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*Version Hystory*

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# **Introduction**

## **Purpose**

This document is intended to describe the use cases of the FIDTCT FID-TCT created by KIRANET s.r.l. (often for simplicity also just “KIRANET”).

## **Description**

FIDTCT manages the "Remote Monitoring" activity of a patient. The patient, wearing an appropriate device (smartwatch), is constantly monitored. To make remote monitoring possible, the following elements are necessary:

* a smartwatch (XXXXXX);
* an Android App installed on the same smartwatch, called FidWatch;
* an Android App called Fidcare;
* a module of Fidcare, called TCT.

This document describes the use cases related to TCT.

Upon first boot, the smartwatch will display a QR code identifying the device. The patient (or relative, in case the patient is not independent), downloads the FIDCARE app on their smartphone. After logging in, they will be able to access a "Telemonitoring" section. At the first use, it will be asked to activate the camera to read the smartwatch's QR code. The App will then be prepared to read the QR Code using OCR technology. In this way, a unique association is obtained between the patient, already associated with the Android App, and the smartwatch. When the association is verified, the App will retrieve the GPS location of the patient, which will be helpful to monitor possible departures of the patient from a defined 'safety' perimeter. Subsequently, if through the FidCare module the number to be contacted in case of pressing the SOS button of the smartwatch has not yet been configured, it is asked to the patient to enter the phone number before enabling the actual operation of the smartwatch. If the patient is not independent, the operation can be carried out by a relative and/or by the general practitioner.

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The smartwatch is capable of accommodating a SIM, communicating data over the internet, and must be autonomous and independent from the smartphone. Independence from the smartphone is crucial considering the type of patient this solution is intended for (patients with dementia, amnesia, Alzheimer's, etc.). At the first use, the association between smartwatch and patient is required and, after this association, patient monitoring will begin. Identification is mandatory for the use of the smartwatch and the consequent exchange of information. The smartwatch includes the FidWatch app that allows monitoring the patient and recording all information.

In the TCT module, it is possible to set a reception timing (in minutes) representing the interval in which the smartwatch sends to the FIDCARE platform the values of the parameters detected by it (communicating with it by MQTT protocol). The following parameters are specifically monitored:

1. Heartbeats;

2. The patient's exit from a 'safety' perimeter and their position;

3. The number of steps;

4. Possible falls;

5. Possible SOS calls.

In particular, ad-hoc algorithms need to be prepared for the parameters listed above, implemented in the FidWatch app.

Among the objectives of using the smartwatch is to verify if the patient has moved too far from their home, exceeding a 'safety' perimeter. For this purpose, a point C representative of the "center of the patient's home" is introduced (obtained through a localization of the patient at the time of association with the device and using Google APIs to get latitude and longitude) and a radius R (in the order of hundreds/thousands of meters). Given the magnitude of the radius, the determination error of C is considered acceptable. If greater accuracy is needed and thus the goal is to understand when the patient leaves their home, it is necessary to implement an algorithm allowing that, at first configuration, latitude and longitude are recorded in the home (this requires the first configuration to take place inside the patient's home).

Regardless of reception timing, the smartwatch provides instant notifications in case of:

1. Falling;
2. Heartbeat anomalies;
3. Whenever the patient crosses a safety perimeter. A maximum distance is set between the patient's location and home. If this distance is exceeded, the system generates an alert. The notification allows viewing a map with the smartwatch's location;
4. The battery status;
5. SOS button press.

All information and notifications are sent concurrently to the TCT module (and thus to the FIDCARE platform) and Android app.

The smartwatch has an SOS button that, if pressed, starts a call to a phone number entered and specified in the TCT module during setup.

Each parameter logged by the device is sent to the platform for display in the patient's medical record and data is updated at every reception timing interval. In the patient's medical record, in the 'Remote Control' section, there is a 'Readings' section. In this section, the values ​​recorded by the smartwatch are shown. In particular, for heart rate and the number of steps, the values ​​will be updated every X minutes. In case of falls, SOS calls and departures from the safety perimeter, the values ​​are updated only if the events are effectively recorded. The readings can be graphically displayed. In particular, it is possible to view the trend of the readings on a daily, weekly, monthly and/or quarterly basis, depending on the parameter.

