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| Straight outta compe |
| Final Test Plan |
| Performance and Functionality of the Overall System |
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# Revision History

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| --- | --- | --- |
| Date | Rev. Author | Revision |
| Nov. 6, 2015 | J. Bokhiria | Integration of test plan. |
| Nov. 6, 2015- Nov. 7, 2015 | J. Merchan | Correction and Addition of Test Plan |
| Nov. 7, 2015 | J. Merchan | Addition of table of Contents and Document Description |
| Nov. 7, 2015 | Z. Rauen | Editing and formatting |

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1. Introduction
   1. Identification

This document shall be known as “Testing of Performance and Functionality” and has an identifier of SOC-Testing to be referenced in future documents.

* 1. Purpose

The purpose of this document is to define the testing procedure for the quality and performance of the car system. This documents contains a detailed description test procedures as well as the expected results.

* 1. Scope

This document’s scope is for the overall system. The testing procedures in this documents are meant to test the quality and performance of the overall system design according to the system requirements specified in SOC-SysReq.

* 1. Definitions, Acronyms and Abbreviations
     1. Definitions
        1. **Car:** The main product, the Intelligent Car Version 3.
        2. **Mode:** A constant state of the system, in this case of the car. This can be changed by input from the user (1.4.1.5).
        3. **Product:** The entire system (1.4.1.4) as a finished design.
        4. **System:** This refers to the entire system in use, in this case the car as well as the personal computer that the car connects to in order to use data logging. Additionally this will include the optional mobile phone that acts as a remote as well.
        5. **User:** The person(s) that will be using or interacting with the product.
        6. **We:** The members of Straight Outta CompE.
     2. Acronyms
        1. **I2C:** Optionally I2C. Inter-Integrated Circuit.
        2. **IEEE:** Institute of Electrical and Electronics Engineers.
        3. **PC:** Personal Computer.
        4. **LED:** Light emitting diode.
     3. Abbreviations
        1. **V:** volts.
        2. **°:** degree(s).
        3. **Ω:** Ohms
        4. **μ:** Micro ()
        5. **k:** Kilo ()
        6. **p:** Pico ()
  2. References
     1. Documents
        1. SOC-SysDes-1
        2. SOC-SysDes-2
        3. SOC-SysDes-3
        4. SOC-SysReq
        5. SOC-Tuning
        6. PID Autotune V1 - https://github.com/br3ttb/Arduino-PID-AutoTune-Library/blob/master/PID\_AutoTune\_v0/
        7. Materials from EE416/464, Fall 2015
     2. Standards
        1. I2C
        2. UART

1. Test Plan of the Overall System
   1. Testing Scope

The procedures described in this section are design to test the quality and performance of individual parts of the Car System. This testing procedures will test the functionality of major car components as well as the interaction between components.

