D4.2.1
Backend, Frontend & Profiling

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Task	**T4.2 Back-end, Front-end, & Profiling**
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Project PLAYTIME

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Contents

1 Executive Summary

This report provides an overview on the development of the server component – back-end – of the serious game suite in the frame of amicasa and PLAYTIME.

The back-end provides an access and evaluation framework as well as repository of game and training units for the caregiver at hand.

The front-end - the app - is represented mobile or stationary touch devices and enables login, assistance in training, playing the games, acquisition of measurements through applied sensors and transfer of extracted data to the back-end for storage and evaluation.

2 Back-end

2.1 Backend Server Specifications

The selected server consists of standard web-server components, which nowadays could be found almost everywhere, where a client-server-communication has been established. All the chosen parts and technologies are proven and tested over years and the best practice for these kind of applications.

- WebServer Stack with Linux,
- MySQL 5.6, PHP 5.6/7.1 and Apache,
- with at least 4 CPU-Cores and 32 GB RAM.

Linux systems are well known for their ability to run for years without failure. In fact, many Linux users have never seen a crash. That's great for users of every kind, but it's particularly valuable businesses and applications, for which downtime can have disastrous consequences.

Linux also handles a large number of processes running at once much better than Windows does. In combination with MySQL and Apache it builds a solid, dependable and secure base for the playtime environment.

The last level of the three-level-tier is partitioned into various applications. Firstly, the backend which offers a professional environment for intensive operations in PLAYTIME. For this – in comparison with the playful multimodal training platform – a higher degree of expertise in the handling of PCs and software in general is required.

The backend used as basis technologies HTML5, CSS3 and Angular.js. The presentation layer is based upon the widely distributed GUI framework Bootstrap. Through this and by the use of GUI templates the backend can be used also with mobile devices, for example with smartphones and Tablet PCs.

The only requirements for the client side application of the backend are access to internet and a widely used web browser.

The backend has to run smoothly and should be – despite its high functionality – of intuitive use. The graphical user interface (GUI) should allow the design of a game like appearance without too much complexity.

The backend communicates directly with the server logic and receives standard UI elements (forms, etc.) actions from the user and triggers at the server site appropriate functions. Some validations and plausibility checks will be performed by the backend so that problematic actions or data cannot be operated on the server, secondly, so that resources of the server will not be charged too much, and thirdly, enable a faster and therefore better UI feedback.

2.2 Further development and considerations

Figure 1 depicts a schematic overview of the major functional architecture components of the planned development of the back-end PLAYTIME system. A central component is the “player” function that receives input from unit descriptions in a series described by the “sequencer” function. A “Recommender” function is able to apply adjustments to otherwise predefined series of unit encodings. These adjustments are precomputed from input derived by current user results and direct feedback, by motivation analytics and reinforcement analysis, and by multimodal diagnostics that itself receives input from multimodal data (eye tracking, motion, etc.) captured in the “central database” (CD) from various other components (emotion, attention, motion, etc.).

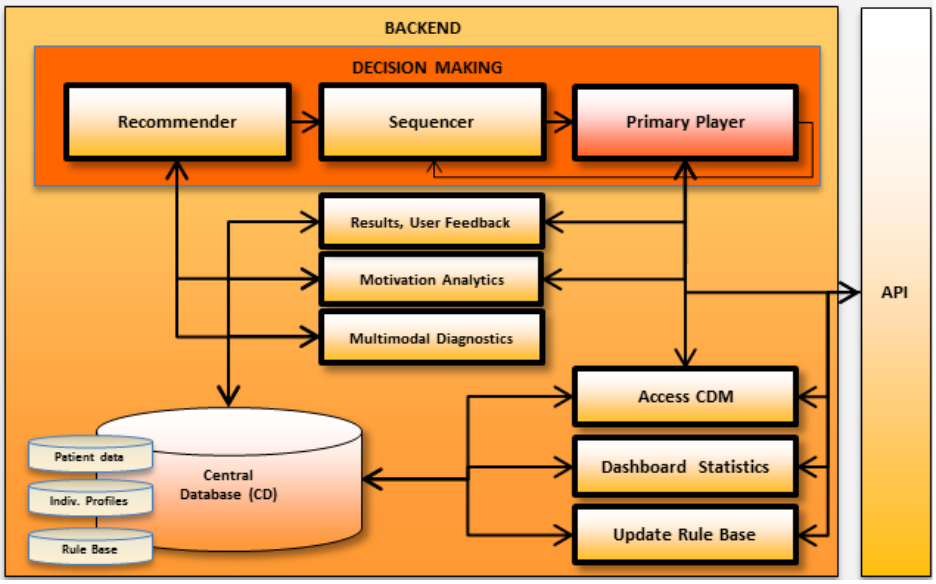

Figure 1. Schematic sketch of the PLAYTIME back-end component (from PLAYTIME Deliverable D4.1.1) that represents the integrating aspects. In particular, the components “Central Database”, “Recommender”, “Multimodal Diagnostics” and “Motivation Analytics” provide implementations that operate on inputs from various components and generate output of concern for an integrated view of the intervention and assessment system features.

