CS473 Software Requirements Engineering

Software Requirements Specification

E-Pill Device

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1 INTRODUCTION

1.1 Purpose

This specification provides a complete description of the functional and nonfunctional requirements for the E-Pill device. It explains the purpose, scope, features, and functionality of the device. It also describes the user and system requirements, and the constraints under which it must operate. This document is for the stakeholders, including the development team.

1.2 Scope

The E-Pill Device is a hardware device made for individual users. The goal of the device is to remind the user to take their medication. By scanning the barcode of a prescription bottle to retrieve the medication name, and inserting pills into the device drawer, a user can set information in the device about that medication. Users must input the time to take their medication, the dosage required at each time, as well as the duration they intend to be taking that medication. The device alerts users at their predetermined times set for taking their medicine. Its software additionally alerts users to any dangerous combinations of medications they have inserted into the device. The users of this device can be the patient him- or herself, or anyone responsible for that patient; a doctor, a nurse, or a relative.

1.3 Definitions, Acronyms and Abbreviations

Term	**Definition**
E-Pill Device	**Electronic-Pill Device**
User	**A person who interacts with the device including; patients, and caretakers.** There is no difference among users in device functionality.
Stakeholder	**People who interact with the system and are not on the development team.**
Device Drawer	**Physical interface for users to insert/receive pills into/from the device**

Table 1: Definitions, acronyms, abbreviations

1.4 Overview

First we explain the functions the product must be capable of. These are the functions that, without them, the product would not be of value to the customer. We define the users or

classes involved with the product and what entails from their involvement. There are some constraints necessary to consider when using the product, which we also discuss in this document.

The document includes descriptions of all external interface requirements; those for users, hardware, software and other communications. The document contains some hypothetical images of what these interfaces may look like after development, to help readers better understand the product. The document covers system features of the product, followed by its nonfunctional attributes. We present some system models to illustrate the behavior and relationships of the product.

2 OVERALL DESCRIPTION

2.1 Product Functions

- The device shall act as an alarm for ingesting medication.
- The device shall scan medication bottle barcodes to store the medication name.
- The device shall accept pills through a drawer to sort and store.
- The device shall save information about different types of medication.
- The device shall expel medications from its drawer interface at the proper times.
- Users shall be able to adjust the time(s) in hours:minutes.
- Users shall be able to adjust duration of pill in days.
- Users shall be able to edit any information about a medication already known to the device.
- The system shall be able to recognize if the user is taking any combination of medications with harmful side effects by checking its embedded database which has a record of medications and their side effects.
- A maintenance person shall be able to fix the device in the event of any malfunction.

2.2 User Characteristics or Classes

The system has four basic actors.

- User (medication-user or some involved party)
- Functions: The main user will insert the medications they would like to be reminded to take (or would like to remind the person they are caring for to take). The user should scan the barcode of their pill bottle. The user places their medication into the drawer, enters what time(s) they need to take that medicine, and what dosage to take. The user should also enter into the system the duration their prescription will last. At any time the user can edit these categories of information. When the alarm goes off on the device, the user should acknowledge it, and receive their medication.

- Maintenance Person
- Functions: The maintenance person will only be involved with a device when it is broken so he or she can fix it.
- System
- Functions: The system works as a communicator between the user and the hardware. It asks the user the number of days they will be taking each different medication so it can calculate how many individual pills it needs to store, the number of pills to be taken per day, and the time. Then, it has to alert the user based on this information.
- Barcode scanner
- Functions: The barcode scanner should interact with the system to read the barcode.

2.3 Constraints

The device can store only a month's supply (30 days) of 10 different types of pills (maximum). If the user is inserting a large amount of large-sized pills into the device at one time, they may have to wait for the device to process and store some, and then insert the rest, as the device drawer has a limited capacity. The system requires batteries to work. If the batteries run out, the owner needs to change them.

3 SPECIFIC REQUIREMENTS

3.1 External Interface Requirements

3.1.1 User Interfaces

The user should power on the device by pressing any button. The user will see the screen activate with a message to let them know the device has turned on successfully (figure 1). At this point, the user can begin the process of inserting pills or, if this isn't the first time using the device, access the edit menu (figure 8) by pressing reset.

Figure 1: The ON screen

The user can begin the process of inserting pills by scanning the barcode of their pill bottle. This is how the user can prompt the device to begin collecting information. All subsequent information entered by the user after scanning a bottle will be associated with the medication name that the scanner retrieves from the bottle.

