ECE 411
Team #5

Shooting Chronograph
HW#7: Test Plan Rev.1

Sean Schorzman
Jaeyoon Lee
Jianyu Hao
Kelly Makinster

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1.0 Introduction

Shooting chronograph is a product that can measure a projectile speed that is travelling through a tube by measuring the time spent between a certain distance. It is a compact, light-weight device that can be mounted on a tripod and is powered by a 9V battery. It is ideally designed for recording Nerf gun darts.

1.1 This Document

This test plan briefly documents the process of testing the device using simple test cases.

1.2 Conduct of the System Tests

The system tests are primarily to check the functionality of the board. Will be done in a controlled environment to ensure personal performing tests are abiding by NFPA 70E guidelines for electrical safety in the workplace.

1.3 Recording of Results, Witnessing, and Authorities

Tests will be monitored and witnessed by multiple members to confirm the validity of the tests.

2.0 Reference Documents

The following documents are referenced in this test plan.

2.1.1. PDS, Rev 1
(https://github.com/makinster/ECE411_TEAM_5/blob/final/Design%20Log/1_PDS.pdf)

2.1.2. IR Light Level Code Rev. 0
(https://github.com/makinster/ECE411_TEAM_5/blob/final/Arduino%20Code/ECE411_IR_LIGHT_LEVEL_CODE)

2.1.3. Block Diagram Level 1, Rev. 1
(https://github.com/makinster/ECE411_TEAM_5/blob/final/Block%20Diagrams/Block%20Diagram%20Level%201.png)

2.1.4. High Quality Chronograph Test Rev. 0

(https://github.com/makinster/ECE411_TEAM_5/blob/final/High%20Quality%20Chronograph%20Test)

2.2 Design Documentation

The following documents describe the design approach for the shooting chronograph.

- Chronograph PDS Rev.1 (https://github.com/makinster/ECE411_TEAM_5/blob/final/Design%20Log/1_PDS.pdf)
- Chronograph Block Diagram Level 1, Rev. 1 (https://github.com/makinster/ECE411_TEAM_5/blob/final/Block%20Diagrams/Block%20Diagram%20Level%201.png)
- Chronograph Schematic Rev. 5 (https://github.com/makinster/ECE411_TEAM_5/blob/final/FINAL%20FINAL%20ECE%20411%20Chronograph%20Schematic.sch)

2.3 Other

Chronograph Platform:

Chronograph will be setup in an enclosure and the enclosure will be able to be set up on a tripod for stability control.

Testing Tube:

Testing tube will be used as a guide to ensure the sensors detect the projectile.

3.0 Chronograph Overview

3.1 Operation Description:

A projectile will be shot through the tube, sensor 1 will detect the projectile, start the timer, then sensor 2 will detect the projectile and stop the timer. The difference of the time will then be used put into an equation to determine the speed of which the object is going. The distance between sensors will be approx. 5 inch. Thus the ft/s will be given (5/12inch)/time difference.

3.2 Definition of Terminology

FPS - Feet per second is a standard term used to describe speeds of bullet, arrow and many more applicable projectile in the industry.

3.3 Display Methods

Visual display of the speed of the projectile will be displayed via LCD screen in FPS.

3.4 Computational Methods

ft/s will be given ((5 inches) / (12 inches/foot) / ((stopTime-startTime) µs)(1E6 1/µs)

4.0 Pretest Preparation

Arduino code is loaded onto atMega microprocessor

4.1 Test Equipment

- Various Nerf Guns (different known velocities)
- Arduino IDE (Installed on PC)
- Testing tube (IR sensors attached)
- Multimeter for testing voltage output
- Personal Computer

4.2 Test Setup and Calibration

Tests are carried out to check the device's functional test of essential components (power and IR sensors) and as well as the reset button that is soldered onto the board.

5.0 System Tests

5.1. Functional Checks

5.1.1. Power Switch/Port and indicator

When we turn on the power switch the green LED near the power switch should light up and the LCD display should light up as well. Visually check for confirmation that the power switch is working and components are getting power supplied to them.

5.1.2 Power Supply Voltage and Current Levels

Verify that all parts on the board on not receiving more than 5V and current that is not burning parts up.Check visually and make sure no products smell like they burnt out. Check voltage with multimeter.

5.1.3 IR Sensor Test (Test ID: IR-SENSOR TEST)

5.1.3.1 Initialization (Ready)

Verify visually that when the system goes from off state to on state that the system initially goes from reset state to ready state via LCD display and that analog values are displayed.

5.1.3.2 Signal Strength Check

Tests the IR Pair sensors to ensure that they are triggering when acceptable. Lower analog value means detection. Do this by blocking the IR pair and observing that the value on the LCD changes

5.1.4 RESET-TEST (Test ID: RESET-TEST)

5.1.4.1 Sensor Calibration

In case of unusual recordings and/or sensor malfunction (alignment error), on-board reset button recalibrates the sensors

6.0. Speed Range and Accuracy

Speed Range: Determined by blocking both sensors at the same time and reading the display via LCD.

Accuracy: Refer to High Quality Chronograph Test Document to compare values (https://github.com/makinster/ECE411_TEAM_5/blob/final/High%20Quality%20Chronograph%20Test)

7.0 Issues and Associated Risks

The following issues and risks can occur while testing the chronograph.

- The second sensor may not be able to detect the projectile and make no recording.
- The projectile must be shot straight otherwise precise measurement can't be made.
- Wires may get disconnected if not handled with care.
- Battery will run out if power switch is left on continuously (use wall outlet to bypass this issue)

Chronograph: Test cases

Test Writer: Team 5						
Test Case Name:	**IR Sensors Test**		**Test ID:**	IR-SENSOR TEST		
Reference Doc.	**Block Diagram, rev 0 ; PDS, rev. 1, IR Light Level Code Rev. 0**					
Description:	Tests the IR Pair sensors to ensure that they are triggering when acceptable. Lower analog value means detection.		**Type**	Black Box		
Tester Information:						
Name of Tester			**Date:**			
Hardware Ver:	**1.0**		**Time:**			
Setup:	Make sure that the system is started from an *off* state Upload Arduino code to read analog values of IR sensors					
step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	**Nothing**	Displays equilibrium analog values of sensors				
2	**Block IR Pair 1**	Displays lower analog value of IR pair 1				
3	**Unblock IR Pair 1**	Returns to equilibrium analog value of IR pair 1				
4	**Block IR Pair 2**	Displays lower analog value of IR pair 2				
5	**Unblock IR Pair 2**	Returns to equilibrium analog value of IR pair 2				
Overall Test Results:						

Test Writer: Team 5						
Test Case Name:	**Reset Test**		**Test ID:**	RESET-TEST		
Reference Doc.	**Chronograph Schematic, rev. 5**					
Description:	In case of unusual recordings and/or sensor malfunction, on-board Reset button recalibrates the sensors		**Type**	Black Box		
Tester Information:						
Name of Tester			**Date:**			
Hardware Ver:	**1.0**		**Time:**			
Setup:	Make sure that the system is started from an *off* state					
step	**Action**	**Expected Result**	**Pass**	**Fail**	**N/A**	**Comments**
1	**Nothing**	Device starts in ready state Display says: “Ready”				
2	**Cross sensor 1**	Device moves to waiting state Display says: “Started…”				
3	**Nothing (for .5 sec)**	Device times out Displays says: “Error”				
4	**Reset**	Reset BTTN is pushed Display says: “Ready”				
Overall Test Results:						