

MECHATRONICS

BOOK SERIES

SYSTEM DESIGN AND SIGNAL PROCESSING

VOLUME 2

Editors

Md. Raisuddin Khan

Md. Mozasser Rahman

Muhammad Mahbubur Rashid

Shahrul Na'im Sidek



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**MECHATRONICS BOOK SERIES:
SYSTEM DESIGN AND SIGNAL
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Md. Raisuddin Khan
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CHAPTER 34

DEVELOPMENT OF AUTO PARKING SYSTEM AND AUTO BILLING SYSTEM USING IMAGE PROCESSING TECHNIQUE (PART 2)

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34.1 Introduction:

The auto parking system comprise of many parts and components. The system is divided into sub-systems which are 'FULL' display system, image acquisition and plate number recognition, auto direction system and auto payment system. The block diagram on Figure 34.1 shows the connection;

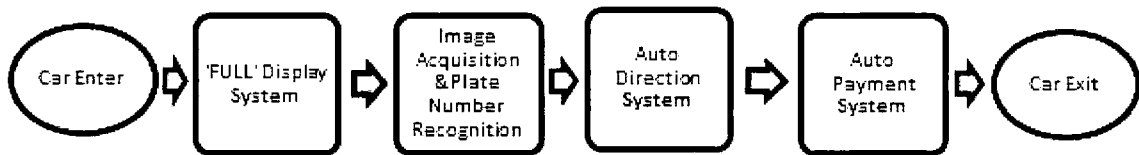


Figure 34.1: Auto Parking System block diagram

Then, it is separated into five parts according to the main functions: 1. Data Acquisition 2. Data Analysis, 3. Information Display, 4. User Interface and Management and 5. Hardware interface. Mostly the above systems are incorporated in data acquisition part. Firstly, data is acquired from ultrasonic sensors of each parking space to count the availability of parking spaces in the parking area [1, 2]. Then, the image of the car is acquired in the entrance to be analyzed. During this time, time entering and license plate reference number are recorded for future transaction.

Secondly, the image acquired from hardware components are analyzed in data analysis part where mostly done in Matlab. The image of the car is analyzed for its license plate numbers for future reference. The time entering is analyzed during car exiting to calculate the fees of parking [3,4]. Plus, the data acquired from ultrasonic probes of each parking space is calculated for the calculating free parking spaces [5, 6].

The 'FULL' sign is expected to be displayed thru LCD display. Other information to be displayed is fees accumulated according to specific parking rate. The direction system also expected to be having information display where it is used to guide drivers to nearest free parking space [7].

In addition, the auto parking system needs interface and management systems to communicate with drivers and system's developers. Firstly, the barrier gate is managed to be opened when the main program acquired the license plate reference and it is recorded.

CHAPTER 35

DEVELOPMENT OF AUTO PARKING SYSTEM & AUTO BILLING SYSTEM USING IMAGE PROCESSING TECHNIQUE (PART 3)

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35.1 Introduction

Matlab [1-3] software is used for the development of Automatic Parking System. Matlab has many toolboxes that can deal with simple and complex engineering calculation. Toolboxes are comprehensive collections of Matlab functions (M-files) that extend the Matlab environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others [4, 5].

For the case of auto parking system, the *image processing toolbox* can be used to pre-processing the image acquire from the CCD camera which is the sub-system Image Acquisition and Plate Number Recognition [6, 7]. Thus, the image will be read by the software and the next process is done according to algorithm proposed.

35.2 Methodology

The objective of this project is to recognize the number plates in parking system. Main files for image processing are 1. Databases of characters development, 2. Characters to matrix processing, 3. Databases of real car plate images, 4. Characters recognition using MSE and other techniques, 5. Graphical User Interface of the system. Each phase needs different approach and coding. Thus, all the phases are very crucial to the system. Fig. 35.1 shows the flowchart of the whole system.

