UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PANIC SENSING AND SPONTANEOUS STABILITY SYSTEM TO AVOID ACCIDENT

This report is submitted in accordance with the requirement of the University Technical Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer System) with Honours

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DECLARATION

I hereby, declared that this report entitled “Panic Sensing And Spontaneous Stability System To Avoid Accident” is the results of my own research except for quotes as cited in references.

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Author’s Name	:	………………………………………….
Date	:	………………………………………….

APPROVAL

This report is submitted to the Faculty of Engineering Technology of University Technical Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the award of Bachelor of Computer Engineering Technology (Computer Systems) (Hon). The member of the supervisory is as follow:

………………………………

(En. Zulhasnizam Bin Hasan)

ABSTRAK

Projek ini akan membangunkan kestabilan kenderaan sistem baru untuk membantu mengurangkan kadar kemalangan jalan raya di Malaysia. Malah, kestabilan kenderaan sistem yang boleh membantu untuk mengesan putaran setiap roda dan pusat graviti di atas tanah. Dengan membangunkan sistem ini, keadaan slip kenderaan akan dapat dikurangkan sebagai pemandu dapat mengetahui keadaan roda kenderaan. Sistem ini dapat berfungsi apabila kelajuan kenderaan adalah lebih tinggi atau sama dengan 110 km / h. Secara umumnya sistem ini banyak digunakan apabila kenderaan yang memandu di lebuh raya. Jika keadaan kenderaan itu dipenuhi keperluan sistem, sensor akan menilai dan penunjuk amaran akan menyala untuk memberi amaran kepada pemandu untuk memperlahankan atau stabilkan kenderaan. Walau bagaimanapun, sistem ini juga dibangunkan dapat mengesan jarak objek antara kawasan buta kenderaan. Jika objek yang telah dikesan, buzzer akan berbunyi untuk memberi amaran kepada pemandu untuk mengelakkan oversteer dan terhempas yang tidak perlu. Melalui sistem ini, pemandu akan tahu dan dapat mengawal serta kestabilan kenderaan itu sebelum keadaan sesuatu telah berlaku dan akhirnya menyebabkan kemalangan.

ABSTRACT

This project is going to develop a new vehicle stability assist system purposely to help to reduce the rate of road traffic accident in Malaysia. In fact, the vehicle stability assist system is able to detect the rotation of each of the wheels and the central of gravity above the ground. By developing this system, the slip situation of the vehicle will get reduce as the driver able to know the condition of the vehicle wheel. This system is only function when the vehicle speed is higher or equal to 110 km/h. Generally this system mostly used when the vehicle driving on highway. If the vehicle condition is fulfilled the requirements of the system, the sensor will then evaluate and the warning indicator will be light up to alert driver in order to slow down or stable the vehicle back. However, this system is also developed able to sense the distance of objects between vehicle blind sport areas. If the objects been detected, the buzzer will sound to alert driver to avoid oversteer and unnecessary crashing. Through this system, driver will know and able to control well the vehicle stability before something conditions had happened and finally cause accident.

DEDICATION

To my beloved parents and family

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First and foremost, I thanks to En Zulhasnizam Bin Hasan for his supervision, encouragement, suggestions and trusted throughout the duration of this project. Without him, I can lost and flee away from the tract I should follow. In addition, I also would like to say thank to other lecturers who are gave me many guidelines and best suggestion to finish this report.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

VSA	-	Vehicle Stability Assist
ESP	-	Electric Stability Program
BMW	-	Bavarian Motor Works
DSC	-	Dynamic Stability Control
VSAS	-	Vehicle Stability Assist System
ABS	-	Anti-lock Braking System
TRAC	-	Traction
GPS	-	Global Positioning System
RISS	-	Reduced Inertial Sensor System
MEMS	-	Micro-Electro-Mechanical System
INS	-	Inertial Navigation System
IMU	-	Inertial Measurement Unit
KF	-	Kalman Filter
4WD	-	4 Wheel Drive
Ve-DYNA	-	Real Time Simulation of Vehicle Dynamics
I_z	-	moment of inertia (kg/m^2)

