Mini Project Report on

Automatic Recognizing & Cooking Assistant

Human Machine Interaction Laboratory

B.E Semester VIII

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Chapter 1

Introduction

1.1 HMI and its Importance

A human machine interface (HMI) is an interface which permits interaction between a human being and a machine. Human machine interfaces vary widely, from control panels for nuclear power plants to the screen and input buttons on a cell phone. Designing such interfaces is a challenge, and requires a great deal of work to make the interface functional, accessible, pleasant to use, and logical. Some engineers specialize in developing human machine interfaces and changing the ways in which people interact with machines and systems. HMI is the acronym for Human Machine Interface, and can be designed as just that; an interface between the user and the machine. An HMI is considered an interface; a very broad term that can include MP3 players, industrial computers, household appliances, and office equipment.

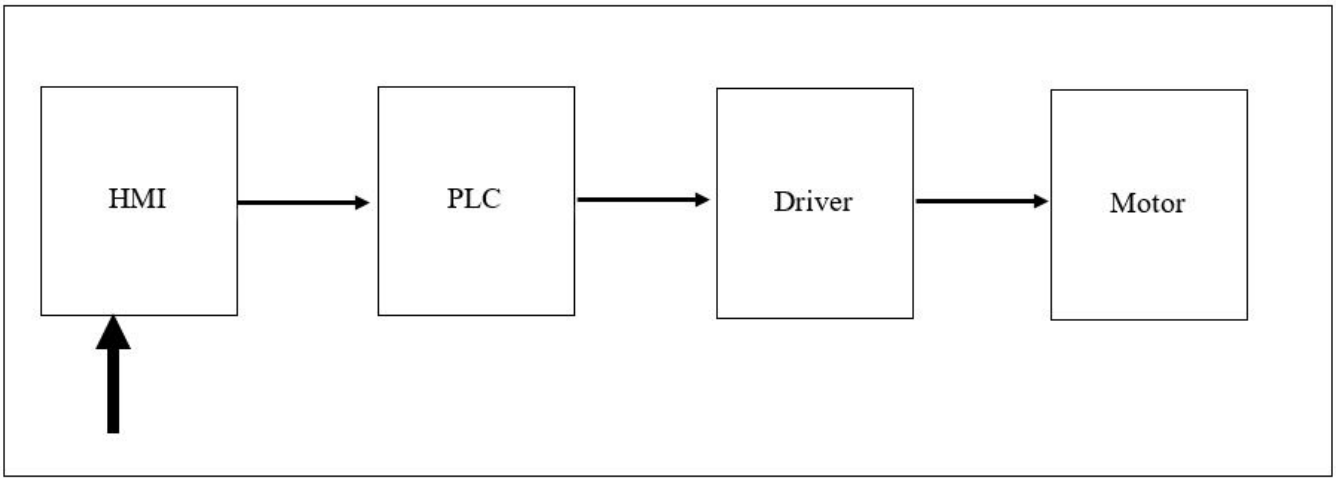

Fig 1.1 – Human Machine Interface Block Diagram

A Human Machine Interface (HMI) is exactly what the name implies; a graphical interface that allows humans and machines to interact. Human machine interfaces vary widely, from control panels for nuclear power plants, to the screen on an iPhone. However, for this discussion we are referring to an HMI control panel for manufacturing-type processes. An HMI is the centralized control unit for manufacturing lines, equipped with Data Recipes, event logging, video feed, and event triggering, so that one may access the system at any moment for any purpose. For a manufacturing line to be integrated with an HMI, it must first be working with a Programmable Logic Controller (PLC). It is the PLC that takes the information from the sensors, and transforms it to Boolean algebra, so the HMI can decipher and make decisions.

