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Abstract: This document contains the description of critical ALAMEDA software components that are going to be implemented in the use cases for the assessment and monitoring of the patients. Specifically, these include the following applications: WellMojo, Chatbot Android App, Mood Estimation Android Application, Virtual Keyboard, Virtual Supermarket Test application, Line tracking test application, and the Experts' Dashboards.

**** Dissemination Level:*** *PU= Public, RE= Restricted to a group specified by the Consortium, PP= Restricted to other program participants (including the Commission services), CO= Confidential, only for members of the Consortium (including the Commission services)*

***** Nature of the Deliverable:*** *P= Prototype, R= Report, S= Specification, T= Tool, O= Other*

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Glossary

Abbreviation	Full name
ACTIVLIM	Activity Limitations
AMSQ	Arm Function in Multiple Sclerosis Questionnaire
API	Application Programming Interface
BAI	Back Anxiety Inventory
ED	Experts’ Dashboards
EEG	Encephalography
EU	European Union
FH-Q	Food Habits Questionnaire
GOD-Q	Godin Leisure – Time Exercise Questionnaire
IT	Information Technology
MDS – UPDRS	MDS-Unified Parkinson’s Disease Rating Scale
MEEA	Mood Estimation Android Application
MFIS	Modified Fatigue Impact Scale
ML	Machine Learning
MS	Microsoft
MSWS-12	Multiple Sclerosis Walking Scale
LTT	Line Tracking Test
OAB-Q	Over Active Bladder Questionnaire
OS	Operating System
PA	Physical Activity
PD	Parkinson’s Disease
PDQ	Perceived Deficits Questionnaire

PHQ-9	Patient Health Questionnaire-9
PMSS	Parkinson’s, MS and Stroke
PSQI	Pittsburgh Sleep Quality Index
QoL	Quality of Life
SemKG	Semantic Knowledge Graph
VST	Virtual Supermarket Test
WM	WellMojo
WP	Work Package

Executive Summary

The objective of Task 5.2 – ALAMEDA Digital Companion App and Experts Dashboards – is to present critical ALAMEDA software components that are going to be implemented in the use cases for the assessment and monitoring of the patients. These components are the **Digital Companion Application**, the **ALAMEDA Standalone tablet – based applications** and the **Experts Dashboards**. Altogether, they serve the ALAMEDA's vision which is to offer not a single service/framework, but a set of communicating services, operating on different levels and managed by different stakeholders in the PMSS delivery of care pathway (more information on ALAMEDA's vision can be found in D5.1 'Description Methodology & Design Principles of ALAMEDA AI Toolkit Version 1.0').

The ALAMEDA Digital Companion App consists of four applications that contribute to its functionality. **WellMojo** is the central Digital Companion App interface and the application that is responsible for the integration of the rest of the applications in ALAMEDA platform. Its user interface provides information about his/her physical activity and an evaluation of QoL based on developed algorithms, considering data collected by a wearable (Fitbit) and by questionnaires. Moreover, WellMojo hosts the required questionnaires per use case. WellMojo functionalities are presented in detail in Section 3.2.

The **Chatbot** (see Section 3.3) provides a user-friendly graphical interface for patients and caregivers to interact with the ALAMEDA Conversational agent. Its aim is to offer a conversational interface mimicking human communication to personalize the patients' journey. As part of this personalization, Chatbot is responsible for hosting various questionnaires or simple questions, contributing to the patient-specific information required per use case.

The **Mood Estimation Android Application (MEAA)** is responsible for monitoring the user while s/he is interacting with other ALAMEDA core modules, like, e.g., WellMojo or the conversational agent. MEAA's goal is to analyze the facial expressions of the users and assess their overall mood while they are conducting the related tasks (i.e., filling in the questionnaires or having a conversation with the agent). Details can be found in Section 3.4.

The **Virtual Keyboard** is an app designed to assess users' typing patterns on a mobile device. This app will contribute to the assessment of patients participating in ALAMEDA Parkinson pilot. (Section 3.5)

Furthermore, two standalone tablet-based applications are going to be used for the evaluation of the participants in ALAMEDA pilots. The **Virtual Supermarket test application** (Section 4.1) is a tablet app designed to assess older adults' cognition through a simple task modeled on an everyday activity. The application is aimed at activating a multitude of cognitive processes namely visual and verbal memory, executive function, attention and spatial navigation with the emphasis placed on executive function. The **Line Tracking Test application** (Section 4.2) is a tablet app designed to assess older adults' hand dexterity. Developed within the NoTremor EU project, the Line Tracking Test measures the ability to follow a randomly moving target (the cyan line) while ignoring the distracting target (the red line).

Finally, the **Experts Dashboards** application offers ALAMEDA pilot participants access to all project information, as well as powerful visualization and analysis tools (Section 5). It consists of three different dashboards: the main pilot dashboard (Section 5.2.2) where pilot specific information is displayed (pilot participants, patients, overall status etc.), the patient dashboard (Section 5.2.3) where patient specific information is displayed such as observations, variables etc. and analysis and visualization dashboard where various options of data visualization are available based on back-end analysis.

Each one of the sections that refer to Digital Companion components and Experts Dashboards presents description of the application’s general design, use (via brief user manuals) and integration logic with ALAMEDA platform.

This document presents the design and functionality of the applications developed for ALAMEDA pilots. They are web and mobile applications, for easier accessibility and flexibility, customised in such a way that ensures security and privacy. Each application deals with a separate aspect of monitoring features, allowing researchers to gather raw data, which is then pre-processed and stored in a semantic database. Powerful tools allow more unobtrusive and at the same time more efficient patient monitoring, while the ML and AI tools of the ALAMEDA AI Toolkit assist in data correlation and identification of potentially interesting results. Finally, the ED application offers access to all gathered and inferred information, to support the effort for better and earlier prediction of a patient's status evolution.

1 Introduction

In the ALAMEDA project, there are three distinct user applications that are developed. The applications aimed at patient users are mobile or tablet based, while for the medical professionals a web application is developed. The objectives of each application are presented in the following subsections.

1.1 Digital Companion application objectives

The Digital Companion is ALAMEDA's application component that comprises of the mobile applications that the ALAMEDA patient users operate (**WellMojo, Chatbot, Mood Estimation Android Application, Virtual Keyboard**). The objectives of this application are briefly described in the following bullets:

- The provisioning of various tests and questionnaires required for the patient's progress and QoL monitoring
- The display of statistics regarding the patient's physical, nutritional, and emotional status.
- The provision of a pleasurable and easy interface for the patients to increase their engagement in terms of the ALAMEDA pilots.
- The robust interconnectivity and communication among the applications that constitute the Digital Companion app.
- The communication and integration with the ALAMEDA cloud infrastructure and related components.

1.2 ALAMEDA standalone tablet-based applications objectives

Two standalone tablet-based applications will be used in the ALAMEDA pilots to assess participants cognition and hand movement. The **Virtual Supermarket Test (VST)** app will be used to assess participant's cognition as it has been shown to be very sensitive to subtle impairments and allows for cognitive assessment through an enjoyable, ecologically valid task. Furthermore, its computerized format allows for the assessment of various complex metrics providing a detailed picture of the user's cognition. The VST has been validated in various cohorts across regions ensuring its suitability for ALAMEDA pilot studies' participants. The **Line Tracking Test (LTT)** app will be used to assess older adults' hand dexterity in the Parkinson's disease pilot. Used previously in the NoTremor EU project (FP7-ICT), it has been shown to be sensitive in detecting subtle impairments in hand movements in Parkinson's patients. Thus, it was selected as a valuable clinical assessment tool for the ALAMEDA Parkinson's pilot.

1.3 Experts' Dashboards application objectives

The **Experts' Dashboards (ED)** application is the project's portal for the doctors, medical researchers and everyone else in the teams running the pilots. It aims to offer easy authorized access to all project data stored in the main semantic database. All data management complexity is to be handled transparently to the users, allowing them to focus on their research. A set of visualization tools will help users to observe potential correlations and interesting abnormalities that may lead to medical advances. Initially, the AI Toolkit suite will be partly accessible via ED, enabling users to run complicated algorithms and evaluate intricate models, to examine and validate their hunches and theories. The user interface will allow expert users to exploit the full potential of the project's tools and data, without burdening novice users with overwhelming details.

1.4 Deliverable structure

This deliverable is structured as follows. In **Section 2**, the design approach of ALAMEDA applications as well as the applications' users are presented. Sections 3-5 present the general design, technical specifications, user manuals and integration logic for each of the ALAMEDA applications. Specifically, **Section 3** presents WellMojo, Chatbot, Mood Estimation Android application and Virtual Keyboard. In **Section 4**, the standalone tablet-based applications, i.e., VST and LTT integrated in ALAMEDA platform are presented. **Section 5** is about presenting Experts' Dashboards in accordance with the prementioned structure for ALAMEDA applications. Finally, in **Section 6** the summary and next steps of the project are discussed.

1.5 Relation to other tasks and WPs

Task 5.2 of the ALAMEDA project aims to produce and realize the user applications, both for patients with PMSS diseases and their carers, as well as for the medical experts who are responsible for their regular monitoring.

Given both the user diversity and the complexities that the PMSS diseases themselves introduce, the task is designed wisely, heavily dependent on the work performed in WP3. It is the medical experts of the project, as well as the patients themselves and the local community groups that provide valuable feedback and guidance on how general features and requirements can be mapped to meaningful functionalities for the monitoring of PMSS patients. From the compilation of features to the design of the user interface and how the included functionalities are offered to the application users, WP3's work heavily influences the evolution and the implementation of the user applications.

Task 5.2 is additionally closely related to the data collection activities in Tasks 4.2 and 4.3, as especially the Digital Companion plays the role of the facilitator for the data collection of user generated inputs.

In terms of integration with the ALAMEDA platform, Task 5.2 is closely related to Task 5.4, where the Semantic Knowledge Graph API (SemKG API), the entry point to the data management layer of ALAMEDA, is developed as well as the rest integration points among all ALAMEDA modules to the ALAMEDA platform.

2 Design of ALAMEDA applications

2.1 Application users

The Digital Companion (DC) application users are the ALAMEDA patients and their respective informal carers. Through the DC, patients (and their carers) will be able to not only facilitate the collection of PMSS related data which are deemed as important by the project's medical partners but will also be able to have an overview of the data collected, receive notifications and reminders, as well as recommendations on their disease.

The Experts' Dashboards application users are the Healthcare professionals.

In the following, a brief overview of what patients and their carers can perform via each of the user applications offered in ALAMEDA.

2.1.1 WellMojo

WellMojo platform integrates the required questionnaires as a service per use case in accordance with ALAMEDA medical partners. Both patients and carers will have access to WellMojo platform. The users will be asked to use WellMojo to complete the prementioned questionnaires whenever indicated.

