CHAPTER 1
INTRODUCTION

In this chapter, the background study of the project will be introduced. Next, the problem statements and the objectives of the project will be discussed. This will be followed by the scope of study for this project.

1.1 Background of Study

This project is developed in order to ease the searching process for available parking spaces in a short period. With the increasing number of vehicle, other problem related to the parking problem is traffic congestion and overflow usage of available parking spaces in parking area. Hence, this project shows the possible way to solve these problems by providing the number and location of available parking spaces. This project consists of circuit's design and hardware implementation to detect available parking spaces. Besides that, it also involves software design and integration.

1.2 Problem Statements

The problems to search empty car parking spaces in the short time can lead to other traffics problems. By developing this project, the problems that most probably can be solved or avoided are such as below:

1. Time wasted in order to search for empty parking spaces.
2. Traffic congestions at the car parking area.

1.3 Objectives

This project is developed with the objectives of:

1. To detect the cars using sensors in every parking lots in parking area.
2. To provide user information on the availability of empty car parking lots in the parking area.
3. To capture the entering car registration number and assign it a designated parking space.

1.4 Scope of Study

In order to carry on with this project, several scope of study had to be achieved. The major scopes are follows:

1. To get information and proper modelling on designing the intelligent parking system.
   - There will be researches towards the current existing system that have almost the same concept and design.
   - The design should be more effective and have added features than the existing system in Malaysia.
   - The proper way of designing should be considered from time to time.

2. To study on the hardware, mechanism and tools to design this system.
   - It will be some research on software related.
   - Determining the suitable hardware such as sensor to be used in implementing the project.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the available literatures of on-going project will be explained. This is the result of the research that has been done to do the project. This literature review has given some ideas and methods on how the project can be carried out and designed.

2.1 Guided Parking System

2.1.1 Parking Guidance System in Tapiola, Finland

Difficulty in finding an unreserved parking space in a city centre of Tapiola is emphasized in T Ristola. The paper states that beside the insufficient parking numbers problem, it is the drivers themselves are not aware of where the vacant spaces are. The searching traffic, caused by this lack of information, can in some cases be estimated to account for as much as 20% - 30% of the total traffic in a city centres [1]. The main objective of parking guidance is to guide the driver to a suitable parking space along a suitable route and thus reduce the searching traffic. The paper also stated that the parking guidance introduced in Tapiola, Finland in year 1992. The system consists of a service of gate-arm counter and introduction loop detectors located at the entrance and exits of the car parks. Then, it will count the vehicles going in and out of the car parks. This data is processed in car park control units and sent to the control centre. The central computer assesses the overall situation and decides what to display in the display mechanism.

2.1.2 The Optimum Configuration Of Car Parking Guide System Based On Wireless Sensor Network.

Wireless sensor network based on ad hoc network is being widely use in various environments to monitor and collect information [2]. A wireless sensor network are consists from large number of low-cost sensor nodes which can be self-organized to establish an ad hoc network through the wireless communication module. These parts enable sensor nodes to be easily used to collect, process, and transmit information. However, energy consumption and time delay are important factors of wireless sensor networks which should be considered. In this paper, they applied wireless sensor network to car parking guidance system with large scale of parking lots, where the total number of wireless sensor nodes are divided into some cluster group and cluster head in each group will do the role of relaying the sensing information from nodes. Because the power consumption and time delay occur mainly at cluster head in the car parking guide system, the analysis was focused in deriving the power consumption and time delay according to the number of cluster heads [3].

2.1.3 Implementation of Intelligent Parking Guidance at OR Tambo International Airport

O.R. Tambo International Airport is the largest airport in Africa. This airport has a huge demand on road parking facilities as a majority of travelers get to the airport by motor vehicles. The demand for parking has caused many people searching for an empty parking space for over 8 minutes or more. Most of the times, this travelers are stranded in the airport because they spent too much time looking for an empty parking space and has caused the missed their flights. This led to a number of complaints to the parking offices from unsatisfied peoples. Technologies are typically used in parking guidance systems. These can be adjusted to suit the requirements of the particular airport. Dynamic Message Sign is an electronic signs that are used to provide information on parking availability in the different places. These can be used both outdoor and indoor as inside the cover parking area to display the availability of the parking space. Then, they used Zone Board which is an electronic signs that guide users within the parking space to the correct aisle by displaying the number of bays available in each aisle and directing the car owner with green arrows [4]. They are using the Ultrasonic LED Sensors which is an electronic sensor that is used to detect vehicle presence using ultrasound technology. The sensors display bay availability using colours LED. For the outdoor parking the wireless outdoor sensors is used to detect vehicle presence using a magnetometer. The sensor can either be surface mounted or embedded in the ground. Then, central software system is acting to provide an interface for operators to manage parking processes and availability; place messages on the electronic signs and log data for reporting and analysis [4].