Choosing the right HMI is as important as choosing the PLC itself. A well-designed HMI should do more than just control the process. It should be safe, reliable, and cost effective and it should provide an operator

with the bird's eye view of the entire process. HMI's are the principal point of contact between the user and the process. It should perform all functions with minimal effort, increasing productivity to the user's satisfaction. The greatest advantage of an HMI is the user-friendliness of the graphical interface. The graphical interface contains colour coding that allows for easy identification (for example: red for trouble). Pictures and icons allow for fast recognition, easing the problems of illiteracy. HMI can reduce the cost of product manufacturing, and potentially increase profit margins and lower production costs. HMI devices are now extremely innovative and capable of higher capacity and more interactive, elaborate functions than ever before.

1.2 Project

While designing a project to control a particular process, one has to keep in mind, what kind of visual, auditory or tactile feedback is best suited for that application. Filling the screen with irrelevant group of objects will force an operator to spend his time searching for relevant information. Forcing an operator to search for required information, increases response time and potential errors. A good project design should make the operator progress through it intuitively and logically. Not everybody has to access the maintenance screen, but everybody should be able to get to the screen where there is are basic start or stop buttons to start or stop a machine. Knowing your operator while designing the project is important. Safety considerations are a critical part of HMI system design. Human error is a contributing factor in most accidents in high risk environment. Selection of a good HMI directly affects the operator and overall system performance. Working through the above-mentioned factors will result in a better decision. Selecting an underpowered or under featured HMI will eventually result in spending a lot more in the future and unsatisfied customers.

Chapter 2

Problem Statement

There are many people that are troubled about which new recipe to cook at a daily basis for their various reasons like for their family or for their excitement to try something new. At this time these people have a set of ingredients that they wish to use but don't have any particular recipe/ dish to cook in their minds. Prepare a platform for these users to guide and find some recipes that will best suit to their desires. Give the users the option to verbally communicate with the system in order to cook a dish to guide the user with the steps to prepare a dish or recipe.

Chapter 3

Proposed Solution

Many times, there are situations when people are searching for new dishes and recipes that people want to make and try for themselves. For their cooking experience to be effortless and with a remaining handful of ingredients available at home, ARCA application idea came into action. Therefore, for the ease of people and to quench their needs and excitement, ARCA application idea was introduced which gives users the benefit of choosing the ingredients when searching for a dish recipe to cook. Users will be provided with a voice-enabled assistant for the people which will guide and assist them over the cooking steps. This assistant will be providing the user with a better hand-free experience who listens to its users when needed. ARCA is a mobile application for cooks and cooking enthusiasts providing them a variety of dishes in numerous cuisines over the world which can be shared along with the steps to prepare them and the assistance at each step with a number of commands for ARCA to perform certain in-between tasks. The following stated below are the objectives of this ARCA application –

- User should have a platform to get all the necessary information regarding a recipe dish.
- User should be provided with an option to search for the recipes through name of the recipes or the ingredients that could be used for the preparation of the intended recipes.
- User should be provided with an in-app function to detect the recipes or the ingredients if the user chooses to search for recipes through ingredients.
- User should be provided with a voice assistant for guiding through the entire process of cooking the respective recipe dish.
- All the above objectives should be fulfilled with a stable working application for Android OS devices.

Chapter 4

Client Description

ARCA is a service provided to all the people who are interested in cooking dishes or people wanting to learn or prepare new recipes. People those who want to get information about certain recipe dishes are the users. As, the consumption of food is a basic human need, how to prepare edible food to get better choices for taste and nutrition for the food we consume is initial choice of many. Hence, all people can be the users of the ARCA application. ARCA is a mobile application, so everyone who has a smartphone device can use the ARCA services to the optimal stage of the app. ARCA service promotes the mobile learning process but reduces the hassle faced by the people while searching for the dishes.

Chapter 5

Requirements of the End Users of the System

In order to find the end user requirements of the ARCA application, information gathering techniques are required. For finding comfortability, users requirements system must able to do all the functionalities which are essential. By asking questions, taking surveys and making forms are some methods for collecting data from the users. Here in this prototype model data is collected from the different sources. For developing the final mobile application specific objective requirement analysis is conducted. Through the observations of the user problems the mobile applications developed by other web developers and the information is obtained on researching over the idea.