CHAPTER 36

AUTOMATIC CAR PARKING MANAGEMENT SYSTEM FOR LARGE PARKING LOT

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36.1 Introduction

In general, parking lots consist of multiple lanes with rows of parking spaces between each one. The location of the parking spaces for each vehicle is usually indicated with pavement markings or lines similar to center lines on streets. A very common arrangement in large parking lots is angle parking for two rows of vehicles between driving lanes, with the parked vehicles facing front to front between the two rows. At the sides of the parking lot, other driving lanes connect these lanes perpendicularly so that a vehicle can drive into and out of the parking lot at designated locations. For this typical car parking system, drivers need to find empty spaces by examining each of the parking spaces [1]. Drivers always encounter difficulty in finding empty parking spaces while parking especially in a huge car park [2]. These delay in searching for empty parking spaces and slow vehicle retrieval results in car park congestion, poor car park utilization and delayed exit of vehicles. An automatic car parking guidance system has been developed in order to improve the effectiveness of conventional car parking system [3]. The system gives drivers current information on parking status within controlled region [5]. The system is a combination of traffic monitoring, communication, processing and variable-message sign technologies [6]. It is designed to assist drivers in searching for empty parking lots by directing them to the unoccupied lots. Besides, the numbers of unoccupied lots are also displayed at several strategic locations within the car parking area. The project to be undertaken is important because by having the automatic parking guidance system it will significantly improve the current parking system. This include optimal use of the parking area, reduction in congestion due to fewer cars driving around searching for spaces, reduction in time spent and fuel consumed while searching for available parking spaces and lastly reduction in illegally parked vehicles.

36.2 System Design

The system design covers the functional block diagram (Fig. 36.1 and Fig. 36.2), system components, and functional design whereas the software development stage involves the overall system integration of each component according to the sequence of the system operation.

CHAPTER 37

DEVELOPMENT OF WIRELESS HOME POWER MONITORING SYSTEM

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37.1 Introduction

Nowadays, the development of technology gives impact to our everyday life and it will become more and more spreading later on. Because of using the high technology, of course there will be a lot of power usage that will give harm to the earth. Wireless home power monitoring system is a system that is can control the electrical appliances from a certain distance by using universal remote control (URC). This system can also measure the power usage of the electrical appliances.

The main advantages of using wireless home power monitoring system are firstly it can reduce power consumption where people are able to switch on or off the electrical appliance whenever they want at a certain distance. Moreover, by using this wireless home power monitoring system, people can save their time to switch on or off their electrical appliances. In addition, this system can be applied in industrial sector such as factory. According to Masjuki H.H and Jahiril M.I., It was found that electrical motors consumed the highest amount of energy (47.05%) followed by pumps (13.75%), air compressors (8.85%), air-conditioning systems (7.21%), workshop machines (6.00%), lighting (5.65%), overhead cranes (3.00%), ventilation (1.96%), furnace (1.26%), conveyor systems (1.00%), boilers (0.88%), refrigeration systems (0.49%), dust collecting equipment (0.30%), lift/escalators (0.20%), and other equipment (3.38%).

This end-use electricity can be reduced by using this system to the industry. Even though it cannot solve the problem, but it still can reduce power consumption thus can reduce the cost of electricity for the industry.

37.2 System Design

Generally, the wireless home power monitoring system is designed to measure and control the electrical appliance in the house or building using universal remote control (URC). This system is capable to measure the power usage of the electrical appliance. At the same time people can control the status of electrical appliance whether it is on or off using the remote control or through internet. From Fig. 37.1, shows how the wireless home power monitoring system is connected between the master and the slaves. The remote control will connect with the master to give command from the user. Besides using the control, user also can give instruction through internet using wireless ZigBee. ZigBee is a wireless technology developed as an open global standard to address the

