

# ALFRED

Personal Interactive Assistant for Independent Living and Active Ageing



## WP7 – Pillar IV: Serious Games for Physical & Cognitive Impairments Prevention

### D7.4.2: App Building and Deployment

Deliverable Lead: TUDA

Contributing Partners: CHA, ATOS

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This document describes the additional applications developed in WP7 besides this work package's main contribution to the ALFRED system, the Game Manager component. Different to the applications contributed by the other development work packages (WPs 3 to 6), the applications developed in WP7 are all games and meant to both entertain the user and to increase her amount of physical and/or cognitive activity. This deliverable provides information on the scope and status of these games.



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## Note

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## Executive Summary

This document describes the five games developed for the ALFRED system: Dance with ALFRED, ALFRED's Back Trainer, ALFRED's Balance Bike, ALFRED's Puzzle Arena and finally, Detective ALFRED.

Dance with ALFRED has been refined and released in April 2016 with an entirely new user interface and various comfort functions to make it more accessible to older players. ALFRED's Back Trainer is available in its final version and has been extensively evaluated by CHA during their pilot studies, see D8.3.2 about the test pilots. ALFRED's Balance Bike is also ready for evaluation by end user partners. Both ALFRED's Puzzle Arena, a brain-training game, and Detective ALFRED, an outdoor multiplayer exergame, they have been slightly updated within the last months and are available as prototypes for testing and follow-up activities by ALFRED consortium members.

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# 1 Introduction

ALFRED – Personal Interactive Assistant for Independent Living and Active Ageing – is a project funded by the Seventh Framework Programme of the European Commission under Grant Agreement No. 611218. It will allow elderly people to live longer in their own homes with the possibility to act independently and to actively participate in society by providing the technological foundation for an ecosystem consisting out of four pillars:

- **User-Driven Interaction Assistant** to allow older people to “talk” to ALFRED and to ask questions or define commands in order to solve day-to-day problems.
- **Personalized Social Inclusion** by suggesting social events to older people, considering his interests and his social environment.
- A more **Effective & Personalized Care** by allowing medical staff or carer to access vital signs of older people monitored by (wearable) sensors.
- **Physical & Cognitive Impairments Prevention** by incorporating serious gaming to improve the physical and cognitive condition by offering games and quests to older people.

This deliverable describes five of the 25 initial additional applications that come with the ALFRED system, all of them being games: “Dance with ALFRED”, “ALFRED’s Back Trainer”, “ALFRED’s Balance Bike”, “ALFRED’s Puzzle Arena”, and “Detective ALFRED”.

## 1.1 ALFRED Project Overview

One of the major problems today is the increasing isolation of older people, who do not actively participate in society either because of missing social interactions or because of age-related impairments (physical or cognitive). ALFRED will allow overcoming this problem with an interactive virtual butler for older people, which is fully voice controlled.

The ALFRED project is wrapped around the following very clear main objectives:

- Empowering people with age related dependencies to live independently for longer by delivering a virtual butler with seamless support for tasks in and outside the home. The virtual butler ALFRED will have a very high end-user acceptance by using a fully voice controlled and non-technical environment.
- Prevailing age-related physical and cognitive impairments with the help of personalized, serious games.
- Fostering active participation in society for the ageing population by suggesting and managing events and social contacts.
- Improved care process through direct access to vital signs for carers and other medical staff as well as alerting in case of emergencies. The data is collected by unobtrusive wearable sensors monitoring the vital signs of older people.

To achieve its goals, the project ALFRED conducts original research and applies technologies from the fields of Ubiquitous Computing, Big Data, Serious Gaming, the Semantic Web, Cyber Physical Systems, the Internet of Things, the Internet of Services, and Human-Computer Interaction. For more information, please refer to the project website at <http://www.alfred.eu>.

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## 1.2 Deliverable Purpose, Scope and Context

The purpose of this deliverable is to describe the scope and state of the additional applications (“extensions”) that are developed within WP7 besides this work package’s main contribution, the Game Manager subcomponent.

## 1.3 Document Status and Target Audience

This document is listed as “public” in the Description-of-Work (DoW), as it provides general information about ALFRED’s software extensions. While the document mainly aims at the project’s contributing partners, this public deliverable can also be useful for the wider community

## 1.4 Abbreviations and Glossary

A definition of common terms and roles related to the realization of ALFRED as well as a list of abbreviations is available in the supplementary document “Supplement: Abbreviations and Glossary”, which is provided in addition to this deliverable.

Further information can be found at <http://www.alfred.eu>.

## 1.5 Document Structure

This deliverable follows the structure of all other “prototype deliverables”. This first chapter gives a general introduction to the ALFRED project. It is followed by a description of this document’s context and scope in chapter 2. Chapter 3 describes the five games that have been developed within WP7. Chapters 4 to 6 have information on how to install and run these games on an off-the-shelf Nexus 5 device. Chapter 7 details the games’ test results; Chapter 8 lists the applicable key-performance-indicators. Finally, chapter 9 provides a summary.

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## 2 Context and Scope

The ALFRED project aims to develop a mobile assistant for older users in order to empower them to maintain their wellbeing and independence for as long as possible. To this end, the project relies on four pillars. The fourth pillar is about “Physical & Cognitive Impairments Prevention”, and is in the focus of the project’s work package 7.