Software and Hardware Requirements of the end user to run the ARCA application in their devices are –

- Operating System (OS) on the device – Android OS
- RAM size of the device – 3gb or higher
- ROM size required – Higher than 100mb
- Display of the device – Working condition standard output display
- GPU required – Not essential for ARCA
- Internet Access – Needed for fetching the recipe details
- Storage Access – Needed for the cached data

Chapter 6

Technology Used for the Development

6.1 Android Studio

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as the primary IDE for native Android application development. Android Studio is the IDE tool used to work on alterations and code for ARCA application.

6.2 Kotlin Language

Kotlin is a cross-platform, statically typed, general-purpose programming language with type inference. Kotlin is designed to interoperate fully with Java, and the JVM version of its standard library depends on the Java Class Library, but type inference allows its syntax to be more concise. Kotlin is also termed as one of the advanced java languages and our whole application was structured and coded in this language at the backend.

6.3 XML Language

Extensible Mark-up Language (XML) is a mark-up language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. It is majorly used to make layouts for each activity in Android Studio. XML language was used to code the frontend designs for the ARCA application.

6.4 DialogFlow

Dialogflow has an open approach that makes it very easy for most developers to take on new channels without expensive integration work, and the platform was self-explanatory, well-documented, and easy to use. Dialogflow provides various agents and in those agents, intents. An agent in dialogflow is an application program interface to perform certain task by training a model on providing certain intents. Each intent is a trained approach to a similar action or question. There can be a lot of intents with various actions and approaches.

6.5 Text-to-Speech Engine (TTS)

Text-to-Speech (TTS) refers to the ability of computers to read text aloud. A TTS Engine converts written text to a phonemic representation, then converts the phonemic representation to waveforms that can be output as sound.

6.6 Android Chat UI Library

Android Chat UI is an open-source library or package made by a github developer by the username of “timigod” for making the chatting layout customizable and readily accessible to all the fellow developers. In this library there are premade classes and a layout which is very much customizable in order to display the chatting page and the messages without any backend logic initially.

6.7 Gif-ImageView Library

Gif-ImageView is an open-source library or package made by Kotlin developers. This package gives its own component of XML language to which we can input a gif image in order to display it to the users.

Chapter 7

Good Screen Design Principles

A Human-Machine Interface (HMI) is the interface an operator uses to interact with and control healthcare system. At a minimum, a poorly designed interface impedes the operator from performing his or her job well. At the worst, a poorly designed HMI contributes to human error and accidents that can be catastrophic.

7.1 Match the Operator's Mental model

The HMI should support the operator's goals and rely on their knowledge of how the world works. It should follow real -world conventions in making information appear in a natural and logical order.

7.2 Fit Design to the Operators' Physical Environment

The design team continually referred to the rig environment and the conditions in which operators work. For many control systems currently in use on rigs, operators manually devise work-arounds or cheat sheets to interpret operational instructions.

7.3 Provide a sense of Place

People should be able to tell at a glance where they are in the HMI and have a good grasp of how the system is organized. A system header is always found at the top of the screen and provides a high-level status of the system, the status of alarms, the title of the current screen and the date and time.

7.4 Anticipate Operators' Needs

The HMI should anticipate the actions an operator can take and the information they will need for a given function and provide that in context. In this HMI, there is a display of information that shows status and verifies the correct functioning of mechanical components.

7.5 Minimize Cognitive Load

The HMI should present information when and where needed but much information and not all at once. The right balance is stuck by presenting information in context and reduce the calculations that operators have to do.

7.6 Be Consistent & Follow Conventions

Operators should be able to learn an action sequence in one part of the system and apply it again to get similar results in other places. Consistent language, layout and interactions help operators learn a system faster and find information quicker.

7.7 Show Status & Provide Feedback

Help the operator understand the effect their actions have on the system and guide the operator to the successful completion of their task. In this HMI, each type of system component has a uniquely designed icon that provides information about what that component is, as well as the operational position of that component.

