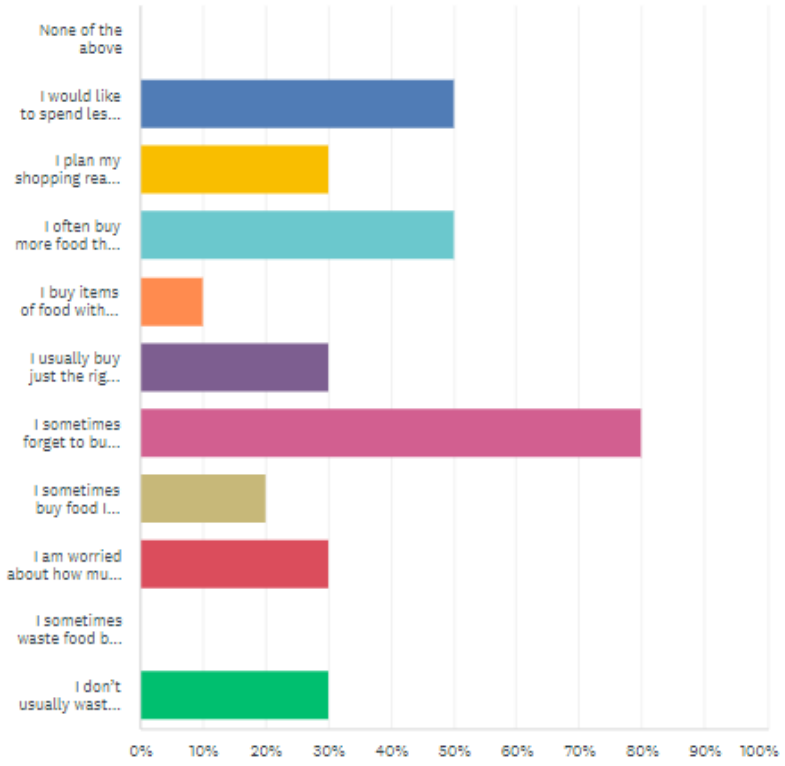

The App helps me achieve less waste and buy for the heathy meals I need
4/18/2022 11:44 AM
View respondent's answers
Add tags
I will plan a little more ahead in regards to what i really need
4/18/2022 11:41 AM
View respondent's answers
Add tags
Yes, I think a bit more about using up stuff in the fridgez
4/18/2022 11:36 AM
View respondent's answers
Add tags