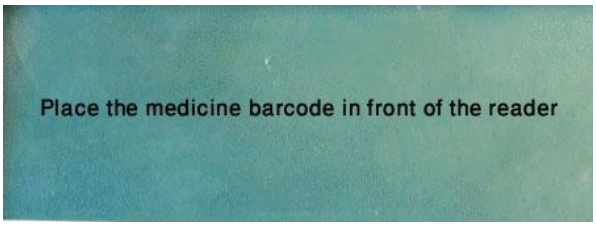

Figure 2: Scanning the barcode

First the device prompts the user to use the arrow keys to enter the duration this prescription will last. Pressing the up or right arrow will increase the count by one, and pressing down or left will decrease it. When the counter shows the desired number, the user should press set to move to the next step.

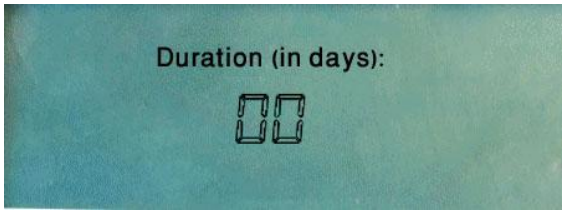

Figure 3: Duration

The user must also know how many times a day their medication is prescribed to be ingested. The user can follow the same button usage as the previous step. They can set the value and move to the next step when their desired number shows by pressing set.

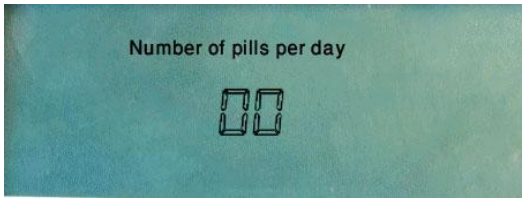

Figure 4: Pills per day

The user needs to enter what time of day they want reminders to take their medicine. To move between the hours and minutes sides, the user can use the left and right arrows. The up arrow will increment the time, and the down will decrement. After the user has reached the time they need, they should then choose AM or PM in the same manner they choose their time.

When the time is completed, pressing set will bring them to the next step, if they've only chosen 1 pill per day in the previous step (figure 4). If the user has previously entered that this medication is taken multiple times a day, then the time entering process will be repeated for each time the user needs to take their medicine.

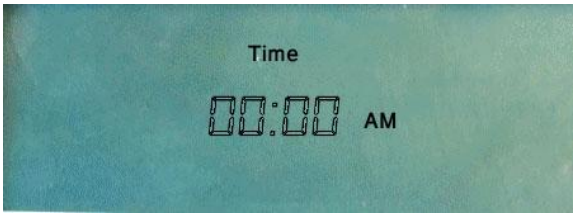

Figure 5: Time

After completing entering information, the user will see the message to open the drawer to insert their pills. They can open the drawer by pressing push. Now they can drop some pills into the drawer. The user should be aware that they haven't over-filled the drawer. As long as the drawer closes easily without resistance, the user hasn't over-filled the drawer. If the user presses reset during entering any of the previous steps (figures 3, 4, and 5) they can set the counter back to its default (00 or 00:00) state.

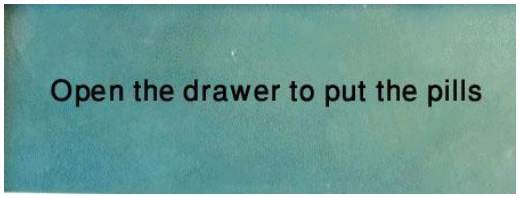

Figure 6: Message to open drawer

Upon closing the drawer, the process for programming the device for one medication completes. The user can check their info from the menu option (figure 8). The user can repeat the process for up to 10 different medications. When the time comes that the user has set for their medication, the device will make a loud beeping sound and display a message (figure 7) that the user must respond to. To acknowledge the alarm, the user should press push to open the drawer and get their medicine.