7.8 Coordinate the Visual Design with the Information Design

The visual design needs to support the information hierarchy by emphasizing the most important elements and de-emphasizing the less important ones. The design team in this project reviewed many HMIs that use so much colour in the interface that it overwhelms the importance of any particular colour's meaning. It also requires mental effort for the operator to remember what each colour indicates and to apply the appropriate reaction.

7.9 Use Appropriate Language

Use words and concepts from the operator's world. Don't use system--specific terms. Avoid ambiguity. Use proper syntax and grammar and the appropriate tone and level of formality. This principle was especially taken to heart in the design of alarm messages.

7.10 Prevent Errors & Help Operators Recover from Errors

Even better than a good error message is a careful design that prevents a problem from occurring in the first place. Error messages should be expressed in plain language, not in codes. They should precisely indicate the problem and constructively suggest a solution.

7.11 Design with Principled Aesthetics

Design should follow basic principles of form and composition and meet aesthetic expectations of the operators. Above all, the aesthetics should not detract from usability. This HMI design follows best practices in visual design and design for process controls.

Chapter 8

Components Used in UI of System

ARCA has various components in the frontend which are used in the mobile application for better visual and interaction between the user and system. Components such as navigation bar, text boxes, images views, buttons, gif view, container view, list view etc are used in our application. When user needs to perform a particular action, it is necessary to interact with graphical interface for that purpose mobile components are used.

8.1 Types of Application-bar

There are two types of application bars used in the ARCA application which were used in all of the pages (referred to as activities in Android application) to be visited. The two types are –

1. **Non- Collapsing Appbar**

   A non-collapsing application bar has title bars as the child classes. These title bars don't collapse whenever users scroll downwards to read the bottom content. This means the non-collapsing bars are fixed on the respective activity they are assigned to.

2. **Collapsing Appbar**

   A collapsing application bar has title bars as the child classes as well. These title bars collapse whenever users scroll downwards to read the bottom content. This means the collapsing bars are not fixed on the respective activity they are assigned to. The collapsing bars' attributes are not fixed and are changeable as per the developer's choice.

8.2 Types of Messages

A text message is a form of text communications. Text communications are essential in any system to let the user know about the current state of the system.

1. **Information messages**

   These messages are known as notification message. It allows users to provide the information. This type of message is used in ingredient selection as well as respective recipe activity. If the user selects less than 4 ingredients, they will be alerted by an alert box containing information message to select

more than 4 ingredients to proceed to next activity. Also, if system is unable to access internet, users are requested and asked by an alert box to give the ARCA application access.

2. **Warning messages**

   The user must determine whether the situation is in a fact problem and may be asked to advice the system whether or not to proceed. This type of message is used to warn users about current state.

3. **Question messages**

   The assistant activity provides question messages to the user. When user enters a query regarding the recipe details, the assistant provides proper trained response.

8.3 Use Screen Controls

In ARCA, various screen controls are used for interaction purposes with the user. Controls in application development are termed as “Views”. These views consist of text views, image views, gif views, image buttons, buttons, list views, container views and many more.

1. **Edit-text View**

   An edit-text view acts as an input-box. This view takes input from the user in the form of texts. This component is used in assistant part to receive commands from the user and in Recipe activity to get input for the searching operation of recipes.

2. **Text View**

   A text view is no different than a text box. It shows the user a multi-line text box. In this application, text views are used at all the places to display messages.

3. **Image View**

   An image view acts as a box to display user given respective image. This view is used in Respective Recipe activity to showcase the recipe image to the user.

4. **Gif View**

   A gif view is similar to image view but is used to display gif images in the system. This view is used in Main activity of ARCA to showcase the selectable options to the user.

5. **Button**

   A button acts as a clickable text view, that is, a text view which can be clickable by the user to perform certain action in a system. This view component is used in most of the activities of ARCA to redirect the user to the next activity.

6. **Image Button**

   An image button is similar to button view but, in this view, user is displayed with the image instead of a text. This view component is used in Ingredient Selection Activity.