CHAPTER 3

SELF-POWERED SOLAR TRACKING SYSTEM

PART 2: SYSTEM DESIGN

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3.1 Introduction

A solar tracker is a term used to describe devices that orient toward the sun. The devices attached with solar relatives items such as photovoltaic panels, reflectors, lenses or other optical devices. In standard photovoltaic (PV) applications, trackers are used to minimize the angle of incidence between the incoming light and the normal of a photovoltaic panel. This increases the amount of energy produced from a fixed amount of installed power generating capacity. Concentrated photovoltaic (CPV) and concentrated solar thermal (CSP) applications trackers are used to enable the optical components in the CPV and CSP systems. The optics in concentrated solar applications accepts the direct component of sunlight light and therefore must be oriented appropriately to collect energy. Tracking systems are found in all concentrator applications because systems do not produce energy unless oriented toward the sun [1]. The main issue regarding conventional solar panel is about its efficiencies of power absorption. Researches had been conducted and found out that the maximum power absorption happen when the panel is normal to the solar rays [2]. To orient the solar panel according to the sun's position can be achieved by using motors and actuators in the system. The implementation of motors and actuators will create a mechanism to control the orientation of the panel. This angle differs with its location. For accommodating this matter, dual axis solar tracking system should be more appropriate [3,5] which is discussed in chapter 2 while this chapter is the continuation of the previous chapter of solar tracking system.

The design of the tracking system consists of both mechanical and electrical parts. For mechanical part, we need to control the tilt angle of the panel according to the elevation angle of the sun. The movement of the panel controlled by the actuators must be accurate according to the sun position. There are several types of actuators and motors those are commonly used for tracking system.

For the electrical part, we need to affix the functions of autonomous using electronics components such as Arduino microcontroller [6], motor driver. The self-powered feature need electrical component that can integrate between photovoltaic panel, batteries and load supply. In this chapter of Solar Tracking System the system design is discussed.

3.1 Solar Tracking System Design

3.1.1 Mechanical Design. The mechanical design of the solar tracking system is developed and tested using CATIA CAD software. We designed our platform to have a frame with two limbs and a base. The limbs will hold the panel and linear actuator will control the tilt angel of the panel. Fig. 3.1 and Fig. 3.2 shows the mechanical design using the design software.

Chapter 7

MODELING OF DISC ROTOR INDUCTION MOTOR

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7.1 Introduction

In a conventional induction machine, the output is usually a function of the size of machine. As bigger as the size of the machine, the bigger its output power. The use of samarium–cobalt disc multi polar magnet in the stepper motor enables the constraint implied above apparently to be refuted. High energy content in samarium cobalt results comparatively high torque/inertia ratio, and hence fast acceleration. An example of a motor using samarium- cobalt disc rotor is a stepper motor which has a diameter of 5 mm and output of 30 watt. In this following analysis investigation had been carried out develop the effect of physical size of the rotor on the torque. A machine designer has to adjust the size of shaft and also the amount of conductors on the stator which is near the shaft. Assuming the rotor and stator have a common shaft of the same diameter, a fixed outer radius of the rotor is assumed in the following analysis. This is usually the case in the analysis of small motors. Hence the size of rotor shaft is a factor to be considered seriously to develop maximum torque.

7.2 Formulation of torque equation as a function as a function of R_1 and R_2

Considered the element of disc (annulus) as shown in Figure 7.1, the resistance of the element

$$\partial\theta = \frac{\rho dR}{2\delta\theta.rh} \tag{7.1}$$

Resistance of the path between R_1 and R_2 ,

$$R = \int_{R_1}^{R_2} \frac{\delta.dr}{2.d\theta.r.h} = \frac{\delta}{2hd\theta} \ln\left(\frac{R_2}{R_1}\right) \tag{7.2}$$

