TAKPAD:

Tactile Audio Playback Device

Test Plan Documentation: Rev. A1

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Authors:
Daniel Christiansen
Aaron Halim
Tsegaslase Mebrahtu
Tyler Thompson
Jesse Zelaya

TAKPAD: System Test Plan

1.0 Introduction

The TAKPAD is a prototype device and proof-of concept project that aims to showcase an functional extension of a popular electronic music device known as a grid controller. The TAKPAD's goal is to integrate force-sensitive programmable adjustments to digital audio playback.

1.1 Main Objective

The Main objective of the product test plan is to document how the TAKPAD device will be tested to verify that the device performance conforms with all the specifications of the TAKPAD product design specification (PDS) document and functions properly.

1.2 Purpose

This document describes the procedure on how to test the system and verify that it's operating properly. It ensures that the operational, functional, performance and interface requirements are met.

2.0 Reference Documents

2.1 Design Documentation

- Product Design Specification (PDS)
- Eagle Circuit Schematic
- Eagle Board Layout
- Top Layer
- Bottom Layer
- Bill of Materials (BOM)

2.2 Other Documentation

- ATMega328p Datasheet
- LM386 Datasheet
- AAT3693 LiPo Battery Charging IC Datasheet
- AVR Library Homepage

2.3 Definitions and Acronyms

- IDE - Integrated Development Environment
- PC - Personal Computer
- SD (card) - Secure Digital (card)
- .WAV - WAVeform Audio File Format
- MSO - Mixed Signal Oscilloscope
- AC - Alternating Current
- DC - Direct Current

3.0 Testing Approach

3.1 Testing Scope

3.1.1 Tests within scope

- Playback fidelity within programmed-defined adjustments
- User input and interfacing
- PDS Functionality requirements
- PDS Performance requirements
- Interoperational testing between internal components
- Structural testing of device casing and components

3.1.2 Tests outside of scope

- Performance of alternate programming to digital audio adjustments
- Power efficiency testing of powered device
- Device durability against environmental forces
- Any component level stress test not related to physical force based use (e.g. circuirty stress testing)

3.1 Testing Stages

In this document, there are three levels of testing are employed. Unit testing, Integrated testing and system testing are the three levels testing, and each test is implemented in the order that they appear. Each level of testing must be completed before proceeding to the next level due to inherent device operational requirements or prerequisites in the testing hierarchy.

3.1.1 Level 1: Unit Testing

This stage involves testing all the modules of the system individually. Both the software and hardware components are tested and debugged individually to make sure that they are operational according to their functional specifications. Unit testing specifically focuses

- Objectives
    - Test all functional requirements.
    - To check if it meets the specifications stated in PDS.
    - To conduct Black box testing.
    - To conduct White box testing.

3.1.2 Level 2: Integrated Testing

This stage involves that the modules are connected for a basic functionality test and makes sure that modules can communicate correctly. The first test is powering up the system properly which is testing whether a properly rated voltage and current is supplied into the system. Once the DC power up test is verified, the next step will be verifying module to module communication.

- Objectives
    - Identifying and fixing problems with interconnectivity of modules.
    - Verifying the expected outcomes generated when the modules are integrated.

3.1.3 Level 3: System Testing

In this final stage, all the modules are connected, and the product is tested as a whole.

- Objectives
    - Verify functional and performance specifications are met.
    - Identify input data that results in unexpected outcome.
    - Verify that it meets all the requirements outlined in the PDS.

3.3 Operational Description

The system takes an input in the form of analog voltage wave from the vibration sensors and WAV files from microSD card or from WAV tables within internal memory of the microprocessor unit. The filtered analog voltage is then processed by the microcontroller which will output a processed .WAV file into an audio amplifier. For every vibration sensor, the system will play a unique .WAV file. If the sensor is not pressed, then no sound will be played.

3.4 Testing Strategies

Each test will conducted on a prototype device that contains all modules and components necessary for each of the outlined tests within the Section 5 Systems Tests portion of this document. The tests will be conducted in the defined hierarchical order as defined in the aforementioned sectio. The other prototype device boards will be used reproduce any abnormal results from the main prototype testing board.

4.0 Pretest Preparation

This section includes

- test equipment needed to perform validation testing
- Setup and calibration procedures.

4.1 Test Equipment

-Tektronix MSO 4054 Oscilloscope

- To analyze the output voltages of the vibration sensors
- To analyze the performance of the audio amplifier
- To verify and detect expected waveforms from device inputs and outputs
- Tester must have familiarity with circuit analysis AC and common oscilloscope operation

-AVR Dragon Flash Programmer

AVR programmer is used as an interface between personal computer (any compatible laptop) and microprocessor and subsequently to load code into the ATMega328p microprocessing unit.