7. **List View**

   A list view is used to display the user with a list of components to select from. This view is used in Recipe selection Activity when directed from the main activity.

8. **Container View**

   A container view is used to display a certain number of images or texts for some duration. This container view is used for carousal in First Time Boot Activity.

9. **Recycler View**

   A recycler view is similar to a list view but an added feature of syncing the whole list items according the user's actions. This view is used in Recipe Activity when directed from the Ingredient Activity or when a search is given in the Recipe Activity itself.

10. **Check View**

    A check view is similar to a button. In button, when clicked, any relevant action specified in the system can be performed whereas in check view, when clicked that view is only selected for further single operation. User can select multiple check views at a time, if given an option. This view is used in Ingredient Activity in order to select the ingredients.

8.4 Navigation & Flow

The ARCA application mainly performs two operations- Recipe Recommendation Operation and Assistant Operation. Initially, user is shown the First Time Boot Activity (shortened to FTB Activity) to give a tutorial of what all operations ARCA can perform. Secondly, on clicking next button, user is directed to Main Activity, in which user is provided with two choices – Recipes Selection and Ingredients Selection. Recipe Selection button on clicking is directed to the Recipe Activity which gives a list of recipes to the user to choose/select from. On pressing Ingredient Selection Button, user is directed to Ingredient Activity. In Ingredient Activity, the user is urged to select the desired ingredients with a condition (of atleast selecting 4 ingredients) to proceed further. On selecting ingredients, user can now proceed to the Recipe Activity, but this time a list of shortlisted recipes is displayed with respective to the ingredients selected by the user in previous step. On selecting any of the recipe (list tile), user is directed to Respective Recipe Activity(shortened to Res-Rec Activity) in which all the details for preparing the respective activity is displayed to the user. If the user chooses to get assisted

by the assistant feature, the user is directed to Listening Activity where he can converse with the assistant through text conversation or voice two-way conversation.

8.5 Colour & Images

Colour is a major component of the HMI. The main characteristic of the HMI is that it should be intuitive and user friendly. With the use of appropriate colour's, the HMI can be designed in such a way that the user focuses only on the specific part of the interface at that specific time period. Choosing the right colour for the background, control buttons, alarms, text and other objects is very critical to design a good HMI.

1. **Background Colour**

   An HMI graphic should always have a dull background (preferably blue). There should be no animation and crossing lines should be avoided, so that the operator does not get distracted from important data. Primary colours (red, green, blue) should never be used as background. In this application, mixture of purple and violet colour, orange, aqua colours are used as accent colours and in the backgrounds lighter black shade and darker white shades are used in most places.

2. **Images**

   In HMI, images play very important role. It illustrates the information in graphical format. For attraction purpose and better visual representation the photos are used in ARCA in most places.

Chapter 9

Results

In this chapter, some of the screenshots of the ARCA mobile application are showcased with a very brief statement about the shown process. The screenshots of each activity sequentially with a brief over each is given below –

FTB Activity is used to show how to access activity components and a tutorial to the application for the users.