* 1. Car System Design Test Table

The testing table below contains the procedure and expected results for every component. The different sections of this table can be referred to by Section 2.2.*N* where *N* corresponds to the test number.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | N | Procedure | Expected Results | Pass | Fail | Comments |
| Line Camera Performance | 1. | 1. Place the car on the track, centered with the black line  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Accuracy mode by flipping mode using switch 2 located in the top rear of the car. | 1. After 5 seconds the car starts moving  2. The car recognizes the black line and follows the black line around the track |  |  |  |
| Pixy Camera | 2. | 1. Connect the pixy camera to PC  2. Set signature of an color post object using PixyMon and confirm that pixy camera can recognize the color post | In PixyMon you can see that pixy camera detects and recognize the set signature of an color object |  |  |  |
| 3. | 1. Place the car on the track  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Accuracy mode by flipping mode switch 2 located in the top rear of the car. | After 5 seconds the car start moving  Before the intersection, the pixy detects the color post and when the car reach the intersection the car will travel in a direction based on color post command |  |  |  |
| 4. | Repeat the above step but this time move that color object | Again. in PixyMon you can see that pixy camera detects and recognize the set signature of an color object |  |  |  |
| Steering | 5. | 1. Manually turn the front to the left or right by simply rotation the servo located in the front center of the car. The magnitude of the rotation should be between 20 and -20 degrees  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF) | When car is fist powered on the steering servo will keep the front wheel alien with the rear wheels.  Therefore if the front wheels are not alien then car system is powered on the servo will correct the wheels position. |  |  |  |
| 6. | 1. Disconnect the green wire located in Freedom board Microcontroller in pin J1PIN16 and connect this cable to a function regulator using a BNC cable.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Use the function generator to output a 100Hz 5V pulse. Then change the duty cycle from 5.25% to 9.75% using 0.1% increments. DO NOT exceed these percentages as doing so might damage the steering hardware.  4. When done place the green Wire back in the Freedom board Microcontroller in pin J1PIN16 | The servo should still turn the front wheels form left to right. |  |  |  |
| 7. | 1. Place the car on the track  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Accuracy mode by flipping mode switch 2 located in the top rear of the car. | The car will be able to turn the front wheels while the car is moving and sharply make turns following the black line. |  |  |  |
| H-Bridges (Independent left and right side speed regulation ) | 8. | 1. Elevate the car by placing a small bock (Freedom Board box is great for this) under it. (Make sure the wheels are not making contact with any surface)  2. Carefully remove the cables connected to pin J2Pin8 in the microcontroller.  3. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  4. Pick the Accuracy mode by flipping mode switch 2 located in the top rear of the car.  5. Pace a black object in front of the car (the object most have the same thickness as the black line in the track, Black duct tape is great for this) the object most be directly under the line camera located 1.5” in front of the car.  6. When finishes place the wire back in pin J2Pin8 in the microcontroller. | After five seconds the car will try to move forwards. By disconnecting the wire located in pin J2Pin8 of the microcontroller. Only the right side wheels will move forward. |  |  |  |
| 9. | Repeat test procedure number 8 But Instead of disconnecting the cable located in J2Pin8 of the microcontroller. Disconnect the cable located in J2Pin6. | After five seconds the car will try to move forwards. By disconnecting the wire located in pin J2Pin6 of the microcontroller. Only the left side wheels will move forward. |  |  | This test follows the procedures 1, 3-5 of test 8. Step 2 should be replaced with the description of this test |
| 10. | Repeat test procedure number 8 But Instead of disconnecting the cable located in J2Pin8 of the microcontroller. Disconnect the cable located in J2Pin14. And pull in Low by connecting it to J4Pin2 in the microcontroller. | By grounding this pin the Break is activated and the car will not move |  |  | This test follows the procedures 1, 3-5 of test 8. Step 2 should be replaced with the description of this test |
| 11. | 1. Repeat test procedure number 8 but skip step 2 entirely.  2. Move the black object described in Test 8 Step 5 from left to right. | By moving the black object placed in front of the car. The car system will assume that there is a turn ahead and it will alternate the speed of the right and left side motors. The car will also steer the front wheels in the direction of the black object. |  |  | This test follows the procedures 1, 3-5 of test 8. Step 5 should include the description of this test |
| Power Regulator | 12. | Connect the Battery and flip the operation switch to the on position, then use a multimeter to measure the output of LM7808 Pin 3 located in the top left corner of the distribution board. | The voltage reading should be 6 volts |  |  | The distribution board is located inside the car chassis to get access to it follow the procedure bellow:  1. Flip the car upside down and remove the 4 screws located in the each corner of the bottom plate (This screws are painted red) using a number 1 Fillips screw driver.  2. Carefully remove the Distribution board located inside the car. (This board is insolated with golden duct tape) |
| 13. | Connect the Battery and flip the operation switch to the on position, then use a multimeter to measure the output of LM7805 Pin 3 located in the top right corner of the distribution board. | The voltage reading should be 5 volts |  |  | Refer to the comments in test 12. |
| Mode Controller testing | 14. | 1. Place the car 3 feet from track facing any direction.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Discovery mode by flipping mode switch 2 located in the top rear of the car. | If the car is placed outside the track within 3 feet. The car will turn 360 degrees until the Pixy camera locates a marker. When a marker is located it will drive in that direction until the line camera detects a line. When a line is detect the car will alien itself and complete a lap around the track.  If the car doesn’t find a line within 3 minutes it will stop at that point the user will have to reset the car by powering the car off. |  |  | Addition Testing categories for this mode are described in Section 3.2.1 |
| 15. | 1. Place the car in the start line of the track.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Speed mode by flipping mode switch 2 located in the top rear of the car. | The car will complete 1 lap at maximum speed without leaving the track at any point. |  |  | Addition Testing categories for this mode are described in Section 3.2.3 |
| 16. | 1. Place the car in the start line of the track.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Accuracy mode by flipping mode switch 1 located in the top rear of the car. | The car will complete 1 lap at a moderate speed without leaving the track at any point. |  |  | Addition Testing categories for this mode are described in Section 3.2.2 |
| SD card | 17. | Take the SD card out of microcontroller and connect it PC’s mini MMC SD/RS slot | On the PC, go My Computer then SD card folder to get the collected data |  |  |  |
| Turn Signals | 18. | 1. Place the car in the start line of the track.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the any mode by flipping any mode switch located in the top rear of the car. | When the car is turning the light in the turning side should turn on. Additionally in an intersection the signal light corresponding to the marker will turn on before the car turns. |  |  |  |
| Headlamps | 19. | Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF) | A series of LED lights located in the front of the car will turn on. |  |  |  |

1. Performance Testing
   1. Performance Testing Scope

The Scope of the performance testing is the overall car system, this table will be used to determine if the car system performs as expected and more intently if it satisfies all the system requirements described in SOC-SysReq.

* 1. Performance Test Table

The testing table below contains the procedure and expected results for every operation mode. The different sections of this table can be referred to by Section 3.2.*N* where *N* corresponds to the test number.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | N | Procedure | Expected Result | Pass | Fail | Comments |
| Discovery Mode Testing | 1. | 1. Place the car 3 feet from track facing any direction.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Discovery mode by flipping mode switch 3 located in the top rear of the car. | -The car search for the track when the mode is selected  -The car find the track within 3 minutes  - The car restart after 3 minutes  - The car completes a whole lap after it finds the track |  |  |  |
| Accuracy Mode Testing | 2. | 1. Place the car 3 feet from track facing any direction.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Accuracy mode by flipping mode switch 1 located in the top rear of the car. | -The car start at the starting point  -The car stop after the second lab  -The car is accurate when following the line  - Can the car complete 2 laps without leaving the track |  |  |  |
| Speed Mode Testing | 3 | 1. Place the car 3 feet from track facing any direction.  2. Turn on the car by flip the power switch to ON (located back side of the chassis and marked as ON/OFF)  3. Pick the Speed mode by flipping mode switch 2 located in the top rear of the car. | - the car follow the black line and complete two laps  - the car stop after the second lap  - The car complete the challenge in less than two attempts  - the car stay inside the track (all wheels)  - the car complete at list one lap |  |  |  |