The outcomes of work package 7 can be grouped into two categories. The first group of results are contributions to the Game Manager component, which is a subcomponent of the integrated ALFRED assistant. Among other things, the Game Manager is tasked with ensuring that the set of serious games that are developed for the ALFRED system are actually being played by the user, as these games are meant to ensure that the user stays active, thus helping to prevent her physical and/or cognitive decline. A set of such games is the second outcome of work package 7. While tasks 7.1 to 7.3 focus on advancing the Game Manager subcomponent, task 7.4 is concerned with the development of five serious games: the dancing exergame “Dance with ALFRED”, the strength training game “ALFRED’s Back Trainer”, the cardio and balance training game “ALFRED’s Balance Bike”, the brain training game “ALFRED’s Puzzle Arena”, and the outdoor exergame “Detective ALFRED”. This document focuses on describing these games.

Note that the deliverable is a “prototype deliverable”, meaning that it is accompanied by the actual application files. How they are being installed and executed is described in chapters 4 to 6 of the document.

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### 3 State of the Development

This chapter describes the five serious games developed in task 7.4. The motivation for all games is drawn from user stories compiled in the context of task 2.3 (see deliverable D2.3 for more information)

#### 3.1 Dance with ALFRED

The exergame “Dance with ALFRED” is based on User Story 102 (see deliverable D2.3, p.61).

|                   |  |              |                     |                 |       |
|-------------------|--|--------------|---------------------|-----------------|-------|
| <b>ID</b>         | US102  | <b>Title</b> | Games for Interests | <b>Priority</b> | 2     |
| <b>User Group</b> | Older Person   | <b>Tasks</b> | T3.4, T7.1, T7.2    | <b>Use Case</b> | UC2.4 |
| <b>Summary</b>    | As an older person, I would like to have games that include my favourite sports (swimming, badminton, mountaineering, tennis, skiing, music....) |              |                     |                 |       |

Dance with ALFRED is a game for up to four players, although it can also be played by a single player. Players initially select a song and an instrument to play that song with and then need to follow simple movement instructions as presented to them on their smartphone screen (take a step forward, take a step back, take a step to the left, take a step to the right, turn around). By doing so, they generate a part of the selected song, which then plays from their device’s loudspeaker. If multiple people get together in a room, they can thus “dance” together.

Dance with ALFRED was already available in a very first version at the end of the project’s first year and since then the game underwent multiple evaluations by the project’s end user partners ESE and NFE. The feedback from these evaluation sessions has been very helpful for improving the game’s user friendliness and accessibility. A third version of the game has been created since the last report, with an entirely updated user interface. In this new version, the movement instructions presented on-screen has been coming from an actual real dancing person, whose movements the players of the game have to follow. The update also featured other improvements, such as a “Play Now” button on the start screen that automates all configuration steps and that is especially useful to technically inexperienced players, as it allows them to instantly jump into a game session. This final version of Dance with ALFRED has been made available in time for the pilot studies which started in May.

Dance with ALFRED – Collaborative Dancing has been published by TUDA in a new textbook on Serious Games (Springer, 2016), see also D 9.4.5 for the full reference.

## 3.2 ALFRED's Back Trainer

ALFRED's Back Trainer is based on User Story 101 (see deliverable D2.3, p.60).

|                   |   |              |  |                 |                    |
|-------------------|---|--------------|--|-----------------|--------------------|
| <b>ID</b>         | US101   | <b>Title</b> | Use of Health Data<br>in Serious Games | <b>Priority</b> | 2                  |
| <b>User Group</b> | Older Person  | <b>Tasks</b> | T6.1, T6.2, T7.1,<br>T7.2              | <b>Use Case</b> | UC1.5,<br>2.2, 2.4 |
| <b>Summary</b>    | As an older person, I would like to do guided exercises with ALFRED.<br>ALFRED should also use sensors to capture health data while I am<br>doing exercises |              |  |                 |                    |

The Back Trainer game is meant to help users improve their lower torso muscles, especially the erector spinae muscles. The erector spinae is responsible for straightening one's back, and is the antagonist of the rectus abdominis, the popular "sixpack" muscles. Since the erector spinae muscles are often used but rarely trained, especially older people are likely to eventually suffer from chronic back pain. Even worse, weak erector spinae can lead to slipped disks and other severe injuries. Consequently, it is of utmost importance to improve the strength and stability of this group of muscles but to the best of our knowledge, no applications or serious games are targeting this problem.

For ALFRED, partners TUDA and CHA have conceptualized a serious game that requires players to utilize their erector spinae muscles. In order to "play" the game, the player needs to lie down on two Nintendo Balance Boards, one below her pelvis and the other below her scapula. The game then visualizes the player's weight distribution on the device screen, which enables medical carers to give instructions regarding the player's muscular effort. Different visualization techniques allow an adaption to the user's background. The ALFRED Back Trainer has been evaluated extensively by CHA during the pilot studies conducted in Germany and the results will be presented in a dedicated scientific publication. A first paper that describes the concept of the ALFRED Back Trainer has already been published by Springer (Sandro Hardy, Florian Feldwieser, Tim Dutz, Stefan Göbel, Ralf Steinmetz, Elisabeth Steinhagen-Thiessen: *ALFRED Back Trainer: Conceptualization of a Serious Game-Based Training System for Low Back Pain Rehabilitation Exercises*. In: Stefan Göbel et al. (eds.): *Serious Games*, p. 36-47, Springer, July 2015.).