L_1	-	front axle distance from center of gravity (m)
L_2	-	rear axle distance from center of gravity (m)
F_{y1}	-	front lateral tire forces in the car body axis (N)
F_{x1}	-	front lateral tire forces in the car body axis (N)
F_{yw1}	-	front lateral tire forces (N)
F_{yw2}	-	rear lateral tire forces (N)
V_g	-	velocity of the center of gravity (m/s)
σ	-	Front Steering Angle (rad)
β	-	Sideslip Angle (rad)
μ	-	Tire-Road Friction Coefficient
m	-	Metre
Hz	-	Hertz
cm	-	Centimetre
$\circ$	-	Degree
$u_{x,sensor}$	-	Longitudinal Velocity at Sensor Location
$a_{x,m}$, $a_{x,bias}$	-	Longitudinal Accelerometer Measurement and Bias
$u_{y,sensor}$	-	Lateral Velocity at Sensor Location
$a_{y,m}$, $a_{y,bias}$	-	Lateral Accelerometer Measurement and Bias

CHAPTER 1

INTRODUCTION

1.1 Project background

In 1885-1886 year, Carl Benz was developed the first gasoline stationary and the Figure 1.1 is shown the outlook of first invented motor car.

Figure 1.1 Benz patented motor car.

However, in the early days, there should have understanding about the problems associated with braking system, and the appearance advances improvement that have been made in order to overcome these problems. The very first type invented brakes was a crude system used even before the Roman Empire. This type of brake is to slow a cart down by friction and just involved a brake lever that pressed a simple wooden block against the wheel. Below is the illustration figure.

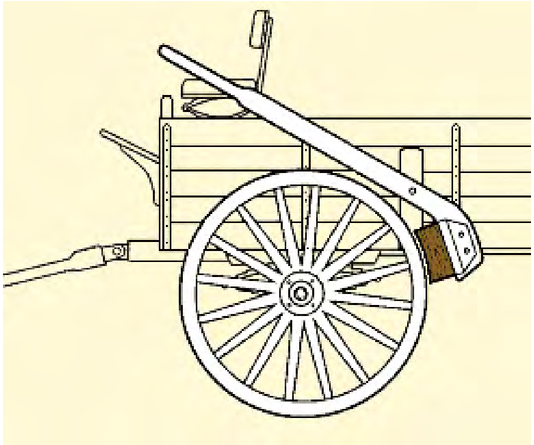

Figure 1.2: The wooden block and lever

Many types of advanced brake had been created in 20th century. As the developing in automotive and trucking industries, brake systems improved. Early automobiles had band brake which were then followed by drum brakes, both were applied mechanically through linkage. In the 1920's – 1940's, hydraulic systems were a major improvement and the hydraulic system is work when the force is applied at one point is transmitted to another point using fluid that unable being compress. The Figure 1.3 illustrated the simple structure of hydraulic brake system.

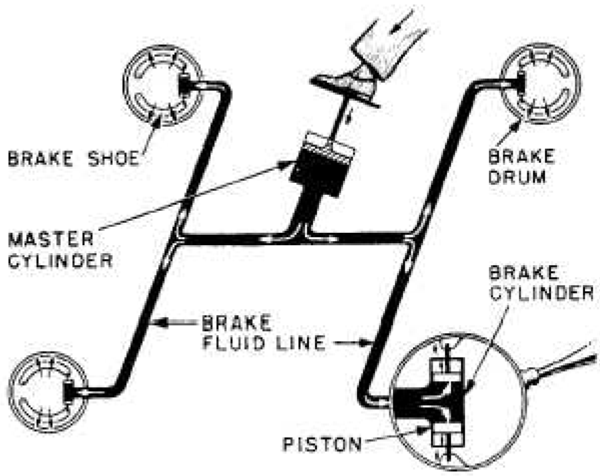

Figure 1.3: Illustration of Hydraulic Brake System

Since the 1960’s, disc brakes have become familiar and not strange on cars and trucks. Disc brake almost similar the brakes on a bicycle. Bicycle brakes consist of caliper, which squeezes the brake pads against the wheel. The brake pads squeeze the rotor instead of the wheel, instead of through a cable, the force is transmitted hydraulically in the disc brakes. The pads and disc will generate friction and slows down the disc.

