**Test Plan (Team Assignment)**

ECE 411 Fall 2019 Homework 7

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***PIGGY BANK DEVICE: System Test Plan***

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## 1.0 Introduction

The purpose of this test document is to provide thorough instruction on the test procedures required for the verification and acceptance of the Piggy Bank Device. This device will use a mechanical sorter to sort common U.S. change. The atmega328p microcontroller will read output from IR sensors and will keep track of how much change has entered the piggy bank.

## 2.0 Objectives and Tasks

### 2.1 Objectives

The objective of this test plan is to verify a working product. To accomplish this, a series of functional and integrative test procedures will be used to verify each component of the device. Once each stage of component testing has been completed there will be an integrative test that will integrate 1 additional component at a time. This will continue until all electrical components have been integrated and the final acceptance test will include the integration of the entire system (both electrical and mechanical).

### 2.2 Tasks

1. Successful Software Compile
2. Sensor Functionality Test
3. Mechanical Sorter Functionality Test
4. Integrate the Microcontroller and LCD Screen (on breadboard) Test
5. Integrate the Microcontroller and LCD Screen with Sensors (on breadboard) Test
6. Integrate the Microcontroller and LCD Screen andSensors on PCB Test
7. Integrate the Electrical Components with the Mechanical Components Test.
8. Product Acceptance Test

## 3.0 Scope

**Code:** The arduino code that will be uploaded to the microcontroller. This code is a loop that polls infrared sensors and increments coin values determined by which sensor was triggered. No additional functions exist and testing requires a simple compiling verification.

**IR Sensors:** The IR sensors send out an infrared signal and read the reflected value indicating motion. This functionality will need to be tested before integrated with the microcontroller

**Microcontroller:** The brain of the product. It reads the inputs from the sensors, and outputs to the LCD screen. Make sure that the code uploads to this microprocessor successfully. Build a simple breadboard circuit to run the microcontroller and use a verified LCD screen and switch interface to test the functionality of the microcontroller.

**Mechanical Sorter:** This is a series of holes cut to filter coins coins by their size. Once the coin falls in its specific slot it is guided over the sensor VIA a rail. Perform an exhaustive test to determine that the sorter will work for the specific coins consistently.

## 4.0 Unit Testing

This section focuses on the code functionality and successful compilation.

### 4.1 Software

This test is a verification of the code. You will use an arduino Uno and attempt to compile and upload the code to the arduino uno. The test is successful if the code compiles and uploads successfully.

## 5.0 Functional Testing

This section focuses on the functional verification of individual project components.

### 5.1 Sensor

Wire up the sensor with 5 volts supply and attach the output of the sensor to a digital multimeter. Pass an object (your hand) in front of the sensor. When the object comes within 1 cm of the sensor you should notice that the voltage reading of the digital multimeter is a high value (5 Volts). Once the object passes completely by the sensor there should be a 0 Volts reading on the digital multimeter. If the passing distance in front of the digital multimeter is more or less than 1 cm adjust the potentiometer on the sensor until the distance of detection is 1 cm.

**Detailed Test Case Description for Functional Test 5.1**

| **Test Writer: Team 17** | | | | | | |
|---|---|---|---|---|---|---|
| **Test Case Name:** | Sensor Test | | **Test ID #:** | | | ST_Rev1 |
| **Description:** | Sensor Functional Test. Must be completed for all 4 sensors used in the device. | | **Type:** | | | White Box |
| **Test Information** | | | | | | |
| **Name of Tester:** | | | **Date:** | | | |
| **Hardware Ver:** | 1.0 | | **Time:** | | | |
| **Setup:** | Ensure that system has been reset and total is $0.00 | | | | | |
| **Step** | **Action** | **Expected Result** | **Pass** | **Fail** | **N/A** | **Comments** |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Connect sensor VCC pin to 5 Volts source | N/A | | | | |
| 2 | Connect sensor GND pin to ground of the 5 Volts source | Power indicator LED on all 5 sensors should be on. | | | | |
| 3 | Connect the DO pin of the sensor to a digital multimeter who shares the same ground. | Multimeter should be reading 5 Volts. | | | | |
| 4 | Pass an object in front of the sensor that is wired | 1. Green LED should light up.<br>2. Multimeter should be reading 0 Volts | | | | |
| **Overall test result:** | | | | | | |

### 5.2 Mechanical Sorter

Exhaustively test that the corresponding Quarter, Dime, Nickel and Penny slide down the ramp and into the correct slot of the corresponding holes. Do 10 trials for each coin. If all trials go through the appropriate hole then it has passed.

## 6.0 Integration Testing

This section focuses on the functionality of verified components when integrated with one another.

### 6.1 microcontroller & LCD via breadboard

Program the atmega328p to display a dollar amount equal to the amount of money that has passed through the coin sorter. Place the atmega327 on the breadboard test circuit. Connect the 4 pins of the LCD to the RX, TX, GND and VCC pins of the atmega. Power on the circuit and confirm that the dollar amount display properly. Use the switches included in the breadboard circuit connected to pins 12, 11, 5, and 4. These will be the Quarter, dime, nickel and Penny pins respectively.

### 6.2 (microcontroller & LCD) & Sensor via breadboard

Using the breadboard test circuit, test whether triggering each of the 4 sensors with the appropriate voltage (5V) will produce the correct currency amount as displayed on the LCD screen.

**6.3 (microcontroller & LCD) & Sensor on PCB**

Using the PCB circuit, test whether triggering each of 4 sensors with the appropriate voltage will produce the correct currency amount. This can be done by passing any object in front of each sensor (finger is acceptable). Verify that the savings amount is updated accordingly.

**Test Case Description for Integration Test 6.3**

| **Test Writer: Team 17** | | | | | | |
|---|---|---|---|---|---|---|
| **Test Case Name:** | Coin Test #1 | | **Test ID #:** | | | CT_Rev1 |
| **Description:** | Simulate inserting a quarter, dime, nickel, and penny with system integrated onto PCB. | | **Type:** | | | Black Box |
| **Test Information** | | | | | | |
| **Name of Tester:** | | | **Date:** | | | |
| **Hardware Ver:** | 1.0 | | **Time:** | | | |
| **Setup:** | Make sure that system has been reset and LCD reads the amount $0.00. | | | | | |
| **Step** | **Action** | **Expected Result** | **Pass** | **Fail** | **N/A** | **Comments** |
| 1 | Simulate Inserting a Quarter | Screen should read $0.25 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Simulate Inserting a Dime | Screen should read $0.35 | | | | |
| 3 | Simulate Inserting a Nickel | Screen should read $0.40 | | | | |
| 4 | Simulate Inserting a Penny | Screen should read $0.41 | | | | |
| 5 | Power off, on | Screen should read $0.00 | | | | |
| **Overall test result:** | | | | | | |

**6.4 electrical and mechanical components integration**

This test is to be done on the With this completed system, insert three of each type of coin. Test whether, when each coin is inserted, the total displayed on the LCD screen increases by the appropriate amount. Additionally verify that the coins slide effortlessly and enter the correct slot every time.

## 7.0 Acceptance Test

The purpose of the acceptance test is to determine whether the product is acceptable to the client. In order to pass acceptance tests, the system must meet both functional and performance specifications. For the current system, the acceptance test will determine that the product is accurately recording the amount of change entered, that it is easy to use, and that it continues to function properly with repeated use.