Q6

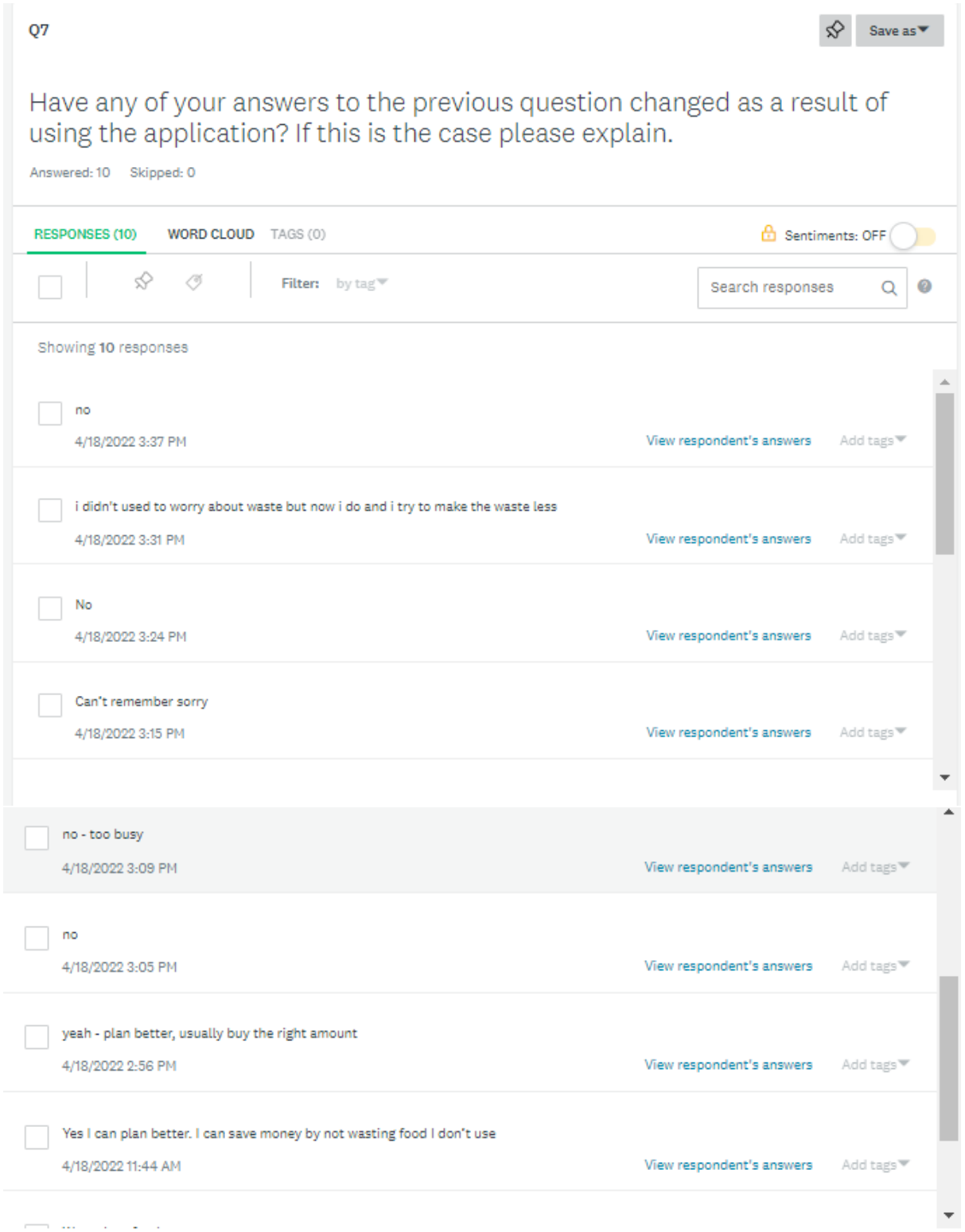
Customize Save as

Which of these statements are true about you? Please tick all that apply

Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
None of the above	0.00%	0
I would like to spend less money on food.	50.00%	5
I plan my shopping really well.	30.00%	3
I often buy more food than I use.	50.00%	5
I buy items of food without knowing how I will use them	10.00%	1
I usually buy just the right amount of food.	30.00%	3
I sometimes forget to buy all the ingredients I need.	80.00%	8
I sometimes buy food I don't need because I have forgotten I already have it at home.	20.00%	2
I am worried about how much food I waste.	30.00%	3
I sometimes waste food but this doesn't bother me.	0.00%	0
I don't usually waste food.	30.00%	3
Total Respondents: 10		


Q7
Save as
Have any of your answers to the previous question changed as a result of using the application? If this is the case please explain.
Answered: 10 Skipped: 0
RESPONSES (10)
WORD CLOUD
TAGS (0)
Sentiments: OFF
Filter: by tag
Search responses
Showing 10 responses
no
4/18/2022 3:37 PM
View respondent's answers
Add tags
i didn't used to worry about waste but now i do and i try to make the waste less
4/18/2022 3:31 PM
View respondent's answers
Add tags
No
4/18/2022 3:24 PM
View respondent's answers
Add tags
Can't remember sorry
4/18/2022 3:15 PM
View respondent's answers
Add tags
no - too busy
4/18/2022 3:09 PM
View respondent's answers
Add tags
no
4/18/2022 3:05 PM
View respondent's answers
Add tags
yeah - plan better, usually buy the right amount
4/18/2022 2:56 PM
View respondent's answers
Add tags
Yes I can plan better. I can save money by not wasting food I don't use
4/18/2022 11:44 AM
View respondent's answers
Add tags

Yes I can plan better. I can save money by not wasting food I don't use

4/18/2022 11:44 AM View respondent's answers Add tags

Waste less food

4/18/2022 11:41 AM View respondent's answers Add tags

Yes, I check what I've got at home so I don't buy duplicates.

