

# TEST PLAN

## SMART INHALER

**PROJECT MANAGER: BISHWANATH BASTOLA  
ERIC RIZK, ISSAC GARCIA**

**UNIVERSITY OF NEW MEXICO  
SCHOOL OF ENGINEERING**

**SPONSOR: THUVIA SYSTEMS LLC  
429 COMMERCIAL ST NE  
ALBUQUERQUE, NEW MEXICO, 87102  
11/01/2021**

Remove this box and put an approved  
Sponsor logo in this space ONLY if your  
Sponsor approves doing so.



### Revision History:

Version	Revision Date	Description	Author

### Contents

1.....	Introduction	3
--------	--------------	---

2.....	Relationship to other documents	3
3.....	System overview	3
4.....	Hardware Features to be tested	3
4.1.....	External LEDs	3
4.2.....	Audio Speaker	3
4.3.....	External Buttons	3
4.4.....	Flow Sensor	3
5.....	Software Feature to be tested	4
5.1 Smart Phone Application .....		4
5.2 User Interface (feedback) Program .....		4
5.3 Default Operation Program.....		4
6.....	Not to be Tested	4
7.....	Approach	4
8.....	Testing materials (hardware/software requirements)	4
9.....	Test Cases	4
9.1.....	Test Case #1: Hardware Components & Sensors	4
9.2.....	Test Case #2: Default Operation Program	6
9.3.....	Test Case #3: User Interface Program	7
9.4.....	Test Case #4: Whole Unit Operation	8
9.5.....	Test Case #5: Smart Phone Application	9

# 1 Introduction

*This document provides the details and process for testing the development and functionality of a smart inhaler. The Smart Inhaler being designed is similar to a traditional inhaler used for asthma, except it is a smart medical device. This means it connects to a phone app, has lights and audio feedback and is loaded with digital sensors. The Smart Inhaler improves adherence of asthma medication, through positive reinforcement, gamification and reminders.*

## 2 Relationship to other documents

*Refer these other documents that are relevant.*

- *The Functional Specification*
- *Preliminary Requirements*

## 3 System overview

*At the heart of the design, the Smart Inhaler will be utilizing a Silicon Labs Thunderboard. This Thunderboard is a 32bit microcontroller development platform, that is equipped with Bluetooth capabilities and several sensors. A relative humidity & temperature sensor, a UV and ambient light sensor, a Hall effect sensor, and a 6-axis IMU sensor. The Thunderboard will be interfaced with an external Flow sensor, to collect inhalation data when the inhaler is being used. The Thunderboard will also be interfaced an audio speaker, as well as more LEDs and buttons for user feedback and device operation. The Smart Inhaler will be programed using the software development kit, Simplicity Studio 5. code will be written to activate the sensors and control the lights and audio, Data will then be sent to a smart phone application via Bluetooth. This smart phone application will be created in unison and included with the Smart Inhaler. The phone app will collect and track data based on the usage of the Smart Inhaler.*

## 4 Hardware Features to be tested

### 4.1 External LEDs

### 4.2 Audio Speaker

### 4.3 External Buttons

### 4.4 Flow Sensor

## **5. Software Features to be tested**

### **5.1 Smart Phone Application**

### **5.2 User Interface (feedback) Program**

### **5.3 Default Operation Program**

## **6. Not to be Tested**

The SI Thunderboard is not included in this test plan. The Thunderboard and all of its components and sensors will be checked prior to use.

## **7. Approach**

*Check all hardware first, before integration. Test all external components and sensors that will be connected to the Smart Inhaler. Then systematically check all components and sensors work after being interfaced with the Thunderboard. Do they work when operated by the microcontroller. Smart Inhaler will be connected to a machine at sponsor facility to mimic inhalation. Smart Inhaler will be linked to smart phone application and features of the app will be evaluated.*

## **8. Testing materials (hardware/software requirements)**

- *Voltmeter*
- *Power Supply*
- *Machine at sponsor facility*
- *Computer*
- *Mobile Smart Phone*

## **9. Test Cases**

### **9.1 Test Case #1: Hardware Components & Sensors**

<b>Tested By:</b>	n/a	
<b>Test Type</b>	n/a	
<b>Test Case Number</b>	1	
<b>Test Case Name</b>	Hardware Check	
<b>Test Case Description</b>	Test all hardware prior to integration. Do components and sensors turn on and work	
<b>Item(s) to be tested</b>		
1	Flow Sensor	
2	LEDs	
3	Buttons	
4	Speaker	
<b>Specifications</b>		
<b>Input</b>		<b>Expected Output/Result</b>
Check Data Sheets		Check Data Sheets
<b>Procedural Steps</b>		
1	Connect to Power	
2	Measure Voltage / Current	
3	Perform Visual / Physical Check	

## 9.2 Test Case #2: Default Operation Program

Tested By:		n/a
Test Type		n/a
Test Case Number		2
Test Case Name		Default Operation Program
Test Case Description		Does the Smart Inhaler perform desired task(s) it is programed to do. Does the Flow Sensor turn on and measure data and the right time. Do the buttons and LED work as desired.
Item(s) to be tested		
1	Operation of Flow Sensor (through Thunderboard– based on program)	
2	Condition of 6-axis IMU Sensor	
3	Button(s) operate and perform programed task when pressed	
4	LEDs turn on correctly – indication of programed task	
Specifications		
Input		Expected Output/Result
n/a		n/a
Procedural Steps		
1	n/a	
2		
3		

### 9.3 Test Case #3: User Interface Program

Tested By:		n/a
Test Type		n/a
Test Case Number		3
Test Case Name		User Interface Program
Test Case Description		This is to test the audio/visual user feedback, based on device usage. Does the Smart Inhaler perform desired tasks it is programed to do. Do the correct LEDs turn on based on conditions of device operation. Does the speaker output audio at the right time. Do the buttons perform the desired task
Item(s) to be tested		
1	LED(s)	
2	Button(s)	
3	Audio Speaker	
4		
Specifications		
Input		Expected Output/Result
n/a		LED(s) turn on Speaker outputs audio
Procedural Steps		
1	n/a	
2		
3		

## 9.4 Test Case #4: Whole Unit Operation

Tested By:		n/a
Test Type		n/a
Test Case Number		4
Test Case Name		Whole Unit Operation
Test Case Description		Testing the Smart Inhaler tfully assembledDoes the Smart Inhaler work as expected when hooked up to the machine that mimics inhalation.
Item(s) to be tested		
1	Operation of Flow Sensor	
2	Condition of 6-axis IMU Sensor	
3	Speaker Outputs Audio / LEDs turn on correctly	
4	Medication is dispensed	
Specifications		
Input		Expected Output/Result
n/a		n/a
Procedural Steps		
1	Hook up to machine	
2	Test functionality of Smart Inhaler	
3		



## 9.5 Test Case #5: Smart Phone Application

Tested By:		n/a
Test Type		n/a
Test Case Number		5
Test Case Name		Smart Phone Application
Test Case Description		Testing the smart phone application. Does Smart Inhaler connect to the app. Is data collected and tracked. Does the app give notifications. Does the app give reports on how the Smart Inhaler was used (proper or incorrect) - Does the app provide tips to improve usage.
Item(s) to be tested		
1	Bluetooth connection	
2	Data Collection	
3	Notifications	
4	Reports	
Specifications		
Input		Expected Output/Result
n/a		n/a
Procedural Steps		
1	Connect Smart Inhaler	
2	Use Smart Inhaler in several different cases – proper way, wrong way, ect.	
3	Check if Data, Reports and Notifications	