In TCT, the minimum and/or maximum thresholds are set from which an alert is generated (for example for anomalies related to heart rate or to inform that the patient has left the home and to detect his position in real time). Finally, in the TCT module, the categories of users who should receive notifications in case of generating an alert following abnormal readings are defined. Each notification, based on the parameter it refers to, will have one or more categories of recipients and possible transmission channels, which can be defined during setup.

When an alert is generated, it is always sent to an operational center, whose task is to take charge of the report and close it after completing its tasks.

## **1.3. Definitions, Acronyms and Abbreviations**

Below are all the definitions, acronyms and abbreviations required to interpret the document correctly.

|  |  |  |
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|  | **Definition** | |
| **1.** | **Remote Control** | It is generically defined as an automation solution that includes supervision through software and data collection through a network of devices and tools geographically distributed on a complex system. |
| **2.** | **Operations Center** | Operators who handle reports, notifying the competent staff and/or relatives of the assisted individuals. |
| **3.** | **Safe Boundary** | It is defined starting from the coordinates of the residence where the assisted person is located, through a radius R. The perimeter represents an area in which the assisted person can move without generating an alert notification. |
| **4.** | **Alert** | It is generated at the moment when a value recorded by the device and sent to the system, when compared with the thresholds set for each individual, is found to be higher than a maximum threshold, lower than a minimum threshold, or between two defined thresholds. |
| **5.** | **Notification** | It is generated by an alert. It is an internal notification to the system that can be viewed once you have logged in. |
| **6.** | **Heart Rate** | Number of heartbeats per minute. Measured in bpm (beats per minute). Alerts are generated for rates higher or lower than preset thresholds. |
| **8.** | **SOS called** | Following the press of an SOS button on the smartwatch, a call to a pre-configured number is generated. The number of calls made by an assisted person is tracked. |
| **9.** | **Fall** | An alert is generated if falls from the person being assisted are recorded. The number of falls is tracked to evaluate their frequency. |
| **10.** | **Number of Steps** | The steps that a patient takes during the day are counted every X minutes in order to assess their motor activity. |

|  |  |  |
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|  | **Acronyms** | |
| **1.** | **TCT** | Remote control |

## **1.4. Reference documents**

Internal documents:

* K01720.GUI.01
* K01720.SDD.01
* K01720.USR.01

External documents:

* IEEE/ANSI 830-1993 “IEEE Recommended Practice for Software Requirements Specifications”
* FDIS 12207, Systems and software engineering - Software life cycle processes
* Using a Single Business Pattern with the Rational Unified Process (RUP), IBM Redbooks Paper
* From Waterfall to Iterative Development – A Challenging Transition for Project Managers
* IBM Rational Unified Process, <http://www-128.ibm.com/developerworks/rational>

Applying Requirements Management with Use Cases, IBM Rational.

1. **Preliminary assumptions**

## **2.1 Assumptions**

* The patient owns a smartwatch and is registered on the platform.
* To access the Telemonitoring module, any logged-in actor must access the "HOME CARE" section from the Homepage.
* When the logged-in actor is the patient and/or a relative, once the access section (hospital, outpatient, home care) has been chosen, the patient's personal area is displayed directly, in which there will be an area dedicated to Telemonitoring (logged in or associated with the relative/caregiver).
* When the logged-in actor is the doctor, once the access section (hospital, outpatient, home care) has been chosen, all the doctor's patients are displayed. The doctor chooses the patient whose personal area he wants to view, in which there will be an area dedicated to Telemonitoring.

## **2.2 Component Diagram TCT**

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Diagramma 1: Component Diagram TCT

## **Actors**

In this section, the actors involved in the use case model are described and how they are involved. In particular, the following figures should be considered actors in the system:

* **MMG**: freelance professional affiliated with the National Health Service. The two main types of general medicine doctors are the Primary Care Physician (or Family Doctor) and the Continuity of Care Physician (still more widely known as Out of Hours Doctor).
* **Patient**: A person registered among those entitled to the assistance services of an entity.
* **Family Member**: A user who is permitted to access the clinical information of the assisted person.