ALFRED's Back Trainer requires two Nintendo Balance Boards in addition to the ALFRED device in order to be playable as intended.

### 3.3 ALFRED's Balance Bike

The “Balance Bike” game is based on User Story 108 (see deliverable D2.3, p.62).

|                   |  |              |                        |                 |                |
|-------------------|--|--------------|------------------------|-----------------|----------------|
| <b>ID</b>         | US108  | <b>Title</b> | Training for Muscles I | <b>Priority</b> | 3              |
| <b>User Group</b> | Older Person   | <b>Tasks</b> | T7.1, T7.2             | <b>Use Case</b> | UC 2.2,<br>2.4 |
| <b>Summary</b>    | As an older person, I would like to have training for specific muscle groups |              |                        |                 |                |

Balance Bike is an exergame for improving one's muscles of the lower extremities and of the lower torso. It relies on a special type of indoor cycle to which's handle a simple smartphone holder is attached. The user's ALFRED device is placed into this handle and automatically connects to the cycle via Bluetooth. On screen, the player sees a 3D—track with obstacles. By pedalling, the player advanced on the track but in order to dodge the obstacles placed on the virtual track, she has to lean to the left and to the right on her cycle. This way, the player trains both her legs and her torso stabilizing muscles.

ALFRED's Balance Bike requires access to a spin bike (also known as “group cycle bike”).

### 3.4 ALFRED's Puzzle Arena

The “Puzzle Arena” is based on User Story 117 (see deliverable D2.3, p.64).

|                   |   |              |                        |                 |       |
|-------------------|---|--------------|------------------------|-----------------|-------|
| <b>ID</b>         | US117   | <b>Title</b> | Mind Stimulating Games | <b>Priority</b> | 2     |
| <b>User Group</b> | Medical caregiver   | <b>Tasks</b> | T7.1, T7.2             | <b>Use Case</b> | UC1.5 |
| <b>Summary</b>    | As a medical caregiver, I would like ALFRED to propose training that promotes complex thinking. |              |                        |                 |       |

ALFRED's Puzzle Arena is a brain trainer game for older users. It presents a series of minigames to the player, such as memory and solving mathematical puzzles. The game has a clean user interface and uses large fonts and friendly colours in order to appeal to its specific player group.

### 3.5 Detective ALFRED

The game “Detective ALFRED” is based on User Story 098 (see deliverable D2.3, p.60).

|                   |   |              |                                 |                 |                    |
|-------------------|---|--------------|---------------------------------|-----------------|--------------------|
| <b>ID</b>         | US098   | <b>Title</b> | Motivation of New<br>Activities | <b>Priority</b> | 1                  |
| <b>User Group</b> | Older Person  | <b>Tasks</b> | T5.4, T7.2                      | <b>Use Case</b> | UC2.4,<br>3.3, 2.4 |
| <b>Summary</b>    | As an older person, I would like ALFRED to give me goals and missions that encourage me to do new activities and exercises and to go out. |              |                                 |                 |                    |

Detective ALFRED is an outdoor exergame for multiple players. At the start of the game, one of the players is randomly chosen as “The Spy”. This player then needs to move away from the other players. As soon as “The Spy” is far enough from the rest of the players, they need to start looking for her, based on the directions indicated on their smartphones. If the other players manage to catch “The Spy” within a limited time, they win. Otherwise, “The Spy” wins.



