AED SIMULATION SOFTWARE

COMP 3004 Team Project

Abstract

The objective of this project is to create a software simulation that mimics the core functionality of an AED Plus device, allowing users to perform actions such as analyzing heart rhythms, providing electric shocks, and offering guidance during an emergency.

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Use Cases:

Use Case 1: Power On

Actor: User (individual responding to a cardiac emergency)

Pre-condition: AED device is available and properly maintained.

Minimal Guarantees: The AED powers on and completes its self-test successfully.

Success Guarantees: The AED is ready for use, indicated by visual and audible signals.

Main Success Scenario:

1. User activates the AED by turning it on.
2. AED initiates a self-test to ensure functionality.
3. Visual and audible indicators confirm successful completion of the self-test.
4. AED is ready for use.

Extensions:

- If the self-test fails, the AED indicates an error, and the user is instructed not to use the device. Contact emergency services for assistance.

Traceability:

Use Case 2: Checking Responsiveness

Actor: User (individual responding to a cardiac emergency)

Pre-condition: AED is powered on and ready for use.

Minimal Guarantees: User checks the patient's responsiveness.

Success Guarantees: User checked the responsiveness and patient is still alive.

Main Success Scenario:

1. User checks the status of the patient.
2. Patient is still responsive.

Extensions:

- If the patient is not alive, end program.

Traceability:

Use Case 3: Call For Help

Actor: User (individual responding to a cardiac emergency)

Pre-condition: User checked the patient's condition, the patient is still alive.

Minimal Guarantees: User calls for help.

Success Guarantees: Help is on the way.

Main Success Scenario:

1. User makes a 911 call.
2. 911 answers the call
3. 911 is on the way.

Extensions:

- 911 does not answer the call.
    - Proceed with the AED usage while repeatedly trying to get a hold of 911.

Traceability:

Use Case 4: Electrode Placement

Actor: User (individual responding to a cardiac emergency)

Pre-condition: AED is powered on and ready for use.

Minimal Guarantees: Electrode pads are properly connected to the AED.

Success Guarantees: Electrode pads are correctly placed on the patient's chest.

Main Success Scenario:

1. User retrieves and opens the electrode pads and scissors from the AED.
2. User cuts open the patient's chest following the AED instructions.
3. User identifies and follows labeled instructions for "Adult Pads" or "Child Pads" based on the patient's age.
4. Electrode pads are correctly placed on the patient's bare chest.

Extensions:

- If the electrode pads are not properly connected, the AED provides an error prompt, guiding the user to reconnect the pads.

Traceability:

Use Case 5: Heart Rhythm Analysis

Actor: AED

Pre-condition: Electrode pads are correctly placed on the patient's chest.

Minimal Guarantees: The AED initiates heart rhythm analysis.

Success Guarantees: AED accurately determines the presence of a shockable rhythm.

Main Success Scenario:

1. AED analyzes the patient's heart rhythm through the connected electrode pads.
2. AED identifies a shockable rhythm (ventricular fibrillation or ventricular tachycardia) or a non-shockable rhythm.

Extensions:

- If a shockable rhythm is not detected, the AED provides instructions for continuing CPR.

Traceability:

Use Case 6: Visual Prompts

Actor: AED

Pre-condition: Heart rhythm analysis is completed.

Minimal Guarantees: AED provides clear visual prompts.

Success Guarantees: User receives accurate guidance throughout the process.

Main Success Scenario:

1. AED prompts the user to "Stand clear" to ensure safety.
2. AED announces "Analyzing" as it evaluates the heart rhythm.
3. If a shockable rhythm is detected, AED prompts "Shock advised."
4. AED guides the user through shock delivery steps.

Extensions:

- If a shockable rhythm is not detected, the AED instructs the user to continue with CPR.

Traceability:

Use Case 7: Shock Delivery

Actor: User (individual responding to a cardiac emergency)

Pre-condition: AED advises a shock is needed.

Minimal Guarantees: AED is capable of delivering a shock.

Success Guarantees: AED successfully delivers a shock to the patient.