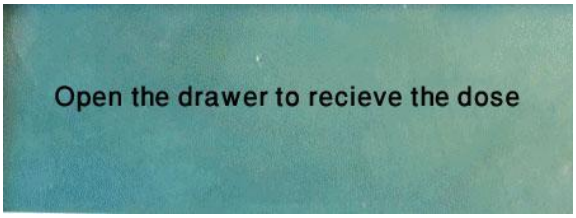

Figure 7: Message when alarm goes off

The user has the option to access the menu to edit the information associated with a medication. The menu is accessible by pressing reset when the device is in an idle state (not while entering information on a medication). The user can move between options listed in the menu using the arrow buttons. The process discussed in figures 3-6 is repeatable by selecting "Insert a new pill". Selecting "Edit" will allow the user to update any categories of information for any medication they have inserted so far.

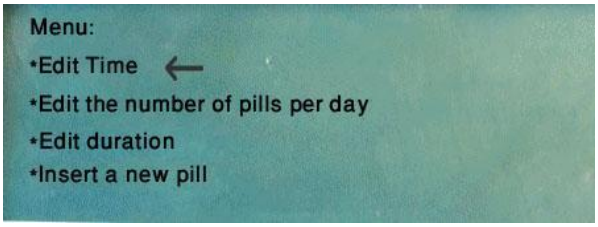

Figure 8: Menu

Additionally, in some irregular situation, the user might see an alert from the device (figure 9) indicating that the medication they are in the process of entering has a negative reaction or is a dangerous combination with a medication they are already taking (already

entered in the system). The user can ignore this alert, and they can choose to continue entering the medication, or can cease.

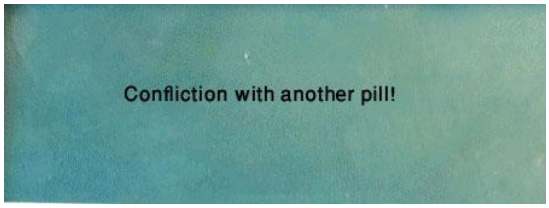

Figure 9: Conflict

3.1.2 Hardware Interfaces

Figure 10: Possible device design

The device has 6 buttons; set, reset, and 4 arrows for setting time and duration. It also has a "push" button to open the drawer when needed. It has a screen to display a small menu for the user in which the user can edit the medication and interact with the device. In addition, it has a drawer in which the user will put the pills inside the device, and take the pills from it. The device organizes the pills inside it in a manner where if there is more than one kind of pill, no pills are mixed together. It also has a barcode scanner to save the pills information inside it.

3.1.3 Software Interfaces

- The barcode scanner shall be able to extract the medication name from any pill bottle it reads.
- The system shall maintain an internal database in order to determine what medications are conflicting.

3.1.4 Other Communications Interfaces

The device shall communicate with the system to achieve the goal. In addition, it should interact with the barcode scanner to recognize the pill (medication name).

3.3 SYSTEM FEATURES

3.3.1 System feature 1: [Read Barcode]

3.3.1.1 Introduction/purpose of feature

The system shall have a barcode scanner that extracts the pill name from the barcode. It reads the barcode to relate the time and other settings to the pill. It also checks conflictions with other medications.

3.3.1.2 Stimulus/Response sequence

- The user opens the device.
- When inserting a new pill, a message will appear to ask the user to place the barcode in front the barcode reader.
- The user scans the barcode of a medication bottle/box.
- The device reads the barcode.

3.3.1.3 Associated functional requirements

3.3.1.3.1 Functional requirement 1

"As a user, I want to scan the barcode so that I can insert a pill to the device."

Feature 1.1: Scan barcode

Scenario: Given that a user wants to insert a new pill, and he or she scan the barcode. When he or she places the barcode in front of the reader correctly, the device shall read the barcode.

3.3.1.3.2 Functional requirement 2

"As a device, I want to alert the user in case of confliction with other medication so the user can be aware of side effects."

Feature 2.1: Alert to confliction

Scenario: Given the device reads the barcode correctly, and it checks its embedded database. When it finds a confliction between the newly inserted pill and the already stored pills, the device shall alert the user.

3.3.2 System feature 2: [Store pill information]

3.3.2.1 Introduction/purpose of feature

The system shall store the information associated with each pill and relate it to the pill name scanned.

3.3.2.2 Stimulus/Response sequence

- After scanning, the device asks the user to enter pill information (Duration, number pills per day, and time).
- The user enters the information one by one.
- The device saves the information along with the medication name.

3.3.2.3 Associated functional requirements

3.3.2.3.1 Functional requirement 1

"As a device, I want to store the pill information so that the user can insert this pill."

