Motorcycle Proximity Sensor

Test Plan

Rev. 1.2 11/23/14

Team T04

Rusty Wiseman
Dan Frister
Noah Erickson
Branden Driver

<u>Motorcycle Proximity Sensor Test Plan</u>

1.0 INTRODUCTION
- Background
- Objective
- Constraints
- Standards

2.0 Design Documentations
- Design Specifications

3.0 Test Equipment
- Oscilloscope
- DC Power Supply
- Function Generator
- Logic Analyzer

4.0 Test Cases

4.1 Sensors

4.1.1 Verify proper output

4.2 Mainboard

4.2.1 Upload "Hello World" to microprocessor

4.2.2 Verify microprocessor outputs

4.3 Power Supply

4.3.1 Connect to DC source

4.3.2 Check for 5VDC output

4.3.3 Check for power dissipation

4.4 Display Board

4.4.1 Test demultiplexer for proper output

4.4.2 Check latch functionality

4.4.3 Test FET switches

4.4.4 Test with sequential code from microprocessor

4.5 System Integration Test

4.5.1 Mainboard to Display
- Test microprocessor output to demultiplexer
- Test demultiplexer output to latches
- Check that LED's light up

4.5.2 Sensors to Mainboard
- Check for sensor input to microprocessor
- Check for microprocessor binary output

4.5.3 Entire System
- Verify proper distance measurements
- Test total system current draw

1.0 Introduction

Background

Motorcyclists are especially vulnerable on the road. They are exposed to the elements and a lot smaller than other traffic on the road. As such, other motorists do not always see them or pay attention to them when they do. This means it is necessary for a motorcyclist to always be aware of every car on the road whether they be in front or behind them. The proximity of a vehicle behind and to the sides of a motorcyclist determine the rider's lane position and riding style in order to ride safely and defensively. With the popularity of vintage motorcycles, café racers, and modifications to motorcycles a lot of riders are finding themselves with aftermarket rearview mirrors, if any at all. These aftermarket mirrors can be inconveniently positioned or possibly suffer from vibration making them hard to use effectively.

Objective

Our proximity sensor will give a visual representation of the distance of a vehicle from the rear of the motorcycle. This will be shown in three zones; close, near, and far with all zones within 15 feet of the rear of the bike. Optionally, there will be side sensors as well that show a detection of a vehicle in the rider's blind spot. The display will be mounted in the front of the bike near the speedometer where the rider does not have to take their attention from the road in front of them in order to know how close traffic is. This will give the rider a good indication of where to position themselves in the lane and what their current surroundings are.

Constraints

The display must be visible in all conditions and be durable enough to survive in inclement weather since it will be exposed. The power source is 12.6 VDC from the motorcycle lead-acid battery so it cannot draw more current than the motorcycle can give which is not a major concern. The unit will need to be compact so as to mount easily on the front of the motorcycle within sight of the rider.

Standards

The unit must comply with any sort of federal safety standards that may be in effect regarding sensors (RF, IR, Ultrasonic, etc.). There should be no communication or data standards needed in this implementation.

2.0 Design Documentation

REQUIREMENTS SPECIFICATION		
Marketing Requirements	**Engineering Requirements**	**Justification**
5	The unit must detect an object at least 13 feet away with accuracy to +/- 3in.	The average car length is ~15ft and less than that is considered "close" for a motorcycle rider.
4	It must be able to be powered by a 12V DC source.	The unit will be powered from the 12V lead-acid motorcycle battery
3	The unit must light a display based on the distance of detected object in 3 zones; Close, Medium, Far.	The changing display will tell the rider how close a car is getting.
2, 3, 6	The display must be bright enough to be seen in full sunlight.	Time of day cannot restrict use of the unit.
2, 4, 5	The unit will be modular.	The display will be mounted up front and the sensors will be mounted in the rear.
3, 6	Display must update in real-time.	The rider must know how close an object is with no delay.
6	The unit must be weather-proof.	Motorcycles are exposed to all elements during operation and ridden frequently in inclement weather.
1	Total parts and manufacturing should not exceed $50.	The end-user cost should be low for a safety device in order to encourage sales.
5	The system should draw max current of 500mA.	The system should not be a considerable power drain on the motorcycle electronics system.
4, 5	The modules should be low-profile and easily mounted	Motorcycles are all different and do not have a lot of unused space to mount peripherals.
3, 6	The unit may have side sensors for blind-spot detection.	A rider must physically turn his head (and therefore) attention away from the road in front of him in order to check blind spots.