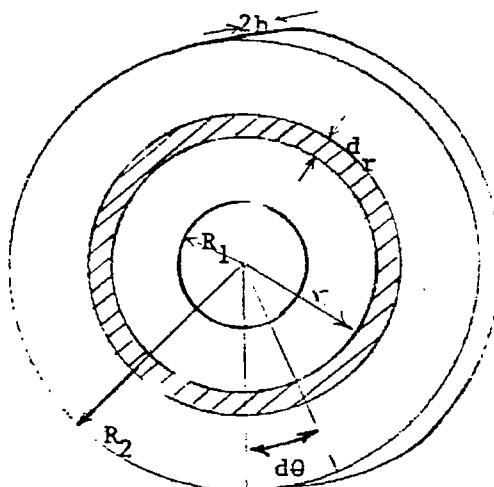


Figure 7.1: Disc Rotor

CHAPTER 4

SELF-POWERED SOLAR TRACKING SYSTEM

PART 3: SYSTEM INTEGRATION AND TESTING

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4.1 Introduction

Solar energy is the least polluting and most inexhaustible of all known energy sources. The sun bathes the earth with more energy each minute than the world consumes in one year. In Malaysia, the sun intensity does not vary with season. It is a suitable place to develop the solar cell system. To make solar energy more efficient, the solar panel system must be optimized. This project is regarding the development of a sun tracking solar system [1, 2]. This system is a simple tracking solar system using linear actuator, motor and light sensor. The solar tracking system used in this method could increase the power collection efficiency by developing a device that can track the sun to keep the panel at normal to its rays. To utilize the power, this system is made self-powered using the mechanism of battery charging.

The design of the tracking system consists of both mechanical and electrical parts. For mechanical part, we need to control the tilt angle of the panel according to the elevation angle of the sun [3-5]. The movement of the panel controlled by the actuators must be accurate according to the sun position. There are several types of actuators and motors those are commonly used for tracking system. For the electrical part, we need to affix the functions of autonomous using electronics components such as Arduino microcontroller [6], motor driver. The self-powered feature need electrical component that can integrate between photovoltaic panel, batteries and load supply. The system modelling is discussed in chapter 2 and system design is discussed in chapter 3. This chapter discusses the system integration and testing with a discussion on results.

4.2 System Integration

4.2.1 Integration of Mechanical Components. Basically, we need to design the mechanical parts of the system with the ability to integrate with the electrical components. The mechanical parts was basically a frame to hold the solar panel and with 2 Degree of freedom. The shape that we used is a simple rectangular plate with a link support between each limb frame to make it strong. The material that we used is aluminum alloy.

4.2.2 Integration of DC Motor. In order to integrate the dc motor to the base of the frame, a hole needs to be drilled at the center bottom of the frame. The distance of the hole to both ends must be equally measured so that it is aligned with the axis of rotation of the system. After the drilling process is done, the dc motor is attached under the platform by using screws provided. The rotating rod of the motor is fixed at the hole by using stopper and screws as in Fig. 4.1.

CHAPTER 5

SMART SYSTEM FOR MONITORING ELECTRICAL POWER USAGE AT HOMES

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5.1 Introduction

Global warming and its disasters environmental and economic effects are considered as one of the major challenges that mankind will face during this century. Therefore, green technologies are very needed nowadays to reduce global warming. The smart device proposed in this chapter can help environment in reducing carbon footprint and save energy consumption at homes. Malaysia is now in mission towards “Green Earth” so any smart green technologies which may corresponds to this mission will get much of the attention worldwide. Smart home system functionality is dividing into the following five components which are sensor system, signal transmission systems, power transmission system, action system and central control system. Sensory system work having the responsibility to collect data. Whereas, power transmission is responsible for the various parts of the power supply, refers primarily to electric doors and windows, curtains, electrical switches and other actions to complete the module terminal and lastly the most central part of the central control system.

5.2 Smart Home Power Monitoring Systems and its Development

Today, low power design is a mature research area and power consumption is considered at all levels of system generalization. As smart home becomes increasingly popular, People are in need of more home automation devices to upgrade their living spaces and enjoy a high-tech and tranquil yet cost-saving life [1]. They went to equip their houses with more sensors and actuators for optimum convenience, security and entertainment.

5.2.1 Concept of Smart Home Power Monitoring System. An external plug-in device is used as one way in smart home management in terms of power consumption. Power outlets or power socket are the most commonly-used electrical devices in modern home environment. External plug is used as a monitoring device that can show specifically power consumed on each appliance attached to power socket. User can also remotely control the power on/off of particular appliance using a controller through this external plug.