Feature 1.1: Enter duration

Scenario: Given that a user wants to insert a new pill, and the device reads the barcode correctly. When the user enters the duration, the device shall store the information.

Feature 1.2: Enter number of pills per day

Scenario: Given that a user wants to insert a new pill, and the device reads the barcode correctly. When the user enters the number of pills per day, the device shall store the information.

Feature 1.3: Enter time

Scenario: Given that a user wants to insert a new pill, and the device reads the barcode correctly. When the user enters the time, the device shall store the information.

3.3.2.3.2 Functional requirement 2

"As a device, I want to be able to update the pill information and store it so the user can edit the medication."

Feature 2.1: Edit medication

Scenario: Given that a user wants to edit the information associated with the pill, and he or she chooses the information to modify. When the user has to re-enter the info, the device shall store the information.

3.3.3 System feature 3: [Store pills]

3.3.3.1 Introduction/purpose of feature

The system shall be able to store the pills entered by the user inside the device in an organized way.

3.3.3.2 Stimulus/Response sequence

- After entering the pill's information, a message will appear to ask the user to open the drawer and insert the pills.

- The user puts the pills inside the device.
- These pills will be stored.

3.3.3.3 Associated functional requirements

3.3.3.3.1 Functional requirement 1

"As a device, I want to store the inserted pills so that the user can receive the pills on time."

Feature 1.1: Store pills

Scenario: Given that a user enters a new medication, and he or she enters the information associated with the pill. When the user empties the pills inside the drawer, the device shall store the pills inside it.

3.3.3.3.2 Functional requirement 2

"As a device, I want to store the inserted pills by type so that the pills are not randomly stored."

Feature 2.1: Organize pills by type

Scenario: Given that a user wants to enter more than one kind of pill, and he or she enters the information associated with the pill. When the user empties the pills inside the drawer, the device shall store the pills by their types indicating that each medication will have its own section.

3.3.4 System feature 4: [Alert user to receive the dose]

3.3.4.1 Introduction/purpose of feature

The device shall alert the user when the time comes for them to take their medication. The device shall empty the proper dosage of pills into the drawer for the user to receive at that time.

3.3.4.2 Stimulus/Response sequence

- The time entered previously for a medication arrives.
- The device empties the pills needed at that time into the drawer.
- The device beeps.
- The user acknowledges the device by pressing "push" to open the drawer.
- The user takes the pills out of the drawer and closes it.

3.3.4.3 Associated functional requirements

3.3.4.3.1 Functional requirement 1

"As a device, I want to alert the user to take their medication so the user can receive the dose."

Feature 1.1: Alert the user

Scenario: Given that the user entered a pill with its information, and the device stored them correctly. When the time that the user entered for a medication arrives, the device shall beep until the user acknowledges it.

Feature 1.2: Deliver the dose

Scenario: Given that the time that the user entered for a medication arrives, and the device ejects the specified amount of pills in the drawer. When the device beeps, the user shall open the drawer to receive the dose.

3.4 SOFTWARE SYSTEM ATTRIBUTES

3.4.1 Availability:

- The system shall be available 24x7.

3.4.2 Portability:

- The system shall be capable of running with batteries to make it easier for users to travel with it anywhere.

3.4.3 Performance:

- Response time shall be no more than several seconds.

3.4.4 Reliability:

- The system shall be dependable since the user has to specify time and duration and the device functions accordingly.

3.4.5 Maintainability:

- The maintenance person shall fix the device if it's broken or has any errors.