In 21st century, many brands of vehicle are invented after the development of technology. For instance Honda, Audi, BMW and etc. Every brands of vehicle are invented with their own stability system. For example, Honda with Vehicle Stability Assist (VSA), Audi with Electronic Stability Program (ESP), Bavarian Motor Works (BMW) came with Dynamic Stability Control (DSC) and etc. What does the vehicle stability system for? In general, vehicle stability system is a system that helps prevent and avoid side skids and help stabilize the vehicle while turning. Vehicle stability system is divided into throttle based and braking based stability control. Throttle based stability control system is uses an electronic throttle and spin of wheel in observing in order to avoid over steering the rear wheel drive vehicle, and under steering in front-wheel drive model. Throttle based stability control is very useful and suitable under the icy or wet conditions in high powered rear wheel as well as for handling torque steering in high powered front wheel. However, the basic stability control braking apply braking force to stabilize the vehicle likely to be found in the vehicle with all-wheel drive and powered hubs difference. Braking based is to calculate and measure the wheel spin on all four wheels as well as to steer wheel angle and throttle input. It will release little braking force as necessary at each of the four wheels, to prevent over steering or under steering, and allow the vehicle to be as neutral as possible during turning a corner. Stability control looks to deal its large part as a means of safely. When excessive force is used to rear wheel drive vehicle when cornering, the vehicle will be driving more and typically spin. This situation can lead to an accident for average driver under unexpected condition. Especially when in traffic, this usually occurs when rotating the rear wheels lose traction, whether due to the overwhelming power of grip available, or because of ice or hydroplaning that causes sudden loss and unexpected traction at the rear wheels. Due to the fast response time of the system's stability control, this traction losing can be count on, and throttle reduced before traction is overwhelmed, helping to prevent rotation and keeping full control of the vehicle. Undoubtedly, stability control could guide to an increase safe for regular driver in normal driving situation.

1.2 Problem Statement

Nowadays, drivers do not realize the vehicle stability and condition and causing minor or severe accident. Driver themselves do not aware when will be the situation and how serious it could be, they just depends on the so call vehicle stability system. Drivers do not able to analyze the vehicle stability when they are driving, they do not know how fast the speed they can drive. According to the Statistic of Road Accident in Malaysia, the road traffic accident rate from 1980 until 2000 have been increased dramatically. In 2004 to 2013, the death of people in road accidents is up to 65,850 people. In other words, the driver should be alert before the unexpected situation is happened and sufficient time to slow down or control the vehicle to avoid accident.

1.3 Objective

1. To develop a Vehicle Stability Assist System (VSAS).
2. To analyze the vehicle stability.
3. To analyze the wheel speed and the central of gravity of the vehicle.
4. To ensure the vehicle is under control by driver.
5. To reduce the traffic road accident rate with implementation of VSAS.

1.4 Scope

This project is to develop a Vehicle Stability Assist System (VSAS). VSAS is able to analyze the stability of the vehicle by calculating the wheel speed and central of gravity. The relationship between vehicle speed and central of gravity will be measured to maintain the vehicle stability and alert the driver before unexpected condition happened.

1.5 Summary

Project background, problem statement, objectives and scope has been discussed in chapter 1. Chapter 1 is important for the next progress of the project as it may provide guidance and direction in developing the VSAS. However, literature review will be discussed in chapter 2 and chapter 3 is going to discuss methodology. Methodology is discussing about the methods and steps on creating the entire system. However, chapter 4 is discuss the result and discussion of the report based on the progress. Lastly, chapter 5 is discuss the conclusion and the recommendation of this project. The future work and the potential of this project is also will be discussed in chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Nowadays vehicle stability control system is brand new concept and idea to reinforce and enhance the stability problem of vehicle and also countering certain emergency situation. However, there are few aspects that will cause the vehicle being unstable, that are centre of gravity of the vehicle, vehicle speed, sideslip angle, road friction and the braking force at individual wheel. Majority of vehicle user doesn't really understand the concept and function of vehicle stability control. To explain the concept of vehicle stability control, an analogy will be used referring to Figure 2.1.