Marketing Requirements

1. The system should have an end-user cost of $100 or less.
2. The display should be visible in peripheral vision.
3. The system should tell the rider how close an object is.
4. The system should be physically small.
5. The system should be easy to install.
6. The system should be able to be relied on for physical safety.

4.0 Test Cases

4.1 Sensors

4.1.1 Verify Proper Output

Use a logic analyzer to verify proper outputs of sensors. That is, pulse each of the trigger pins high and verify duration of the echo pin logic high corresponding with target distance.

4.2 Mainboard

4.2.1 Upload “hello world” to microprocessor

Program the mainboard through the USB to serial cable connected to the 6 pin header on the mainboard to verify the microcontroller’s functionality.

4.2.2 Verify Microprocessor Outputs

Program the microcontroller to output an alternating high and low signal on each output pin.

4.3 Power Supply

4.3.1 Connect to DC Source

Connect the mainboard input power pins to a current limited power supply. Start at 6V and gradually increase to 12V to verify the power supply works.

4.3.2 Check for 5V DC output

Verify that the output of the voltage regulator is 5V with a digital multi-meter.

4.3.3 Check for power dissipation

Measure current through the voltage regulator and multiply by the voltage dropped across it.

4.4 Display board

4.4.1 Test display board power

Apply power and ground to seven pin display connector. Test voltage at each IC power pin and at each display LED resistor using volt meter.

4.4.2 Test demultiplexer for proper output

Apply 4-bit binary inputs to the demultiplexer with function generator or by individually putting a logic high on each input pin then use the logic analyzer to check for corresponding logic out.

4.4.3 Check latch functionality

Using 5V supply on the set and reset pins for each latch, check corresponding output on oscilloscope or logic analyzer for proper operation.

4.4.4 Test FET switches

Put logic high (5VDC) on gate of each FET to see if corresponding LED lights up.

4.4.5 Test with sequential code

Test functionality of entire board by manually inputting each binary code and pulsing enable to demultiplexer, then checking that corresponding LEDs light up.

4.5 System Integration Test

4.5.1 Mainboard to display

Test microprocessor output to demultiplexer by using a dummy code that has microprocessor outputs sequentially step demultiplexer inputs from binary 0-16 and observe LED output.

Each LED that corresponds to the sequential microprocessor output should light up when received and all should go dark when master RESET code sent to latches.

4.5.2 Sensors to mainboard

Once sensors are plugged into mainboard, check for logic high pulse from microprocessor for triggering sensors. Once that is verified check for detection output logic high on each input pin of microprocessor corresponding to that sensor.

Using logic probe, check for proper binary output on microprocessor pins corresponding to each sensor and range detected from that sensor.

4.5.3 Entire System Integration

Using a 15ft measuring tape, verify that distance thresholds of 5ft, 10ft, 15ft light up corresponding LEDs indicating that distance with that sensor.

In worst case scenario (i.e. object within 5 feet of each sensor) all LEDs will light up. Test current draw of system with all LEDs lit.

Test Writer: Noah Erickson						
Test Case Name:		Main Board to Display Test #1			**Test ID:**	MPS-Main Board-01
Description:		Upload "hello world" to microprocessor			**Type:**	Black Box
Tester Information:						
Name of Tester:					**Date:**	
Hardware Ver:		Main Board V1.5			**Time:**	
Setup:		The mainboard should be completely assembled and should be connected to the 5V power supply. The input voltage to the power supply should be anywhere from 6V to 12V. The USB to serial programming cable should be connected to the 6 pin serial programming header on the mainboard. A standard 5mm LED should be connected to one of the display board header pins and a 330 Ohm resistor.				
Step	**Action**	**Expected Result**	**Pass**	**Fail**	**Comments**	
1	Turn on input voltage	Mainboard should be powered				
2	Write program in Arduino IDE	A source code file that compiles without errors with the purpose of blinking an LED				
3	Upload program to mainboard	The program load successfully				
4	Wait	The LED should blink				
Overall test result						

Test Writer: Rusty Wiseman			
Test Case Name:	Demultiplexer output test #1	**Test ID:**	MPS-Display-02
Description:	Checks that binary inputs to the display board produce the correct corresponding outputs on the demultiplexer.	**Type:**	White Box
Tester Information:			
Name of Tester:		**Date:**	
Hardware Ver:	Display V1.4	**Time:**	
Setup:	Display board should have 5V power with demultiplexer enable tied low, Y0-Y15 pulled low, and data input to demultiplexer inputs A[0-3]. Sequential binary inputs done via script.		