2.2 Sensor

2.2.1 Ultrasonic Sensors

Ultrasonic signals are like audible sound waves, except the frequencies are much higher. Ultrasonic transducers have piezoelectric crystals which resonate to a desired frequency and convert electric energy into acoustic energy and vice versa. Sound waves are transmitted in the shape of a cone and then are reflected back to the transducer. In this point, an output signal is produced to perform some kind of indicating or control function. A minimum distance from the sensor to the target is required to provide a time delay so that the “echoes” can be read. The variables that can affect the operation of an ultrasonic sensor include: target surface angle, reflective surface roughness, and change in temperature or humidity. The targets can have any kind of reflective form and even round objects.[5]

The advantages of ultrasonic sensor are discrete distances of moving objects can be detected and measured, less affected by target materials and surfaces, not affected by colour, it has solid state which virtually unlimited maintenance for free life, small objects can be detected over longer distances, it also has resistance to external disturbances such as vibration, infrared radiation, ambient noise, and EMI radiation.

2.2.2 Ultrasonic Sensors - Parking Systems Technologies

The availability of the vacant parking spaces is calculated by the installed sensors in the parking areas, which count the number of cars that enter and exit from the parking space. The number of parking tickets given at the ticket counter also can be used to calculate the vacant spaces. All the information from the sensors and the ticket counters is used to update a central database which stores all the information about the areas of the parking space which is vacant or occupied. Smith and Roth also compare the parking techniques used at various airports in the United States. Some of the examples are Houston International airport and the Baltimore airport at Massachusetts [6]. The parking spaces at Houston international airport have wires embedded at the entry, exits and the others levels of the parking lots. These wires function as sensors and record the entry and exit of the drivers to update the central database. At the Baltimore airport, there are ultrasonic sensors at the top of each parking space which sense the availability or unavailability of each space [6]. Information from this central database is used to display information at the "way-find" signs at the end of each row of the parking area and tell the drivers whether the parking space is available or unavailable in that particular row.

2.2.3 Design and experimental study of an ultrasonic sensor system for lateral collision avoidance at low speeds

This involve the implementing an ultrasonic sensor system for lateral collision avoidance of vehicles at low speeds. The developed sensor system is useful for detecting vehicles, motorcycles, bicycles and pedestrians that pass by the lateral side of a vehicle. The system can be adopted to enhance the rear-view mirrors of present vehicles, which have blind spots on the lateral sides. Ultrasonic sensors, which have been widely used on cars for rear object detection during parking, are developed for lateral object detection at low speeds. Detailed experimental studies are presented in this paper. Experimental results show that the proposed system can detect a vehicle at speeds up to 40 km/hr with a maximum range of 6 meters. Moreover, the influence of wind on the measurement is also investigated. The developed sensor system gives satisfactory results for a wind speed up to 35 km/hr[7]

2.2.4 A sensor guided parallel parking system for nonholonomic vehicles

A parallel parking system for nonholonomic vehicles with embedded microprocessor and ultrasonic sensors is described. A general four-wheel vehicle is used as a nonholonomic system to reflect the motion constraints applied to the vehicle. By using the ultrasonic scanning data acquired, a collision-free path is important part of the system. The path may require a few backward and forward maneuvers if the parking space is tight or the range of steering angle is narrow. Speed control during the maneuvers and a scheme of speed variation is presented. The parking system has been installed on a mobile robot, and experiments have been carried out, which proves that parking spaces are detected correctly, and the path thus produced are feasible [8].

2.2.5 A Parking Management System Based on Wireless Sensor Network

Wireless sensor network usually consists of a large number of low cost sensor nodes that are deployed in sensing area. These nodes can sense, sample and process information gathered from their surroundings. They form an ad hoc network to exchange information and transfer data to remote servers in a hop-by-hop manner. When the system is running, all sensor nodes form a tree-like topology automated gathering for data. The monitoring nodes check the availability of each parking space and transmit the report messages to the sink node hop by hop. The sink node collects the report messages and delivers them to the management station, and then user can get the visual status information of the whole parking lot on his monitor screen [9]. The management station calculates the guiding information for each guiding node and sends the guiding messages to them through the sink node. The guiding nodes will receive the messages and display the instruction.