Figure 1: Dance with ALFRED Start Screen



Figure 2: Dance with ALFRED Song Selection



Figure 3: Dance with ALFRED Loading Animation



Figure 4: Dance with ALFRED Ingame

|   |   |                     |                      |                  |
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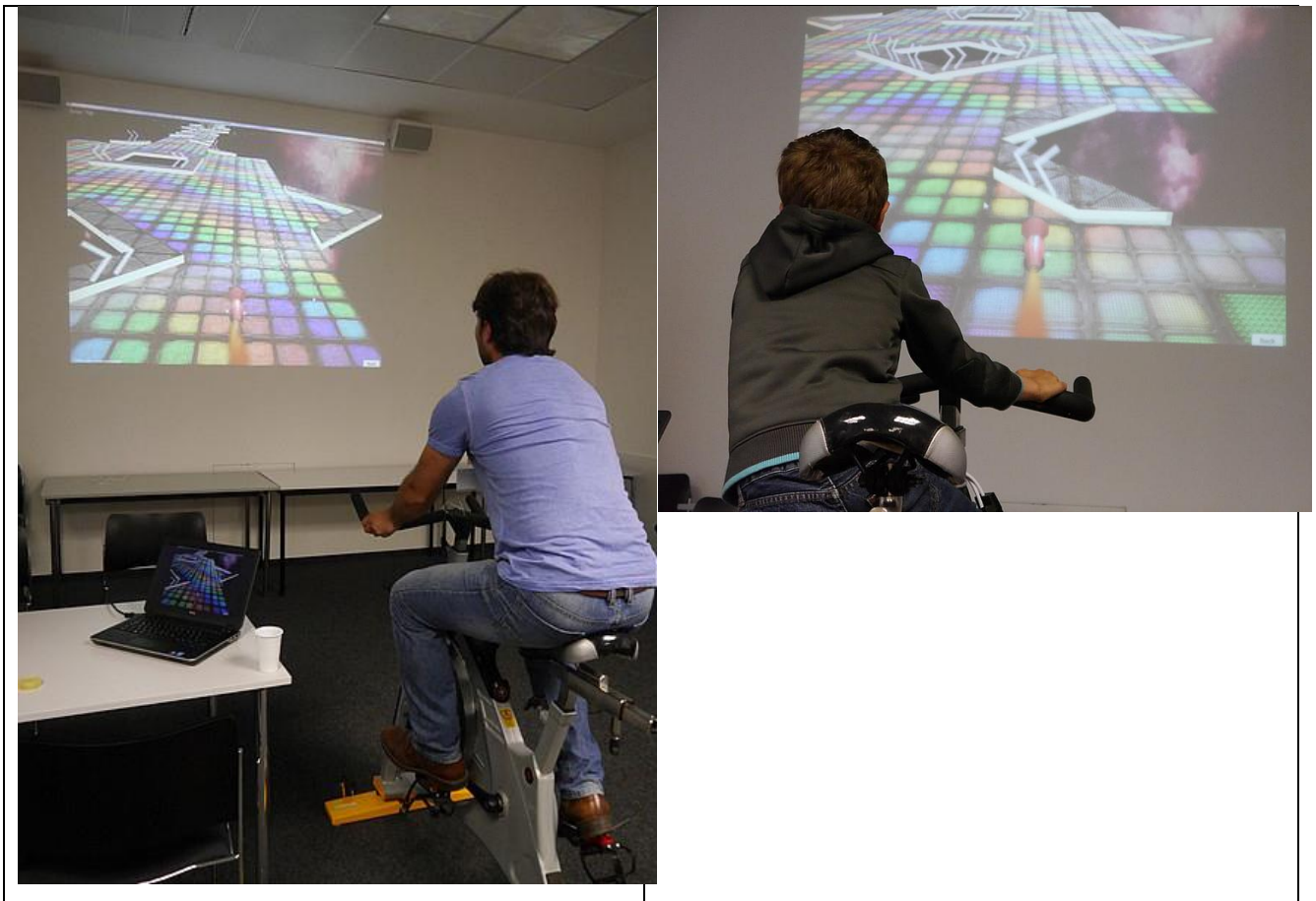


Figure 5: ALFRED’s Balance Bike Spin Bike (Source: GameDays, TU Darmstadt)



## 4 Requirements and Preparations

This chapter explains the requirements that need to be met prior to installing and running the stand-alone versions of ALFRED's games. The next two chapters will then explain how to actually install and run them. **NOTE: The integrated version of the ALFRED system does automate most of these steps for the user, as the ALFRED extensions – including the serious games – can simply be downloaded from the ALFREDO marketplace.**

- The most basic requirement is a mobile Android device at your disposal, most preferably an LG Nexus 5 or its successor, the LG Nexus 5x. Although the applications introduced may also run on other Android smartphones and tablet computers, they have only been tested on these two devices.



Figure 6: LG Nexus 5 on the Left; on the Right the Slightly Larger LG Nexus 5x

- Ensure that the Android operation system running on the device is up-to-date. We recommend using Android 6.0.1. To check the Android version of your smartphone, go to [Settings], scroll down for [About Phone] and look for the item [Android version]. **NOTE: The preparation and installation instructions in chapters 4, 5 and 6 are written for Android version 6.0. The steps may be different for older and newer versions.**

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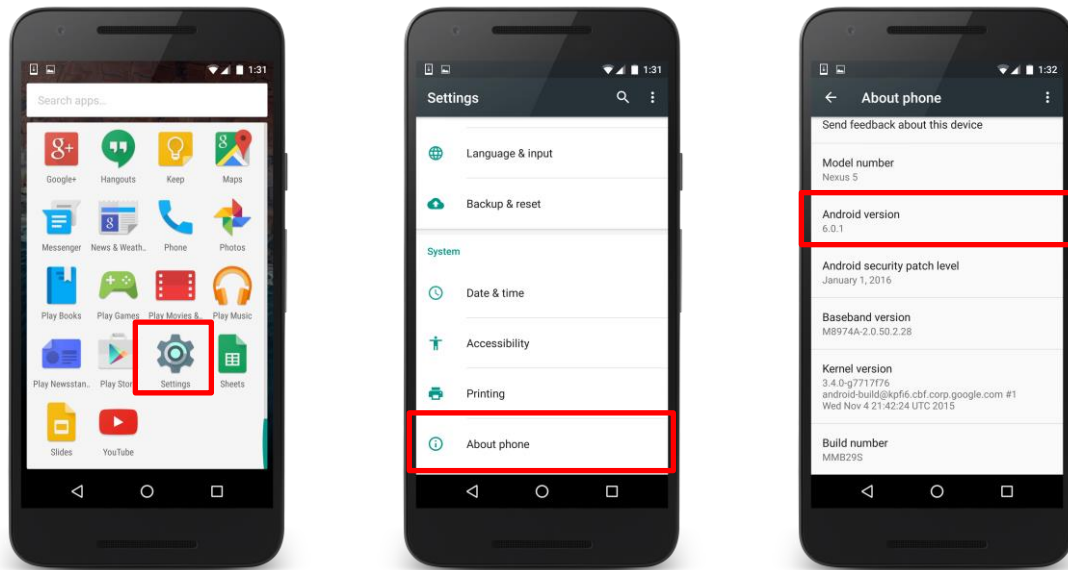


Figure 7: Steps for Checking the Android Version of the Device

- Before you can install the stand-alone game on your Android device, you need to enable it to run unpublished software that has not been obtained via the official Google Play Store. The first step is to enable the “developer mode” of the phone. In order to do this, go to the [About Phone] screen as shown above, but this time scroll down until you see the entry [Build number]. Now tap this entry multiple times in a row, until you receive the notification “You are now a developer!”.