2.1.2 Chatbot Android App

Chatbot Android App hosts parts of the required (not standardized) questionnaires in the form of conversational flow regarding the monitoring of emotional well-being. Both patients and carers will have access to Chatbot App. The users will be asked to use Chatbot App in order to complete the prementioned questionnaires whenever indicated.

2.1.3 Mood Estimation Android Application (MEAA)

MEAA is responsible for the monitoring of emotional changes by analyzing user's expressions. If it is activated, it uses the camera to capture facial expressions. It has no visible interface, thus users cannot interact with the application. This analysis will be applied to all the pilot participants.

2.1.4 Virtual Keyboard

Virtual Keyboard is designed to assess users' typing patterns on a mobile device. This application is going to be implemented for the patients' registered in all use cases of ALAMEDA projects. Patients will be asked to use the keyboard in their everyday life and the collected data will be used for the assessment of their typing patterns.

2.1.5 Virtual Supermarket Test application (VST)

VST is designed to assess older adults' cognition through a simple task modeled on an everyday activity. This application is also going to be used by all patients participating in ALAMEDA pilots.

2.1.6 Line tracking test application (LTT)

Line tracking test is designed to assess older adults' hand dexterity. This application is dedicated to the patients of ALAMEDA's Parkinson pilot. The objective of line tracking test is to periodically assess the patient's hand movement.

2.1.7 Experts' Dashboards (ED)

ED is developed as a web interface to display all the gathered and stored data during the pilots. All the pilot participants are going to have access to this interface and to the analysis/information presented. This platform is not meant to be used by the patients.

2.2 Application design approach

2.2.1 WellMojo

WellMojo is responsible for the integration of all the ALAMEDA mobile applications, eventually constituting the functional basis of the ALAMEDA Digital Companion. WellMojo is the main mobile user interface for the target user that assist users daily in terms of assessing their health status and enabling them to self-manage their condition through coaching and tips. WellMojo provides a dashboard allowing for the presentation of patient related data in the nutrition, social, mood and physical activity aspects (including also details and historical data) as well as presentation and management of (medical and application specific) questionnaires and their answers. Moreover, WellMojo offers push notifications acting as reminders for taking actions or for presenting PMSS related information.

2.2.2 Chatbot Android App

The chatbot is responsible for collecting data about the emotional well-being and perception of social support by means of carefully constructed interactions. These interactions will contain questionnaires that were deemed by the medical partners of ALAMEDA as more appropriate to be presented through a conversational interface. However, a unified way to interpret and quantify the data collected from all the participants is still required. Hence for the standardized questions, predefined options (e.g., as buttons) are presented to the user. To take advantage of the conversational nature that a chatbot offers and make the interactions more personal, we also collect data in a free-text form. To engage the patients and carers to interact with the app, a notification system is developed. Given that the questionnaires need to be answered at specific time intervals, the notifications will let the user know when a questionnaire is available. Additionally, follow-up notifications will be sent as reminders in case some questions were left unanswered.

2.2.3 Mood Estimation Android Application (MEAA)

MEAA is responsible for monitoring the user's expressions and estimating his/her mood accordingly. MEAA's core can be integrated with other smartphone-using applications within ALAMEDA, to facilitate in shaping a more holistic view on the user's status and condition. To achieve this functionality, it is necessary to engage the front camera of the smartphone and receive the incoming frames for the analysis from the other ALAMEDA mobile applications i.e. WellMojo and Chatbot. To minimize distraction on behalf of the user, MEAA will run in the background of the other applications and will not provide a visible interface. In this case, MEAA will run as a foreground service, for which the user is informed with a notification on the status bar of the phone. Having the application running as a service makes it also possible for other applications to use it (i.e., WellMojo, conversational agent, etc.), without having to modify their interface or add/remove functionalities.

2.2.4 Virtual Keyboard Application

The Virtual Keyboard application has been designed to unobtrusively record and analyze typing patterns of smartphone users. The main design goal of the app is to allow the user to maintain the typing experience they are used to. Thus, the Virtual Keyboard is essentially a custom software keyboard, similar to the Android OS default keyboard, including all modern functionalities, such as word prediction and auto-correction, which replaces the Android OS default keyboard. Piloting of the Virtual Keyboard in a diverse sample of users has validated its usability and ability to discern typing patterns related to certain conditions such as depression.

2.2.5 Virtual Supermarket Test Application (VST)

The VST has been designed within the En-NOISIS GR-funded project with the aim of conducting cognitive assessment in an ecologically valid and enjoyable manner. The main aim in respect to the VST design has been to overcome issues that are common in cognitive assessment apps such as the use of tasks that are not reflective of everyday activities and functionality and lack of user engagement due to the often-boring format of tasks. Given that the VST features a complex scenario, it was designed through a bottom-up participatory design approach to incorporate users' voices. Therefore, end-users were involved in every stage of its design, implementation, and testing. The usability and diagnostic effectiveness of VST has been validated through various studies across different populations and regions.

2.2.6 Line Tracking Test

The LTT has been designed with the aim of quantifying hand movement parameters and detecting subtle hand movement issues in patients with Parkinson's disease (PD). It was designed in the auspices of the NoTremor EU project and thus the structure of the task and the relevant technical requirements were formulated based on input from a diverse team of European PD specialists. Its subsequent piloting with PD patients across Europe validated its usability and diagnostic effectiveness.

2.2.7 Experts' Dashboards (ED)

As specified in D5.1, ED design and development is following the prototyping method, as it is necessary to explain many details to all parties involved and make educated group decisions that will allow us to achieve the maximum potential of the project. The first attempts to gather relevant requirements showed that there were too many aspects involved and people could not even imagine what the specific requirements could be, so we tried a first prototype early in the project and it really helped everyone understand more, make relevant suggestions and express clearer requirements for the next stage. As this is a critical application regarding the success of the project, we decided to adopt the initially successful prototyping software development model and use this procedure for efficient internal knowledge dissemination.

The initial approach involved three separate local applications, based on the suggested security measures. Pilot targets aligned, however, and we found more efficient ways to organize data acquisition and management via secure web applications and APIs. The ED is a .NET web application, which can easily be turned to a downloadable bundle for local installation. Both versions will be included in the ALAMEDA Hub at the end of the project, to offer multiple options to similar research endeavors. Most project participants affiliated with a medical partner are not IT experts or power users, so simple window operating system-based solutions are more appropriate and ensure a faster learning curve. Data export enabling use of MS Excel sheets for reports, charts, and offline calculations is also important, as most of those partners are already accustomed to relevant tools and our goal is to assist them as much as possible.

3 Digital Companion application

3.1 Digital Companion requirements and design

The Digital Companion (and respective distinct) application functional and technical requirements were consolidated with the aid of the work performed in WP2 and WP3, as well as with organized meetings between the medical partners and the technical partners involved in ALAMEDA. The collection of requirements performed until now is included in deliverable D5.1.

Due to the dependency to the work performed in WP3 and the inherent complexity of the PMSS diseases themselves, the design and the implementation of the user applications that comprise the ALAMEDA Digital Companion have followed an iterative process, with parallel demonstrations, end user feedback and dedicated meetings.

3.2 Wellmojo

3.2.1 General design

The WellMojo mobile application, developed by WCS, acts as a personal health coach, motivates the users to keep going, rewards them for personal achievements and helps them to attain personal goals. It monitors physical activity, nutritional habits, mood and stress levels using wearables and user input.

It includes features such as:

- Login and automatic sign-in mechanism
- Initial profiling questionnaires
- Link with Fitbit
- Automatic monitoring of physical activity
- Daily or periodic questionnaires integrated in WellMojo in accordance with ALAMEDA medical partners' requirements
- Historic charts of data

3.2.2 Technical Specifications

Any smartphone device powered by Android OS can run the WellMojo app if it meets the minimum requirements. The device is required to be compatible with at least API version 30 (Android 11, R) and come equipped with minimum 4GB of RAM size for facilitating a smooth user experience.

3.2.3 User manual

The WellMojo application will be installed to patients' smartphone device. The patients (or their carers) will go through a user registration process that will enable them to access the application through secured credentials.

Note: The WellMojo UI will be updated accordingly to accommodate the feedback received from the pilots and the needs that will arise during the integration with the ALAMEDA platform.

3.2.3.1 *User login*

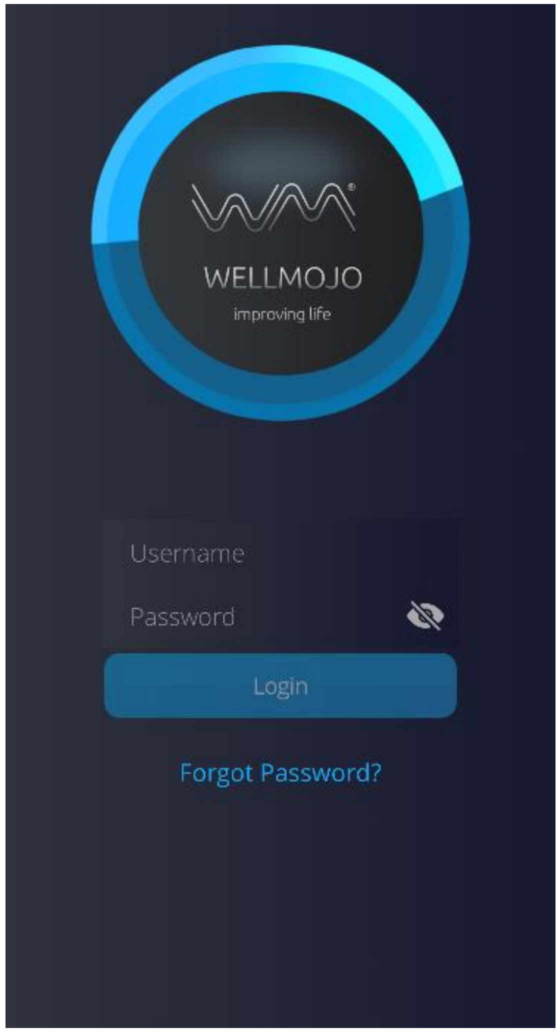

Figure 1 : WellMojo Login page

The user inserts his/her username and password in order to login to WM. From this page, s/he can also reset his/her password in case s/he has forgot it (tap on “Forgot Password?”) or read the terms and conditions (tap on “Terms and Conditions”).

When the user taps on and holds the button s/he can see the password. Upon releasing the button, the password is again showed in stars.

If it is the first time the user logs in to the application, a consent message appears.

3.2.3.2 *Dashboard*

After login, the user enters the main dashboard of the application. The dashboard includes some of the patient's info, the menu of the application and information from the three categories: Nutrition, Physical activity and Mood & Stress. This information is based on the automatic monitoring of physical activity via Fitbit and on the questionnaires' evaluation.

Moreover, a Well-being index is available to the patient (in the circle in the middle of the dashboard) that reflects the overall well-being status of the patient taking into account the information provided by the user for the aforementioned three categories.

Figure 2 : WM dashboard

3.2.3.3 *Nutrition*

In the nutrition section, we display the information gathered from the Food Habits questionnaire.