Main Success Scenario:

1. AED prompts the user to press the button to deliver a shock.
2. User presses the button, and the AED administers the shock.
3. User ensures that no one is in contact with the patient during shock delivery.

Extensions:

- If the shock is not delivered, the AED provides guidance and prompts for reattempting.

Traceability:

Use Case 8: CPR and Post-Shock Care

Actor: User (individual responding to a cardiac emergency)

Pre-condition: Shock delivered or AED advises continuation of CPR.

Minimal Guarantees: AED provides CPR instructions.

Success Guarantees: User performs CPR as instructed by the AED.

Main Success Scenario:

1. AED prompts the user to initiate CPR after shock delivery.
2. User follows AED instructions for chest compressions and rescue breaths.
3. AED provides feedback on the quality and rate of chest compressions during CPR.

   Extensions:

- If the AED detects issues with CPR quality, it provides guidance for improvement.

Traceability:

Use Case Diagram:

The following diagram showcases all actors and their “capabilities” based on the use cases mentioned under Use Cases.

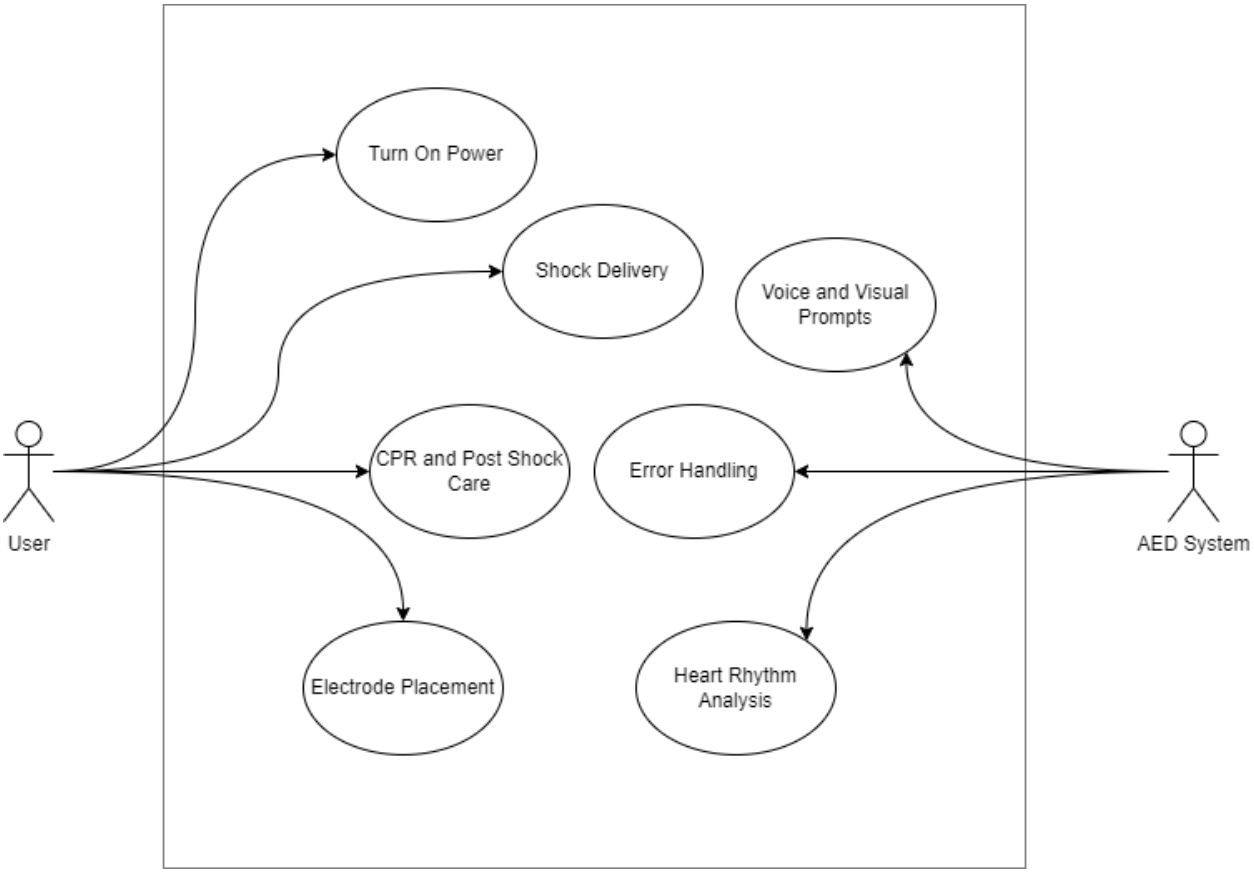

Figure 1

Design Documentation:

UML Diagram:

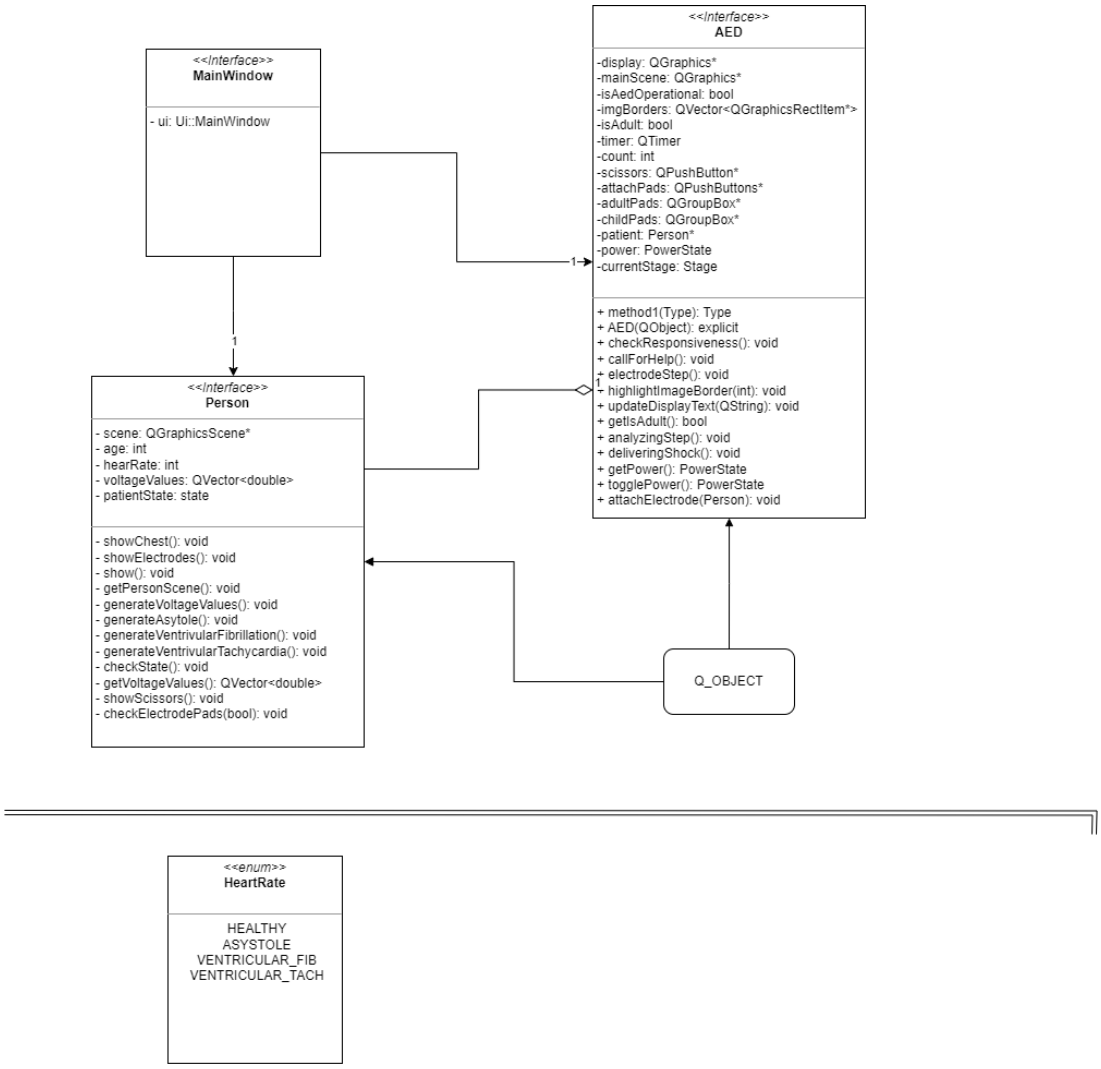

Figure 2

In Figure 2 we show the following classes and their relations:

MainWindow: **Composition** relation with AED and Person classes.

- MainWindow owns an instance of **AED** and **Person**

AED: **Inherits** from Q_OBJECT, **Aggregation** relation with Person

- AED owns a pointer to Person

Person: **Inherits** from Q_OBJECT

Sequence Diagram:

Success Flag 1: Electrodes are placed and AED is analyzing.

In this sequence, we illustrate how to operate the AED from start to finish.

