Member 1 Production Details

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Design for Reliability (DFR)

Design for reliability answers some of the important questions in engineering and design regarding the dependability of a certain product in its life cycle. It answers the question of how reliable a product will function during at any specified and its chances of failure.  It is defined theoretically by the following formula: Reliability = (1 - Probability of Failure). While the goal for any device is to be as reliable as possible and for as long as possible, often this means the performance of a device may need to be sacrificed, especially in computer engineering. Before bringing a product to market, it is critical to test a device to determine its longevity and the quality of its functionality at each phase of the cycle. DFR is usually broken down into sections called availability, testability, maintenance, and maintainability. Availability is simply the duration during which a product is in functioning condition. Testability is the ability to repeatedly measure the performance of a device in a controlled setting. Maintainability is defined as the effort required to maintain the device. Finally, maintenance refers to the ease at which we can do check, repair, or replace necessary devices in a system.

DFR is a very important topic in regard to our project because of the fact that our product deals directly with consumer safety and as such there is zero tolerance for a system to be unreliable. Since the device deals with the detection of hazards, if bicycle rider starts to trust the device to warn it for impending danger, the device should not output any false positives or false negatives because that could be the difference between life or death. In a real-world scenario, the availability of the device would probably be measured in the timespan of as long of years hopefully without any deterioration in performance. The product would need to be tested in a setting with different kinds of conditions that one may find on the road (rain, occasional splashes, vibrations, wind). The main unit should be housed within a watertight case so it can repel with elements that is clear so the LED’s and LCD can still be viewed. The front and back ultrasonic sensors would need to be housed in units to protected from the elements as they may give incorrect readings due to a heavy buildup of dirt and water. The unit should not require any major maintenance as there are no moving parts as points of failure. The lifespan of a HR-SR04 ultrasonic sensor is rated to be Mean Time Before Failure (MTBF) of 200,000 hours or 22 years. Thus, the product built should be able to last the lifetime of the bicycle, given the proper housing is made for the device. The only maintenace ever required would be the possible replacement of the ultrasonic sensors.

In order to take the device to the production stage some modifications to the prototype are required. First, the wire harness connecting the front and rear ultrasonic sensors should be lengthened so they reach from the front of a typical bicycle handlebars for the front sensor and the back seat for the rear sensors. Second, housing for the main unit containing the MSP should be made to protect from the outdoor elements. Lastly, the ultrasonic sensors should be swapped for ones with a maximum operating range greater than 400 cm for real world scenarios.

Cost Analysis at Volume

Cost analysis at volume also known as Cost-Volume-Profit or CVP analysis is the method for calculating the sales that are needed to break even and cover the costs of production. Cost analysis measures the total cost of production, including parts and labour, to take the product to market. The end goal is to determine the optimal production level which would optimize profit. CVP analysis operates on certain assumptions such as sales price, variable costs, and total fixed costs per unit are constant. Everything that is produced is sold. CVP analysis requires that all the costs including manufactuing, selling, and administration fall under variable and fixed costs. There exist factors in business operations and decisions, which along with sales prices, costs, and diagrams are used for analysis. At volume costs affected are production cost per unit, delivery costs, and installation. Minimizing these costs leads to the greatest profit. 