4. ADDITIONAL MATERIALS

4.1 Use Case Diagram

4.1.1 Diagram

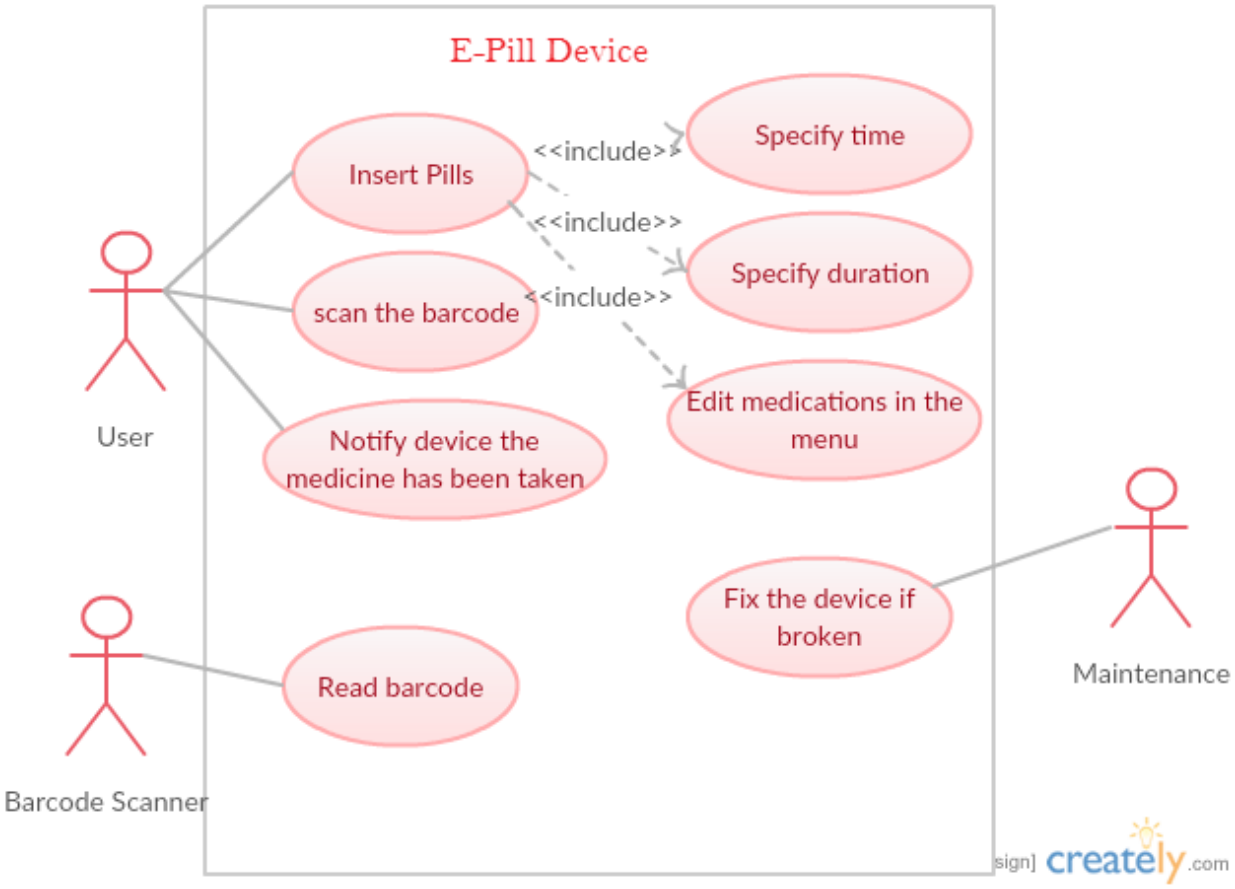

Figure 11: Use Case Diagram

4.1.2 Use Case Table:

Use Case Table *<E-Pill Device>*			
srl no.	***Actor(s)***	***Use Case Name***	***Goal & Rules***
1	User	Insert Pills	The user can insert new pills to the device.
2		Scan Barcode	The first thing to do when inserting a new pill is scanning the barcode of the medication so the device is able to read and extract its name. By scanning the barcode the device can compare the newly inserted pill with the existing ones to alert about any conflictions.
3		Specify time and duration	After scanning the barcode, the user has to insert the information related to the pill (time and duration).
4		Notify device when receiving the dose	When the specified time arrives, the device beeps. The device will display a message instructing the user to receive the dose. By responding to this message and opening the drawer by pressing the button “push”, the user notifies the device that he or she has received the dose.
5	Barcode Scanner	Read Barcode	When the user places the barcode in front of the scanner, the barcode scanner reads the barcode and extracts the pill name.
6	Maintenance Person	Fix the device if broken	If the device is broken, the maintenance person should fix the device for its user.