When the user selects to enter this category, s/he can see line charts of the scores and individual answers they gave in the Nutrition questionnaire over previous time.

Figure 3 : Nutrition questionnaire timeline

3.2.3.4 *Mood and QoL*

In this section, we display the information gathered from the Mood and QoL questionnaires as well as the Heart Rate measured by the wearable.

When the user selects to enter this category from the dashboard, s/he enters the section where s/he is able to view the data gathered from daily mood and QoL questionnaires that are integrated in WellMojo platform for the needs of ALAMEDA pilots as well as the Heart Rate measured by the wearable.

The user has the option to see previous scores and measurements related to mood and QoL. S/he selects the period for which s/he wants to see the results from the options below:

- Last 14 days
- Last month
- Last 2 months

For each day, the average heart rate (in rest phase, i.e., not related to a physical activity) as tracked by the wearable and the scores of the prementioned daily questionnaires are displayed.

Figure 4 : Mood and QoL main page

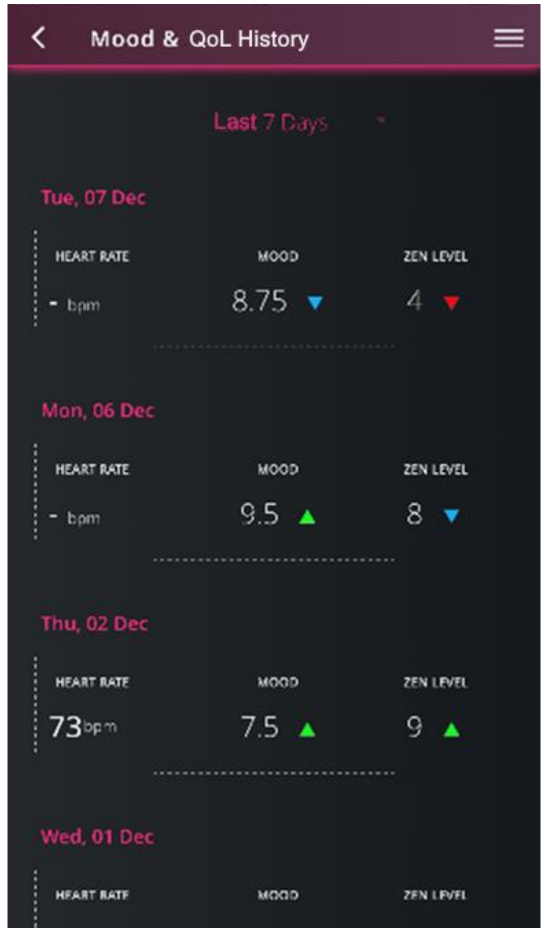

Figure 5 : Mood and QoL history page

3.2.3.5 *Physical Activity (PA)*

In the PA section, we display the information gathered from the Fitbit. When the user selects to enter this category from the dashboard, s/he enters the PA section where s/he is able to view the data gathered from the wearable related to physical activity.

The user has the option to see previous entries related to physical activity. S/he selects the period for which s/he wants to see the results from the options below:

- Last 14 days
- Last month
- Last 2 months

For each day, the distance (or intensity level), the duration and the calories burnt for each activity is displayed.

From the main or the history page, upon tapping on an activity, the user goes to the activity's detail page.

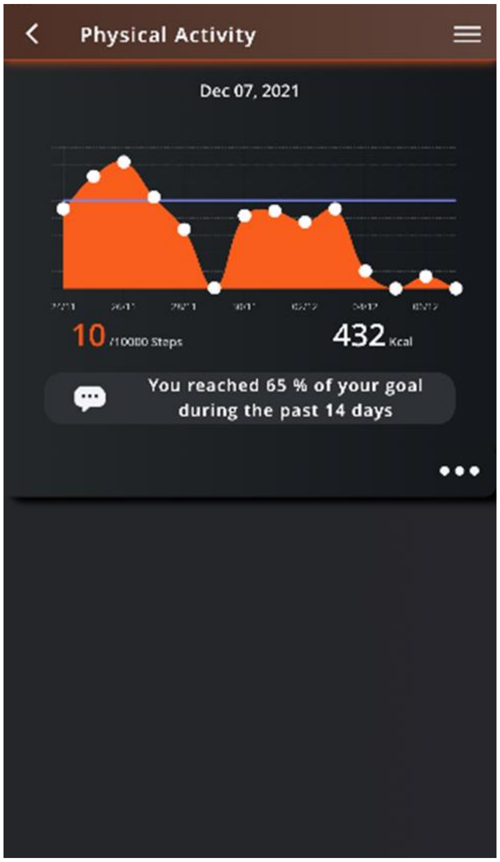

Figure 6 : PA main page

Figure 7 : PA history page

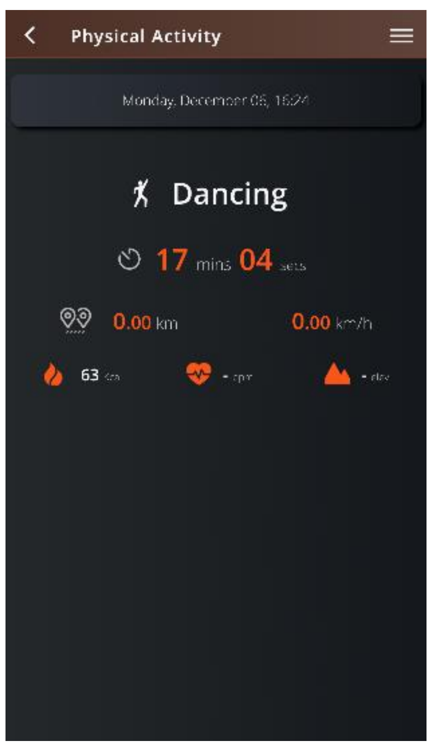

Figure 8 : PA details page

3.2.3.6 *Questionnaires*

Questionnaires are a very significant, indirect method of collecting user inputs on a regular basis. As the patients in ALAMEDA need to periodically fill-in standardized and custom questionnaires on regular intervals, push notifications acting as reminders are sent to the application to notify the user that a new questionnaire has become available. The application user can navigate to the questionnaire list from the top right menu. There, s/he can see only the active and incomplete questionnaires. WellMojo hosts both standardized and other questionnaires in accordance with the requirements of the use cases. Standardized questionnaires are active for at least two days and the user gets notifications to complete them. The objective of the notifications is to maximize the user engagement with the application, thus maximizing the collected amount of important information about the users'/patients' quality of life.

The questionnaire has an introductory page (optional), a set of questions to be answered and a closing page (optional). Each screen displays only one question which covers the whole page. Once the user reaches the last page of the questionnaire, s/he sees a 'Finish' button to submit the responses. An alternative presentation method is available that can present all questions in a single page. This can be configured on a per questionnaire basis.

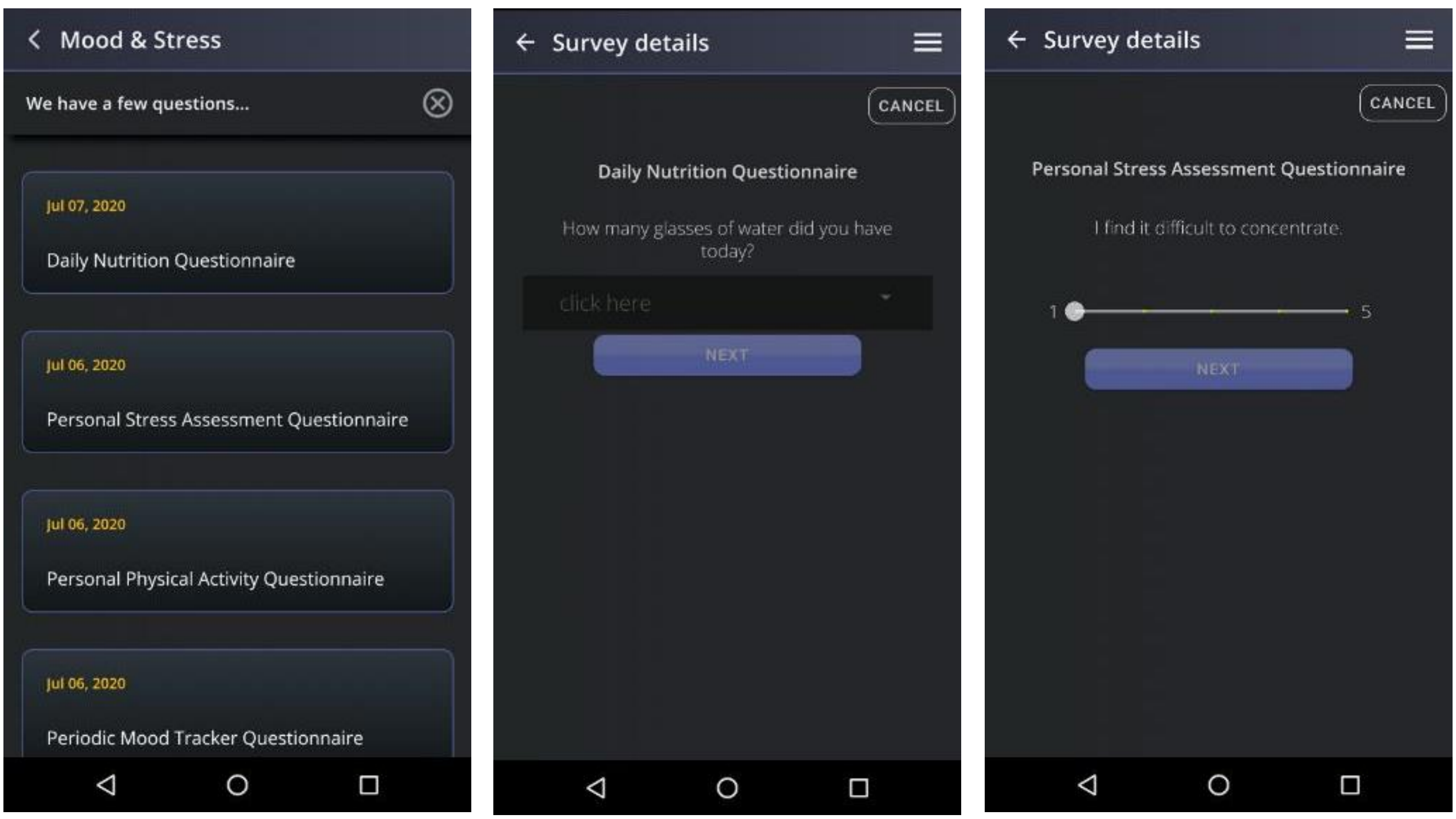

Figure 9: Questionnaire list and question pages

WellMojo integrates the following questionnaires (per ALAMEDA pilot):

- Stroke Pilot (SUUB): PHQ-9
- Multiple Sclerosis (FISM): GOD-Q, PHQ-9, BAI, AMSQ, PSQI, MFIS, OAB-Q, MSWS-12, FH-Q, PDQ

- Parkinson's Disease (NKUA): MDS – UPDRS, PDQ-8 (plus customized questions regarding (i) mobility, general motor or physical function, (ii) sleep disorders, (iii) mental and cognitive ability, (iv) emotional status and (v) Quality of Life and daily living)

Moreover, WellMojo has a set of built-in questionnaires to collect data regarding to patient's nutritional habits and stress-related behaviours in an informal manner that will be exploited in the Parkinson's Disease (NKUA) pilot (for more information see Annex A).