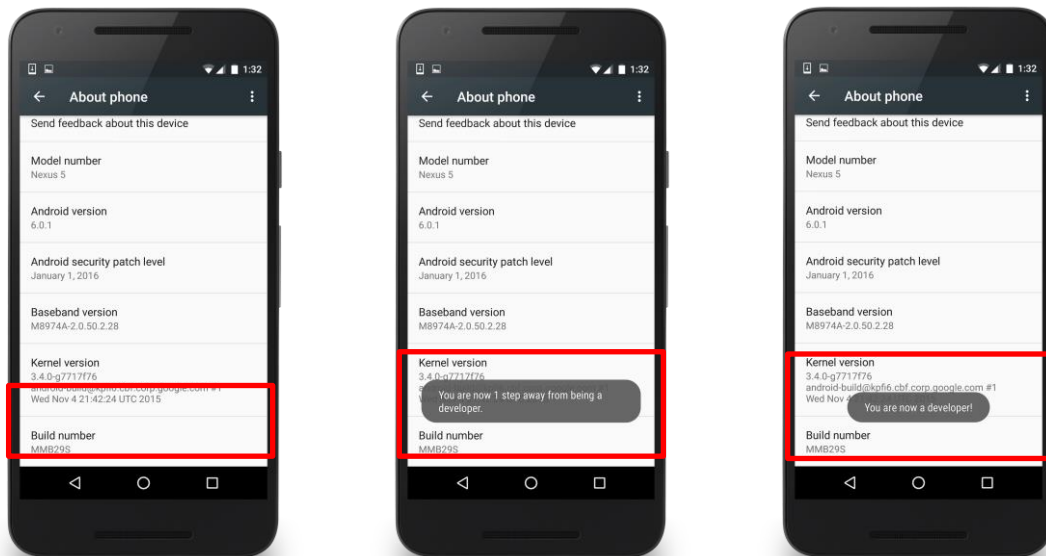


Figure 8: Activating the Developer Mode

- After you have become a “developer”, a new entry in the Settings menu appears. Tap [Developer options], scroll down and activate [USB debugging].

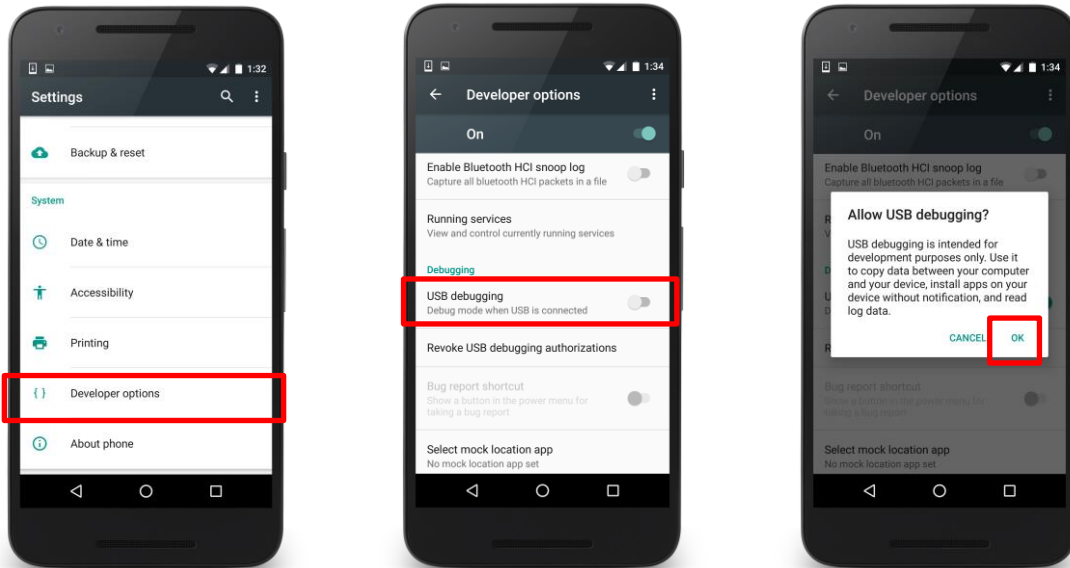


Figure 9: Activation of “USB Debugging” Mode

- One more step: you also need to allow “Unknown sources”. To do this, go to [Security] on the main settings page and activate the [Unknown sources] item.