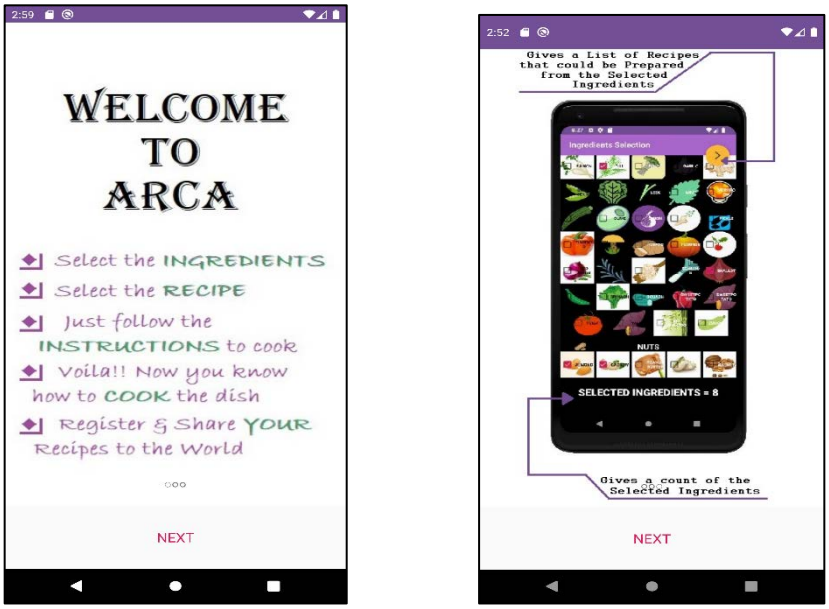

Figure 9.1 – First Time Boot(FTB) Activity

Main Activity with two choices – whether to go for recipe selection or ingredient selection.

Figure 9.2 – Main Activity

Ingredient Activity’s purpose is to showcase ingredients to the user in order to choose from for further steps.

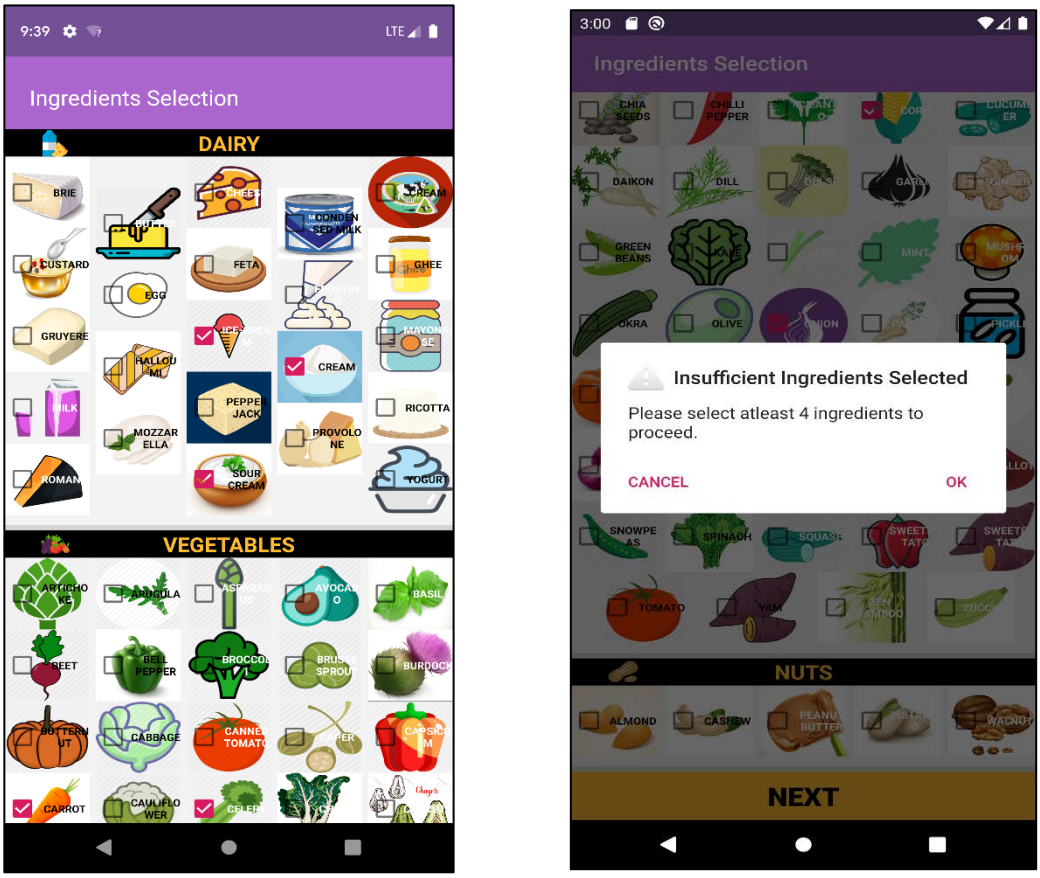

Figure 9.3 – Ingredient Activity

Recipe Activity is used to display list of all the recipes after filtering by the user’s choice.