5.2.2 Development of Smart Home. This project is aimed for getting data (current) of home appliances that have been used by homeowner where we can monitor via software interface. The study aspects are the electrical/electronic devices, software development using LabVIEW, wireless connectivity and mechanical part which aimed to get the best design for the whole system. Hardware development is more concern in designing the circuit connection inside the plug and also the design of plug itself. As this plug has the capability to measure the power consumption, the basic idea inside this plug is a controller that

CHAPTER 8

COMPUTER COMMUNICATION FOR A SMART CARD BASED ORDERING SYSTEM VIA VISUAL BASIC

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8.1 Introduction

This chapter presents a combination of data and computer networking system integration, Graphical User Interface (GUI) and also smart card application. The significance of the project is that the system designed can be used to improve the current system used in fast food outlets. The system designed should improve productivity of the outlet in terms of manpower and ease of work for the workers. Improvements should also be made in terms of customer satisfaction where the services provided should cater to the customer's individual needs. Furthermore, as smart card application is rapidly evolving into technology platform that could trigger changes in everything, therefore it is hoped that this system will help customer to make an order via remote purchasing and also helps the management operator to entertain order in a quick and efficient procedure.

8.2 Basic Concept of Computer Networking

This system is concerned with the data communication systems networking applications. When computers, terminals, or other data processing devices exchange data, there must be a path between two computers either directly or via a communication network. Typical tasks to be performed such [1]:

1. The source system must either activate the direct data communication path or inform the communication network of the identity of the desired destination system.
2. The source system must ascertain that the destination system is prepared to receive data.
3. The file transfer application on the source system must ascertain that the file management program on the destination system is prepared to accept and store the file for this particular user.
4. If the file formats used on the two systems are incompatible, one or the other system must perform a format translation function.

CHAPTER 9

ELECTRONIC SMART ORDERING SYSTEM: GRAPHICAL USER INTERFACE

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9.1 Introduction

Fast food outlets are fast becoming the food of choice for today's society. There are numerous fast food outlets in the markets now ranging from western food such as Mc'Donalds and Kentucky Fried Chicken (KFC) to local cuisines such as Mee Rebus Ramli. The concept of fast food outlets is that a customer can go to the counter, order from a set menu, pay and then receive the food. The service should be fast hence the name 'fast food'. Fast food outlets are a convenient location to purchase food especially for working people during their lunch break. This is highly evident in areas such as the Klang Valley where we can see an extremely packed Mc'Donalds or KFC during lunchtime.

Another changing aspect of modern society is the cashless society. Many monetary transactions are conducted electronically. The exact exchange of cash between two parties is no longer considered the only way of buying and selling. Nowadays, there are many other alternatives to cash such as checks and credit cards. Another example of an alternative is prepaid cards. Prepaid cards are now a common means of using a service. Examples of prepaid cards usage are the card phone, toll services such as Touch N Go cards and even Internet usage.

9.2 Graphical User Interface Design

In brief, a graphical user interface can be defined as follows. A user interface is a collection of techniques and mechanisms to interact with something. In a graphical interface, the primary interaction mechanism is a pointing device of some kind. This device is the electronic equivalent to the human hand. What the user interacts with is a collection of elements referred to as object [1-4]. Today, most applications have a Graphical User Interface (GUI). A GUI provides visual clues such as small pictures, or icons, to help the end user give instructions to the computer. Microsoft Windows is the most widely used graphical user interface. However, the GUI still has the advantages and the disadvantages which are briefly explained in Table 9.1.

CHAPTER 6

VIBRATION BASED PREDICTIVE MAINTENANCE : COMMON ROTATING MACHINERY FAULTS AND THEIR SIGNATURES

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6.1 Introduction

Predictive maintenance method makes use of human senses or other sensitive instruments like audio gauge, amplitude meter, pressure/ temperature strain gauge, vibration analyzer, etc. In this maintenance, equipment conditions are measured continuously. It helps determine the condition of in-service equipment in order to predict when maintenance should be performed. Operating cost can be reduced caused by improved efficiency and productivity, and greater utilization of production time.