1. **User stories to refine**

The use cases of the Telecontrol module are divided into four User Stories:

1. Settings configuration;
2. Thresholds definition;
3. Viewing measurements and alerts;
4. Recording parameters.

**4.1 User Story 0: Setting configuration**

In order to personalize the process for each patient, it is possible to configure certain settings. Specifically, these can be configured:

* The receiving timing (in minutes), that is, the time interval between receiving one value and the next;
* The patient's location useful for defining the safety perimeter and detected when the association between the smartwatch and the patient is made;
* The number to track in case the patient himself presses the SOS button.

In the configuration interface, you can view the part and serial numbers of the smartwatch associated with the patient.

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Diagramma 2: Use Case Diagram User Story 0

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| **TCT: US0.001 – Access the "Settings" section** |
| **Description:** The actor accesses the settings configuration interface in the 'Configuration' section of the FID-TCT application. Specifically, in this section, the timing for receiving information from the device is configured, as well as the number to contact in case of SOS button press, and the location tracking of the user. |
| **Other actors:** Configurator. |
| **Pre-conditions** |
| **Main Scenario**   1. The actor accesses the 'Configuration' section. 2. The system displays the 'settings' sections. 3. The actor accesses the 'settings' section. 4. The system displays a screen with the information to be configured. 5. The actor navigates the screen. |
| **Alternative flows**  **Alternative flow no 01**   1. If the actor at step 5 of the main flow fills in the blank fields, the use case TCT: US0.002 - Configure the parameters of the "Settings" section is initiated. |
| **Exceptions** |
| **Reference Tables: Table no. 1** |
| **Rference diagrams: Diagram no. 2** |
| **Reference GUI: Omissis** |

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Table 1: Settings configuration

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| **TCT: US0.002– Configure the parameters of the "Settings" section.** |
| **Description:** The actor accesses the 'Configuration' interface of the Remote Control module. Specifically, in this section are configured the timing for receiving information from the device, the number to be contacted following the pressing of the SOS button, and the 'Localization of the assisted person', which is detected by performing a localization. It is possible to get the latitude and longitude of the home. The parameter is useful for monitoring the exit of the assisted person from a safety perimeter, defined by a radius 'R', or in cases of necessity from their own home. |
| **Primary actors:** Configurator. |
| **Pre-conditions** |
| **Main Scenario**   1. The actor accesses the 'Remote Control' section and clicks on "Configuration". 2. The system displays a screen with the information to be configured and the location already defined during the association between smartwatch and assisted person. 3. The actor fills in the fields and saves. 4. The system saves the configuration and notifies the smartwatch. |
| **Alternative flows** |
| **Exceptions**  **Exception no. 01**   1. At step 3, the actor saves without filling out the mandatory fields. 2. The system displays an error message "Fill in the mandatory fields". |
| **Reference table: Table no. 1** |
| **Reference Diagrams: Diagram no. 2** |
| **Reference GUI: Omissis** |

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GUI 0- Settings configuration

* 1. **User Story 1: Thresholds definition**

The general practitioner and/or a family member define the thresholds for each parameter to be monitored. The thresholds are necessary to generate an alert in case of abnormal values. Once defined, the thresholds are inserted into a table and can be modified and/or deleted by the user who defined them.

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Diagram no. 3: Use Case Diagram User Story 1

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| **TCT: US2.001– Access the 'Threshold List' section** |
| **Description:** The actor accesses the threshold creation interface of the Telecontrol module. In this section, minimum and/or maximum thresholds for the generation of alerts are set. |
| **Primary actors:** MMG, Relative. |
| **Pre-conditions** |
| **Main Scenario**   1. The actor selects the sub-option 'Thresholds'. 2. The system displays a form for parameter selection. 3. The actor selects a parameter from the list. 4. The system searches for the thresholds related to the given parameter. 5. The system shows the threshold list defined for the given parameter. |
| **Alternative flows**  **Alternative flow no. 01**   1. If in step 3 of the main flow, the actor uses the 'create' feature, the use case TCT: US1.002 - Create threshold is initiated.   **Alternative flow no. 02**   1. If at step 3 of the main flow the actor uses the functionality of displaying the details of a created threshold, the use case TCT: US1.003- Display the details of a created threshold is started.   **Alternative flow no. 03**   1. If at step 3 of the main flow the actor uses the 'deletion' function of a created threshold, use case TCT: US1.005 - Delete a threshold is initiated. |
| **Exceptions** |
| **Reference tables:** |
| **Reference Diagrams: Diagram no. 3** |
| **Reference GUI: Omissis** |