3 Front-end

3.1 Frontend Platform Specifications

Although PLAYTIME will run on any Tablet PC that is at least equipped with Android 5.1 operating system running on it or any iPad with at least iOS 10, a very important task is to find the appropriate device for practical use for persons with dementia, considering that PLAYTIME will run in a perfect ICT environment for the App itself, but also be appropriate for achieving an optimal user experience.

In order to fulfil several requirements and special needs, a proper display size is needed so that the user can interact with it in a convenient way. Therefore the display size should not be too large as well as the device should not be to heavy but also not too small, since small devices are difficult to control. The performance of the device should be at a high level, to manage every task in a fluid way. The complexity and hence the delay in any computation of the user interface should not impact the user. Furthermore, in the special case, it is important that the tablet can be rinsed and disinfected after every use.

For the above reasons we decided to use the SAMSUNG Galaxy Tab Active2 for the field trials with the following specifications:

- Size: 8.0" (203.1mm),
- Resolution: 1280 x 800 (WXGA),
- 1.6GHz Octa Core Processor,
- 3GB RAM, 16GB Memory,
- IP68 Water & Dust Resistance,
- Android 7.1.

The best advantage of the Galaxy Tab Active2 among other devices might be the IP68 Standard, which makes the device completely waterproof and dust resistant.

However, McRoberts' devices will not work (yet) on android. Windows devices do work as described in Section 4.1.5 and 4.2.4. for the field trials it was agreed that the leader (who will do the measurements) will work on a have to have a Microsoft Surface tablet. End users (people living with dementia) can use the Samsung tablet.

Overall this device offers a very good performance for a good price and comes with all the features we need. The display is not the largest, however, for this purpose the IP68 standard is more relevant than the size of the screen.

The playful socio-emotional serious games (SESGs) for people with dementia and caregivers are designed to be responsive and therefore can accommodate mobile devices, tablets, or desktops.

3.2 Frontend Playful Socio-Emotional Serious Game (SESG)

The system is built using the python micro framework, Flask (http://flask.pocoo.org/), which functions as a server to handle multiple pages within a website (e.g., myapp.com/login and myapp.com/store). Flask also allows the system to interface with an SQLite database, and the Jinja2 templating system to dynamically create HTML pages using data from the database.

The Flask framework determines which page to go to, then renders the appropriate HTML page and passes in any necessary arguments or data needed to render the page. For example, a page to list all of the system's psychosocial parameters for a particular game round would make a query to the database to get the desired information and pass that to the HTML page which in turn would generate the HTML based on the number of parameters pass in and their various attributes. Since the system is built on python, integrating it within a larger system would require it to be hosted on a server that was able to run Python and had the appropriate python libraries installed. Integrating anything with the front-end (web browser view) would need to be integrated within the Flask framework, or within the HTML pages themselves, depending on the technology.

3.3 Further development and considerations

The front-end of PLAYTIME will include the following components:

- **Launcher**: An application launcher is a computer program that helps a user to locate and start other computer programs. An application launcher provides shortcuts to computer programs, and stores the shortcuts in one place so they are easier to find. Launchers usually consist of a series of home screens, where we can arrange app shortcuts and widgets and an app drawer. Figure 2 depicts a schematic view of the PLAYTIME app front-end after the launcher has started the front page which will enable to link to one of the PLAYIME basic components.
- **Login GUI**: There will be a unique and single login GUI for all components.
- **Administration GUI**: there will be several separate configurations that need to be maintained:
    - User category specific "behavioral matrix": This matrix associates user profile clusters into serious game and training relevant parameters, such as, duration of training, number of units to be played per training category, etc.
    - "Recommender rule base": The rule base is represented by a decision tree with thresholds to index from discrete / continuous decisive feature values to a behaviorally relevant parameter vector, such as, including difficulty level of game play, etc.
    - "Scores and rewards": Formulas for the computation of game scores are parametrized and map to visual rewards, such as, to increase the use experience and the motivation of the game player (Kartevoll, 2017), in particular, considering the vulnerable users in mental health applications (Fleming et al., 2016).

