



**POLITECNICO**  
**MILANO 1863**

## **RASD**

*Software Engineering 2 Project - TrackMe*

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# 1 Introduction

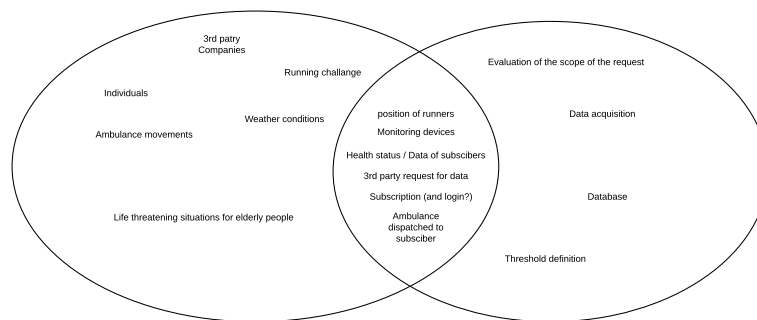
## 1.1 Purpose

TrackMe is a company that wants to offer the following services to individuals and to third party companies:

- Data4Help, that allows people to register and provide their data to TrackMe through devices such as smartwatches or smartphones, while allows companies to get data from a particular group of people;
- AutomatedSOS, that allows individuals, mainly elderly people, to register in order to have their health monitored and to receive an immediate assistance in emergency cases;
- Data4Run, a sport-oriented service that tracks athletes participating in a run. It allows organizers to define the path of the run, participants to enroll to the run, and spectators to see on a map the position of all runners during the run. Track4Run will exploit the features offered by Data4Help

## 1.2 Scope

The *The World and the Machine* approach is used in defining the scope of the project. By defining the real world entities that interact with the system and the properties of the system itself we can determine the intersection between the two sets: the *shared phenomena*.



The system-to-be uses 3 components with different roles in order to work:

- **Data4Help SmartWatch App:** Acquires the data from the smart-watch sensors (heart rate, sleep quality, position, physical activities) and sends them via Bluetooth to the Data4Help Mobile App
- **Data4Help Mobile App:** Gathers data from the smartwatch, shows various statistics, and sends them to the Data4Help Core Database. Each user can choose which service subscribe to
- **Data4Help Website:** Gives third-party companies the ability to request data, either anonymized or user specific. Moreover, it allows run organizers to define the path of the run and the spectators to see the position of all runners on a map.
- **Data4Help Core:** is intended to connect all other components together providing the logic of the application. It is also responsible for the acceptance of all third-party requests of data. It also evaluates the health status of individuals deciding whether they are at risk or not.

The list below shows the main goals the system should be able to accomplish:

- **G0:** The system should be able to monitor user's health parameter.
- **G1:** The system should be able to show acquired data via the Mobile App and the Website.
- **G2:** The system should allow users to register by providing their Fiscal Code or their Social Security Number, an email and a password.
- **G3:** The system should allow companies to register.
- **G4:** The system should allow registered companies to request data from an anonymized group of individuals, only if individuals in the group are more than 1000.
- **G5:** The system should allow registered companies to request data from an individual person, only if individuals accept the request.
- **G6:** The system should allow users to accept or decline a company request for their specific data.
- **G7:** The company should be able to pay through the system in order to buy data queries/subscribe to plans.
- **G8:** A user should be able to enroll in the *AutomatedSOS* at any time.
- **G9:** The system should be able to react to the lowering of the health parameters below threshold in less than 5 seconds and send the position of the person to the ambulance system.

- **G10** The system should allow run organizers to register.
- **G11** If a run organizer is registered, it can define a run i.e. it can define the path that the participants should follow.
- **G12** A user should be able to enroll to a run.
- **G13** Spectators of a run should be able to see each participant's position on a map.

### 1.3 Definitions, Acronyms, Abbreviations

<b>i.e.</b>	<i>Id est</i> , that is
<b>w.r.t</b>	with respect to
<b>w.l.o.g.</b>	without loss of generality
<b>The company</b>	TrackMe
<b>BLE</b>	Bluetooth Low Energy
<b>RAM</b>	Random Access Memory
<b>UI</b>	User Interface
<b>GPS</b>	Global Positioning System
<b>API</b>	Application Programming Interface

### 1.4 Revision history

### 1.5 Reference documents

—**REFD1**— The World And The Machine

—**REFD2**— WearOS

—**REFD3**— GlassFish Minimum Requirements

### 1.6 Document structure

This RASD document is made of the following parts:

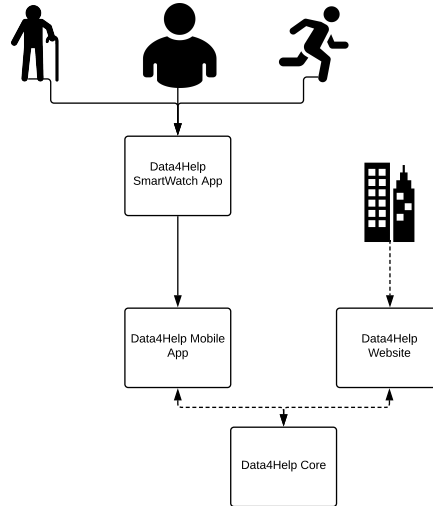
- **Introduction:** this section provides a general and low-detailed description of the system-to-be.
- **Overall description:** this section provides general aspects of the system, like interfaces, constraints, domain assumptions, software dependencies and users' characteristics.

- **Specific requirements:** this section provides scenarios, use cases and a set of diagrams in order to represent the functionalities of the system-to-be.
- **Appendix:** this section contains the Alloy model used to model and verify the system, a list of the tools used to develop this document and the working hours tracking table.

## 2 Overall description

### 2.1 Product perspective

Data4Help Core is the central component of the system that connects all the other parts of the structure. It has the role of .....



The Smartwatch App should be directly connected to the Mobile App to acquire data and let them be shown in the smartphone. In turn, the Mobile App has to communicate with the Data4Help Core that will register the data of the user. The Data4Help Website should communicate with the Data4Help Core as well in order to query directly on the company database.

#### 2.1.1 User Interfaces

##### **Data4Help Mobile App:**

The Mobile app should offer an easy interface aiming a user friendly experience of the customers. It should be possible to open a menu to navigate through the sub-sections. All the main functions (i.e. see history of activities, see account information) should be easy to access from any sub-section of the app. Descriptions of the pages have to be brief and concise. To see the details of the statistics there should be an info button that shows detailed description about the related data. If subscribed to the AutomatedSOS service, there should be a page showing the active controls on the user. In case of using the Track4Run service, there is also the possibility to see the map of a programmed run and seeing on the map all the participants, and their positions. More detailed info of the runners can be shown by tapping on their icon on the map.

The application must follow a proper design for every different mobile operating system:

- Android - Material Design
- iOS - ModernUI

The application should support all the screen resolutions available and optimize the item placement on the screen in the same way for every compatible device.

The user can configure the graphic of the widget visible from the Smartwatch only using the Mobile App component.

**Data4Help SmartWatch App :** The Smartwatch app should provide **widgets** that let the customer see their daily activity. There should be one widget for every type of data acquired by the device:

- Sleep monitoring
- Heart rate (if available)
- Pressure (if available)

The user can receive notifications about his activities in the Smartwatch and delete them through it.

**Data4Help WebSite:** The Website should offer an easy interface aiming a user friendly experience for the subscribed companies. The main menu should be visible on the top of the page, and must be used to navigate through the sub-sections. All the main functions (i.e. acquired data, account information, etc) should be accessible from any sub-section of the web page. Descriptions of the pages have to be clear and exhaustive.

**Data4Help Core:** This component does not have a user interface since it is intended to be accessible only by the qualified staff that manages it.

### 2.1.2 Hardware Interfaces

**Data4Help Mobile App:** The application should require the location services in order to work. If GPS is unavailable on the mobile phone, it can be requested to the Smartwatch app and viceversa. If both unavailable, the application wouldn't work and show an error window to notify the user. The app should also require a connection from either mobile network or Wi-Fi, but is sufficient to turn it at least once per day. If not, the app will notify the user asking to turn on connectivity.

**Data4Help SmartWatch App:** As written for Data4Help Mobile app, but also requires Bluetooth connectivity. If not available, an error message will appear on the Mobile app.



**Data4Help WebSite:** There is not any special hardware interface needed for the WebSite component.

**Data4Help Core:** There is not any special hardware interface needed for the Core component.

### 2.1.3 Software Interfaces

- **Data4Help SmartWatch App:** Development will focus on the production of a WatchOS and a WearOS app in order to properly communicate with their respective smartphone app.  
As an app built for the latest version of those OSes is also backwards compatible with their previous versions, there are no particular *minimum version* requirements. By developing an app for WatchOS and WearOS, the app will reach the 84% of all available Smartwatches.
- **Data4Help Mobile App:** Due to the fact that iOS and Android are the only OSes that provide a seamless integration with their smartwatch counterparts, the app will be developed for those platforms only. In order to support smartwatch communication there is a minimum version required for those OSes, namely:
  - Android > 4.4 (API level 19) (about 94,7% of devices)
  - iOS > 9.3 (about 96,3% of devices)
- **Data4Help Website:** It will require the use of a modern Web Browser to be accessed. It will work either on desktop and mobile Web Browsers.
- **Data4Help Core:** As the *Core* component will need only to provide **REST** endpoints for the communication (with ambulance, Website, App) there are no specific requirements on this component.