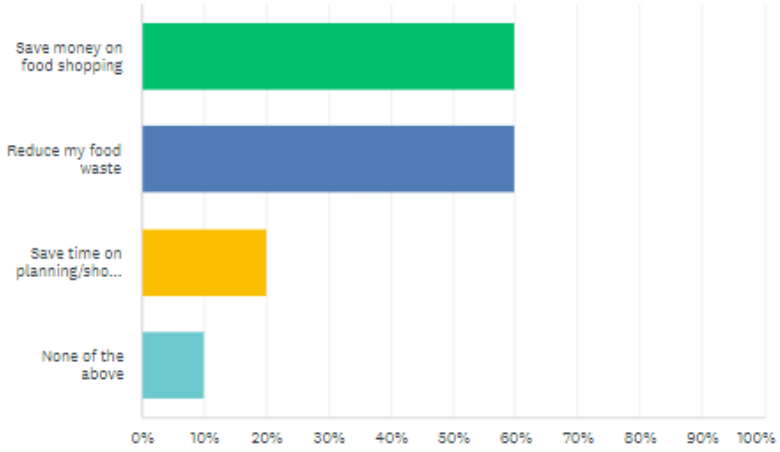
4/18/2022 11:36 AM View respondent's answers Add tags

Q8

Customize Save as

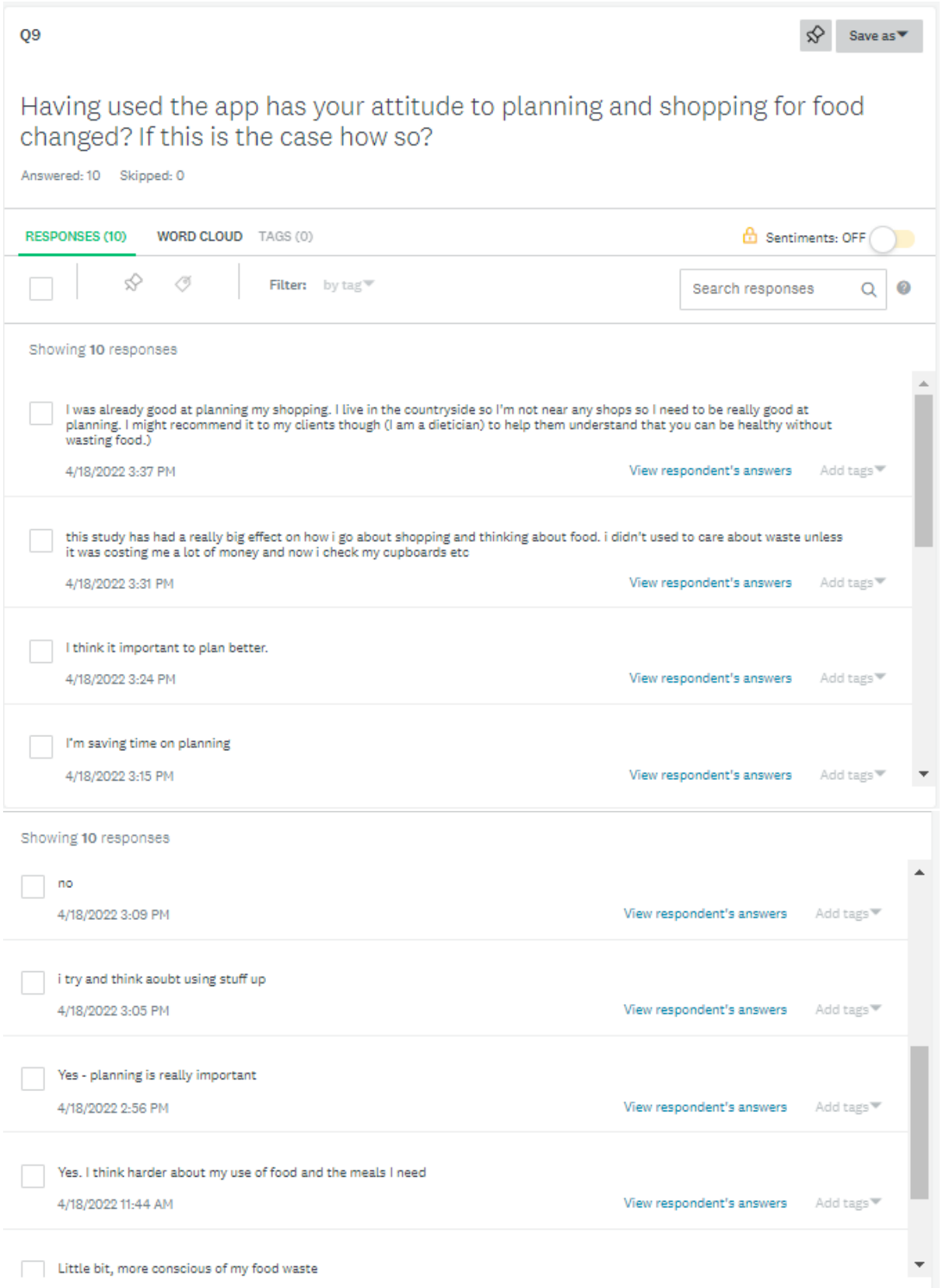
Which of the following do you feel more enabled to do? Tick all that apply.

