Verification and Validation Plan for Solar Water Heating Systems Incorporating Phase Change Material

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1 General Information

The following section provides an overview of the Test Plan for Smart Waiter Solutions. This section explains the purpose of this document, the scope of the system, and an overview of the following sections

1.1 Purpose

The purpose of this document is to describe the various test cases and procedures used Smart Waiter. This document is indented to be used as a reference for all future testing and will be used to increase confidence in the software implementation.

This document will be used as a starting point for the verification and validation report. The test cases presented within this document will be executed and the output will be analyzed to determine if the software is implemented correctly.

1.2 Scope

1.3 Overview of Document

The following sections provide more detail about the V&V of a solar water heating simulator. Information about the testing process is provided, and the software specifications that were discussed in the SRS document are stated. The evaluation process that will be followed during testing is outlined, and test cases for both the system testing and unit testing are provided

2 Plan

This section provides a description of the software that is being tested, the team that will perform the testing, the milestones for the testing phase, and the budget allocated to the testing.

2.1 Software Description

The software being tested is a simulator for a SWHS incorporating PCM. Given the physical parameters of the system, including dimensions, properties of the water and PCM,and relevant physical constants, the simulator calculates the changes in temperature and energy of the water and PCM over time.

2.2 Test Team

The team that will execute the test cases, write and review the V&VR consists of:

- Maya Grab
- Dr. Spencer Smith
- Thulasi Jegatheesan

2.3 Milestones

2.3.1 Location

The location where the testing will be performed is Hamilton Ontario. The institution that will be performing the testing is McMaster University.

2.3.2 Dates and Deadlines

2.4 Budget

The budget for the testing of this system is being funded by McMaster University and NSERC.

3 Software Specification

This section provides the functional requirements, the business tasks that the software is expected to complete, and the nonfunctional requirements, the qualities that the software is expected to exhibit.

3.1 Functional Requirements

- Input the physical constants, properties and initial temperatures of water and PCM, and dimensions of the tank
- Verify that the inputs satisfy the required physical constraints
- Compute the calculated values required to solve the governing differential equations
- Calculate the temperatures and energy of water and PCM over time.

3.2 Nonfunctional Requirements

Priority nonfunctional requirements are correctness, understandability, reliability, and maintainability.

4 Evaluation

This section first presents the methods and constraints that are to be used during the evaluation process. This is followed by how the data obtained by the testing will be evaluated, which includes: how the data will be recorded, how to move from one test to the next, and how to determine if the test was successful.

4.1 Methods and Constraints

4.1.1 Methodology

4.1.2 Extent of Testing

4.1.3 Test Tools

4.1.4 Testing Constraints

4.2 Types of Tests

4.2.1 Functional Testing

4.2.2 Structural Testing

4.2.3 Unit Testing

4.2.4 Manual and Automatic Testing

4.2.5 Static and Dynamic Testing

Static testing refers to testing techniques that simulate a dynamic environment. This does not involve program execution. Instead, a walk-though through will be performed checking pre and post conditions evaluate to requirements specified. As well to make sure proper syntax is used thoroughly.This type of testing is crucial in design stage. On the contrary, dynamic testing refers to executing the program while running test cases to view expected behaviour. This is done to find and fix defects in the program. This will be performed after implementation phase.

5 POC System Test Description

5.1 Barcode Scanning

Smart-Waiter needs to ensure users are able to scan a barcode with minimal attempts. The number of expected attempts will be presented in the final SRS document. Various forms of testing will be performed to evaluate this criteria.

5.1.1 Test Factors

5.1.2 Methods of testing

- Static testing is used to ensure pre and post conditions are met syntactically. That is, implementing the ability to scan a barcode and use it to query a menu from the database.
- Dynamic testing is used to guarantee validity, and record number of successful attempts given a sample size of attempts performed.