- **Dashboard GUI**: A dashboard with interactive data visualization is considered for insight into the temporal analytics of mental health meta-data and game scores in PLAYTIME, for each user. See also Sec. 4.1 for reference to user profile specific data logging.

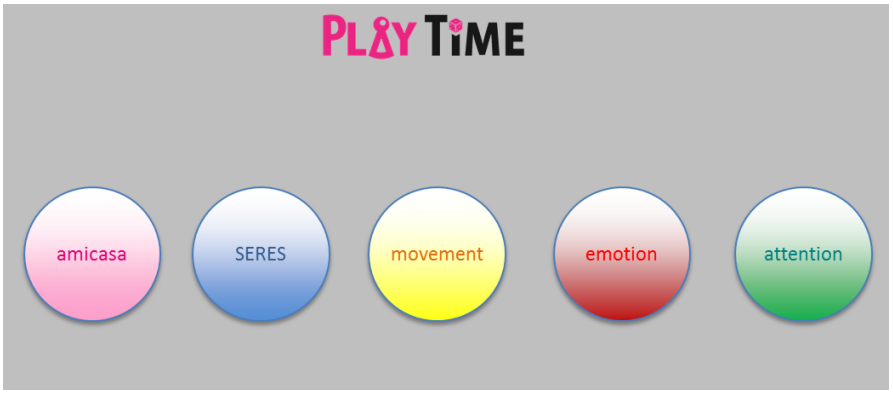

Figure 2. In terms of the start of the front-end of the PLAYTIME suite will operate a launcher that will further link to the individual PLAYTIME suite components.

Figure 3. Template dashboard with interactive data visualization as considered for mental health meta-data temporal analytics and game scores in PLAYTIME.

4 Profiling

4.1 Profile input

From the central database, dashboard statistics can be generated using parameters that were defined by the "**Dashboard GUI**" as part of the general frontend component. The frontend serves for login according to access rights that are determined by **profiles as part of the CD**. In addition there is an administration GUI function that serves management of access rights, organization of units into sessions, introduction of novel units and other services.

The profiles will be gathered from the PwD through the associated caregivers and made available through a simple GUI on the Tablet PC.

4.2 Profile data dependencies

In the complete PLAYTIME game suite, there are several dependencies on initial profile data input and further computations and metadata that will serve for augmented individual profile data structures, as follows,

- The diagnostic toolbox, implemented trough Task 3.5 (Multimodal Analytics) will embody an intelligent data collection and analysis platform, including **data from user profiles**, for a visualization idea see Figure 3.
- The caregiver serious game not only uses science-based data to drive the narratives and the interactions with the user, it also has the ability to capture information about the player's **cognitive and psychosocial profiles** and **gaming behaviors** (decision-making behaviors, gameplay, strategy) enabling to carry out more **in-depth research and analysis of key game mechanics, user interactions and ethical profiles**.
- **Past performance files** will be generated for further analysis, such as, the weekly and monthly summary of playful cognitive and physical training (amicasa) as well as with respect to the attention game suite (MIRA).
- **Selected meta-data** that were stored in the central database (CD) can be displayed as a profile over time in the Dashboard GUI (see Section 4.1). The type of presentations depend on the admission rights of the respective user login.

4.3 Further development and considerations

The user profile configuration software as well as a first prototype of the dashboard GUI will be developed for the second field trial prototype and provided in an extended version until the project end.

5 Conclusions and Outlook

This PLAYTIME Deliverable presented an overview on the development of the server component – back-end – of the PLAYTIME serious game and training suite. The front-end was presented, specifically, with the focus on the app launcher and the dashboard GUI which will be available for the second field trial prototype.

The outlook on the next PLAYTIME Deliverable in this Task, i.e., Deliverable D4.2.2 emphasises on certain updates and concretisations based on the actual implementation for the second field trial prototype as well on a further implementation plan for the remainder of the project until project end.

6 Abbreviations

Table 1. Abbreviations.

Abbreviation	Description
PwD	Person with Dementia

7 Bibliography

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(**Kartevoll, 2017**) Morten Kartevoll (2017). Improving User Experience with Gamification and Reward Systems, Norwegian University of Science and Technology, Master Thesis, Department of Computer Science, June 2017.