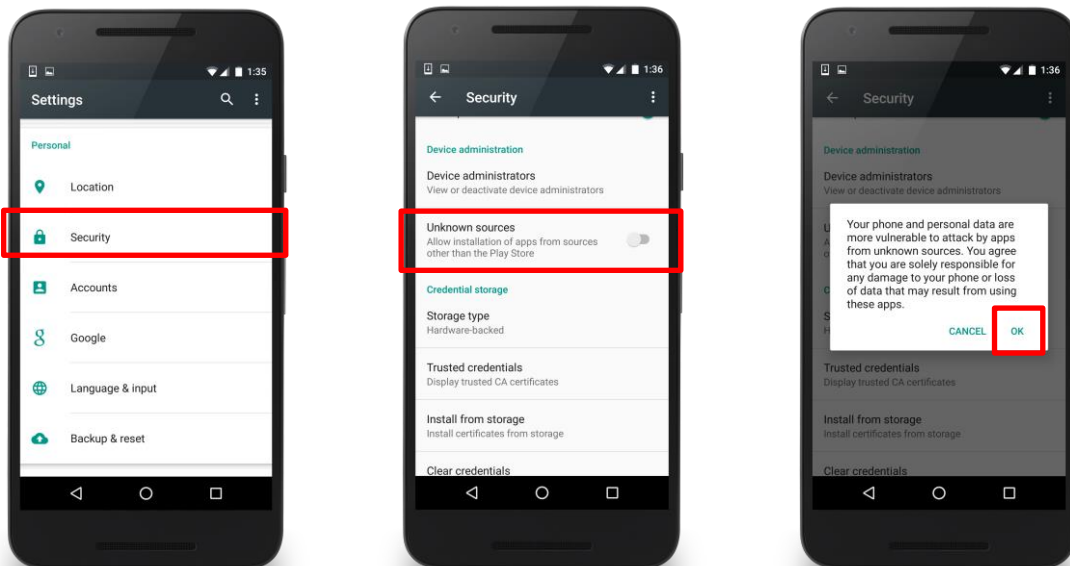


Figure 10: Allowing “Unknown Sources”

- There is one more thing you need to do before we can proceed to the next chapter. Since Android devices do not come with a built-in file explorer (such as the Windows Explorer on Windows computers), we need to download such a software from the Google Play Store. Luckily, there are a number of such applications available for free. We recommend getting the application “File Manager” by ZenUI. Simply look for “file manager” on the Google Play Store, download and install the application. Make sure to give the application access to your local data once downloaded and started for the first time.

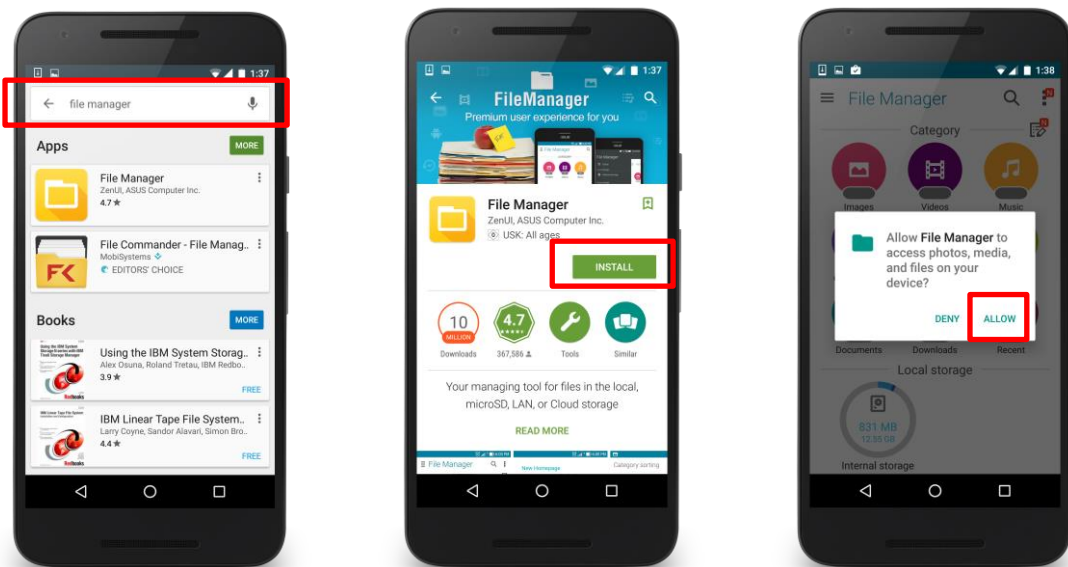


Figure 11: Installing a File Manager on the Device

## 5 Deployment (Installation)

**NOTE:** If you are using the integrated version of the ALFRED system, simply download the games from the ALFREDO marketplace, they will be installed automatically. The following instructions are meant for manually installing the stand-alone APKs of the games.

If you have taken all the steps as described in chapter 4, your device is now prepared for installing the stand-alone version of the ALFRED games. Although the steps in this and the next chapter are specifically for installing the game “Dance with ALFRED”, they are the same for installing the stand-alone version of any other game. Please note that the games “ALFRED’s Back Trainer” and “ALFRED’s Balance Bike” are special cases in that they require additional hardware in order to function correctly. See chapter 3 for details. Please also note that for the sake of simplicity, we are assuming that you are using a Windows PC. If not, please adapt the following instructions accordingly.

- Start with connecting your Android device to your PC. You should have the application APKs ready in a folder somewhere on that PC. Use the USB cable that came with your smartphone for the connection.
- You may need to install the corresponding drivers on your PC if this is the first time that you connect your smartphone. If nothing happens, go to <http://developer.android.com/sdk/win-usb.html> and follow the instructions there.
- If everything works as intended, you should see two notifications on your smartphone screen saying “USB debugging connected” and “USB for charging”. Tap the later one and select the second option from the list [File transfers].