Note: The questionnaires for nutrition tracking were still under investigation by the medical partners while this deliverable was written.

3.2.4 Fitbit wearable tracker configuration

Wellmojo offers the capability of in-application pairing of a Fitbit smartwatch to ALAMEDA. The user is presented with the Fitbit Web API login screen, where s/he can provide her/his personal account details and essentially authorize the dedicated Fitbit Sync Service developed by Wellics to retrieve hes/his data on her/his behalf, for the purposes of monitoring and further processing. More details on how the Fitbit authorization is achieved and how the relevant patient Fitbit data are collected seamlessly via the dedicated Wellics service will be presented in deliverable D4.2 'Report on Behavioural Data Acquisition Methods'.

3.2.5 Integration with other mobile applications

Integration of the Wellmojo mobile application with the remainder of the applications that form the Digital Companion is currently performed on two (2) levels:

- User interface wise, ALAMEDA mobile applications that offer a user interface and can act as standalone applications are easily accessible through Wellmojo.
- Inter-application communication wise, Android intents are used throughout to not only initiate operations but also transfer data from one application to the other. A detailed explanation of how this mechanism works is presented in Section 3.4.4.

Specifically for the MEEA application (Section 3.4), the facial detection mechanism is triggered with the use of a dedicated Android intent sent in the background, when a user opens a mood related questionnaire to fill-in. The score of the mood questionnaire is also transmitted to the MEEA application with the use of a dedicated intent, for it to be factored in the mood estimation process.

3.2.6 Integration with ALAMEDA platform

The interaction of the Wellmojo mobile application interacts with the ALAMEDA platform is depicted in Figure 9.

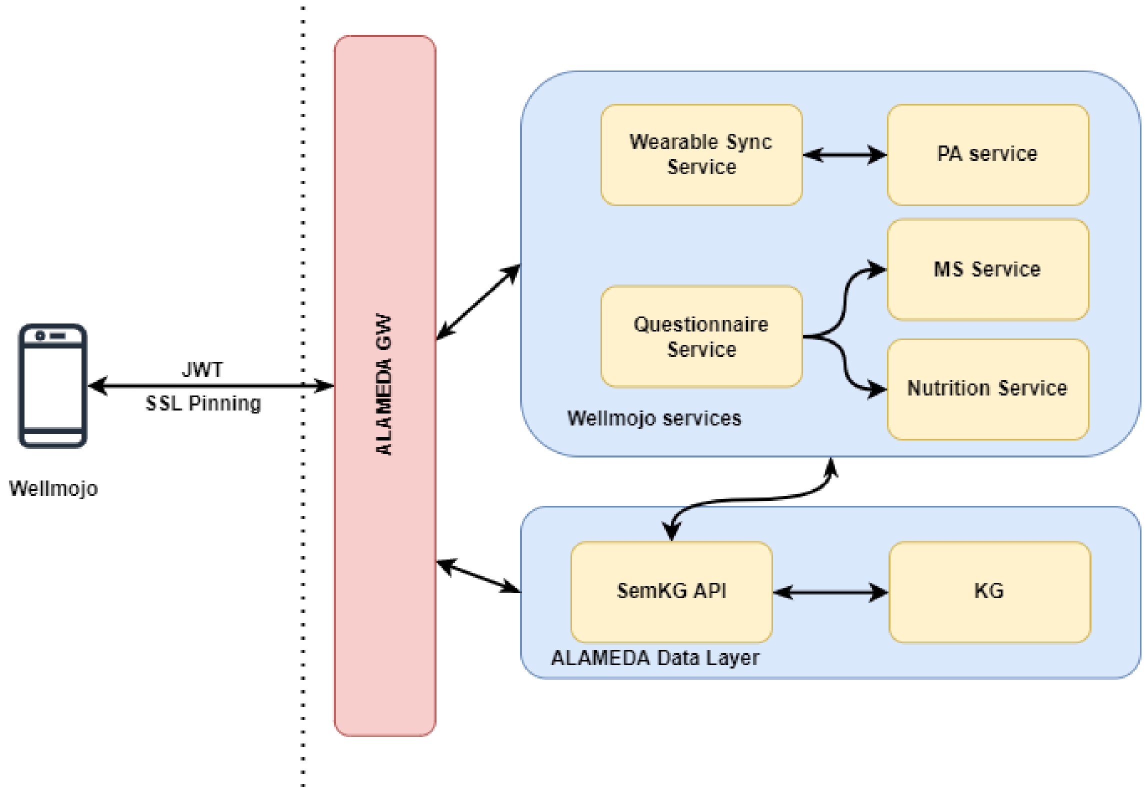

Figure 9: Wellmojo interaction with the ALAMEDA platform and services

Wellmojo is equipped with local services that utilize REST API clients to communicate with the ALAMEDA platform. A set of dedicated Wellics microservices is deployed as part of the ALAMEDA platform, which support the majority of the Wellmojo functionalities:

- A questionnaire service, which holds all the questionnaires and their respective answers and scores (in case a questionnaire is scored) on a per user basis.
- The mood and nutrition services, which hold statistical data on the scores of the respective questionnaires over time.
- The Fitbit wearable sync service, which manages the complete authentication and authorization of the ALAMEDA users to the Fitbit Web API, while at the same time is responsible for the periodic retrieval of all the user data captured by the users' Fitbit trackers.
- The physical activity (PA) service which holds all the Fitbit related retrieved data.

These Wellics microservices are then transmitting the raw data to the SemKG API for permanent storage in the ALAMEDA data layer, to be made available to other platform components and especially the AI Toolkit for further processing and assessment.

The Wellmojo application, already being part of Wellcs' product offering and being adapted to the ALAMEDA requirements is configured to support JWT based communication, while additional security mechanisms, such as device anti-tampering protection and SLL pinning are in place.

3.3 Chatbot

3.3.1 General design

The chatbot android application developed by UNIC will provide a user-friendly graphical interface for patients and caregivers to interact with the ALAMEDA Conversational agent. The chatbot will be used for specific use case scenarios whose details will be finalized in deliverable D4.3. Our aim is to offer a conversational interface mimicking human communication to personalize the patients' journey.

The chatbot will host medical questionnaires specific to each pilot which will be available at different time intervals and at different periods. Predefined options will be provided for the standardized questionnaires in the form of buttons. Additionally, the chatbot will allow free-text answers to specific questions for which the user will be able to freely type what they want. A notification system will be in place for engaging the user and reminding them of pending questionnaires.

For security reasons and ease of the authentication process, each user will be allowed to be logged in only one device at a time. In case the user wants to change their main device, they will be automatically logged out from their previous device.

3.3.2 Technical Specifications

Any smartphone device powered by Android OS can run the chatbot app if it meets the minimum requirements. The devices are required to be compatible with at least API version 30 (Android 11, R) and come equipped with minimum 4GB of RAM size for facilitating a smooth user experience.

3.3.3 User manual

Patients and carers will be able to access the chatbot from their smartphones or through the WellMojo application. If the first time the user opens the app through WellMojo their given credentials will be transferred and there will be no need to log in. If the first time the user accesses the app from their phone menu they will be prompted to a log in where they will have to enter their authentication credentials. Once logged in, the user can start interacting with the chatbot if they are connected to the internet. The chat interface bares resemblance with common messaging apps.

To engage in a conversation the user must type their query in the text box on the bottom of the screen and press the "send" button on the bottom right corner of the screen. While processing the request a typing indicator will appear to let the user know that the app is working on a response.

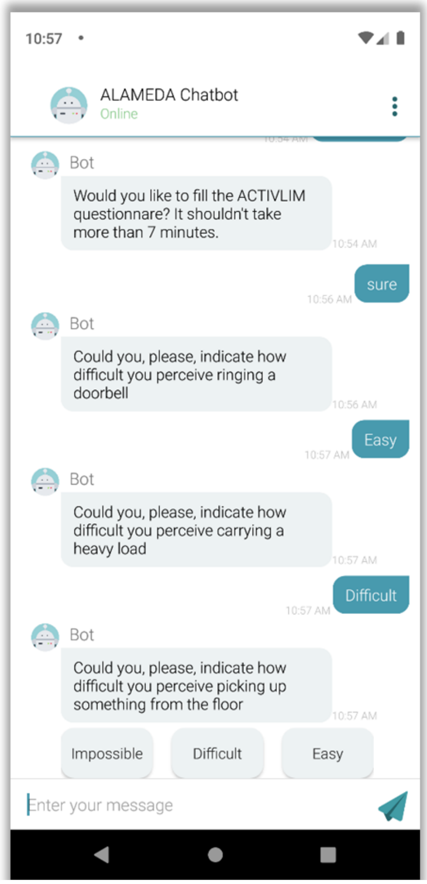

Figure 10: Chatbot ACTIVLIM Questionnaire example

3.3.3.1 *Questionnaires*

Answering questionnaires requires a more interactive design approach since the accepted answers are often very specific. To avoid invalid submissions of questionnaires, instead of directly writing the answer, the user will have to choose one or more of the predefined options by clicking on the corresponding button. In Figure 10 we included an example using the ACTIVLIM questionnaire [1].

Note: The questionnaires' UI will be modified accordingly to accommodate the particularities of all the questionnaires that will be handled by the chatbot.

3.3.3.2 *Notifications & Reminders*

The questionnaire functionality of the chatbot will rely heavily on push notifications. During the pilots, the patients will have to answer at least one questionnaire per day. The notifications will serve as reminders for completing these recurring tasks and as a way to inform the user when a questionnaire is available (Figure 11). Clicking on the notification would direct the user to the main chat and automatically start a conversation.

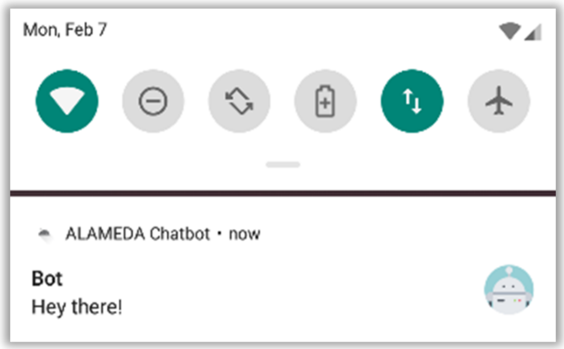

Figure 11: Chatbot Notification example

3.3.3.3 *Speech-to-text Accessibility Feature*

Gboard is a virtual keyboard developed by Google which offers speech-to-text typing in multiple languages in real time. Gboard is the default keyboard in most android smartphones, but it can also be installed from the Play Store. This accessibility feature is not controlled by the chatbot application but by Google itself. However, the user can take advantage of this functionality while interacting with the chatbot app.