-Tektronix DMM4030 Digital Multimeter

- To verify DC voltages and currents
- To verify resistance of components on the board
- To detect defects in device assembly
- Tester must have familiarity with DC circuit analysis and common multimeter operation

-AVR-Studio Compatible Laptop or PC

- Used to interface with the AVR Dragon programmer and load appropriate firmware onto the TAKPAD prototype board devie

- Laptop or PC may be running on any operating system that is compatible with the AVR Studio software IDE and has the necessary drivers and software libraries to run and interface with the AVR Dragon programmer
- Tester must have familiarity with interfacing with the AVR Studio software IDE for programming on to the prototype board

-Compatible Speaker Setup with 3.5mm Jack Audio Input
.Any speaker or sound system capable of playback through a 3.5mm audio jack input will be required for the tester to listen and confirm the audio playback from the prototype device.

4.2 Test Setup and Calibration

- Oscilloscope probes should be calibrated to defaults on the oscilloscope
- The test equipment should be tuned for accurate readings
- The AVR dragon programmer functionality should be verified by the IDE suite on the console PC
- The SD card must be placed inside the SD socket.
- The PC/laptop should be installed with IDE software to write the code and load the code to the microcontroller.
- The code is loaded to microcontroller via AVR dragon programmer.
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5.0 System Tests

Each test has an identification tag referencing testing level and test type. For example: ”L1-R01” indicates L1 (level 1 unit testing) and the R01 (first reliability testing) within the L1 test category.

5.1 Level I: Unit Testing

- Functional Testing
  - L1-F01: Power supply test
  - L1-F02: Charging circuit test
  - L1-F03: Microcontroller functionality test
  - L1-F04: LED operation test
  - L1-F05: Piezoelectric sensor test
  - L1-F06: Audio output test
  - L1-F07: SD card socket test
- Reliability Testing
  - L1-R01: Vibration Input Test

5.2 Level II: Integration Testing

- Functional Testing
    - L2-F01: Test to ensure sensor output is captured by the ADC
    - L2-F02: Test to ensure various sensor levels are recognized
    - L2-F03: Test PWM audio output sounds correct
    - L2-F04: Test audio signal ability to drive a speaker
    - L2-F05: SD Card is readable by microcontroller

5.3 Level III: System Testing

- Functionality Testing
    - L3-F01: Test stability of case in use
    - L3-F02: Test stability of pad surface

- Parametric / Use Testing
    - L3-P01: Test/tune pad thresholds/responses
    - L3-P02: Test various rates of pad strikes
    - L3-P03: Test response timing (pad strike to note start)
    - L3-P04: Test overall usability

- Stress Testing
    - L3-S01: Test durability of pad surface
    - L3-S02: Test durability of case
    - L3-S03: Test durability of USB jack connection
    - L3-S04: Test durability of SD socket connection
    - L3-S05: Test durability of audio jack connection

Appendix A: Detailed Test Descriptions

Detailed Test Case Descriptions for Two Tests

Test Writer: Daniel Christiansen						
Test Case Name:		Input sensor level test			**Test ID#:**	L2-F02
Description:		Test to verify that sensors are connected to ADC properly, and are responding to different levels of force. We will to test the range of a single sensor using LEDs from all four. The number of LEDs lit will indicate the value read from sensor. This test will be completed for each sensor in turn.			**Type:**	White box
Tester Information						
Name of Tester:					**Date:**	
Hardware Ver:		Takpad 1.0			**Time:**	
Setup:		Microcontroller should be supplied with power, input sensors & leds should be connected. Code should be modified to light a number of LEDs (0 to 4) in response to level of input from a single sensor.				
Step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	Load code to test sensor 0	Code successfully loads				
2	Strike sensor pads with various amounts of force	A number of LEDs should light in proportion to the force of strike				
3	Repeat test for sensors 1-3	Same as above				
Overall test result:						

Test Writer: Daniel Christiansen						
Test Case Name:		Power supply test			**Test ID#:**	L1-F01
Description:		Tests that the power supply will provide the expected voltage when USB cable is connected			**Type:**	Black box
Tester Information						
Name of Tester:					**Date:**	
Hardware Ver:		Takpad 1.0			**Time:**	
Setup:		Power supply circuit should be assembled on board, but disconnected from other modules. There should be no battery and the USB cable should start unplugged				
Step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	Connect oscilloscope to power supply test points	There should be 0v measured				
2	Connect 5v dedicated power supply to Vin	Non-excessive amount of current being drawn				
3	Disconnect power supply and plug in USB cable	Output should read 4-5v				
Overall test result:						