The predictive maintenance philosophy of using vibration information to lower operating costs and increase machinery availability is gaining acceptance throughout the industry. Vibration is one of the methods used to determine machinery condition. It is the most effective method in predictive maintenance. Figure 6.1 shows most common maintenance methods.

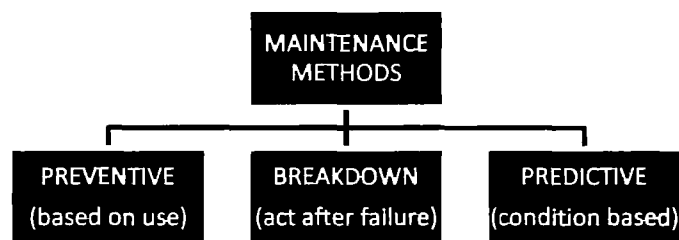


Fig. 6.1: Maintenance techniques

6.2 Common Rotating Machinery Faults

Every machinery fault generates different or unique set of vibration components and characteristics. Some of the most frequent faults patterns are imbalance, misalignment, bearing fault, bent shaft, critical speed and resonance, rotary perturbation and mechanical looseness. Their definitions and vibration signatures are given below.

6.2.1 Imbalance. Unbalanced rotary parts are primary cause of failure or disturbance. Simple unbalance (imbalance) occurs when the center of mass of a rotating object differs from the center of rotation (static unbalance). It also occurs when rotation axis does not coincide with the principal axis of inertia of the rotating body - often called dynamic unbalance. Figure 6.2 shows both center of mass and center of rotation.

CHAPTER 10

INTRUDER AVOIDANCE SYSTEM VIA SHORT MESSAGE SERVICE (SMS)

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10.1 Introduction

Cars getting stolen have become a common occurrence nowadays. This is not only problematic for the car owners, but also for insurance companies who have to fork out large sums of money to compensate the policyholder. Car thefts occur despite the cars being fitted with alarm systems. This is because the current alarm systems have inherent weaknesses. Most car alarms available in the market are only capable of emitting loud noise or siren from the car and flash the headlights when there is an intrusion [1-4]. If the owner of the car is somewhere far away from his or her vehicle, or if they are inside a building, then they might not be able to hear the sound coming from the car alarm. Furthermore, most cars have similar alarm sirens; there is no distinctive siren for each different car, thus a car owner will never be able to distinguish whether the siren is coming from their car or coming from another car. Therefore, a car thief can easily steal a car without the owner even realizing what is going on.

The security system is designed to notify an owner of a car via Short Message Service (SMS) once the car alarm has been triggered. With a rapid increase in the number of vehicles on the road, there has also been an increase in thefts of vehicles, particularly cars. According to Seventh United Nations Survey of Crime Trends and Operations of Criminal Justice Systems (1998- 2000) [5], Malaysia has among the highest rates of car thefts in the world. In the year 2000 alone, 55,879 cases of car theft were reported, 2.41 per capita (per capita figures expressed per 1000 population) [6]. Malaysia is ranked no. 13 for the highest number of car theft cases in the world and no. 15 for the highest number of car thefts per capita. These alarming statistics necessitates for an enhanced security system, such as this project, that would minimize the probability of theft and give the car owner some peace of mind. Cars fitted with such a security system would be much sought after by potential buyers.

10.2 Software Development

The tasks that are involved in this stage include adjusting the settings of the GSM modem, programming of the Programmable Logic Controller (PLC) as well as using the Hyper Terminal Software to verify the PLC programming. The GSM needs to have its settings adjust so that it would be enabled to conduct the Short Message Service (SMS). The GSM Modem is connected to the Personal Computer (PC) via the RS232 interface. The following steps show how the initial settings were saved in the GSM modem.