Once Gboard is set as the primary device keyboard the user can access the speech-to-text functionality by clicking on the microphone icon as shown in Figure 12. After the text dictation is finished, the user can proceed with sending the messaging to the chatbot as described in previous sections.

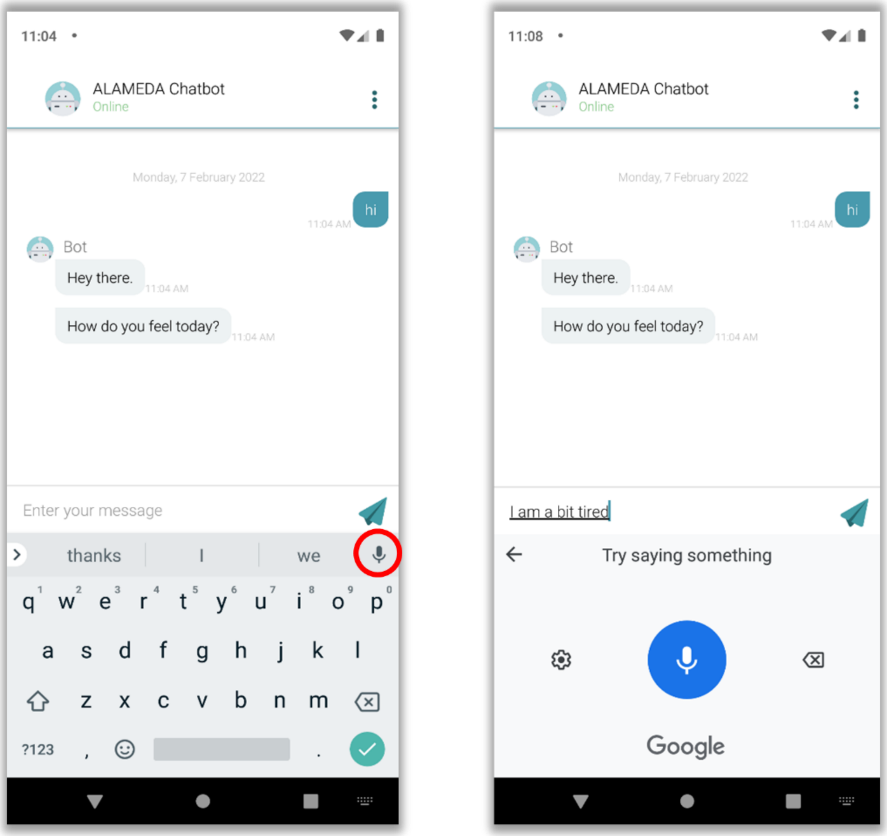

Figure 12: Speech-to-text input

3.3.4 Integration with ALAMEDA platform

The chatbot will be accessible through the WellMojo application and as a standalone application. The chatbot's interactions with the applications in the ALAMEDA platform are illustrated in Figure 13. The process is also described in the following paragraphs.

The user opens the chatbot app and enters their text query in the dedicated input area. While interacting with the app, the mood estimation android app runs in the background and makes predictions in real time based on the user's facial expression. The result of the mood estimation and the original text is sent to the Conversation Agent hosted on the dedicated server for analysis. For the purposes of this deliverable, we refer to the "Conversational Agent" as the "Dialogue System Core". More details about the architecture of this component will be presented in the deliverable D4.3.

The agent (Dialogue System Core) then sends the input directly to the Sentiment Analysis model for textual sentiment extraction which will influence the conversation flow. After the agent processes the input, the results are stored in a database to access them on demand. Finally, the chosen response of the agent is sent to the application and is displayed to the user.

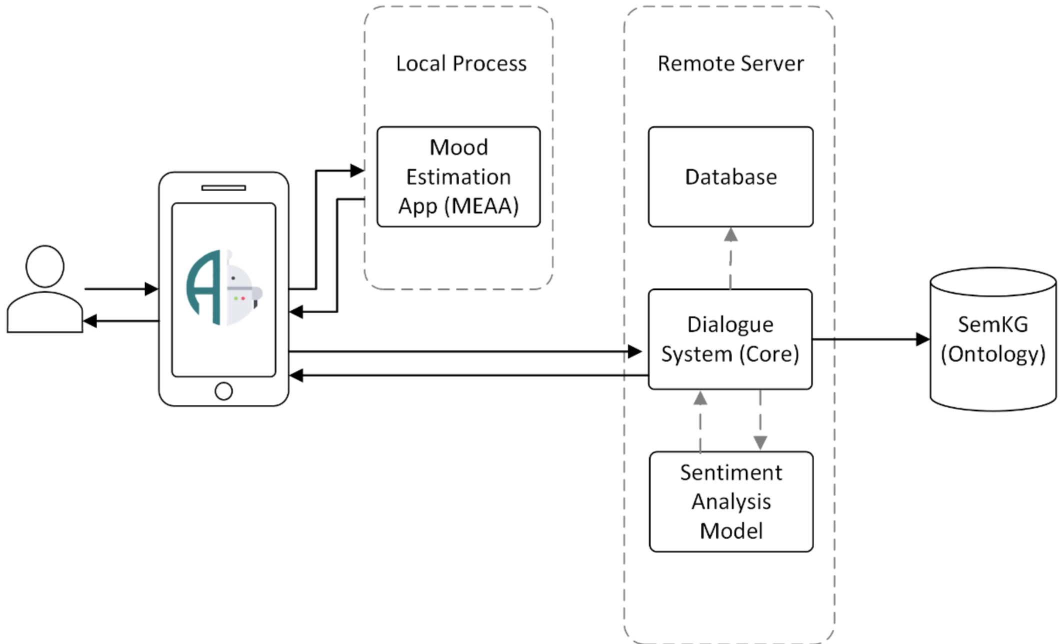

Figure 13: Chatbot Architecture Diagram

3.4 Mood Estimation Android Application (MEAA)

Partner CTL is developing a Mood Estimation Android Application (MEAA) responsible for monitoring the user while s/he is interacting with other ALAMEDA core modules, like, e.g., WellMojo or the conversational agent (see previous two subsections). MEAA's goal is to analyze the facial expressions of the users and assess their overall mood while they are conducting the related tasks (i.e., filling the questionnaires or having a conversation with the agent).

3.4.1 General design

MEAA is utilizing the front camera of the smartphone for capturing frames of the user's facial expressions.

DISCLAIMER*: Those frames are not in any way stored or shared, but instead they are discarded after analysis, protecting thus the privacy of the user. The high-level workflow of MEAA is depicted in* Figure 14 *and more detailed explanations are given below.*

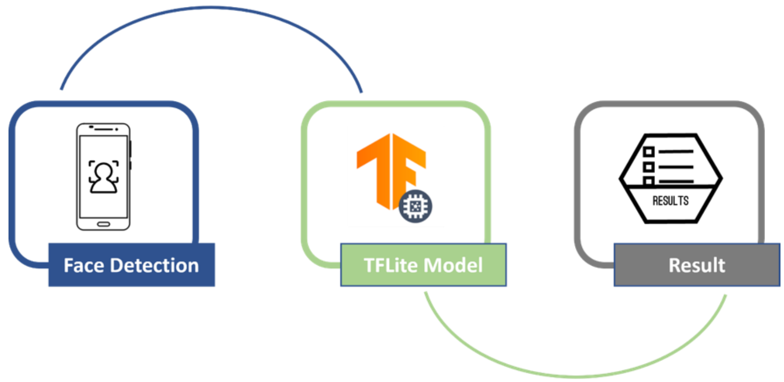

Figure 14: MEAA high level workflow

3.4.1.1 *Face Detection*

Once MEAA starts, it engages the front camera of the smartphone and each incoming frame from the camera is passed to a dedicated face detector in order to locate the face of the user within the frame. The chosen tool for the face detection and localization is ML Kit's face detection API[1]. ML Kit[2] is a standalone library which offers the possibility of on-device machine learning processing. More specifically, ML Kit provides the means for integrating Machine Learning (ML) capabilities into an application through the exposure of the so-called vision APIs. Those APIs refer to both video and image analysis and can be exploited in a wide variety of use cases, such as face detection, barcode scanning, pose detection, text recognition, etc. Within MEAA, ML KIT is utilized to achieve a fast, efficient, and real-time face recognition and localization. Once the face is spotted in the frame, we draw a bounding box around it and we crop the frame so that it includes only the face of the user. The new cropped image is fed as an input to the TensorFlow Lite[3] (TFLite) model for further analysis.

3.4.1.2 *TFLite Model*[4]

Our aim is to design, train, evaluate, validate and deploy an ML model that takes video frames as input from the front camera of the phone and outputs the emotional state of the user. For training our emotion recognition deep learning model, large amounts of image data are required. Since no large quantities of freely available face images can be found online, we decided to train our model using the Transfer Learning approach. According to this approach, a Convolutional Neural Network (CNN) model that has already been trained on different datasets is selected. The fully connected layers are removed, and new ones are added. Then, all the convolutional layers remain frozen (in other words, they are set as non-trainable), and, during the training process, only the fully connected layers are trained on the new dataset. It should be noted that we also experimented with unfreezing the last two convolutional layers and, indeed, the results were slightly better. But, due to the fact that there is plenty room for improvement,

[1] https://developers.google.com/ml-kit/vision/face-detection
[2] https://developers.google.com/ml-kit
[3] https://www.tensorflow.org/lite
[4] Regarding the conversion of our model to a TFLite model, we are aware that the model's parameters are reduced, and the model is pruned. However, we check the recognition accuracy before and after the conversion to monitor and prevent the degradation of the performance.

we proceeded our experiments with models that have a small number of parameters and, thus, require less data for training. We, therefore, trained the whole model from scratch.

We experimented with different pre-trained models, such as VGG16 [2], MobileNetV1 [3] and MobileNetV2 [4]. We removed their fully connected layers that were responsible for the classification task, we added new ones and re-trained them from scratch in order to fit our model on the data. For improving the performance, we also set the last convolutional block as trainable (we used the weights of the pretrained network as initial weight values). To find the best performing model, we deployed different architectures and tried different hyperparameter values. We monitored the training process in order to decide which implementation gave us the highest performing accuracy. Initially, the model was trained using Kaggle's facial expression recognition dataset, FER-2013[5]. After training, optimizing, and testing the model, we found out that it needed improvement regarding the 'sad' class recognition and the cases where the volunteer wore an accessory. For that purpose, we collected more images from open-source databases (Kaggle's Jafar Hussain Human Emotions datasets[6], Unsplash[7], Pexels[8] and Pixabay[9]). Our performance metrics are accuracy and F1-score. The problem is framed as a **multiclass classification** (each face is attached to a single emotion label). After validation, the performance of the classifier was improved. The current performance is 64±2%.