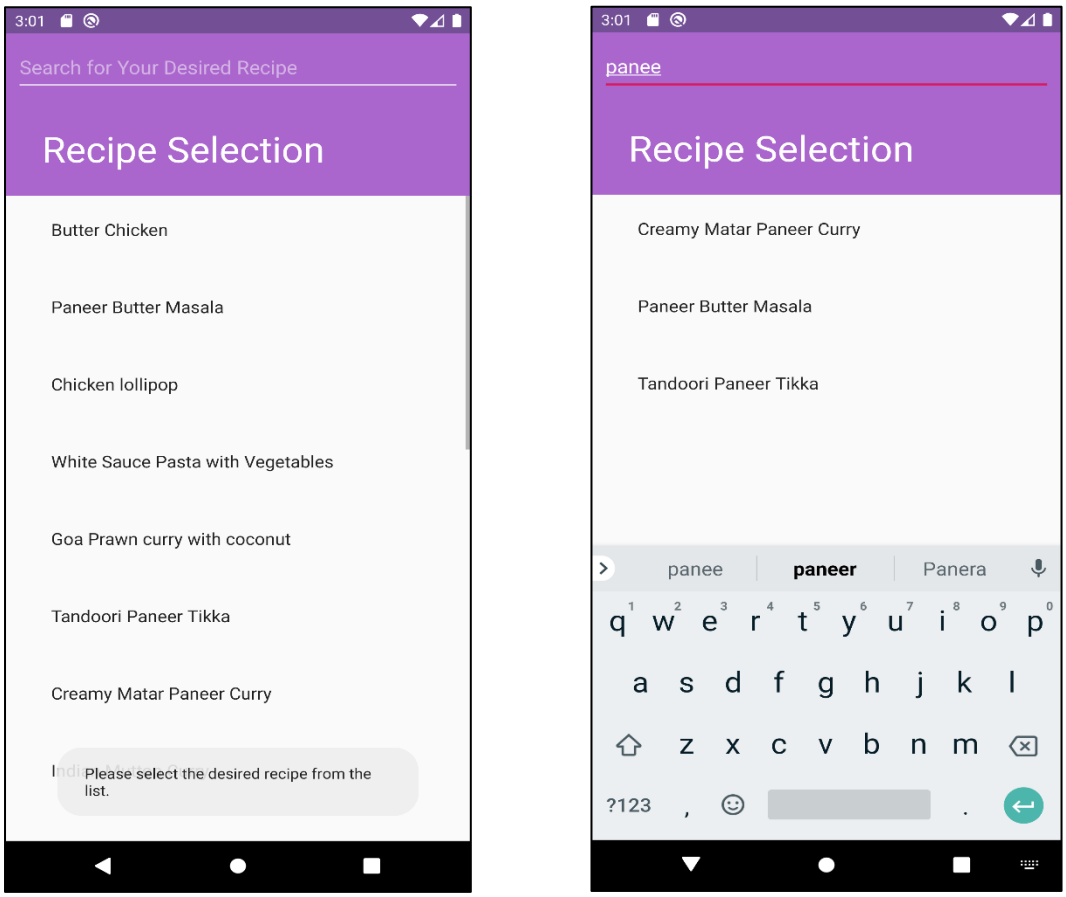

Figure 9.4 – Recipe Activity

Respective Recipe Activity is used to display the details of preparation of the user selected recipe from previous activity.