- Step 1:** The Hyper Terminal program in the PC is opened
- Step 2:** The connection name is given and connected using the COM 1 port

CHAPTER 11

ANTI SKID CONTROL SYSTEM, A TUTORIAL

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11.1 Introduction

Antiskid Braking System (ABS) refers to devices designed for preventing wheel lock during hard and panic braking conditions. These systems have gained attention in the recent time. Most Malaysian cars are equipped with an ABS [1-2]. It is a known fact that four wheel systems provide more security, steerability and stability. ABS systems are designed using system hydraulics, sensors and control electronics.

The antiskid braking system is basically an actuator used in controlling the valve and brake pressure fluid used for stopping cars. The main idea is to control the brake force not to exceed the wheel threshold limit where slip can occur. The vehicle speed and wheel speed play important role in making the car stop in safe way thus avoiding skidding. As long as the driver steps on the brake pedal, antiskid braking system will play its important action to prevent skidding.

Most modern ABS comprises of: Hydraulic brakes for wheels of the vehicle; Actuators provided for respective brake groups each including at least one of the brakes, for controlling a braking pressure or pressures of the brake or brakes of the corresponding groups; Speed sensors, at least one of which is provided corresponding to each actuator, for detecting speeds of the wheels [1-4]. A moving vehicle is affected by weight force, air resistance and voluble resistance of tire above all. The force actuating for tire include: Circumferential force, which is descended from driving mechanism; Side force, which is descended from vehicle control; Normal force, which is descended from vehicle weight.

The forces efficiency depends from road status, tire status and atmospheric conditions. The transferred force intensity between road and tire at accelerating or decelerating are determined by the friction forces. Car safety systems need maximum uses instantaneous value of the friction forces, which is determined by the adhesive force. If there is a high friction force, then more driving force of engine will gives the car more acceleration. If the value of friction force is small enough, the wheel will start to skid. In this case, the Antiskid Braking System (ABS) must reduce the engine driving force to some level if any wheel is skidding. In other words, the braking forces must be reduced so the vehicle stops from skidding.

The most important parameter processed in Antiskid Braking System is slip. The slip is non dimensional parameter designated as λ . This parameter determines the skid rate during braking. The general equation of slip is,

CHAPTER 12

INTELLIGENT ANTI SKID CONTROL SYSTEM

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12.1 Introduction

Nowadays, car safety is very crucial and critical criteria for people to have one. This is not only important for the car owners, but also for car companies who have to make sure that their products provide safety during journey. Car accidents occur even though the cars are equipped with high technology safety equipments. This includes Antiskid Braking System where generally the system is to provide controlled braking force to be applied to each wheel of an automotive vehicle by detecting any wheel behavior that the wheel is about to lock. Most cars are equipped with the conventional Antiskid Braking System (ABS) [1-3]. It is known that during emergency braking, it involves high deceleration of wheel as well as the car. The rapid deceleration causes the high coefficient of friction between the wheel and road surface. Therefore, the wheel tends to lock and the car will slip from the road causes difficulty in controlling the car. This situation will cause accident or collision. The most important safety feature in a car is the stability or quick response to control during critical time especially emergency braking. Thus, car skidding is undesirable and need to be avoided at any time. Furthermore, skidding is easier to occur during cornering and road condition is also another factor that leads to accident caused by slipping vehicle. Current existing systems serve this objective, but it is not perfectly and effective enough. Therefore, the intelligent antiskid control system will yield better braking efficiencies under a wide range of conditions [1-2].

With a rapid increase in the number of vehicles on the road, there has also been an increase in accidents of vehicles, particularly cars. According to Malaysia's Ministry of Transportation, 90% of the accidents cases were involving people whom lost control of their car as the car starts to skid during emergency braking. Malaysia is haunted by accident cases which lead to fatality especially during festival seasons. Surprisingly, most cases were caused by the braking system of the car itself. People will step hardly on their brake pedal as they encounter emergency situation hoping that they can avoid collision ahead. Unfortunately, once they hit the brake pedal as hard as they can, their car will brake immediately and the wheels started to lock and thus their car slide and loses balance. This situation will only make the scenario worse whereby the driver cannot control their car especially when they are negotiating a corner. Most of the time, this situation will lead to accident. These alarming statistics necessitates for an enhanced antiskid system, such as this project, that would minimize the probability of car accident due to skidding during braking. Cars equipped with such advanced antiskid system would be a great deal and desirable for potential buyers.