For validation on real-time video capturing, the app was tested on seven volunteers of different ages (22-60 years old), under different conditions: in poor and good lighting conditions, with and without accessories (glasses, hat), with and without beard. At this point, the app seems to perform well under good lighting conditions, while short beard does not prevent it from correctly identifying the emotion. However, some types of glasses (bold-frame glasses) prevent it from correctly identifying the emotion.

3.4.1.3 *Results*

The aforementioned model gives as a result one of the following options: {"*angry*", "*disgust*", "*fear*", "*happy*", "*sad*", "*surprise*", "*neutral*"}.

3.4.2 Technical Specifications

MEAA can run on smartphone devices powered by Android OS. The minimum required API version is 27 (Android Oreo and above) and the minimum preferable RAM size for facilitating an accurate and fast analysis is 6GB.

[5] https://www.kaggle.com/msambare/fer2013
[6] https://www.kaggle.com/jafarhussain786
[7] https://unsplash.com/
[8] https://www.pexels.com/search/face/
[9] https://pixabay.com/vectors/

3.4.3 User manual

As already discussed, in order not to distract the user while s/he is completing a given task, MEAA does not present a visible interface. Instead, once it is called, it is running as a foreground service. The user can still see that this service is running as a notification on the status bar of the phone (see Figure 15). Although not visible to the user, Figure 16 illustrates a few examples of mood estimation and the respective bounding boxes for demonstration purposes.

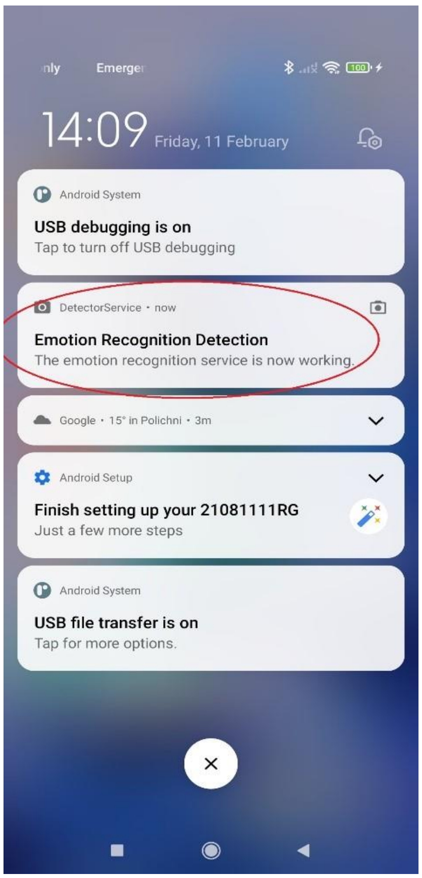

Figure 15: Notification showing that MEAA is running

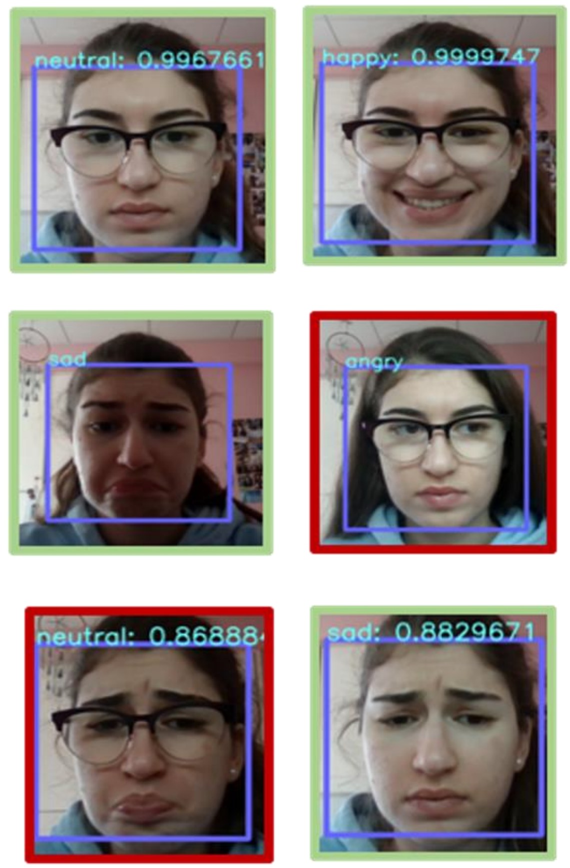

Figure 16: Mood Estimation examples

3.4.4 Integration with ALAMEDA platform

MEAA can be called by other ALAMEDA applications, running as a background service providing mood estimation for users interacting with the specific application. To this end, we have already made an initial approach of integrating MEAA with WCS's WellMojo application and with UNIC's conversational agent. Both partners received MEAA's Android Package (apk file) and a set of 3 simple steps that they need to follow to achieve communication. Hence, after installing MEAA, they had to proceed with the following steps:

1. Android Manifest: They had to insert the following line to the manifest of their application, in order to express their willingness to interact with MEAA (see Figure 17).

```
<queries>
    <package android:name="com.catalink.detectorservice"/>
</queries>
```

Figure 17: Input for the Android Manifest

2. Intents: Intents are characterized by Android as messaging objects that the application can send either to the rest of the components of the application or to other applications of the system in order to perform a specified action. For communicating with MEAA, the other applications had to include two intents to their code, the first for starting the service when the user interacts with their application, while the second is for stopping the service when the user leaves their application. Both intents are shown in Figure 18.

```
val intent : Intent? = packageManager.getLaunchIntentForPackage("com.catalink.detectorservice")
if (intent !=null){
    startActivity(intent)
} else{
    Toast.makeText( context: this,  text: "There is not such an application installed!", Toast.LENGTH_SHORT).show()
}
```

(a)

```
val intent : Intent? = packageManager.getLaunchIntentForPackage("com.catalink.detectorservice")
intent?.apply {  this: Intent
    action = "StopApplication"
}
if (intent !=null){
    startActivity(intent)
} else{
    Toast.makeText( context: this,  text: "There is not such an application installed!", Toast.LENGTH_SHORT).show()
}
```

(b)

Figure 18: (a) Intent to start MEAA service (b) Intent to stop MEAA service

3.5 Virtual Keyboard

3.5.1 General design

The Virtual Keyboard, developed by CERTH, is an app designed to assess users' typing patterns on a mobile device. It runs on mobile devices with Android® operating system. It features a custom software keyboard, similar to the Android OS default keyboard, including all modern functionalities, such as word prediction and auto-correction which replaces the Android OS default keyboard. The software behind the keyboard captures keystroke-related data (key pixel coordinates and timestamps of key presses and releases), as well as typing metadata, i.e., number of deletes, number of characters typed, typing session duration, deliberate long-press events, and the application where the user typed, while the content of the typed text is not recorded.

3.5.2 User manual

As already mentioned, in order to allow the user to operate any application they want, Virtual Keyboard does not present a visible interface. The user can operate the custom keyboard provided by the app which is similar to the Android OS default keyboard, including all modern functionalities, such as word prediction and auto-correction. Data is collected in the background as the user is operating the keyboard.

3.5.3 Integration with ALAMEDA platform

The main application includes the ITI keyboard as a library. The users are prompted to choose the provided keyboard as the default system keyboard. Whenever the keyboard is used, the library saves keyboard sessions within an SQLite database inside the phone. Functions are provided to retrieve non-sent data from the database, as well as to set those data as “sent” afterwards. Periodically, previously not send keyboard sessions are grouped within a json string and are sent to a dedicated server through HTTP POST requests.

Keyboard Events Table			
ID (unique)	DATETIME	SESSION_DATA	SEND_TIME
1	1607954726915	{"CurrentAppName":"Messenger","CurrentCountry":"GR","CurrentIMEI":"dc8dc24c0ccf6b30","CurrentLanguage":"el","Distance":[53.55022923402888,2.4112107425256566,45.80250806793966,...],"DownTime":[137990256,137990968,137991114,...],"DownTimeDelete":[137990977,137991119,...],"IsLongPress":[0,0,0...],"IsShowPopupOn":false,"IsSoundOn":false,"IsVibrationOn":true,"KeyboardScale":0.9,"NumDels":5,"PressureValue":[1.0,1.0,1.0,...]," StartDateTime":1607954708012,"StopDateTime":1607954726849,"UpTime":[137990423,137991019,137991198,137991571,...],"UpTimeDelete":[137991023,137991201,...],"VibrationDuration":10}	null

Figure 19: Virtual Keyboard output

4 ALAMEDA standalone tablet-based applications

This section presents the rest of the ALAMEDA applications that are not part of the Digital Companion but are standalone applications running on tablet devices with Android® that perform additional assessment and data analysis for the target users during their clinic visits.

4.1 Virtual supermarket test application

4.1.1 General design

Partner CERTH is contributing the Virtual Supermarket Test app. The Virtual Supermarket Test is an app designed to assess older adults' cognition through a simple task modeled on an everyday activity. It runs on tablet devices with Android® operating system and a 10-inch tablet is recommended for its administration. The application is aimed at activating a multitude of cognitive processes namely visual and verbal memory, executive function, attention and spatial navigation with the emphasis placed on executive function. The need of simultaneous activation of different cognitive processes makes the program challenging enough to correspond to the ability of the target population while reducing ceiling effects. The latest version of the VST includes advanced navigation metrics with the virtual space divided into three zones (green, yellow and red). Different zones represent different deviations from a pattern of optimal navigation for task completion. The diagnostic utility of the VST has been validated in different populations and it has also been validated against electroencephalography (EEG) biomarkers.

4.1.2 User manual

The latest version of VST comprises a fully automated, self-administered screening routine that can be completed in the span of 30 minutes. An interactive training session ensures that users are familiarized with the operation of the tablet and the various actions they would have to perform during testing. After completion of training a test session is administered three times through an automated administration routine. The VST is designed to mimic one of the most common activities of daily living, daily shopping in a supermarket. During the test sessions, a shopping list is provided to the user who is allowed to navigate freely, buy the products they are instructed to buy and proceed to pay at the till, by entering the correct amount.

Figure 20: Virtual Supermarket Test environment

4.1.3 Integration with ALAMEDA platform

Virtual Supermarket Test data are exported in JSON format and sent to the ALAMEDA platform. Main VST performance metrics comprise average completion time for the 3 test sessions and average mistakes for the 3 test sessions. Additional metrics include metrics expressing navigation performance (how much the user adheres to an optimal trajectory for performing the task) and metrics expressing possible improvement of performance from the 1st to the 3rd test session. A combination of metrics has been used in a diagnostic algorithm for detecting cognitive impairment [5] which will be integrated in the ALAMEDA platform. These metrics are described in Table 1.