Figure 3 maps onto use cases 1-5

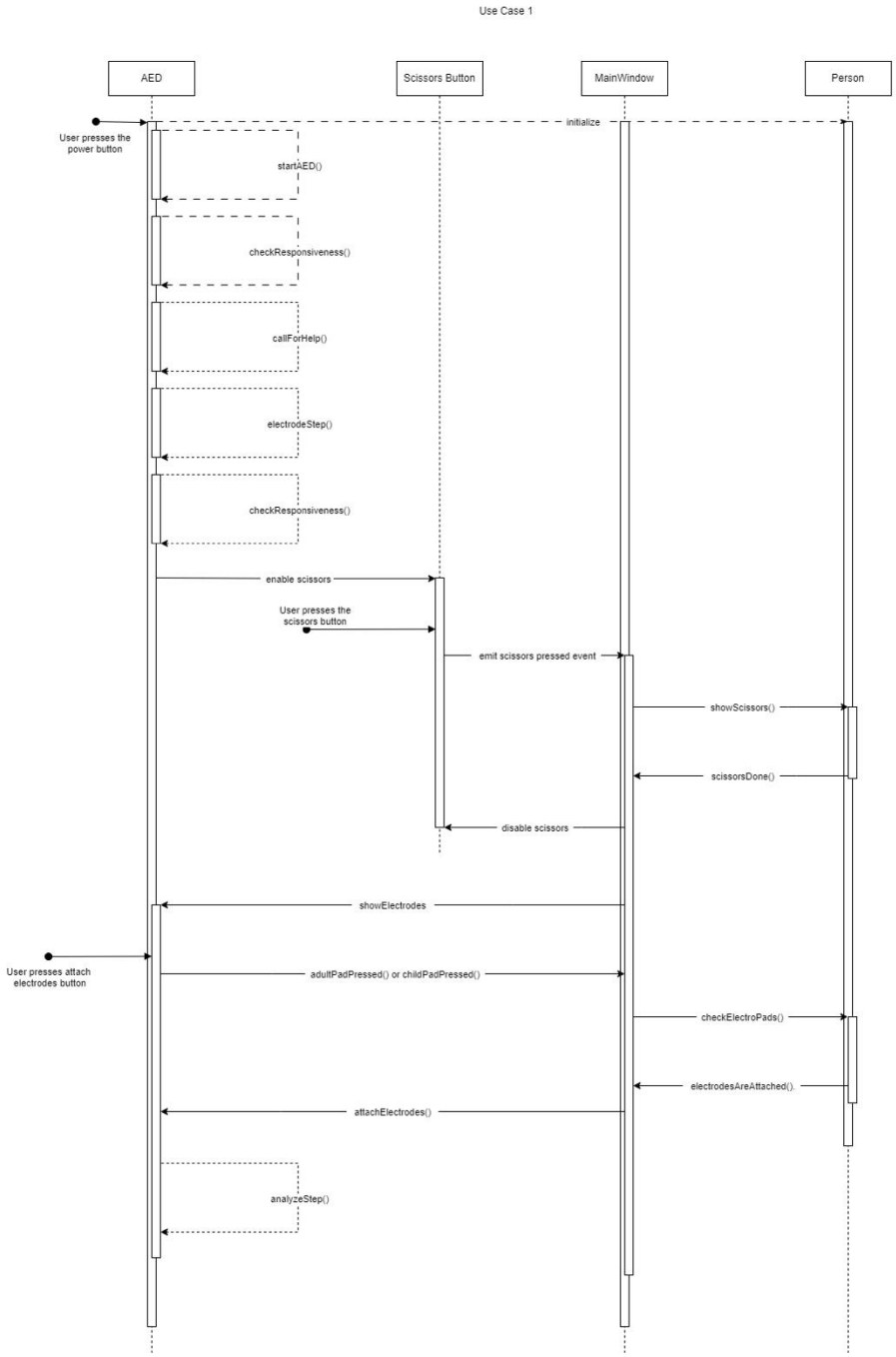

Figure 3

Success Flag 2: Patient is stable.

In this sequence, we illustrate how the AED behaves when a patient is stable.

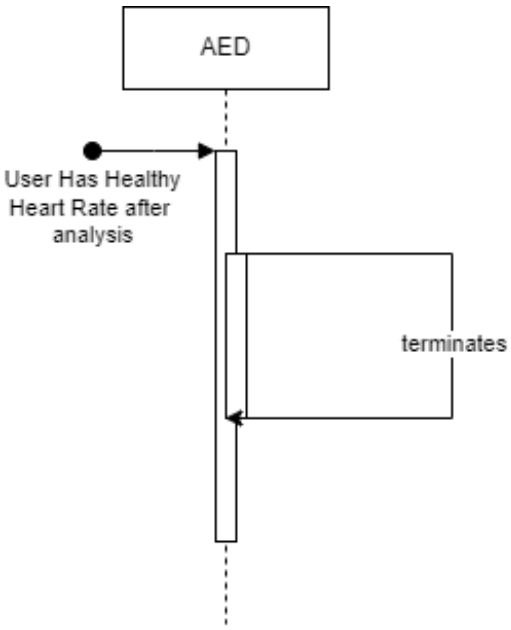

Figure 3

Success Flag 3: Patient needs CPR.

In this sequence, we illustrate how the AED behaves when the user needs to apply CPR.

