Slippage Detection and Traction Control System
Product Life Cycle Report

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1. Introduction

This report examines design decisions and future use issues regarding the life cycle of the Traction Control System that is being created for the University of Idaho's Formula One race team. This system will monitor and compare the wheels' speeds to determine if slippage is occurring. If slippage is detected, the system will send a signal to the Engine Control Unit to cut the spark or adjust the spark timing in order to reduce engine power. This will reduce the wheel speeds and allow traction to be regained. This allows the driver to cut race time and achieve a higher standing in the racing ranks.

2. Customers and Users

This traction control system is being designed for the University of Idaho's 2005 Formula One race team. If the system is effective, it may be used by future University racing teams. People interested in Formula One racing as a hobby may be interested in obtaining schematics for such a traction control system through the University. Another possible user may be an electrical engineering student design group looking to update or improve the system.

3. Customer Support

The Formula One racing team and independent hobbyists will need an Operations and Maintenance Manual to inform them of basic operations and preservation of the system. This manual will include how to assemble the system onto the vehicle, how to operate the system, and basic troubleshooting. The manual will have specifications for the system to enable the user to make substitutions or modifications to customize the system to their
needs and resources. During the design of the system, processes and trouble issues will be recorded, these will be included in the manual to aid the user.

One of the supports for a student design team attempting to update the system would be the University faculty, including Dr. Wall and Dr. Frenzel who have had briefings on the system and knowledge of the components. Another means of support would be a product development manual. This technical manual will explain the process of creating the system and will including data sheets, schematics, and microcontroller code. This resource will inform the team of how the system works and what resources within the system are available for change. Such changes could include expanding the intended scope of the microcontroller, adding another microcontroller for parallel processing or utilizing a different method of measuring wheel velocity.

4. Customer Needs, Concerns, and Problems

4.1 Component Damage

One of the major concerns for this system is component damage. The system is being used on a moving vehicle that has the possibility of a collision with another vehicle or a side wall. The system must have a robust design that protects the parts from the damage caused by being hit or jostled about. The first example is the velocity sensors; these parts have a sensing distance of 5-8mm and the object being detected is a spinning metal toothed wheel. The sensors will need to be securely mounted to reduce the chance of shifting during a race and being hit. The only precaution that can really be taken is the mounting location; specifications for mounting for maximum protection will be included in the Operations & Maintenance Manual. A second example is the connections between components. These will need to be reinforced to ensure proper functioning and eliminate
the chance a system short. The connections are wires that will need to be routed around moving parts along a safe path on the vehicle. These wires could be protected by enclosing the routes in flexible tubing.

4.2 Electrical Malfunction

Another major concern is electronics malfunctions. The electrical components will mostly be mounted on a Printed Circuit Board, this will reduce the chance of a system short. If an electronic malfunction does occur, there is a possibility that parts will have to be replaced. Extra circuit boards will be provided with the system in case the original is damaged. Other parts are basic elements that should be available from any electronics store, so they should be easily replaced if needed. The ratings for all the components will be checked to ensure that they can handle the parameters that the system is working with, these specifications will be included in the Operation & Maintenance and Development Manuals which will allow the users the ability to select parts that are compatible and not a threat to the system.

4.3 Expansion

An issue that may arise upon further use is the effects based on the allowable slippage percent. If the team finds that they need a different magnitude of slippage to increase the system's effectiveness, they need to be able to adjust the slip allowance percents. This will require the development kit for the microcontroller and instructions on how to change the values. An evolution in the vehicle could possibly result in the lack of space available for the current toothed wheel, this issue would need to be resolved for the system to function. Either new compatible sensors will be needed or a different object will need to be used as a target, which could be the wheel lug nuts. This design will
attempt to create a compact system that uses minimal resources, such as I/O pins, of the microcontroller, which will permit system expansion.

5. Support Costs

There are many issues that affect the support costs, and in this scenario the support will have to be preemptive, since the team will not be around to mend future complications. The components of the system will have to be reliable to ensure the longevity of the system, but purchasing higher quality parts can increase the cost. Testing different types of components before selecting one could decrease future support cost by finding the most durable part for the system. Extra components may need to be purchased initially to guarantee they will be available when and if they are needed. The major components for the traction control system were partially selected due to the reputation and establishment of the producer. This gives the reassurance that support will be available in the years to come.

In a typical business atmosphere issues that would affect the support cost would be maintaining knowledge of older or obsolete systems. As new parts come along, the older versions are replaced. To ensure the system the old parts must be retained, new parts must be an exact replacement, or the system needs to be easily adjustable to employ the new part. Each of these takes space or engineering time, which will increase the cost to maintain the system. In order to decrease support costs this system will be easy to use and include detailed system manuals. If the user interface and alterations are simple and the directions are clear, there is less need for actual people to be on call for customer support, which decreases support cost. The traction control system will have minimal user
interfacing (on/off and the slippage detection knob), detailed comments in the code, and a thorough set of manuals.

6. Maximizing Revenue

One step to maximize revenue is to decrease production cost. If this system were to be mass-produced, one way to cut costs is to buy components in bulk. Creating a user friendly and effective system will also create a higher demand for the product, which will lead to more sales. A crucial step is to increase sales price without jeopardizing sales. The life span must be considered if there is a warranty involved with the product since the sales price must include the costs of future repair. This can be taken into consideration in the design phase, by making the system reliable through extensive testing and necessary alterations. One method to reduce the need for warranty repairs is durable containment. Since the system is on a moving vehicle, the containment will need to supply shock absorption, stability, and a shielding enclosure to protect the electronics and connections. This feature will be tested by bumping and hitting the containment while the system tries to function. Another component to be tested is the user switch, this will be tested by repeated use and checked to see if it is still providing the correct data.

7. Design Choices effecting the PLC

Many design choices effect the Product Life Cycle. Purchasing cheap parts could shorten the life expectancy of the system, while expensive parts would decrease the revenue. Developing the system with excessive parts could invoke trouble, the more parts that can fail, the higher the chance the system will fail. To extend the PLC of the system it is best to choose a simple design using tested and dependable parts.