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GUI no. 0- Threshold list

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| **TCT: US1.002 – Insert threshold** |
| **Description:** The actor insert thresholds associated with a parameter. |
| **Primary actors:** MMG, Relative. |
| **Pre-conditions**  The main scenario of the use case TCT: US2.001 has been executed. |
| **Main Scenario**   1. The actor clicks on "add threshold". 2. The system shows an interface with fields to be filled out. 3. The actor fills out the fields and clicks on "save". 4. The system saves the set threshold and displays it in the list. |
| **Alternative flows**  **Alternative flow no. 01**   * 1. At step 3 of the main flow, the actor clicks on "cancel".   2. The system closes the threshold creation interface and displays the list of thresholds associated with the selected parameter unchanged. |
| **Exceptions**  **Exception no. 01**   1. The actor in step 3 of the main flow does not fill out either the 'Minimum Threshold' field or the 'Maximum Threshold' field and uses the save functionality. 2. The system displays an error message "Please enter at least one threshold". |
| **Reference Tables: Table no. 2** |
| **Reference Diagrams: Diagram no. 3** |
| **Reference GUI: Omissis** |

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Table no. 2- Insert Threshold

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GUI no. 03- Insert Threshold

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| **TCT: US1.003– Display threshold details.** |
| **Description:** The actor displays the details of a threshold previously created and associated with a parameter. |
| **Primary actors:** MMG, Relative. |
| **Pre-conditions**  There is at least a threshold in the database. The main scenario of the us case TCT: US2.001 has been executed. |
| **Main Scenario**   1. The actor clicks on "view detail" for a given threshold. 2. The system searches for the threshold details. 3. The system displays the threshold details in a page with editable fields. |
| **Alternative flows** |
| **Exceptions** |
| **Reference tables: Table no. 2** |
| **Reference diagrams: Diagram no. 3** |
| **Reference GUI: Omissis** |

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| **TCT: US1.004 – Update threshold** |
| **Description:** The actor modifies a threshold previously defined for a parameter. |
| **Primary actors:** MMG, Relative. |
| **Pre-conditions**  At least a threshold exists in the database. The main scenario of the use case TCT: US1.003 has been executed. |
| **Main Scenario**   1. The actor modifies a field and clicks on save. 2. The system saves the changes and displays the updated list of thresholds of the selected parameter. |
| **Alternative flows**  **Alternative flow no. 01**   1. The actor at step 1 of the main flow clicks on "cancel". 2. The system returns to the previous screen. |
| **Exception**  **Exception no. 01**   1. At step 1 of the main flow, the actor does not fill in either the 'Minimum Threshold' field or the 'Maximum Threshold' field. 2. The system displays an error message "Enter at least one threshold". |
| **Reference tables: Table no. 2** |
| **Reference diagrams: Diagram no. 3** |
| **Reference GUI: Omissis** |

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| **TCT: US1.005– Delete a threshold** |
| **Description:** The actor removes a defined threshold for a parameter. |
| **Primary actors:** MMG, Relative. |
| **Pre-condition**  At least a threshold exists in the database. The main scenario of the use case TCT: US1.003 has been executed. |
| **Main scenario**   1. The actor clicks on "delete" for the given threshold. 2. The system deletes the threshold. |
| **Alternative flows** |
| **Exceptions** |
| **Reference tables:** |
| **Reference diagrams: Diagram no. 3** |
| **Reference GUI:** |

## **User Story 2: Display detections and alerts**

The general practitioner, the patient and/or a family member can view the measurements taken. The measurements related to six parameters can be displayed: heart rate, number of steps, number of SOS calls, number of falls, number of departures from the perimeter. In particular, in the case of heart rate and the number of steps, it is possible to display the value relative to the last update. The updates occur every X minutes, set by the configurator during the configuration of the settings. The values relating to the number of SOS calls, the number of falls, and the number of departures from home are updated each time a fall and/or an SOS call and/or a departure from the perimeter is actually recorded. The values are reported at the date and time of the last update. It is also possible to view the information in graphic form. Specifically, for the first three parameters, it is possible to display daily, weekly, and monthly graphs. For the number of SOS calls and for departures from the safety perimeter, monthly charts are available. While, for the number of falls, monthly and quarterly charts are available. Actors can also view the alerts generated following abnormal detections. In particular, alerts are generated for the following parameters:

-Falls;

-Departures from the safe perimeter;

-SOS calls;

-Heart rate beyond preset threshold;

-Battery status.