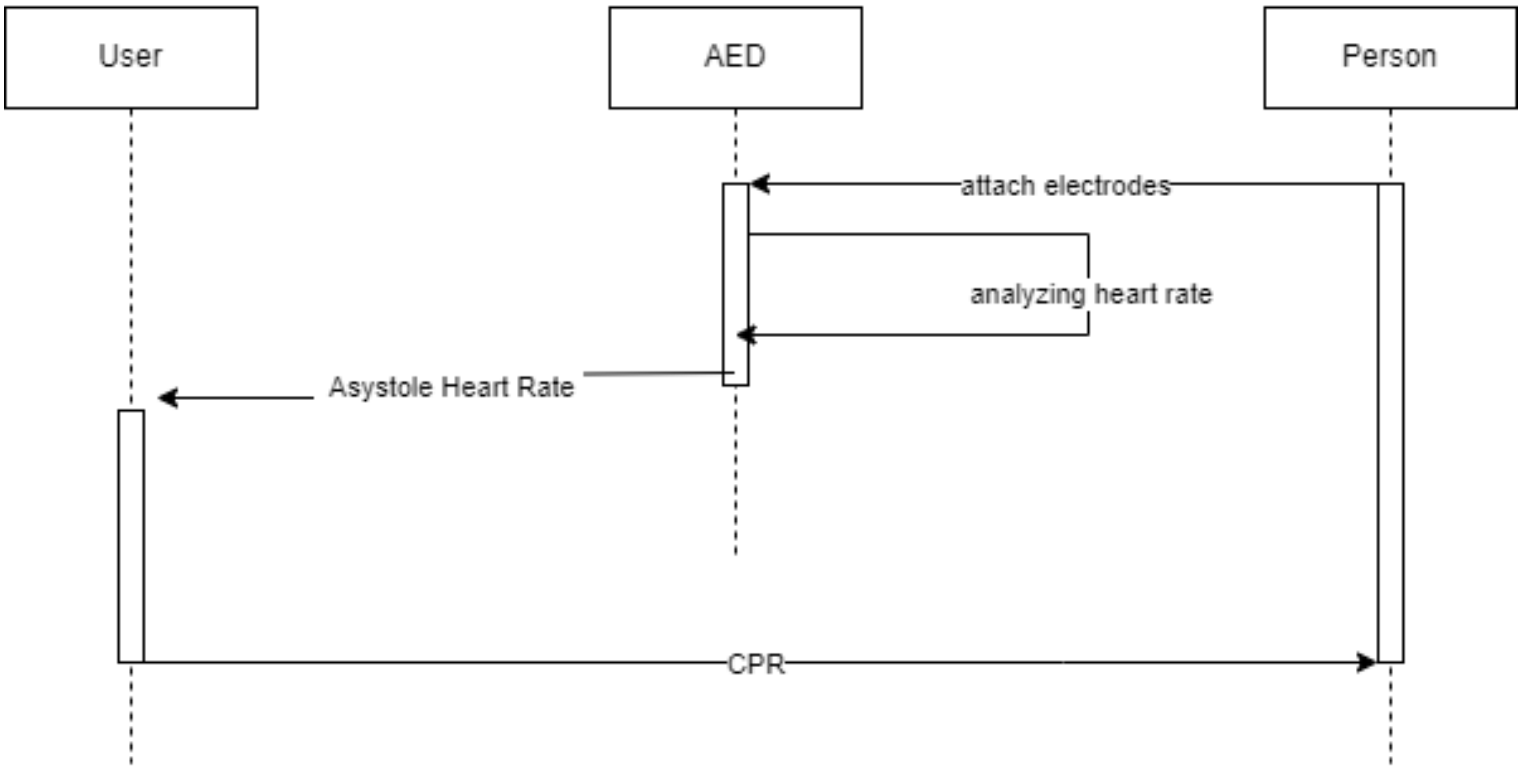

Figure 4

Success Flag 4: Patient has a shockable heart rhythm.

In this sequence, we illustrate how the AED behaves when a patient has a shockable heart rhythm.