5.1.3 Test Cases

Test Case	Initial State	Input	Output
5.1.1	Barcode Scanning Page – Empty	Eligible Barcode	Restaurant Menu
5.1.2	Barcode Scanning Page – Empty	Corrupted Barcode	Message prompt reading, "Please try again". After third attempt, prompt will read, "Please contact waiter" and will indicate an option to report bug
5.1.3	Barcode Scanning Page – Empty	Picture without barcode	Message prompt reading, "Please try again". After third attempt, prompt will read, "Please contact waiter" and will indicate an option to report bug

5.2 Database Querying

5.2.1 Test Factors

5.2.2 Inputs

5.2.3 Outputs

5.2.4 Initial State

5.2.5 Methods of Testing

5.2.6 Test Cases

6 Final Demonstration System Test Description

6.1 Account Login

Smart-Waiter must use accounts to keep track of a user's personal information. The account module has to provide a secure login service.

6.1.1 Test Type

Manual, functional dynamic test

6.1.2 Test Factors

Correctness, data integrity

6.1.3 Inputs

A new user's credentials, with valid information: username, first name, last name, date of birth, email, address, credit card
A new user's credentials, with valid information but a fake credit card
A Google account
A Facebook account

6.1.4 Outputs

A message M, containing either a success of failure message, depending on the account information given.
My Account menu
Add Credit Card menu

6.1.5 Initial State

Create account menu, empty

6.1.6 Methods of testing

Dynamic testing is used to ensure correctness and data integrity, and to observe the application behaviour when given incorrect information.

6.1.7 Test Cases

Test Case	Initial State	Input	Output
6.1.1	Create account menu, empty	Username, first name, last name, email, date of birth, address, credit card information	Message prompt reading: “The username you entered is already in use, please choose a different username.”
6.1.2	Create account menu, empty	Username, first name, last name, email, date of birth, address, credit card information	My account menu
6.1.3	Create account menu, empty	Username, first_name, last name, email, date of birth, address, fake credit card	Message prompt reading “The credit card information you have provided is invalid, please enter a different credit card.”
6.1.4	Create account menu, empty	Google account information	Add credit card menu
6.1.5	Create account menu, empty	Facebook account information	Add credit card menu

6.2 Order Transaction

Smart-Waiter needs to ensure that a user can send in their order, and pay for their order easily and securely. Order transaction will be vigorously tested to ensure complete customer satisfaction.

6.2.1 Test Type

Manual, functional dynamic test

6.2.2 Test Factors

Correctness, reliability, data integrity, data security, ease of use,

6.2.3 Inputs

A set n_i of 10 random orders consisting of different menu items, created manually, where i = 0, 1, 2 .. 9, where i = 0..4 are invalid orders with respect to the restaurant's policies and where i = 5..9 are valid orders.
A valid credit card
An expired credit card
A fake credit card
A VISA debit card
A VISA gift card

6.2.4 Outputs

An order summary O_i, where i corresponds to the i^{th} order from the set of orders n_i.
A message M, containing either a success or failure message, depending on the card type used.

6.2.5 Initial State

Order Test Cases: Restaurant menu module Credit Card Test Cases: Payment confirmation menu

6.2.6 Methods of testing

Dynamic testing is used to ensure validity, record the number of successful tests given a sample.

6.2.7 Test Cases

Test Case	Initial State	Input	Output
6.2.1	Restaurant menu module	n_3 from set of orders n_i	Message prompt reading: “This order does not follow the restaurant's menu policy, a waiter has been called to the table to assist with the ordering process”
6.2.2	Restaurant menu module	n_7 from set of orders n_i	Order summary menu
6.2.3	Payment confirmation menu	Valid credit card	Payment receipt menu
6.2.4	Payment confirmation menu	Expired credit card	Message prompt, reading: “This credit card is expired, please enter valid credit card information”
6.2.5	Payment confirmation menu	Fake credit card	Message prompt reading: “The information provided is invalid, please provide another credit card”
6.2.6	Payment confirmation menu	VISA debit card	Payment receipt menu
6.2.7	Payment confirmation menu	VISA gift card	Message prompt reading “VISA gift cards are not accepted as a valid form of payment with Smart-Waiter, sorry for any inconvenience”

6.3 Usability Testing

6.3.1 Test Factors

6.3.2 Inputs

6.3.3 Outputs

6.3.4 Initial State

6.3.5 Methods of testing

6.3.6 Test Cases

6.4 Performance Testing

6.4.1 Test Factors

6.4.2 Inputs

6.4.3 Outputs

6.4.4 Initial State

6.4.5 Methods of testing

6.4.6 Test Cases

7 Automated Testing Plan