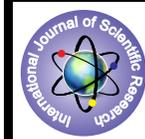


Electronic Control Unit and Skid Detection in a Motor Bike



Engineering

KEYWORDS : Skid detection, Electronic Control Unit for a bike

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ABSTRACT

Many countries today face the problem of having more number of two-wheeled and three-wheeled vehicles than they can handle. Therefore, it should not come as a surprise that number of accidents involving two-wheeled vehicles in such countries is very high. In view of this, we have come up with an actuation and control system with the primary aim of making a motor bike safer.

Inclination of the vehicle, its acceleration along the path and bumps on the road would be detected using a 3-axis accelerometer. NI LabVIEW would be used to analyze this data and detect the driving conditions using various Fuzzy Logic algorithms. The prototype designed would perform following three tasks:

1. Dynamically control the headlights, tail-lights and the indicators. i.e., increase or decrease the range of the lights depending upon whether the bike is accelerating or decelerating, tilting the headlight while turning to cover the blind spots, automatically turning the indicators on and off during turning and so on.

2. Detect the various driving conditions viz., standstill, smooth riding and rough riding.

3. Detect when the bike is skidding or about to skid. This can then be used as an actuation to various systems such as ABS (Anti-lock Braking System), CoG (Center of Gravity) compensation, SPS (Skid Prevention System), etc.

This paper includes development a LabVIEW VI which detects all the above mentioned conditions and provides an estimate of speed using the acceleration values. The data used for analysis are obtained by real life testing on a bike and a hardware prototype.

1. INTRODUCTION

Growing infrastructure and expanding city limits are almost inevitably accompanied by an increasing number of vehicles on road, predominantly two wheelers and motor bikes; Pune being a befitting example of this. With this continual increase in the number of motor bikes on road, their safety is compromised. Thus, as mentioned earlier the primary aim is to make the motor bike riding experience more safe for the rider.

A research on the motorcycle accidents round the world has identified three preliminary issues which result in accidents viz., lack of visibility, bad driving conditions and human error, bike skidding resulting in loss of control by the rider. Keeping these problems in our minds we have come up with possible solutions for them, mentioned in the abstract above.

Thus, the model is divided into three basic modules:

1. Headlight and Taillight Control
2. Driving Conditions Detection
3. Skid Detection

Detection of driving conditions and bike skid is accomplished using a Fuzzy Logic Controller. Upon successful detection of these conditions, appropriate actuations can be triggered in the bike to adapt it to the driving environment.

2. SCOPE OF THE PAPER

The aim is to adapt the bike so as to compensate for various factors which may endanger the bike and its rider. At this stage, we are simply detecting the driving conditions and bike skidding; but the same system can also give us a measure of these conditions which can be used as parameters to continuously monitor and control the various physical aspects of the bike.

Theoretically speaking upon analysis of the data from the accelerometer, it is also possible to detect the driving style of a rider and personalize the bike's parameters to suit it. Thus, driver profiles may be created for a bike, which would not only improve the overall driving experience but also compensate for the 'human-error' issue resulting in accidents.

Also, other than ABS, which at this point of time is available

mostly in high end bikes, there are various other systems which inhibit skidding of bikes such as the COG compensation, and the Skid Prevention System where metallic spikes are intermittently hit on icy roads to improve traction. These systems along with ABS can be controlled by the skid detect parameter to form a complete skid prevention system for a motor bike.

3. NEED FOR FUZZY LOGIC

In words of its inventor Prof. Lofti A. Zadeh, fuzzy logic is a precise logic of imprecision and reasoning. Thus, it finds applications in situations where approximation in reasoning is preferred over fixed and exact so as to reduce the overall system cost (in terms of execution time and complexity). There is always a trade-off between precision and cost in complex systems with a large number of variables. In order to comprehend this fact, consider the example of a driver parallel parking a car. It usually takes usually under half a minute to park a car. However, if the driver were required to park the car precisely within 0.01mm from the side lines and within 0.1 degree from a precise angle, it would take an obscene amount of time to perform the same task.

Also, achieving a specific level of precision, the utility of a system does not increase appreciably for higher levels of precision. Thus, in situations where utility of the system doesn't demand high precision, fuzzy logic can be used to develop cost-effective approximate solutions. This is illustrated by the graph below which relates utility and cost of the system to the precision levels.