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Diagram no. 4: Use case diagram User Story 2

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| **TCT: US2.001 – Measurements taken.** |
| **Description:** The actor accesses the interface where the information showing the progress of the monitored activities is present. The values are reported corresponding to the date and time of the last update. It is also possible to view the information in graphic form. |
| **Primary actors:** Relative, MMG. |
| **Pre-conditions**  At least a measurement exists in the database |
| **Main Scenario**   1. The actor accesses the 'Measurements' area. 2. The system displays a page where it is possible to view the measurement related to the latest update for each parameter. 3. The actor navigates the interface. |
| **Alternative flows**  **Alternative flow no. 01**   1. If the actor at step 3 uses the chart viewing feature, the use case TCT: US2.002 - View detection charts is initiated. |
| **Exceptions** |
| **Reference tables: Table no. 3** |
| **Reference diagrams: Diagram no. 4** |
| **Reference GUI: Omissis** |

Omissis

GUI no. 0- Measurements

Table no. 3: Measurements

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| **TCT: US2.002 – Display measurement graphs** |
| **Description:**The actor views information related to parameter measurements in graphic form. The graphs can be weekly, monthly and/or quarterly depending on the parameter you want to display. |
| **Primary actors:** MMG, Relative. |
| **Pre-conditions**  At least a measurement exists in the database |
| **Main Scenario**   1. The actor accesses the 'Measurements' section. 2. The system displays an interface where it is possible to view for each parameter the measurements related to the last update. 3. The actor uses the graph viewing functionality related to one of the detected parameters. 4. The system opens a popup with the graphs available for the selected parameter. 5. The actor navigates the interface. |
| **Alternative flows**  **Alternative flow no. 01**   1. At step 5 of the main flow, the actor clicks on "close". 2. The system displays the detection interface. |
| **Exceptions** |
| **Reference tables: Table no. 3** |
| **Reference Diagrams: Diagram no. 4** |
| **Reference GUI: Omissis** |

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GUI no. 0- Display measurement graphs

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| **TCT: US2.003 – View Alert** |
| **Description:**The actor views all the received alerts. |
| **Primary actors:** MMG, Relative. |
| **Pre-conditions**  An alert has been generated for an anomalous measurement. |
| **Main Scenario**   1. The system generates an alert following the registration of an anomalous value for a monitored parameter. 2. The actor uses the alert display feature present in the system interface. 3. The system displays the list of all registered alerts. 4. The actor navigates the list. |
| **Alternative flows**  **Alternative flow no. 01**   1. The actor at step 4 selects a specific alert. 2. The system shows the detection screen highlighting the detection to which the alert refers.   **Alternative flow no. 02**   1. At step 4 of the main flow, the actor deactivates an alert in the list to indicate its resolution. |
| **Exceptions** |
| **Reference tables: Table no. 4** |
| **Reference Diagram: Diagram no. 4** |
| **Reference GUI: Omissis** |

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Table no. 4: View Alert

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GUI no. 06: View Alert

## **User Story 3: Parameter Values Recording**

Once the smartwatch is put on and paired, the device will record the parameters. Every X minutes (receiving timing), the device will send detections about the heart rate, the number of steps, and the location of the assisted person. The device records any departures from the safe perimeter, falls or SOS calls, notifying the system of these events.