Table 2: Use case Table

4.2 Activity Diagram

4.2.1 For User:

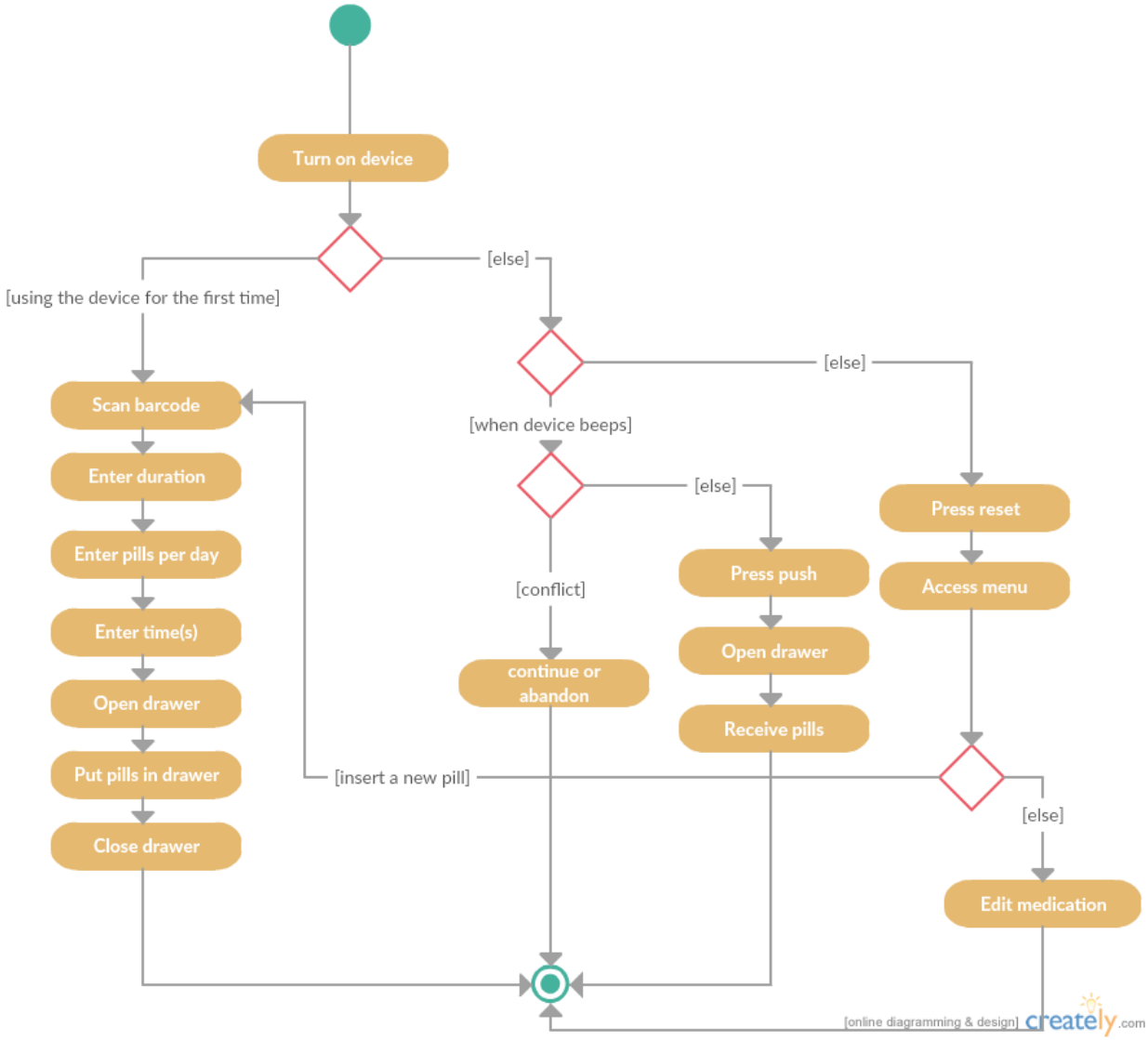

Figure 12: Activity Diagram (1)