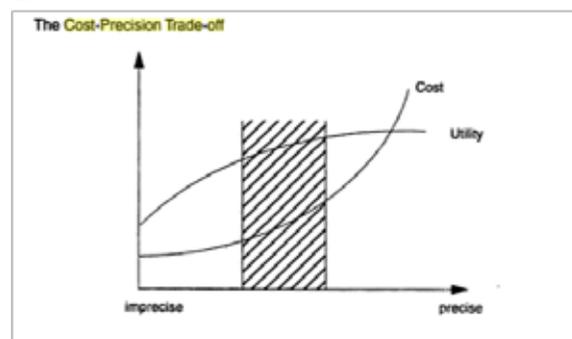


Figure 1.1: Cost-Precision trade-off

4. PRESENT SCENARIO

Fuzzy Logic and LabVIEW are widely used in automotive industries. Fuzzy logic is employed in various control systems such as ABS, traction control, et al. in cars and trucks. It is also used in Automated Parking Systems in cars to parallel-park a car. Motor bikes, being a comparatively smaller segment and being inherently cheaper than cars, has been devoid of most electronic control advancements until recently. The exception to this is the high power bike segment, which usually cost more than the everyday person's car.

We plan to create a control system which would acquire and analyze the data from the bike with as low initial investment as possible so that it can be employed in the commuter bike segment, with the intention that it should reach the masses.

5. SYSTEM SPECIFICATIONS AND REQUIREMENTS

The system was tested for one bike (Bajaj Pulsar 135LS) with a fixed rider for speeds less than 100 kmph. The speed estimate by the LabVIEW VI has an accuracy of about ±5 kmph. The hardware prototype developed has the servo motors representing the position of the headlight reflectors. The basic aims of the prototype are:

- To measure the extent of acceleration or deceleration of the bike along its path and control the range and angular direction of the headlight and taillight accordingly.
- Detect the bike driving conditions viz., standstill, smooth riding and rough riding based on the data acquired from the 3 axis accelerometer and the speed estimate.
- Detect when the bike is about to skid, or is skidding.

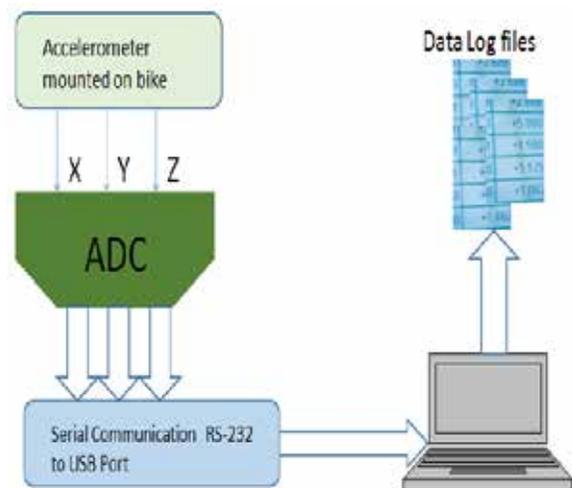


Figure 1: Data Acquisition Block Diagram

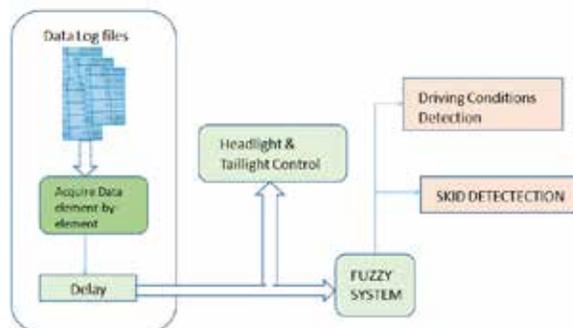


Figure 2: Data Analysis Block Diagram

Since acceleration on such a scale could not have been simulated in lab conditions, data was acquired and logged in text files by physically taking the laptop and the complete sensor and data acquisition assembly on the bike and riding it all around the place to acquire the data for various driving conditions. The system is thus based on practical data with testing done in real life environment.

7. PERFORMANCE EVALUATION AND TESTING

The data logging and testing of our prototype has been done for one bike with the same rider and a pillion rider taking care of the sensor and the apparatus, for speeds less than 100kmph.

8. CONCLUSION

The prototype built was successfully tested for detecting the various driving conditions and headlight/taillight control. The same system can also give variable parameter values proportional to the roughness or smoothness of driving and the amount of bike skidding. These parameters can then be used for adjusting the various physical aspects of the bike.

With a large amount of data it is also possible to implement driver profiles for bikes which would not only personalize the overall driving experience but would compensate for the 'human error' cause of accidents. Lastly, there are various novel and skid prevention models like the Centre of Gravity Compensation, the Skid Prevention System for icy roads, which we would like to actuate and control using our system.

REFERENCE

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