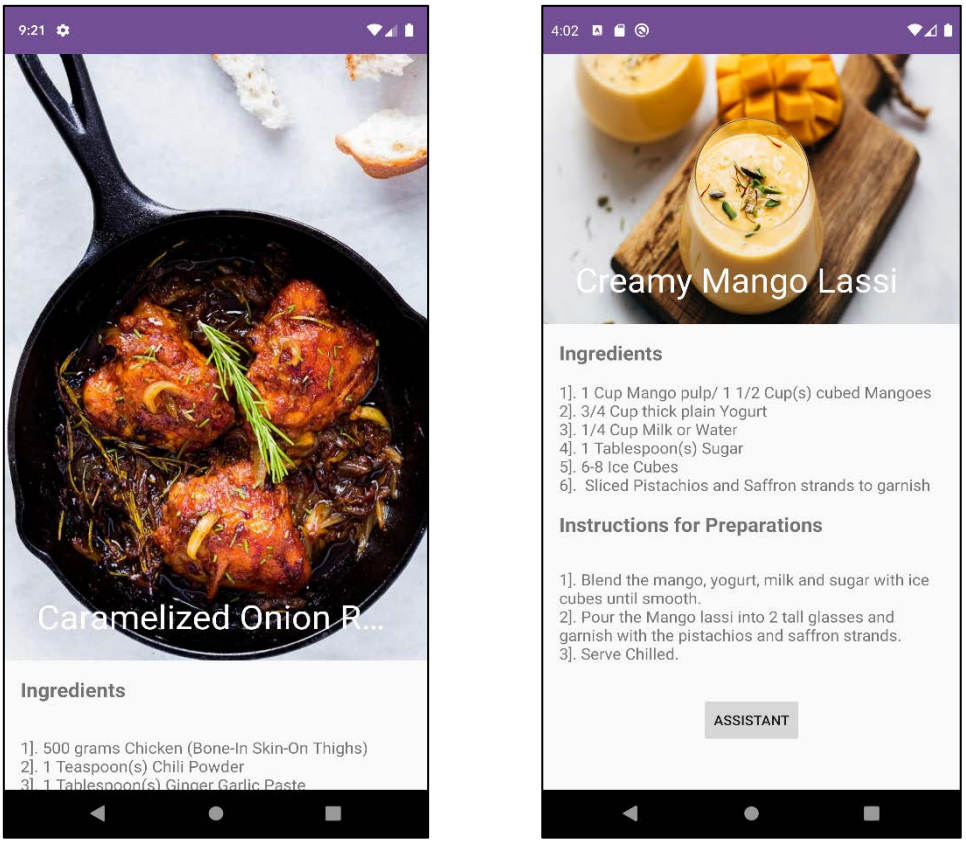

Figure 9.5 – Respective Recipe(Res-Rec) Activity

Listening Activity works as middle process for the user to converse with the assistant showing the conversation history between them.

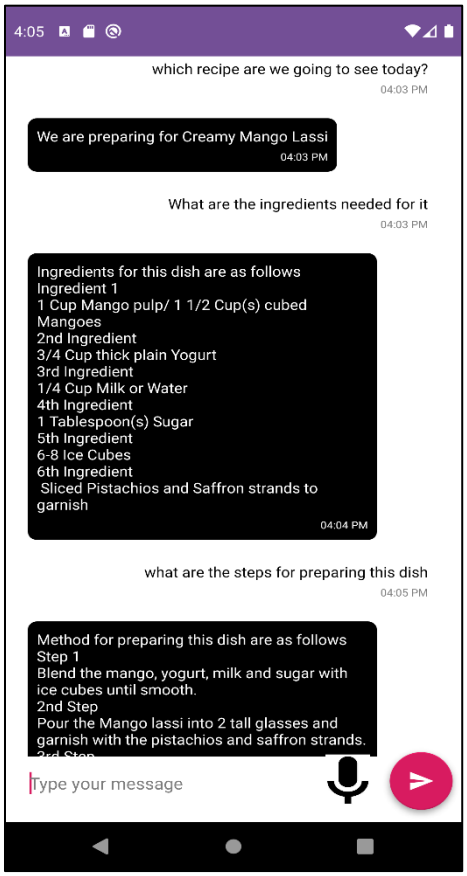

Figure 9.6 – Listening Activity (ARCA Assistant)