Amulete: Smart Garment for Endometriosis
Requirements Document

Version 1.01

Revision History

Version	Date	Description	Sections affected	Author
1.0	2025/02/26	Initial release	All	Lai
1.01	2025/01/19	Finalized Document	All	Lai

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1. Introduction

1.1 Purpose and Scope

Around 190 million women globally are affected with endometriosis, a condition where the uterine lining grows outside of the uterus causing extreme pelvic pain. When these women have their period, the pain is constant for the entirety of their cycle and studies show that at its most intense, period pains can be almost equivalent to the pain you experience during a heart attack. This impacts so much of the women's daily lives and impacts their ability to function normally. There are many ways to remedy the pain including pain relievers and over the counter medicine, but [most people who experience endometriosis](#) say that even these don't work for the pain. On top of that, taking too many pain relievers lead to damage in the liver, stomach problems, and internal bleeding.

What does help is heat. Very warm heat applied to the pelvic area to relax the muscles and provide relief to the period pains. The problem is, women don't want to be carrying around a hot water bottle with them everywhere they go. There are portable heating pads in the market right now, but they are very clunky and big - not seamless and don't blend well with an outfit. This is why I want to propose Amulete, a smart skirt that integrates seamless heating technology to give women both relief with their period pain and the ability to go out without letting their endometriosis get in their way.

1.2 Responsibility

My roles are to make sure everything—heating elements, power supply, microcontroller, and the React Native app—works together smoothly. I'm responsible for setting up the technical requirements and making sure the skirt heats up properly, stays safe, and runs efficiently.

Testing and fine-tuning the design, from temperature control to battery performance, is on me. I need to make sure the skirt is comfortable, functional, and meets safety standards.

All parts of the project—the firmware, mobile app, and hardware—will be built and tested according to the timeline I set, making sure everything is ready to go when needed.

2. Documents

2.1 Applicable Documents

Document Title	URL
Feasibility Document	**https://docs.google.com/document/d/1fNpdW-GdRI2vh3ZjKOQSLGqpJJWZOh5RzkLx2mo3Az4/edit?tab=t.0**
Work Breakdown Structure	**https://docs.google.com/document/d/1lESFCMuzQ_Nd38xgR9ACZEucWx26rTu3rfJTXTsY6n0/edit?tab=t.0**

3. Requirements

3.1 System Definition

 Hardware System

- Heating Elements – Carbon tape connected to wires that can power it up
- Microcontroller Unit (MCU) – Manages the carbon tape and communicates with the appESP32 for Bluetooth/WiFi connectivity
- Power Supply – Rechargeable battery pack attachable to the skirt
- Safety Features – Automatic shutoff, overheating protection, and insulation layers

Software System

- Mobile App (React Native)
    - UI for controlling temperature
    - Connectivity with the microcontroller (via Bluetooth or WiFi).
    - Custom presets for different heating levels.
- Embedded Firmware
    - Code running on the microcontroller to regulate temperature.
    - Communication protocol for data transfer between the skirt and the app.
    - Power management for battery efficiency.

3.2 Characteristics

3.2.1 Physical

A-01 The Physical characteristics of Amulete is a going out skirt with an Amulete battery pack attached. The tech will seamlessly be integrate into the fabrics of the skirt

3.2.2 Environmental

A-02 The skirt would have to be resistant to water and moisture and it would have to be breathable to prevent build up of sweat

3.2.3 Electrical

3.2.3.1 Microcontroller

A-03 Amulete would use an ESP32 for the benefits of the Microctroller being small and having Bluetooth and Wifi connectivity

3.2.3.2. Inputs

A-04 There would be inputs from the app and an emergency button that users can press from the Amulete for emergency cases when their phone doesn't work.

3.2.3.3. Outputs

A-05 The outputs will be heat from the carbon tape.

3.2.3.4. Power

A-06 Amulete will use a high capacity Li-Po Battery Pack with 11V and 5000mAh

3.2.3 Software

A-07 The devices' firmware will use Arduino IDE and C++ for programming the ESP32 and PWM Controls

A-08 Amulete will be connected to a mobile app. The frontend will be React Native that will interface with the device and allow users to control the temperature and monitor the battery

3.2.5 Documentation

3.2.5.1 Slide Deck

A-09 [Amulete Slide Deck](#)

3.2.5.2 Supporting Documents

3.3. Design and Construction

3.3.1. Materials, processes, and parts

Component Type	Component Name	Quantity
Battery	Li-Po Battery (~3.7V, 1000-5000mAh)	1
Microcontroller (w/BLE)	ESP32-WROOM-32 or ESP32-C3	1
Heating Pad	Adafruit Electrical Heating Pad	1
Connectors (Male/Female Pins)	JST connectors or pogo-pin connectors	1 set
Status Indicator LEDs	LED indicators (power/heating/status)	1-3
Resistors & Capacitors	Standard passive components	Multiple
Fabrics	Spandex Jersey	½ yard

Following the Work Breakdown Structure, I am going to work on the electronics first and then move on to designing the PCB, creating the skirt design and the amulet battery encasing, and then putting the electronics and fabrics together.

3.3.2. Safety

The safety concern to this product is overheating and we would prevent this by using a thermistor that can monitor the temperature in real life and set a temperature threshold to lower if too high. We would also integrate auto shutoff, if the user forgets to turn it off, the program shuts off after a certain amount of time.