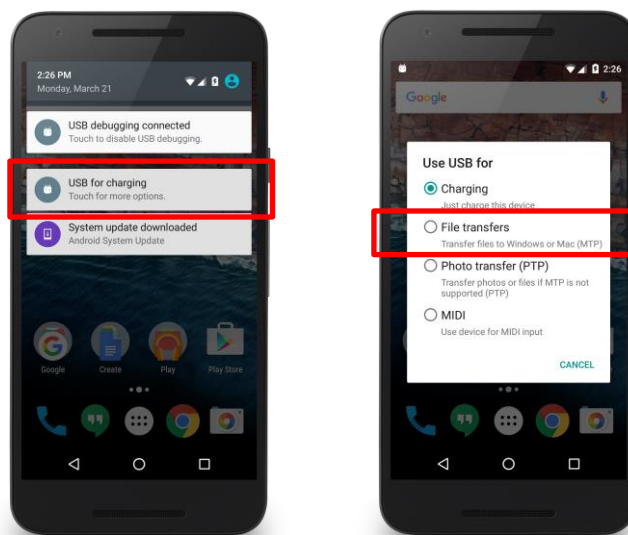


Figure 12: Transferring Files to Your Smartphone

- You can now move files to and from your smartphone, just as if it was an USB stick. Go to your Windows explorer, select the APK of the triggering stand-alone

|                                     |                          |   |                      |                  |
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application “ALFRED-Dance.apk”, and move it to the folder “Download” on your smartphone.

- After all files have been copied, disconnect your smartphone from your PC.
- Open the file manager application on your smartphone to access the downloaded files. If you have installed “File Manager”, as recommended in chapter 4, tap the [Downloads] icon. You should see the APK that you have just copied to your smartphone (and possibly other files). Simply tap it to open the corresponding installation screen.

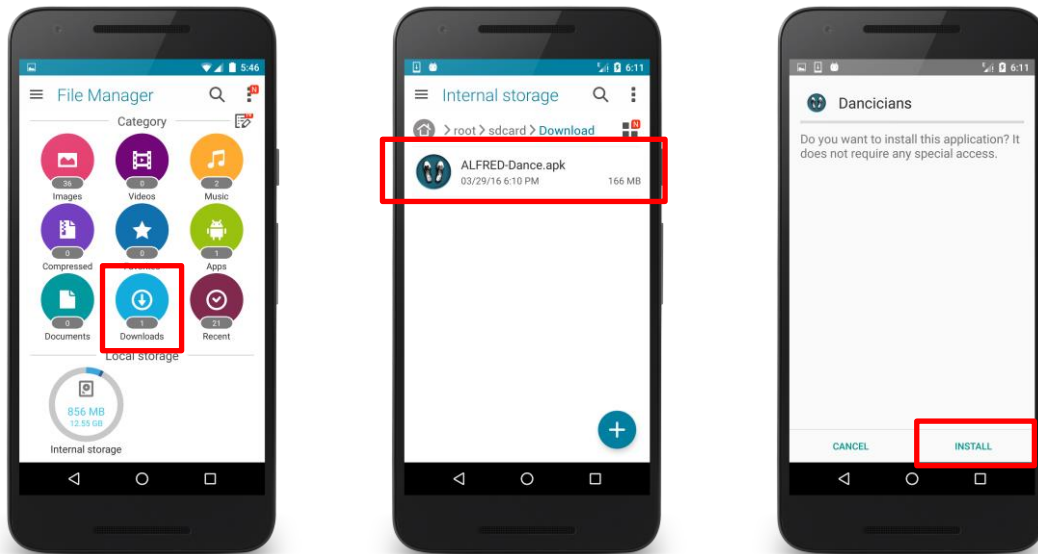


Figure 13: Installing an APK Using the File Manager Application

- Depending on which of the games described in chapter 3 you want to install, you have to copy the correct APK files to your smartphone. The following table states the file names of these applications. As mentioned before, please note that for applications 4 and 5 – “ALFRED’s Back Trainer” and “ALFRED’s Balance Bike” – you will require additional hardware for running the games as intended.

| # | Name of Game          | File Name of Stand-alone Game |
|---|-----------------------|-------------------------------|
| 1 | Dance with ALFRED     | ALFRED-Dance.apk              |
| 2 | ALFRED's Puzzle Arena | ALFRED-Puzzle.apk             |
| 3 | Detective ALFRED      | ALFRED-Detective.apk          |
| 4 | ALFRED's Back Trainer | ALFRED-Backtrainer.apk        |
| 5 | ALFRED's Balance Bike | ALFRED-Bike.apk               |

Table 1: Game File Names

## 6 Execution and Usage

Running the installed apps works just like running any other app obtained from the Google Play Store. Find the corresponding entry in the list of applications locally installed, and tap it once to start it. For detailed usage instructions, please refer to chapter 3 of this document.