4.2.2 For Device:

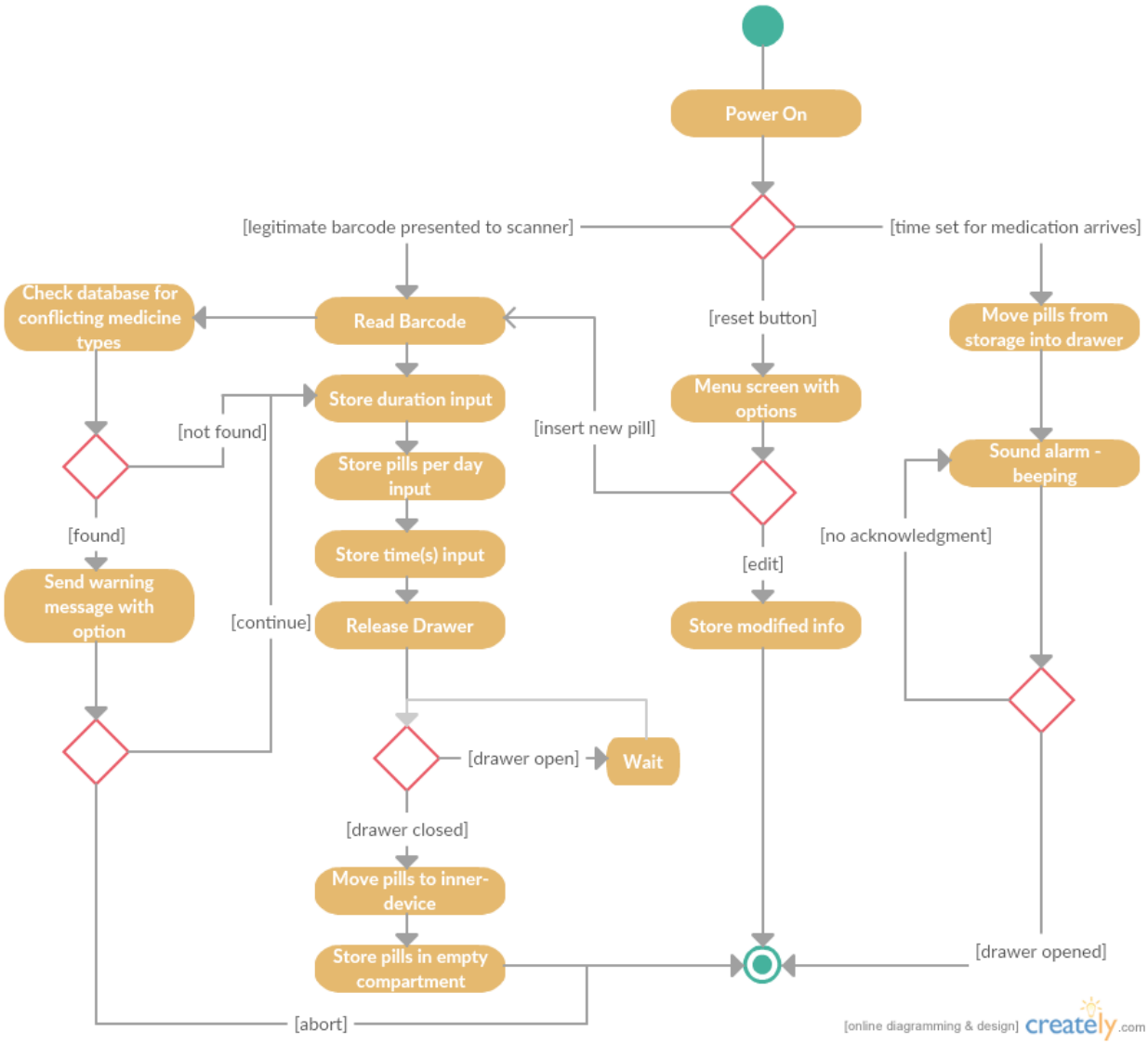

Figure 12: Activity Diagram (2)

4.3 Requirements Elicitation Techniques:

Date	Technique	Discussion
11/17	Interview	In the first meeting, we elicited the basic user requirements from the stakeholders. They gave us a brief idea about the product. No details were specified at this point.
11/26	Brainstorming	● Changed system requirement of pill recognition from manual insertion to barcode scanner (eliminates need for full keyboard on device, easier for user) ● Discussed external hardware interfaces: no keyboard. Include buttons (arrows for setting times & numbers, set, reset), drawer for insertion and expulsion of pills ● Discussed portability: works with battery ● Discussed Constraints: 10 max different kinds of pills
11/30	SRS Evaluation Form	● Discussed in further detail the functionality of the barcode scanner - customers asked for visual of the barcode scanner ● Switched from device keeping the number of pills saved to keeping the duration saved - easier on the user, displaces math on the user's part to math on the system's part
12/7	SRS Evaluation Form	● Customers asked us to clarify and simplify some parts of the document, such as the activity diagram and user interface section

Table 3: Elicitation Techniques