### 2.1.4 Communication Interfaces

In the system there are 2 types of communication.

1. The Mobile App and the Web Site need a bidirectional channel with the Core component of the system to operate properly.  
This can be achieved by providing a REST API on the *Data4Help Core* component.
2. The Smartwatch App needs a direct connection with the Mobile app to give it user's data.  
The communication between the smart device and the smartphone is achieved via *BLE* and, once the channel is established, the Smartwatch App sends JSON messages to the Mobile App concerning all activities performed from the last synchronization.

```

{
  userId: "ka8c57pno3",
  last_synchronization: "1512518400",
  heart_rate: {
    "1512518400": 60,
    "1512519000": 61,
    ...
  },
  activities: {
    "1512518400": {
      "_lat": "",
      "_long": ""
    },
    "1512519000": {
      "_lat": "",
      "_long": ""
    },
    ...
  }
}

```

### 2.1.5 Memory Constraints

- **Data4Help Smart Watch App** As the devices on which the app will run have generally less than 1GB of RAM and less than 16GB of non volatile storage the smartwatch app should offload all the unnecessary computations to the mobile app, therefore reducing its size (which could be kept under 10MB) and its memory footprint.
- **Data4Help Mobile App** Based on the functionalities it will provide, the overall size of the app should not exceed 50MB, without taking into account the saved user data.
- **Data4Help Core** The server on which the *Core* component will run will need at least 2GB of RAM and 250MB of non volatile storage in order to host the application. An additional 2TB of storage should be added in order to retain the user-generated data.  
An estimate on the number of users using the service will suggest at least 64GB of RAM in order to ensure responsive operations for all the services provided.

## 2.2 Product functions

This chapter listing all the functionalities that the system-to-be must offer.

### 2.2.1 Functional requirements

Functional requirements for every system component:

Data4Help Mobile App

- Users can register
- Users can log-in
- Users can only have one account
- Logged-in users can edit their account info
- Logged-in users can see their data statistics
- Logged-in can specify the nature of the daily activities (i.e. running, biking, swimming, hiking)
- Logged-in users can edit their account info
- Logged-in users can define a path for their running activity
- Logged-in users, if subscribed to AutomatedSOS service, can see the monitoring status of their health
- Logged-in users, if subscribed to Track4Run service, can register to a run, if organized via the Track4Run service
- Logged-in users can see a run information, if organized via the Track4Run service

Data4Help Smartwatch App

- Users can see their health data in real time (i.e heart rate, pressure)
- Users can see their sleep monitoring of the previous night
- Users can configure the widgets showing their health activity
- Users who are participating in a run can see their timing and position through the screen of their Smartwatch, if the run is organized via Track4Run service

Data4Help Website

- Companies can register
- Companies can log-in
- Logged-in companies can see their history and account information
- Logged-in companies can subscribe to a payment service of Data4Help

- Logged-in companies can update their account information
- Logged-in companies can query on some group of individuals data previous subscription to an appropriate payment service
- Registered companies can request access to data of individuals..
- Logged-in companies can access to an individual data, if has the rights to do it (i.e. an Hospital that wants to monitor health status of a patient)
- Logged-in users, if subscribed to Track4Run service, can organize a run
- Logged-in companies can export data previously queried using Data4Help
- Organizers of a run, if subscribed to Track4Run service, can define the path for that run

#### Data4Help Core

- Can compute queries coming from Webpage component in the TrackMe Database
- Can charge companies on their payment method respecting Track4Me pricing policy
- Can access the Track4Me database through a web page based front end
- Can send online notifications via SMS to all users
- Can send online notifications via email to all users
- Can save and store permanently user data.
- Can send online notifications via the Mobile app to its users
- Can communicate directly with the nearest hospital *API*.
- Can provide a payment method for data requested by companies.
- Can call the Ambulance providing geographical position and critical health parameters to the emergency employee
- Can compute for every AutomatedSOS user which are the threshold value to take care of for each health parameter
- Can detect the geographical position of runners who are using the service Track4Run
- Can handle run notifications from devices of users using Track4Run (i.e. current runner position and timing)

### 2.2.2 Non Functional requirements

Non-functional requirements:

- Users should be encouraged not to be in trouble for being monitored by companies
- Users should be encouraged to use the Mobile app with their friends
- Users should be encouraged to keep their smart watch all day and all night
- Nurses and doctors should encourage their patients to use the Mobile app
- Companies should be encouraged to use the service by other firms

### 2.2.3 Company pricing policies

The following policies are exclusively referred to the Webpage component services offered to Companies

- **Basic:** The company can query data choosing only from users of one city, one time per day **Price:** 15€/month
- **Basic - Unlimited:** : The company can query data choosing from users of only one city, with no limits **Price:** 50€/month
- **Medium:** The company can query data choosing only from users of one region of Italy, five times per day **Price:** 100€/month
- **Medium - Unlimited** The company can query data choosing only from users of one region of Italy, with no limits **Price:** 200€/month
- **Premium** The company can query data on all Data4Help users, with no limits **Price:** 1000€/month

Also, companies are also allowed to purchase single queries, with price:

- On a city: 5€/query
- On a region: 20€/query
- On all users of Data4Help: 50€/query

The following policies are exclusively referred to government companies who want to monitor individuals (i.e. hospitals, medical clinics)

- Maximum of 100 patients: 500€/month

- Maximum of 1000 patients: 1500€/month
- No limit on maximum patients: 5000€/month

It is not expected to be a pricing policy for Mobile App and Smartwatch App users i.e. the Apps will be free.

As specified in the Functional requirements, the Data4Help Core component is in charge to calculate the final price for every user using the service.

## 2.3 User characteristics

Here is shown the distinction of the users of the Data4Help services.

The common characteristic for all Customers is that all users of the service must be logged in to use it.

The users of using all possible components can be distinguished in 2 main categories:

- **Data4Help Individuals Customers:** Users who use the app to take advantage of services offered by it.
- **Data4Help Companies Customers** Thirty-Party users who can be divided once more in 2 subcategories:
  - Companies who wants to use data for marketing purposes
  - Public companies or clinics who wants to monitor the health status of an individual patient
- **Data4Help staff users:** Represent a group of developers. They have a deep knowledge of all the components and can modify parameters/solve issues.

## 2.4 Constraints

### 2.4.1 Regulatory policies

As Data4Help will handle sensitive user data (e.g. name, birth date, location, state of health) the Application must treat them respecting the local laws, in particular the GDPR European law. Data attributable to the user must be anonymized in order to appear in a Company's search, unless the user has given explicit authorization to that company.

### 2.4.2 Security consideration

All data transferred between Data4Help Mobile App and Data4Help Core must be encrypted in order to minimize the possibility of a man-in-the-middle attack or any unauthorized access. For the same reason, all com-

munication between Data4Help Web site and Data4Help Core must be encrypted. The Bluetooth communication between Data4Help SmartWatch App and Data4Help Mobile app is already encrypted by the Bluetooth stack itself.

## 2.5 Assumptions

Each part of the system is based on the following domain assumptions.

- **Data4Help SmartWatch App**

- | **D1** | The *SmartWatch App* stays always connected via **BLE**, during synchronization, to the *Mobile App*
- | **D2** | The *Mobile App* is always installed on a SmartWatch.
- | **D3** | The SmartWatch on which the *Mobile App* is installed has an accelerometer, a gyroscope, a GPS antenna, and an heart rate sensor.
- | **D4** | Data taken from the previously mentioned sensors are always trusted.
- | **D5** | Data taken from the previously mentioned sensor are always consistent.
- | **D6** | The user keeps the SmartWatch on his/her wrist during day and night.
- | **D7** | User position is known with absolute certainty.
- | **D8** | GPS signal is stable.

- **Data4Help SmartWatch Mobile App**

- | **D7** | Every phone on which the app will be installed have sufficient system resources to properly display the app *UI*.
- | **D8** | Synchronization always happens, even if the app is backgrounded, when it has to.

- | **D9** | The *Mobile App* stays always connected with the *Core Component* during any data exchange (being login, registration, synchronization, etc).
- | **D10** | The phone on which the app will be installed has an internet access and a GPS antenna.
- | **D11** | If the user uninstalls the *Mobile App* it also uninstalls the *SmartWatch App*
- | **D12** | Users of *Automated SOS* have a stable internet connection.

- **Data4Help Core**

- | **D11** | The component can handle multiple request simultaneously.
- | **D12** | The component's database has proper redundancy.
- | **D13** | Data received by the app are instantly stored in the database.
- | **D14** | Every Hospital in which the *AutomatedSOS* service is active has an *API* to call the ambulances.
- | **D15** | The Hospital *API* service is active 24/7
- | **D16** | Every company willing to buy or subscribe to data has a credit card.
- | **D16** | The user has a valid Fiscal Code or Social Security Number.