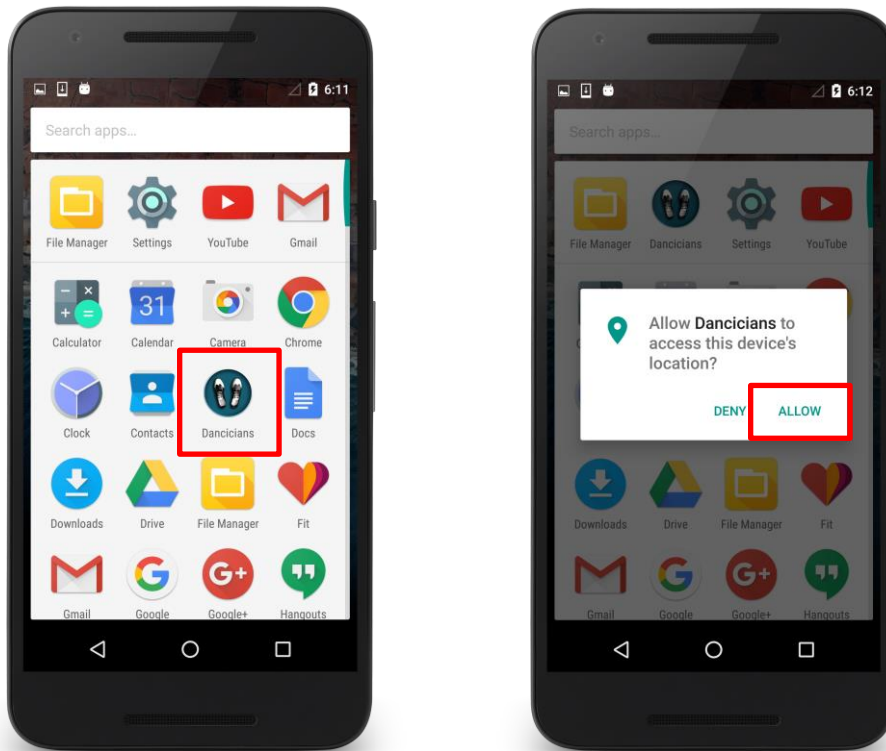


Figure 14: Running the Installed Games



## 7 Test Results

On a technical level, all games were tested multiple times during the initial development phase to ensure their stability. Regarding usability tests, the ALFRED Back Trainer has been extensively tested by CHA in a 12 weeks study with impressive results – referring to both the fun part (user/game experience) and the serious part (intended health effects) – see D 8.3.2 with a comprehensive summary of the tests. Furthermore, the game prototype Dance with ALFRED has been part of demonstration/testing activities for the pilots, but no scientific evaluation studies about the effects have been carried out.

|   |   |                     |                      |                  |
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## 8 Target Performance

The following key performance indicators (KPIs) have been evaluated during the usability tests (see chapter 7). They have been assessed using both questionnaires handed to the study participants, and by relying on logging files that automatically document certain types of behavior. The end users have been informed about the existence of this logging mechanism and have been able to disable it manually at any time.

| Topic       | Description   | Target KPI  |
|-------------|---|---|
| Ease of Use | It is important, that the intended end users of the ALFRED system find all games easy to use. This includes being able to start, run and handle a game without (or with limited) assistance by another person or detailed written instructions.   | During the initial focus group sessions (in April 2016), the test users will be asked to start, run and handle the games, first without an introduction and then again after an introduction has been provided by a supervisor. The target performance for this KPI is that 4 of 10 users are able to handle the respective game on their own without having received an introduction, and that 8 of 10 users are able to handle the game on their own after having received an introduction.   |
| Reliability | Applications that crash or do not function as intended in another way are prone to frustrate users, especially those without a technical background. To this end, the games should not terminate in an unexpected manner or show any other kind of unpleasant behaviour.                          | During the focus group sessions, the supervisors will be asked to document all game related bugs encountered by the end users. The target performance is to receive no reports in this regard. During the pilot tests (May 2016), the application behaviour will be logged and all crashes documented. The target performance is to receive no crash logs.  |
| Usefulness  | ALFRED's serious games serve a dual purpose. On the one hand, they are supposed to entertain. On the other, they are supposed to increase the overall physical and cognitive activity of users. The verification that this is indeed the case is important to assess the usefulness of the games. | During the focus group sessions, the participants will be asked to rate, how much fun they had playing the games and if they believe that they would also want to play the games when being on their own. All ratings will be done on a 5 point Likert scale (with 1 meaning "not fun at all"/"Will never play on my own" and 5 being "extremely fun"/"Will definitely play frequently on my own"). The target performance is that the perceived entertainment of all games is rated 3 or above ("useful", "very useful" or "extremely useful"). During the pilot tests, the number of interactions with all games will be logged. This indicates the amount of physical and cognitive activity caused by the games. The target performance is that every game will be accessed at least once a week. |

Table 2: KPIs for WP7 Extensions/Games

|   |                       |   |                      |               |
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## 9 Summary

This deliverable describes the final versions of the ALFRED games, which are part of ALFRED's project pillar IV ("Serious Games for Physical & Cognitive Impairments Prevention"), and therefore developed within the project's work package 7. The games are supposed to both entertain their players, and to ensure that they are engaged in physical and/or cognitive activities. This document has introduced all five of these games – "Dance with ALFRED", "ALFRED's Back Trainer", ALFRED's Balance Bike", "ALFRED's Puzzle Arena", and "Detective ALFRED" – and provided instructions how to install and run them. During the spring of 2016, the project's end user partners CHA has extensively tested/evaluated the ALFRED Back Trainer.

|   |   |                     |                      |                  |
|---|---|---------------------|----------------------|------------------|
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