2.2.6 Speed of Sound in Air as a Function of Temperature

During the ranging system of the echo, the elapsed time between the emission of the ultrasonic pulse and its return to the receiver is being measured. The range of the distance to the target is then computed using the speed of sound in the transmission medium, which is normally air. The accuracy of the target distance measurement is directly proportional to the accuracy of the speed of sound used in the calculation [10]. The function of both the composition and temperature of the medium through which the sound travels is usually the actual speed of sound (Figure 1).

The speed of sound in air varies with the function of temperature by the relationship:

$$c(T) = 13{,}044\sqrt{1 + \frac{T}{273}}$$

where:

c(T) = speed of sound in air as a function of temperature in inches per second

T = temperature of the air in °C

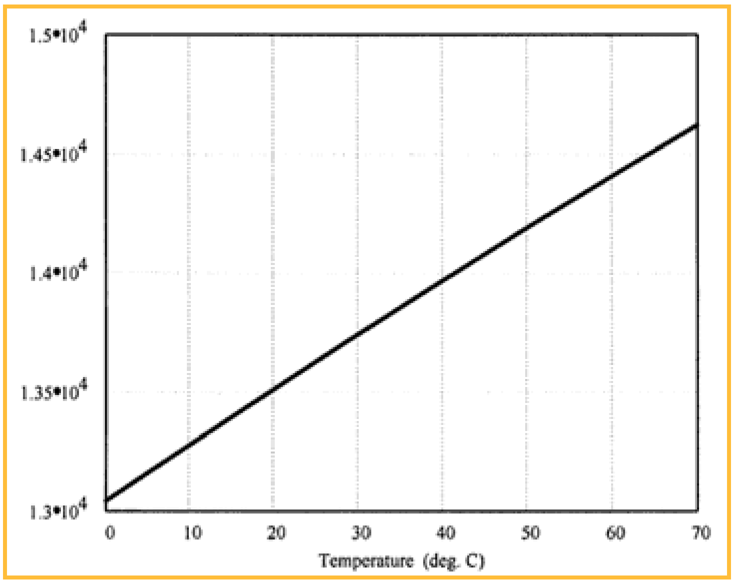

Figure 1: The speed of sound is plotted as a function of the temperature.

2.2.7 Wavelength of Sound as a Function of Sound Speed and Frequency

The wavelength of sound changes as the function of both the speed of sound and the frequency [10], as shown by the formula:

$\lambda = c/f$

where:

λ = wavelength

c = speed of light

f = frequency

Figure 2 is a plot of the wavelength of sound as a function of frequency at room temperature in air.

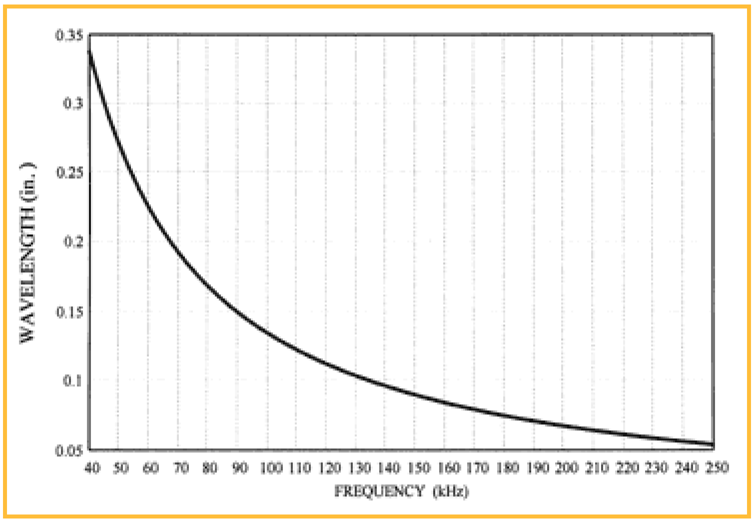

Figure 2: The wavelength of sound in air at room temperature.

2.2.8 Relative Echo Levels from a Flat Surface for Different Ultrasonic Frequencies

When the sound pulse is reflected from a large flat surface, the entire beam is reflected (Figure 3). This total beam reflection is equivalent to a virtual source at twice the distance. Therefore, the sound reflected from a large flat surface cause a spreading loss and absorption loss. To prevent these losses, it is important that the reflecting surface be both larger than the entire sound beam to ensure total reflection, and perpendicular to the sound beam.