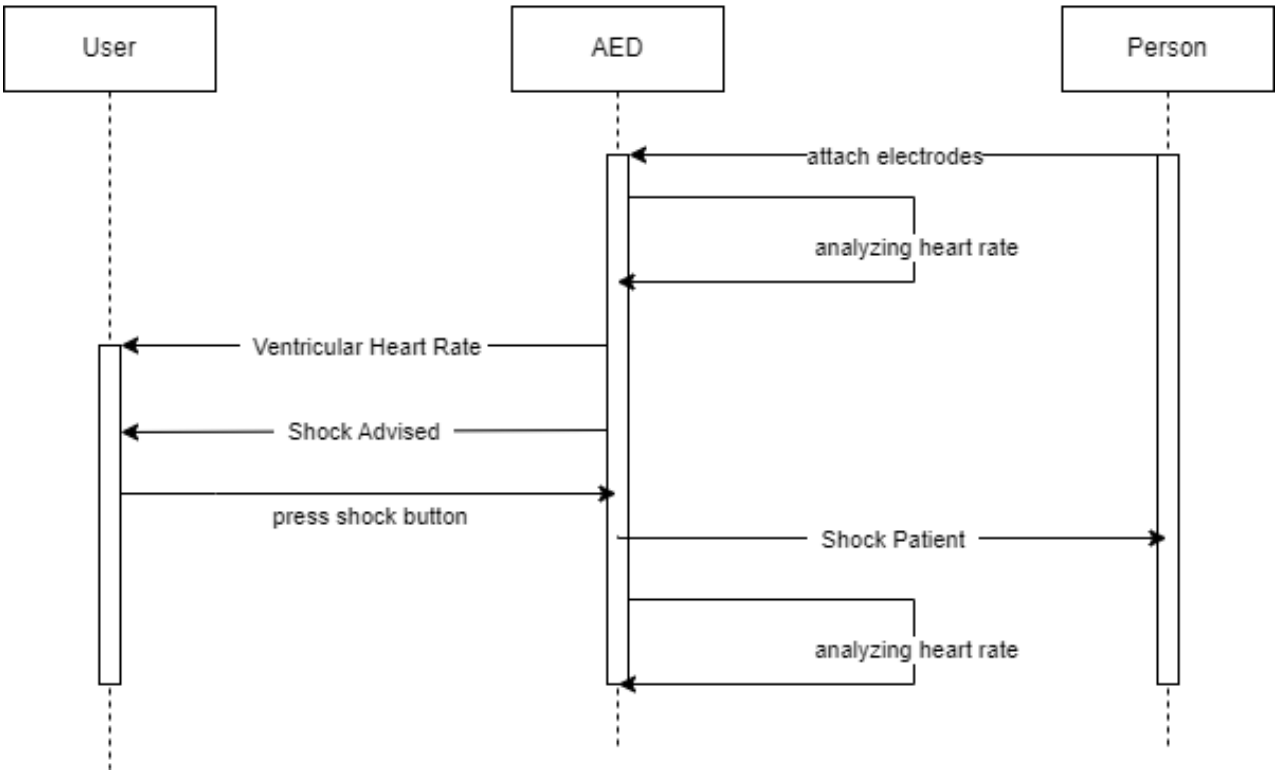

Figure 6

State Diagram:

Figure 4 illustrates the states that the AED can be in, and all events that need to occur for the AED to transition through states.