- **Data4Help Website**

- | **D14** | The website is hosted on a server close enough to the users to ensure minimum latency.
- | **D15** | The user has one of the following browsers: Google Chrome, Opera, FireFox, Microsoft Edge.
- | **D16** | If a company wants to access some data



## 3 Specific requirements

### 3.1 Functional requirements

#### 3.1.1 Scenarios

The functional requirements listed in the subsection 2.2.1 must be implemented to let the system-to-be work well.

Here there are shown some scenarios to better understand the system usage from multiple viewpoints.

##### *Scenario 1* **User registration and log-in**

Pierluigi is a Runner, he runs at least once per day and is very focused on the performance he gets during the training session. In order to do so, he downloaded the Data4Help App on both its Smartwatch and on its Mobile phone, so he registered using its email, confirmed the email, and then inserted personal data such as Age, Nationality, City where he lives and the sport he practices. Once having completed the subscription, he logs in through the Mobile app, turns on Bluetooth on smartphone and smartwatch and automatically the Data4Help apps synchronizes in both his devices. So he set run activity function on Mobile app and starts the run.

##### *Scenario 2* **User parameter consulting**

Matteo has just waken up in the morning after a long night. However he feels very tired and acciaccato EDIT like if he hasnt slept at all. He suspects that something happened, so, in order to verify its hypotesis, he sees the the Data4Help widget on its smartwatch for sleep monitoring and finally, finds out that the quality of the sleeping process was very low. In order to see the details of the sleep monitoring, he opens the mobile app and check the reasons of the bad night, and he finds out that its heart rate was really speedy on the first hours and he moved a lot during the night.

*Scenario 3* **Data synchronization between devices** Letizia is a student that has just finished her Parkour lesson at Milano Gravity sport center. She would like to see the calories she consumed, the maximum heart-bpm and other health parameters. Luckily, she has a Smartwatch with Data4Help application installed. Firstly she turns on the Bluetooth of her smartphone, that automatically synchronizes data with the smartwatch app, then she opens the mobile app of Data4Help and gives a look of the recent statistics.

##### *Scenario 4* **Hospital registration and purchase**

Villa Serena is a clinic set in Jesi that wants to experiment an innovative way of monitoring their patients. To do so, the director of the goes to the website of the Data4Help services, subscribes using the institute email, click on Subscribe to a Premium service choosing the 1000-patient limited option. To guarantee he uses the service for a medical purpose only, he inserts the

RIA code of Villa Serena and waits a mail confirming the subscription, then he adds a payment method and complete the operation. After completing the subscription, he asks to all the doctors of the clinic to subscribe to the Web page of Data4Help using the RIA code of the clinic.

*Scenario 5 Patient registration*

Dr. Verdi is a private doctor of Dermatology in Milan that wants to exploit the features of Data4Help to monitor his patients. To do so, he has already subscribed to a 100-Patient limit option using is Partita IVA code to verify he is a doctor. To use the service, he asked Maria, one of his patients, to download the Mobile app and subscribe to the service. Maria subscribes as a normal user using her mail and, when finished, communicates her email to the Doctor that, immediately, add Maria as her patient. Maria receives a notification asking if she agrees to be monitored by dr. Verdi (identified by his email), she clicks on accept.

*Scenario 6 Company subscription and purchase*

Clear-Water Spa is a company that produces energy drinks for runners that wants to start a marketing campaign in Milan. In order to know where people usually do activities in Milan, they decides to subscribe to a payment option of Data4Help services The Marketing director goes on their Web page, subscribes to the service using the e-mail and Partita Iva, inserts a payment method and purchases the 1-City unlimited query option, specifying Milan as the preferred city. Then he starts to query on the city, inserting:

- Age of the people to search (i.e. from 20 to 25 year old)
- The hour when to search people (i.e. from 9.00 to 10.00)
- The health parameter filters (i.e. heart rate  $\geq$  100 bpm, pressure  $\geq$  130 mmHg)

The Data4Help system firstly checks if the query is satisfiable (i.e. is too specific), if yes, it shows a map with most frequent places of Milan where people go, with average of every health parameter registered from their users.

*Scenario 7*

## 4 Hours tracking

Date	Nicola Fossati	Daniele Montesi	Francesco Sgherzi
15/10/2018	2,5	2,5	2,5
20/10/2018	0	4,0	4,0
21/10/2018	1,5	1,5	2,5
24/10/2018	0	2,5	0
27/10/2018	3	2	0
29/10/2018	5	5	5