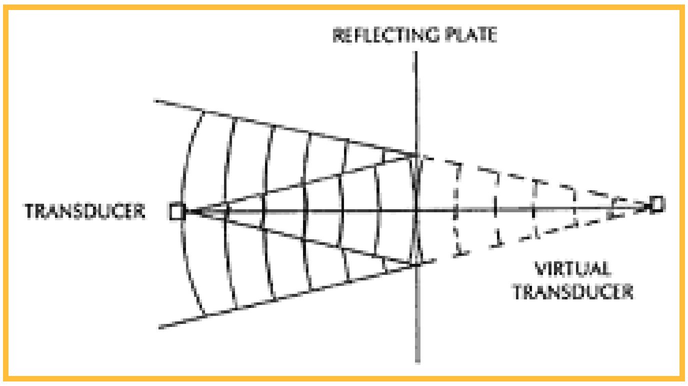

Figure 3: A sound beam reflected from a flat surface.

2.3 Image Processing

2.3.1 Image Processing and Analysis

Image Processing and Analysis can be defined as the "act of examining images for the purpose of identifying objects and judging their significance". Image analyst sense the data and do the logical process in detecting, identifying, classifying, measuring and evaluating the significance of physical and cultural objects, their patterns and spatial relationship.

In the most general way, a digital image is an array of numbers depicting spatial distribution of a certain field parameters (such as reflectivity of EM radiation, emissivity, temperature or some geophysical or topographical elevation. Digital image consists of discrete picture elements called pixels. In each pixel is a number represented as DN (Digital Number), which controls the average radiance of relatively small area within a scene. The range of DN values is normally from 0 to 255. When the pixel size of the picture is reduced more scene detail is preserved in digital representation. Remote sensing images are recorded in digital forms and then processed by the computers to produce images for interpretation purposes. Images are available in two forms-photographic film form and digital form [11]. Variations in the scene characteristics are represented as variations in brightness on photographic films. A particular part of scene reflecting more energy will appear bright while a different part of the same scene that reflecting less energy will appear black.

2.3.2 Design Of Recognition System For Special Malaysian Car Plates

All wet film and digital images of car plates were interpreted by humans. However, there are technology that had developed into the photo-enforcement industry. Computer-based car plate recognition emerged in the 1980's. In the 1993, it made a successful transition from the research to the commercial market. As for now, the technology is finding its way into progressively more solution-oriented system. A car plate recognition system is an image-processing technology used to identify vehicles by capturing their car registration number [12]. Different vendors tend to use slightly different phrases to designate their car plate recognition system. There are some of the car plate is using character like, “Putrajaya”, “SUKOM”, “Proton” and others. The car plate recognition technology is also known as automatic number plate recognition, automatic vehicle identification, car plate recognition, car plate reader or optical character recognition for cars.

2.3.3 The Recognition Of Car License Plate For Automatic Parking System

The recognition of car registration number is important for many applications such as the payment of parking fee, highway toll fee, traffic data collection, crime prevention and others. Since the numbers of cars are not small, it is difficult for human to identify the cars, and this is where the automatic system is required. To identify a car registration number is effective because every car have its own uniqueness. Thus, because of that many research of car identification using car registration extracting and recognition. Lotufo, Morgan and Johnson [13] proposed automatic number-plate recognition using optical character recognition techniques. Johnson and Bird [14] proposed knowledge guided boundary following and template matching for automatic vehicle identification. Fahmy [15] proposed BAM neural network for number plate reading. Nijhuis , Ter Brugge and Helmholf [16] proposed fuzzy logic and neural networks for car license plate recognition.

2.3.4 Car Plate Recognition By Image Processing

The recognition process starts with the search and the extraction of the portion of the original image containing the car plate. The characters contained in the plate are gathered by a robust processing using a non-traditional Discrete Fourier Transform (DFT), and is being isolated and classified by the neural network. The character recognition has been speeded up by the parallel architecture. The algorithm has been tested on a workstation featuring a Pentium Pro PC 200 MHz processor and the Matlab software [17]. The next step will be to write in a high-level language such as C++ or also assembler to enhance the processing speed.

CHAPTER 3

METHODOLOGY

In this chapter, the methodology used to carried out this project will be explained. There are several methodologies are used in doing this project but the most important and first of all is the research method to find information regarding the project. Then, it also provides the prototyping material and tools needed for the project.