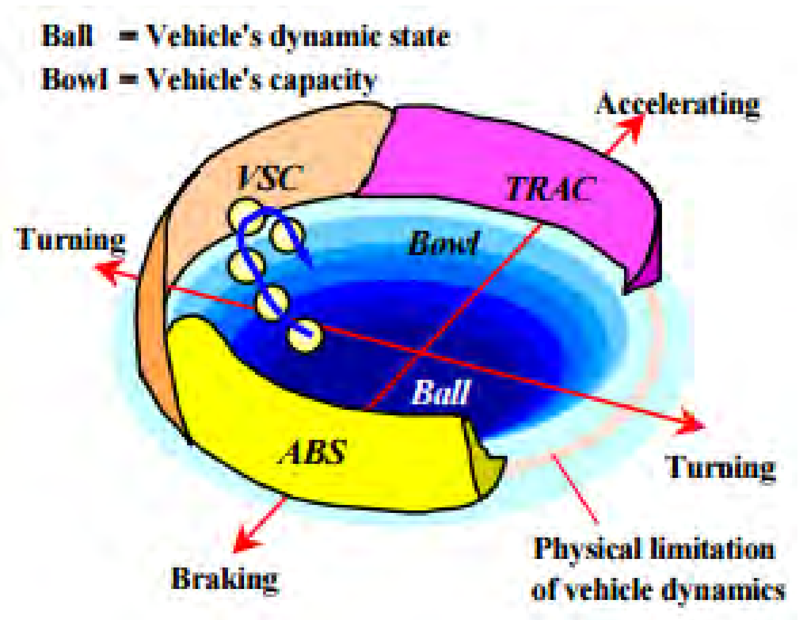

Figure 2.1**:** Concept of Vehicle Stability Control

In above Figure 2.1, vehicle dynamic state is represented by the ball and the capacity of vehicle is the bowl. Control losing can be represents as the ball went over the rim of the bowl. Under normal driving phenomenon, the bowl can be said as enough large and deep for the motion of the ball. When the ball motion becomes over limit, However, as when steering the vehicle suddenly changed, or a smaller bowl into such as when driving on icy roads or snow, it's likely to be repeated over the rim of the bowl. This can be explained why the vehicle becomes hard to handle. Some survey has been done on the relationship between the vehicle stability control and the factors to activate the system as well as the make the vehicle to be more stable.

2.2 Anti-lock Braking System

Anti-lock Braking system is an safely system that allows the wheels on motor vehicle to maintain tractive contact with the road surface according to the driver inputs while braking, preventing the wheels from locking up and avoiding uncontrolled skidding. A skidding wheel has less traction than a non-skidding wheel. For instances, if the vehicle has been stuck on ice, logically all the wheels are spinning without traction. There are four main components to an ABS system, speed sensors, pump, valves and controller.

Figure 2.2: Anti-lock brake pump and valves

2.2.1 Three-channel, three-sensor ABS

This scheme, usually found in a pickup truck with four-wheel ABS, a speed sensor and valve for each front wheel, with a valve and a sensor for both rear wheels. Rear wheel speed sensor for the rear axle is located. This system provides individual control of the front wheels, so the two can achieve maximum braking power. Rear-wheel drive, however, be monitored together; both of them have started to lock up before the ABS will activate on the back. With this system, it is possible that one of the rear wheels will lock during a stop, reducing brake effectiveness.

2.2.2 Four-channel, four-sensor ABS

This is the best scheme. There are speed sensors on all four wheels and a separate valve for all four wheels. With this setup, the controller monitors each wheel individually to ensure they achieve maximum braking power.

2.2.3 One-channel, one-sensor ABS

These systems typically found on pickup trucks with rear-wheel ABS. It has a valve which controls both rear wheels, and a speed sensor, which is located on the rear axle. The system operates in conjunction with the rear end of a three channel system. The rear wheels are monitored together and both have started to lock up before the ABS kicks. In this system, it is also possible that one of the rear wheels will lock, reducing brake effectiveness. The system is easy to identify. Usually there will be a brake line going through a T-fitting to both rear wheels. You can search by looking for speed sensor electrical connection near the rear axle differential housing.

2.3 Stability Control and Traction Control

However, there are some differences between traction control and stability control. In 4WDs, the spinning of wheel axle is detected by using electronics in case of either the spinning is faster than opposite partner. The system will apply braking force towards the spinning wheel, torque is sent to the other wheel and vehicle of course will continue moving. Nevertheless, usage of traction control primarily is more on offroad vehicles so that able to remain the momentum as constant over uneven terrain, in case the wheel starts to spin, by right it can remain and will kick in on road. The older form of traction control only cut the throttle, which can lead to confusion or oversight with the stability control. Control of the throttle grip is often used on the road, as if in the grip of both wheels on one axle lose then obviously reduce torque will help problem solving. This is different from losing a grip on a