CHAPTER 13

PRINCIPLES OF FMCW RADAR SIGNAL PROCESSING

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13.1 Introduction

Frequency Modulated Continuous Wave (FMCW) radar is a short range measuring radar system. During a normal operation this radar system transmits a known stable frequency continuous wave radio energy that is modulated by a triangular modulation signal so that the transmitted signal varies gradually along a certain time period. Variations of modulation such as sine, sawtooth, etc. are possible. The triangle modulation is used in FMCW radars when both range and velocity are to obtain. It is known that the received waveform is a delayed replica of the transmitted waveform, and the time delay is a measure of the range.

When operating the radar in FMCW mode the transmitted modulation waveforms are mixed with the delayed replicas (coming from various targets) via the mixer to produce a beat signal, and then analyzed by an FFT algorithm. The beat signals are passed through an analog to digital converter (ADC) and digital processing is performed on the result. In this work the principle of FMCW radar signal processing will be demonstrated on the example of INDERA (the first maritime radar made in Indonesia).

INDERA is a FMCW maritime radar that is designed to be installed and operated in a ship [1]. During its normal operation INDERA is continuously transmitting modulated electromagnetic waves to detect targets in the surrounding area. Since the transmitted signal is a continuous wave, it needs only a very small power to transmit it. Consequently, the power level of signals arrived on the Rx-antenna is also very low. Therefore, a reliable signal processing plays a significant role in distinguishing between reflected signals coming from real targets and from other (mostly) unwanted sources.

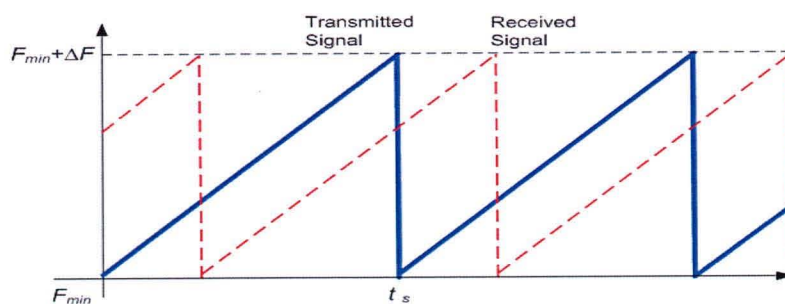


Fig. 13.1: Sawtooth shaped FMCW radar signal.

CHAPTER 14

DESIGN AND IMPLEMENTATION OF A SIMPLE QUEUEING SYSTEM FOR VEHICLE TRAFFIC SIMULATOR

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14.1 Introduction

Traffic congestions and crowded situations in the streets, especially in big cities, are believed to cause negative effects on both the environment and human being. In traffic jam situation vehicles can move forward slowly so that a large amount of unhealthy gas, produced at a certain time on a certain area, can raise non-negligible air pollution. In the same time the traffic noise can also raise serious ecological damage. These discomforts can additionally increase the stress of people trapped in the jam and of them who live nearby the area. In a long term this steady traffic conditions can decrease the productivity of a nation. It was reported that the yearly losses due to traffic congestion in Bogor is estimated at USD 720 millions in 2006 [1].

One important reason for traffic congestion is the raising unbalance between the traffic flow and the street capacity. Well planned traffic rules can be used to control the traffic flow, so that the overcapacity of the streets could be avoided. In this context, a software tool to support in planning the traffic rules is very helpful. Using this software tool, a future impact of newly planned traffic rules can be simulated on a computer model before it is implemented on the road [2-3].

14.2 A Simple Model of the Queueing System

Without limiting the problems, and also because of its simplicity, the traffic condition at the toll gate is chosen as a special case for modeling the queueing system. A typical highway with a series of toll gates is shown in Fig. 14.1.



Fig. 14.1: A highway with a series of toll gates can be modeled by a simple queueing system.