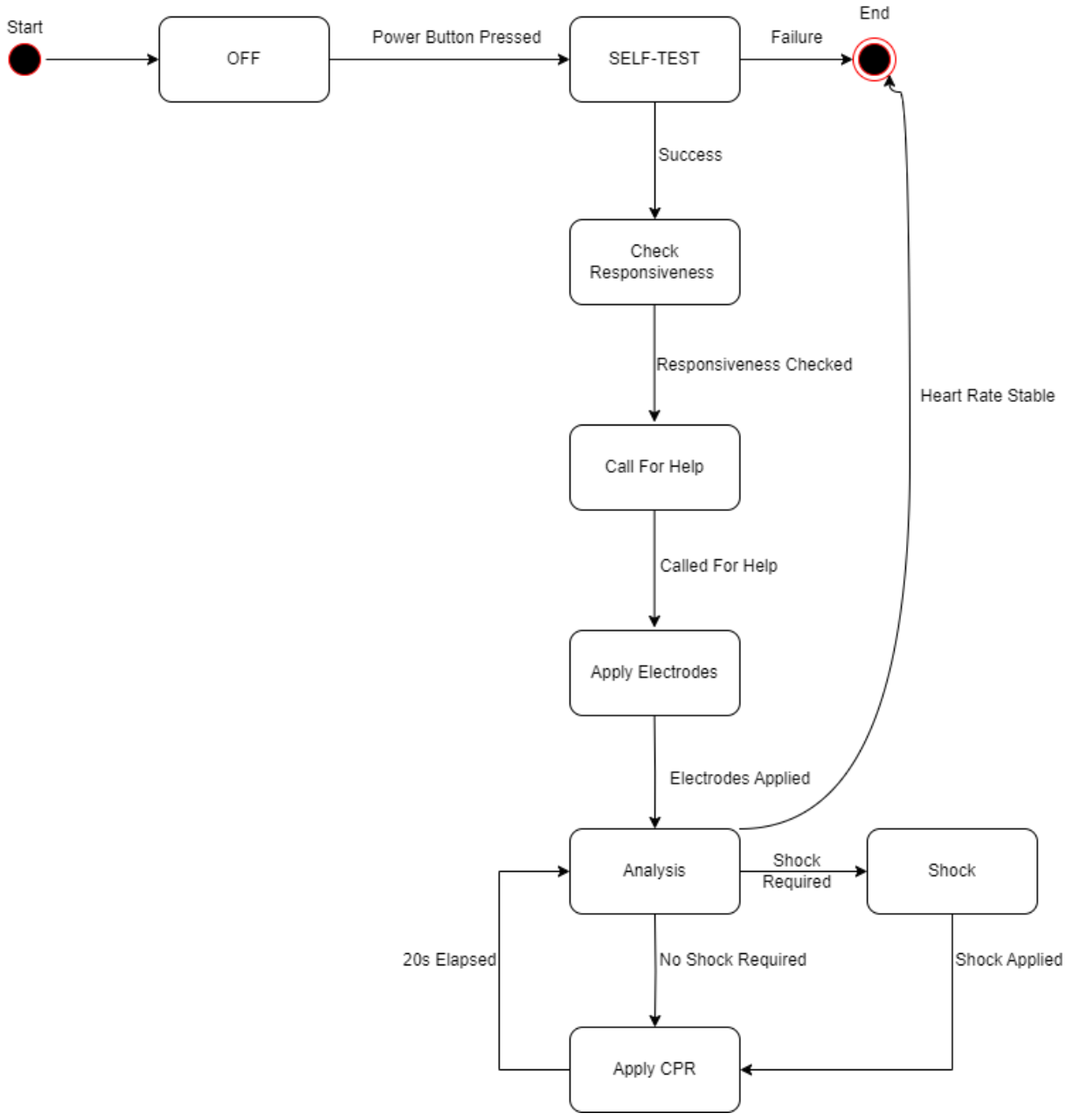

Figure 7

Traceability Matrix:

ID	Requirement	Related Use Case	Fulfilled By	Test	Description
1	The application interface contains buttons, display, patient, and electrodes.	N/A	MainWindow.ui	Run the simulator in Qt to observe the ui.	Using QT's built in user interface framework, the physical AED system was replicated. Also, all buttons are clickable with the mouse.
2	The user clicks on the power button	Use Case 1	AED	Power Button is visible, when clicked "AED operational" is displayed.	After initiating the software, the AED will be visible alongside the "Power Button". Pressing the power button will power on the AED.
3	The AED initiates a self-test	Use Case 1	AED	AED self-tests and returns visual confirmation.	The AED undergoes a self-test upon activation, confirming its operational status with visual signals.
4	The user checks for the patients responsiveness	Use Case 2	User	Clicking the button takes you to the next step	The user has to check if the patient is still even alive.
5	The user calls for help	Use Case 3	User	Clicking the button takes you to the next step	Assuming the patient is alive, the user has to call the ambulance ASAP.
6	The user uses the scissors to cut open the patients chest.	Use Case 4	User	Scissors button appears, when clicked they go across the patient's chest, cutting it open.	The AED comes with "scissors" to cut open the patient's chest before being able to place the electrodes.
7	The user places the electrodes on the patient's chest.	Use Case 4	User	Electrodes are placed when the button is clicked.	Users correctly place electrode pads on the patient's chest, following labeled instructions for "Adult Pads" or "Child Pads" based on age.
8	Heart Rhythm Analysis	Use Case 5	AED	After 5 seconds of analysis, the AED displays the patient's heart rhythm.	The AED analyzes the patient's heart rhythm through connected electrode pads, accurately identifying shockable rhythms.
9	AED administers a shock upon user prompt, ensuring safety precautions are followed.	Use Case 6	User and AED	Shock button appears, when clicked AED indicates that a shock was administered.	The AED administers a shock when prompted by the user, ensuring that safety precautions are observed.
10	AED instructs and provides feedback on CPR quality and rate after shock delivery.	Use Case 7	AED	CPR button appears, once toggled the "user" is "applying" CPR	After shock delivery, the AED instructs the user on CPR and provides feedback on the quality and rate of chest compressions.