Step	**Action**	**Expected Result**	**Pass**	**Fail**	**Comments**
1	Input binary 0	Y0 output high			
2	Input binary 1	Y1 output high			
3	Input binary 2	Y2 output high			
4	Input binary 3	Y3 output high			
5	Input binary 4	Y4 output high			
6	Input binary 5	Y5 output high			
7	Input binary 6	Y6 output high			
8	Input binary 7	Y7 output high			
9	Input binary 8	Y8 output high			
10	Input binary 9	Y9 output high			
11	Input binary 10	Y10 output high			
12	Input binary 11	Y11 output high			
13	Input binary 12	Y12 output high			
14	Input binary 13	Y13 output high			
15	Input binary 14	Y14 output high			
16	Input binary 15	Y15 output high			
17	Input binary 16	Y16 output high			
Overall test result					

Test Writer: Daniel Frister					
Test Case Name:	Main Board to Display Test #1			**Test ID:**	MPS-Integration-01
Description:	Checks that binary inputs to the display board produce the correct corresponding outputs on the demultiplexer.			**Type:**	Black Box
Tester Information:					
Name of Tester:				**Date:**	
Hardware Ver:	Main Board V1.5, Display V1.4			**Time:**	
Setup:	Display board should have 5V and seven pin cable to main board attached. Main board should be powered, have seven pin cable to display board connected, and be loaded with a program to output as a four bit digital up counter with output enable at clock rate 0.5 Hz. Oscilloscope should be connected at channels A0-A3 on main board molex connector.				

Step	**Action**	**Expected Result**	**Pass**	**Fail**	**Comments**
1	Observe binary 0	Right Display Green LED on			
2	Observe binary 1	Right Display Yellow LED on			
3	Observe binary 2	Right Display Red LED on			
4	Observe binary 3	All Right Display LEDs off			
5	Observe binary 4	Rear Display Green LED on			
6	Observe binary 5	Rear Display Yellow LED on			
7	Observe binary 6	Rear Display Red LED on			
8	Observe binary 7	All Rear Display LEDs off			
9	Observe binary 8	Left Display Green LED on			
10	Observe binary 9	Left Display Yellow LED on			
11	Observe binary 10	Left Display Red LED on			
12	Observe binary 11	All Left Display LEDs off			
13	Observe binary 12	No display changes			
14	Observe binary 13	No display changes			
15	Observe binary 14	No display changes			
16	Observe binary 15	No display changes			
Overall test result					

Test Writer: Branden Driver			
Test Case Name:	Entire System Test #1	**Test ID:**	MPS-System-01
Description:	Checks that all connections are functioning properly and that the code loaded onto the microcontroller is set for the correct distances.	**Type:**	Black Box
Tester Information:			
Name of Tester:		**Date:**	
Hardware Ver:	Display V1.4, Main Board V1.5, Sensor V1.0	**Time:**	
Setup:	Both Sensor Board and Display Board will be wire-connected to the Main Board. Main Board will be connected to power supply of at least 6V and at most 12V. Set Sensor Board on edge of table with Left Sensor facing straight out. Using tape measure and masking tape, mark off distances of 5, 10, and 15 feet. Have a flat, solid, light-weight surface (such as a textbook) to place in front of sensor at different distances.		

Step	Action	Expected Result	Pass	Fail	Comments
1	Place surface at distance of 15'	Left Green LED on			
2	Place surface at distance of 10'	Left Green and Yellow LEDs on			
3	Place surface at distance of 5'	Left Green, Yellow, and Red LEDs on			
4	Rotate to rear sensor	Rear Sensor ready to be tested			
5	Place surface at distance of 15'	Rear Green LED on			
6	Place surface at distance of 10'	Rear Green and Yellow LEDS on			
7	Place surface at distance of 5'	Rear Green, Yellow, and Red LEDs on			
8	Rotate to right sensor	Right Sensor ready to be tested			
9	Place surface at distance of 15'	Right Green LED on			
10	Place surface at distance of 10'	Right Green and Yellow LEDs on			
11	Place surface at distance of 5'	Right Green, Yellow, and Red LEDs on			
Overall test result					