Table 1: Virtual Supermarket Test variables used for classification

Average performance and learning variables	
DurAvg	Average duration for the 3 test trials
PosTimeYellow1-3	Time spent in yellow zone positions in trial one minus time spent in yellow positions in trial 3

Trial 1 variables	
Dur-Pos1	Duration minus time in positions during trial 1*
PosTimeGreen1	Time spent in green zone positions in trial 1
PosNumGreen1	Number of green zone positions the user navigated though in trial 1
PosTimeRed/Tot1	Time spent in red zone positions as a fraction of total time spent in positions in trial 1
PosNumRed/Tot1	Number of red zone positions the user navigated through as a fraction of total number of positions the user navigated through in trial 1
Trial 2 variables	
ErrMoney2	Incorrect payment in trial 2
PosNumYellow2	Number of yellow zone positions the user navigated through in trial 2
PosTimeYellow/Tot2	Time spent in yellow zone positions as a fraction of total time spent in positions in trial 2
Trial 3 variables	
PosNumTot3	Total number of positions the user navigated through in trial 3
PosNumGreen/Tot3	Number of green zone positions the user navigated through as a fraction of total number of positions the user navigated through in trial 3

* Essentially this variable expresses time spent in the payment screen

4.2 Line tracking test application

4.2.1 General design

The Line Tracking Test is an app designed to assess older adults' hand dexterity. It runs on tablet devices with Android® operating system and a 10-inch tablet is recommended for its administration. Developed within the NoTremor EU project, the Line Tracking Test measures the ability to follow a randomly moving target (the cyan line) while ignoring the distracting target (the red line). The Line Tracking Test can identify different components of the human movement (e.g., reaction time, movement time, and several internal time delays).

4.2.2 User manual

The user performs the Line Tracking Test on a Windows PC with a touch screen. Hand movement data are collected during the task.

4.2.3 Integration with ALAMEDA platform

Line Tracking Test data are exported in JSON format and sent to the ALAMEDA platform.

5 Experts' Dashboards

5.1 General design

All project data is gathered, pre-processed, and finally stored in one triplestore database, as a semantic graph, meant to support ontological searches and inference. The Experts' Dashboards application offers ALAMEDA pilot participants access to all project information, as well as powerful visualization and analysis tools. It's built using C# and designed to be installed on a .Net enabled server, but can also be modified to run as a standalone app, while we could also use a container or run it as a cloud service in Azure. According to our current restrictions regarding data security, privacy, and non-EU clouds, the most appropriate mode was the web application within our secure pilot network.

State-of-the-art triplestore databases and tools are currently available for Java environments, so ED currently accesses data via the dedicated SemKG API, though some tools scheduled to be released soon for .Net may enable the transition to a more homogeneous approach.

As a web application, the only client it requires is a web browser, though security and privacy reasons dictate that users follow the Data Management Plan and perform all critical updates on time. The main tests are being performed on Chrome, but more browsers will follow soon, depending on feedback from the pilots.

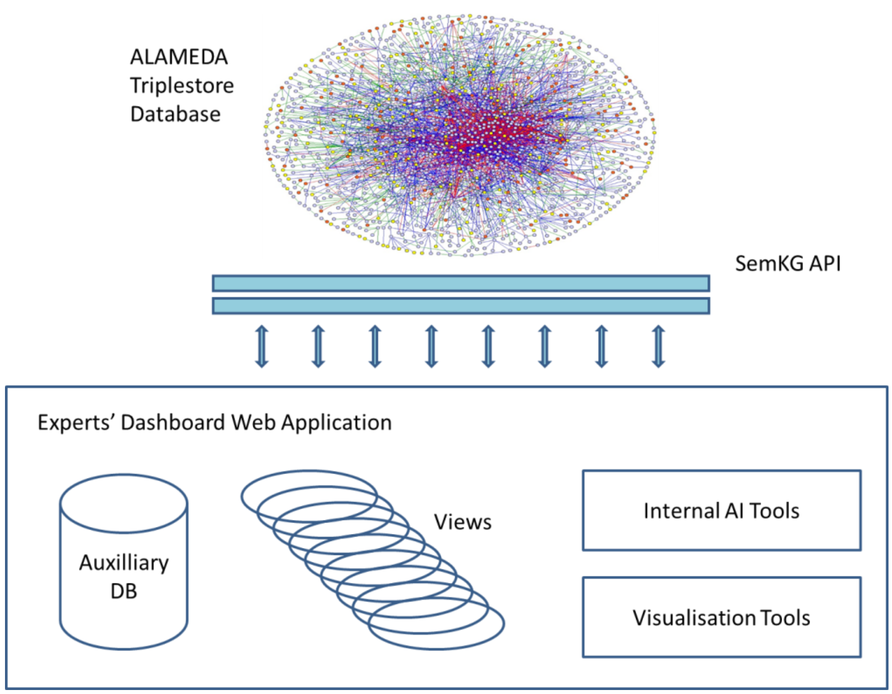

Figure 21: Experts' Dashboards Architecture Diagram

ED has a database of its own, initially used as a buffer, but periodical data synchronization or even customised graph-to-SQL mirroring is under consideration.

5.2 User manual

5.2.1 Login Screen

ED users will need to identify themselves to enter the portal. ALAMEDA pilot participants will be assigned a username and password, while we may also exploit authorization tokens or consent from cooperating applications in special cases. Each simple user will be connected to a specific pilot and will gain access to that pilot's data upon authentication, except administrators, who will have global access.

Figure 22: ED Login Screen

5.2.2 Main pilot dashboards

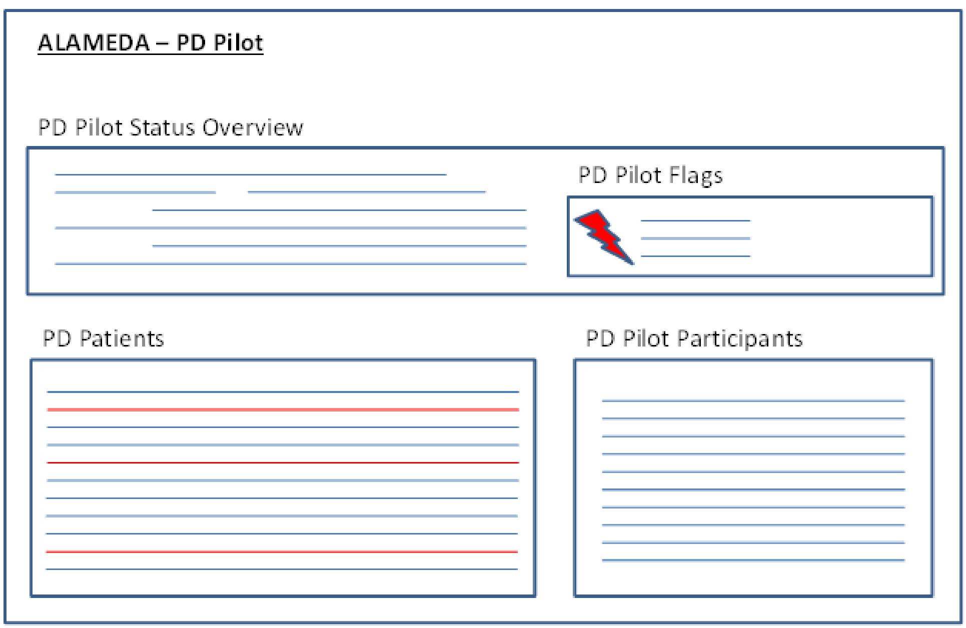

Figure 23: Pilot Dashboard

The first screen a user will see after a successful login is the main dashboard of the specific pilot s/he is associated with. Various extra customization options have been discussed but are currently of low priority and will be discussed again later. The main dashboard contains a general status overview (time passed, statistics, notes …), a set of pilot-specific flags (for example a red flag if more than half of the patients are not performing their tasks timely/properly, indicating potential issues regarding instructions), and the lists of patients and pilot participants (researchers, doctors, staff, caregivers …). The names in the list of patients will be colored differently, depending on various patient-specific flags (for example red if the patient has not been getting enough sleep for over a week, indicating potential problems …), and will link to more information regarding any chosen patient. Similarly, the names of pilot participants will link to the profiles etc. Details on the alerts that have been specified to be of interest can be found in D3.1 'Digital Transformation and Value-Based Assessment - Version 1.0'.

5.2.3 Patient dashboard

By clicking on a patient's name, the user can see the patient's dashboard, which offers access to all relevant data. Profile information, medical data, statistics, and flags regarding this patient are all presented in this screen.

The number of tracked variables is high, so the initial decision was to choose some parameters and create a quick view, for example information on the patient name, pilot participation status (active, inactive - some patients may drop out at some point), timestamp of last data update, alert flags which would indicate if that patient's readings regarding a specific variable is far from "nominal", and "Observations" text which would contain general notes taken about that patient by medical partners (all observations will initially be visible to everyone in the pilot, but it is possible with minor changes to isolate each user).

The plethora of data makes it difficult to even think sometimes, so special viewing modes have been requested. First of all, the font color used for each variable in the list will be red if an alert or special flag has been raised, saving the doctors' time and helping them focus on what is more important. Furthermore, there are various choices available for viewing the data. By clicking on a variable and then pressing one of the buttons, the viewer can take a quick look at a table containing the most recent data values, have a look at the full history, examine the chart, and of course export data to a file. Since all collected data will form timeseries, it makes sense to be able to export data, for example to a .csv file, for further offline research (access rights to the export features, along with anonymization issues regarding exported files are to be discussed at the next stage, before actual data release).

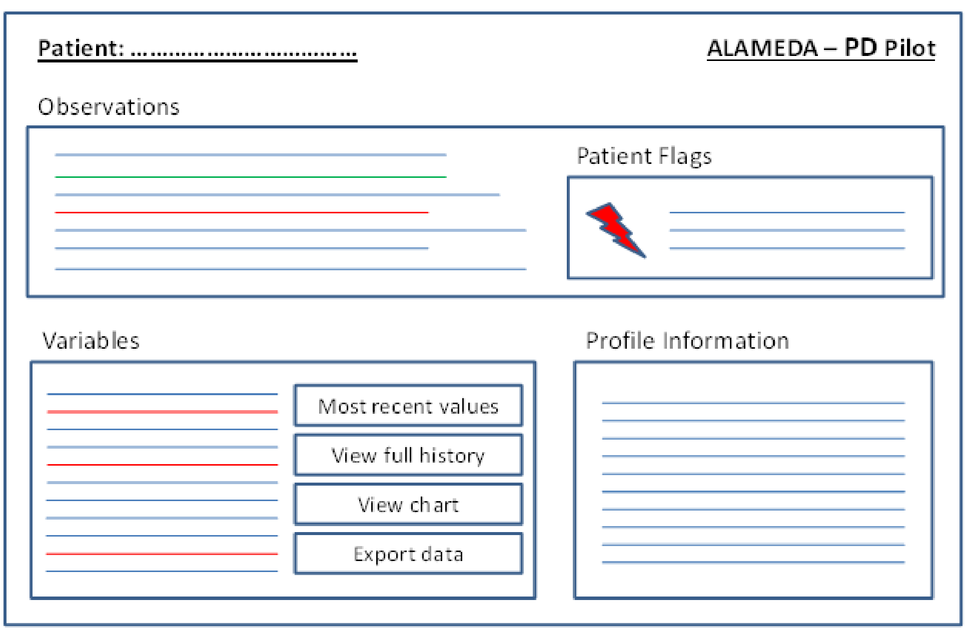

Figure 24: Patient's Dashboard

5.2.4 Analysis and Visualization

Apart from monitoring the pilot patient data, doctors and researchers will need to analyze it and explore potential correlations. The ED already offers access to all available data, so it makes sense to offer appropriate analysis and visualization capabilities. User-friendly ways to make specific queries allow users to see interesting charts, test theories using AI tools, and export data or reports. Discussions showed that the most important AI tools would be those predicting the outcome of one of the inferred variables, so that's what we will be focusing on. This functionality obviously depends on AI Toolkit tasks, so there is close cooperation with partners involved in them.