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Diagram no. 5: Use Case Diagram User Story 3

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| **TCT: US3.001 – Record the exit of the patient from the security area.** |
| **Description:** The device detects the exit from the safety area by the patient and counts the number of times it occurs. In order to detect the location of the patient, the device identifies the home of the individual and a radius (in meters) that allows for identifying a safe area. Once this area is crossed, the patient's exit is identified; this information is sent to the system, which records it and allows for viewing. |
| **Primary actors:** Device. |
| **Pre-conditions**  The patient is wearing the device and the association between the smartwatch and the patient has been successfully made to allow the exchange of information with the platform and the display of information in the medical record. |
| **Main Scenario**   1. The device detects the location of the patient and calculates the difference between this and a position identified as 'location' (detected at the time of the association between the smartwatch and the patient); if it exceeds a configurable distance, the device records the patient's departure. 2. The information is sent to the system, which records it and allows it to be viewed in the patient's medical file. The system sends a notification to inform that the patient has left the safety perimeter and to detect their real-time location. |
| **Alternative flows** |
| **Exceptions** |
| **Reference tables:** |
| **Reference diagrams:** |
| **Reference GUI:** |

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| **TCT: US3.002 – Patient’s steps count** |
| **Description:** The device detects the number of steps taken by the patient and sends this information to the system that records it and allows its display. |
| **Primary actors:** Device |
| **Pre-conditions:**  The patient is wearing the device and the association between the smartwatch and the patient has been correctly established to allow the exchange of information with the platform and the display of information in the medical record. |
| **Main scenario:**   1. The device records the number of steps taken by the patient. 2. The information is sent every X minutes (reception timing) which records it and allows it to be displayed in the patient's medical record. |
| **Alternative flows** |
| **Exceptions** |
| **Reference tables:** |
| **Reference diagrams:** |
| **Reference GUI:** |

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| **TCT: US3.003 – Record the patient's heartbeat** |
| **Description:** The device monitors the patient's heartbeat by recording the bpm detected and sends them to the system to allow their display in the patient's medical record. From the continuous monitoring of the heartbeat and the definition of minimum and/or maximum thresholds, an alert is generated in case of exceeding these thresholds. |
| **Primary actors:** Device |
| **Pre-conditions**  The patient is wearing the device and the association between the smartwatch and the patient has been correctly established to allow the exchange of information with the platform and the display of information in the medical folder. |
| **Main Scenario**   1. The device monitors the patient's heart rate, counting the bpm and recording the data. 2. The information is sent to the system every X minutes (reception timing) which records it and allows it to be viewed in the patient's medical record. |
| **Alternative flows** |
| **Exceptions** |
| **Reference tables:** |
| **Reference Diagrams:** |
| **Reference GUI:** |

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| **TCT: US3.004 – Insert a patient’s fall event** |
| **Description:** The device detects a fall of the patient. Each time the patient falls, the data is sent to the system so that this information can be displayed in the patient's medical record and a notification is generated to report the incident. |
| **Primary actors:** Device |
| **Pre-conditions**  The patient is wearing the device, and the association between the smartwatch and the individual has been successfully established allowing the exchange of information with the platform and the visualization of information in the medical record. |
| **Main Scenario**   1. The device detects a fall and a notification is generated. 2. Information about the number of falls is sent to the system, which records it and allows it to be viewed in the patient's medical file.. |
| **Alternative flows** |
| **Exceptions** |
| **Reference Tables:** |
| **Reference Diagrams:** |
| **Reference GUI:** |

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| **TCT: US3.005 – Record the number of calls following the press of the "SOS" button.** |
| **Description:** The patient clicks on the "SOS" button and a call is initiated to the number properly set on the platform in the 'Configuration' section. The number of calls made is sent and recorded by the system, and furthermore a notification is generated to inform about the pressing of the help button. |
| **Primary actors:** Patient, Device |
| **Pre-conditions**  The patient is wearing the device and the smartwatch-patient pairing has been successfully completed, allowing for the exchange of information with the platform and the display of information in the medical record. |
| **Main scenario**   1. The patient presses the "SOS" button. 2. The device initiates a call to the number entered in the 'Settings Configuration' section of the system and sends the information of the SOS button press. 3. The system records the number of times the SOS button is pressed, logs them, and allows them to be viewed in the patient's medical record folder. |
| **Alternative flows** |
| **Exceptions** |
| **Reference tables:** |
| **Reference Diagrams:** |
| **Reference GUI:** |