3.1 Procedure Identification

For methodology, in Figure 4, it shows the works related for the whole project design in FYP 1 and FYP 2. The works have been divided into two which are for FYP 1 and FYP 2. For the whole project design, including the FYP 1 and FYP 2, the flowchart has been given in the Figure 1. In this flowchart, the methodology starts with the research of literature review and end with the completion of the final report.

For FYP 1, the works involve the sensor circuit. This sensor circuit is integrated with a microcontroller to produce complete guided parking system. This will involve with coding simulation, circuit testing and calibration.

For FYP 2, as shown in Figure 5, the works involve the designing the image processing coding. This is to produce the car plate number recognition system. With this system designed, it is then integrated with the guided parking system that is produced in FYP 1.

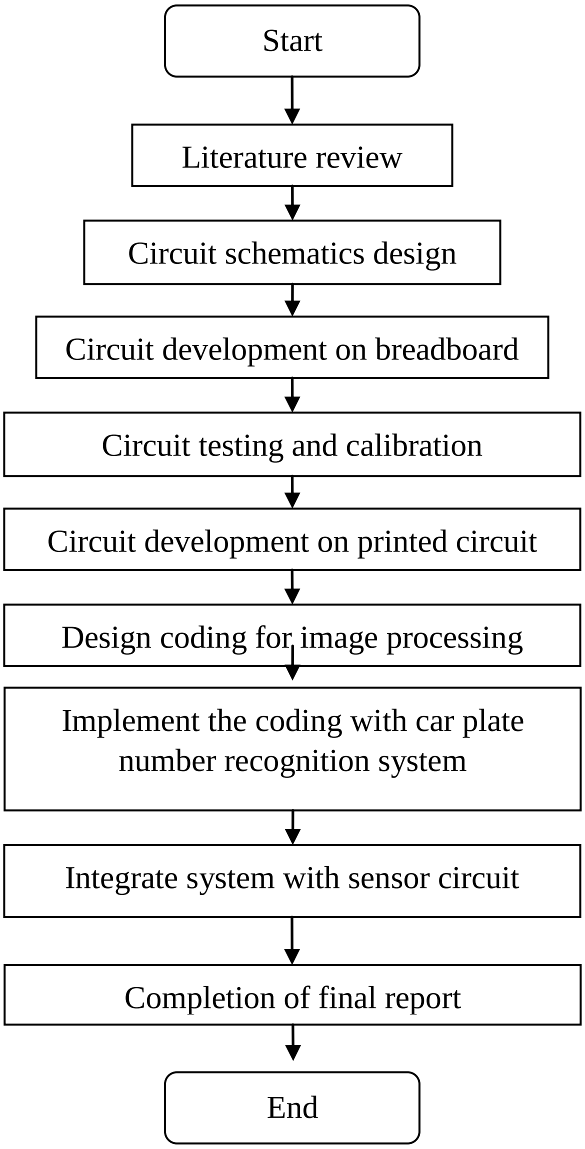

Figure 4: The Flowchart of the Whole Project Design.