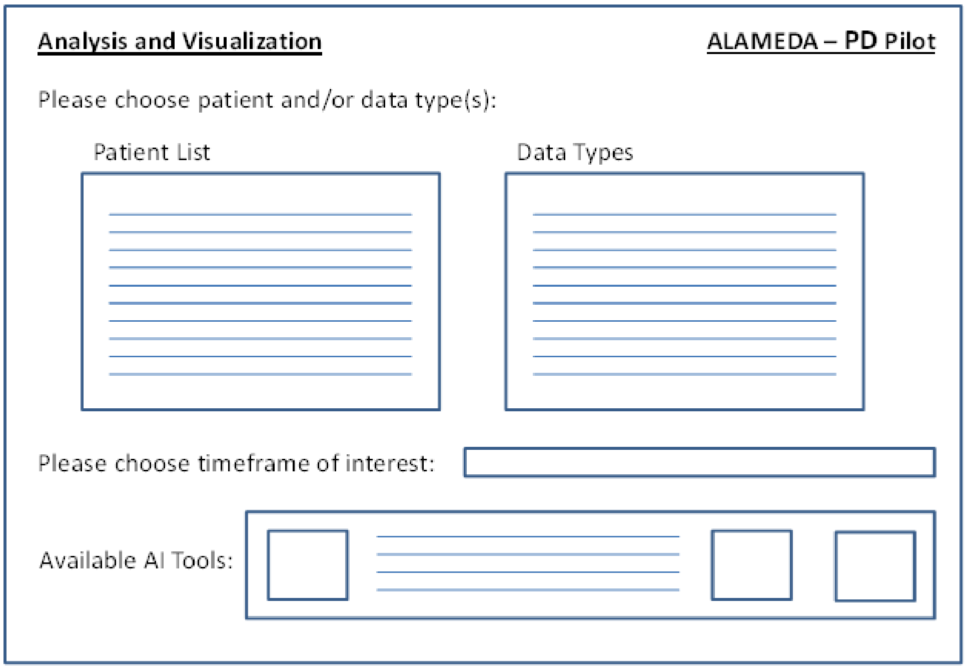

Figure 25: Analysis and Visualization Dashboard

5.2.5 Administrative Dashboard

There is a special administrative screen for administrative tasks, such as user management and various settings. This screen is common for all pilots and is only available to users with administrative privileges. It will also provide the interface for data synchronization tasks and some integration tests. This screen will take a lot of different forms, which will be documented whenever needed in relevant tasks' deliverables, as appropriate.

5.3 Integration with ALAMEDA platform

The ED is a standalone web application, cooperating with other modules, tools, and components mostly based on web APIs, such as the SemKG mentioned earlier. Some parts of the AI Toolkit will be included in the ED as C# libraries, as for example some elementary neural network tools. No further integration is currently foreseen.

6 Summary and next steps

The deliverable D5.2 presents the general design principles, the usage, the functionalities and the integration logic behind the applications that comprise all the applications that the ALAMEDA users will interact with. It includes the four Digital Companion applications, namely WellMojo, Chatbot, Mood Estimation Android Application and Virtual Keyboard, as well as those of Experts' Dashboards and of two standalone applications, Virtual Supermarket Test and Line Tracking Test. All the prementioned applications are going to be used by the patients during the ALAMEDA pilots, except for Experts' Dashboards that is developed for the medical partners. Their interfaces aim to accomplish aesthetic balance, high levels of usability and clear demonstration of the information and analysis needed for the evaluation of each patient.

The Digital Companion App is going to be the central axis of data collection and interaction between the medical partners and the patients during ALAMEDA pilots. Being the combination of various approaches in the context of remote health solutions, Digital Companion App implements the functionalities required for the pilots and the monitoring of the patients.

We intend to keep improving every possible part of these applications, according to integration testing and feedback from the pilots. Further enhancements will depend on the feedback from the medical partners before and after the start of ALAMEDA pilots regarding the integration and development of vital parts of ALAMEDA project. These improvements will be made available as soon as possible so as to allow their integration in the pilots and their evaluation.

7 References

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Annex A. WellMojo built-in questionnaires

A.1 Initial questionnaire

Personal details

1. **What is your age?**

2. **Select your gender**
   - ○ Male
   - ○ Female
   - ○ Other

3. **What is your weight (in kg)?**

4. **What is your height (in cm)?**

5. **In which of the following categories would you place yourself?**
   - ○ I have made changes (>6 months) and wish to keep them
   - ○ I am currently working on improving my lifestyle.
   - ○ I intend to make changes in the next 30 days.
   - ○ I intend to make changes in the next 6 months.
   - ○ I am not considering any changes.
   - ○ I could use some changes but...

6. **What, if any, health/fitness goals are you currently trying to reach?**

   - □ Not ready to answer
   - □ Eat healthier foods
   - □ Get more exercise
   - □ Improve sleep habits
   - □ Manage stress
   - □ Manage health condition
   - □ Other

7. **Are you interested in learning more about the following topics?**
   - □ Sleep
   - □ Physical activity
   - □ Nutrition
   - □ Release workplace stress
   - □ Time-management skills
   - □ Building self-efficacy
   - □ Identifying my triggers
   - □ Thinking patterns
   - □ Building workplace relationships
   - □ Building healthy rituals
   - □ Overcome procrastination

Activities

1. **On a scale 0 (Never) to 4 (Always), how often do you exercise**
… alone?

2. **…with a personal trainer?**

3. **… with a relative, friend, or acquaintance?**

4. **… in a group?**

5. **… indoors?**

6. **… outdoors?**

Nutrition

1. **Are you on a specific diet for medical, religious or other reasons? If yes, please specify.**

□ No, I am not on a specific diet.
□ vegan
□ vegetarian
□ weight loss
□ high in protein & low in carbohydrate (eg Atkins, Dukan)
□ intermittent fasting
□ diabetes management diet
□ cholesterol management diet
□ hypertension management diet
□ Other

2. **Do you avoid consuming any of the following food groups due to health reasons, allergy or intolerance? If yes, please specify.**
   - □ No, I can eat everything.
   - □ Nuts
   - □ Fruits
   - □ Vegetables
   - □ Fish
   - □ Shellfish
   - □ Dairy
   - □ Whole grain products
   - □ Legumes
   - □ Other

3. **How many meals and snacks do you eat a day? Consider every fruit, yoghurt, or a glass of milk etc. as a single snack. Plain coffee or tea are not considered a snack.**
   … During the week
   - ○ 1-2 meals & snacks a day
   - ○ 3-4 meals & snacks a day

- 5-6 meals & snacks a day
- more than 6 meals & snacks a day

4. …at the weekend

- 1-2 meals & snacks a day
- 3-4 meals & snacks a day
- 5-6 meals & snacks a day
- more than 6 meals & snacks a day

5. How often (times/week) do you typically eat
… breakfast?

6. … lunch?

7. … dinner?

8. How often do you get up at nights to eat (times/month)?

9. Do you eat <u>more</u> when you're stressed?
1: Strongly disagree - 5: Strongly agree

10. Do you eat <u>less</u> when you're stressed?
1: Strongly disagree - 5: Strongly agree

Work-Life

1. Please choose which stress level you identify with the most each day.

- I feel some stress related to my work and personal life, but not every day.
- I experience a manageable amount of stress during my day.
- I feel like my days are ending with me more stressed as time goes on.
- I feel extremely stressed at the end of the day with trying to manage work and my personal life.
- I don't feel stressed at all at the end of my day

2. ***Please indicate the degree you agree with the following statements (*****1: Strongly disagree – 5: Strongly agree)*:***

- The demands of my work interfere with my ability to manage family/home responsibilities.

- Family/home responsibilities interfere with my ability to perform my job well.

3. How often do you think or worry about work (when you are not actually at work)?
0: Never – 4: always

4. Do you find time to eat properly, exercise and maintain a good health?
0: Never – 4: always

5. Do you reserve at least 30 minutes of "me time" each day?

0: Never – 4: always

6. What type of activities do you engage in that help you manage stress arising from work?

- □ Watching TV
- □ Socializing/communicating
- □ Playing game/computer use
- □ Reading
- □ Sports, exercise, recreation
- □ Meditation
- □ I don't have time to relax
- □ Other

7. Have you been worrying about anything?

Being aware of the things that affect our mood can make it easier to understand when you are struggling.

- □ Health issues
- □ Personal life/relationships
- □ Work issues (deadlines, workload etc.)
- □ Life changes
- □ Stress-related disease
- □ None of the above
- □ Other

8. Are you satisfied with your work-life balance?

1: Strongly disagree – 5: Strongly agree

Work

1. During my workday, I typically feel tense or stressed out.

1: Strongly disagree – 5: Strongly agree

2. How would you rate your average daily level of stress from work?

1: Little/no stress - 5: A great deal of stress

A.2 Daily Nutritional Behaviour

Please take a minute to answer the following questions related to your today's food and drink consumption:

1. **How many glasses of water did you have today?**
   a. 0 – 2 glasses
   b. 3 – 6 glasses
   c. More than 6 glasses

2. How many pieces of fruit did you have today?

a. 0

b. 1-2
c. >2

3. How many salads did you have during the day?

a. 0
b. 1
c. 2

4.Did you order take-out today? If yes, how many times?

a. >1
b. 1
c. I did not have take-out meals

5. How many meals you have during the day?

a. 1-2
b. 3-6
c. >6

6. Thinking of today's meals/drinks, which statement best describes you?

d. It is difficult for me to put effort on what to eat/drink.
e. I am somewhat satisfied. I wish I had made some healthier choices.
f. I am overall satisfied.

A.3 Mood tracking

Ever notice how your mood changes? Mood-tracking is a positive psychology technique that helps you gain insights into your feelings and how they influence your everyday life.

Select how you have been feeling today.

Happy
Sad
Upset
Neutral
Disappointed
Irritable
Angry