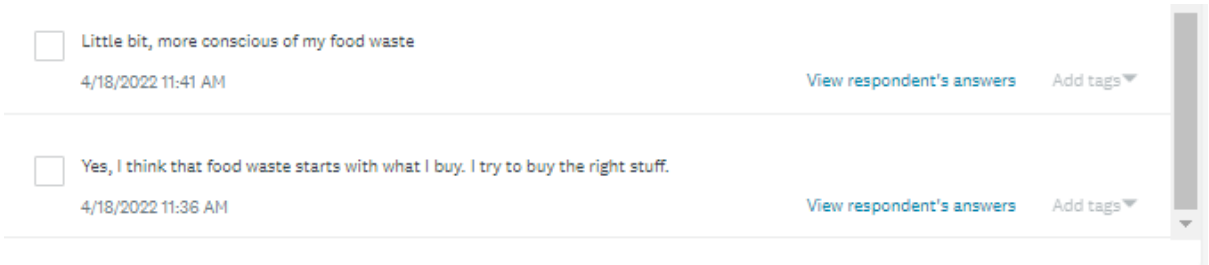
Answered: 10 Skipped: 0



ANSWER CHOICES	RESPONSES	
Save money on food shopping	60.00%	6
Reduce my food waste	60.00%	6
Save time on planning/shopping for food	20.00%	2
None of the above	10.00%	1
Total Respondents: 10		

Comments (1)


Q9
Save as
Having used the app has your attitude to planning and shopping for food changed? If this is the case how so?
Answered: 10 Skipped: 0
RESPONSES (10)
WORD CLOUD
TAGS (0)
Sentiments: OFF
Filter: by tag
Search responses
Showing 10 responses
I was already good at planning my shopping. I live in the countryside so I'm not near any shops so I need to be really good at planning. I might recommend it to my clients though (I am a dietician) to help them understand that you can be healthy without wasting food.)
4/18/2022 3:37 PM
View respondent's answers
Add tags
this study has had a really big effect on how i go about shopping and thinking about food. i didn't used to care about waste unless it was costing me a lot of money and now i check my cupboards etc
4/18/2022 3:31 PM
View respondent's answers
Add tags
I think it important to plan better.
4/18/2022 3:24 PM
View respondent's answers
Add tags
I'm saving time on planning
4/18/2022 3:15 PM
View respondent's answers
Add tags
Showing 10 responses
no
4/18/2022 3:09 PM
View respondent's answers
Add tags
i try and think aoubt using stuff up
4/18/2022 3:05 PM
View respondent's answers
Add tags
Yes - planning is really important
4/18/2022 2:56 PM
View respondent's answers
Add tags
Yes. I think harder about my use of food and the meals I need
4/18/2022 11:44 AM
View respondent's answers
Add tags
Little bit, more conscious of my food waste


Little bit, more conscious of my food waste
4/18/2022 11:41 AM
View respondent's answers
Add tags
Yes, I think that food waste starts with what I buy. I try to buy the right stuff.
4/18/2022 11:36 AM
View respondent's answers
Add tags