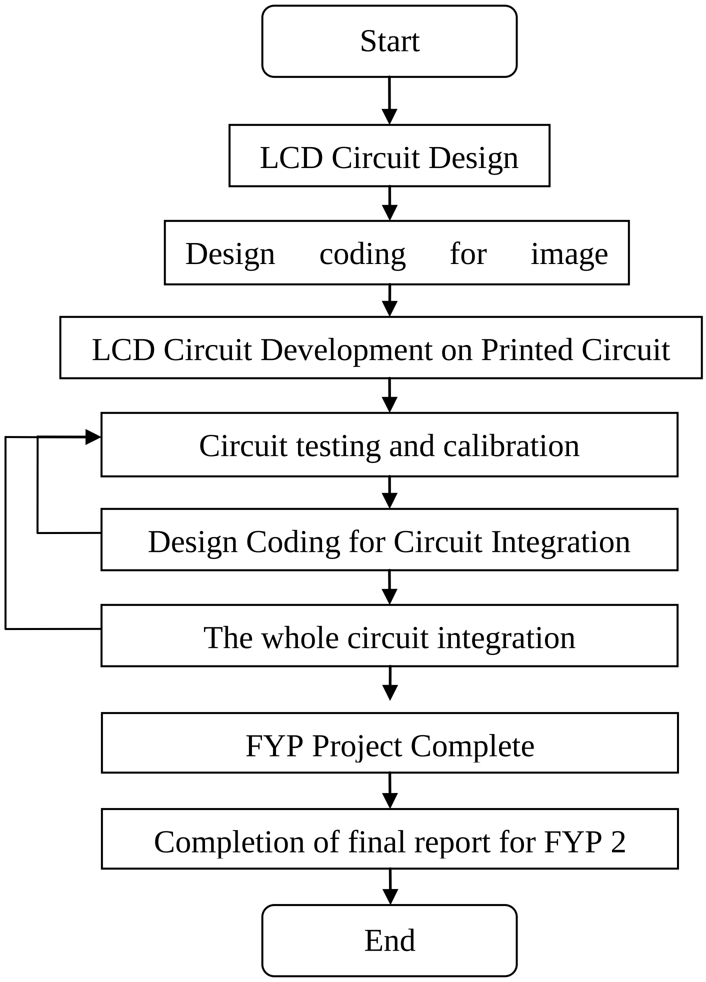

Figure 5: The Flowchart Of FYP 2 Work.

3.2 Research Method

This study is making use of the available resources in search for information on parking guidance system and the foundation model design. Several methods are applied in detecting the cars and modification of the embedded coding can be done after testing the prototype. The procedures in developing the system are shown below:

1. Research on equipments, components and tools to be used.
2. Start on Embedded Software development for parking detection and counter.
3. Testing the coding on Microcontroller.
4. Design model system.
5. Integrate Software and Electronics.
6. Testing on detection and counter of the cars.

3.3 Tools And Equipments

This section shows the list of material in producing the prototype for Intelligent Parking System.

Electronics

1. PIC Microcontroller
2. Ultrasonic sensor
3. Single core wires
4. ICs
5. Resistors
6. LCD display
7. LEDs
8. USB Camera

Softwares

1. Matlab
2. MikroBasic Pro for PIC Software for PIC programming
3. Visual Basic

3.4 Sensor Circuit Testing Material

This section shows the list of components needed in order to build the sensor circuit.

1. Ultrasonic Sensor Receiver
2. Ultrasonic Sensor Transmitter
3. Resistors
4. IC LM 567
5. IC LM 555
6. IC LM 741
7. Capacitors

3.5 Image Processing Design

Matlab are used in developing the image processing. This design requires the use of camera (webcam) to be integrated with the coding done in Matlab and then produce the output display of the car plate number. Then, it is integrated with the sensor circuit to complete the whole project design. Figure 6 shows the steps for the image processing coding design.

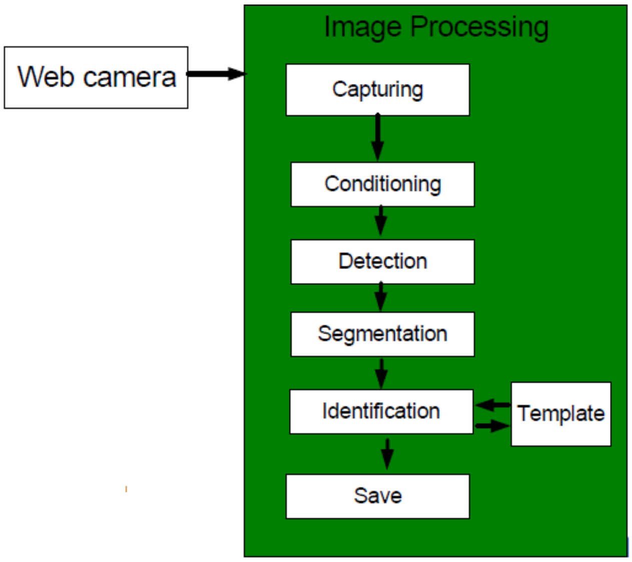

Figure 6: Flow Chart of Image Processing Coding Design

CHAPTER 4

RESULT AND DISCUSSION

In this chapter, the explanation on the result that has been obtained in designing the system is discussed. The design implementations are also discussed.

4.1 Choosing a Sensor

In this project, the chosen sensor is the ultrasonic sensor. The reason of this is because the ultrasonic sensor is more accurate in detecting distance of certain object and in this case the car compare to other sensor. In Figure 7, it shows how the sensors are used to detect the object. Here are the list of the advantages of the ultrasonic sensor and why it is suitable to use in this project.

1. Discrete distances of the objects can be detected and measured.
2. The sensor is less affected by target materials and surfaces.
3. The sensor also not affected by colour.
4. It has solid state – virtually unlimited maintenance - free life.
5. Small objects can be detected over longer distances by this sensor.
6. It has resistance to external disturbances such as vibration, infrared radiation, ambient noise, and EMI radiation.

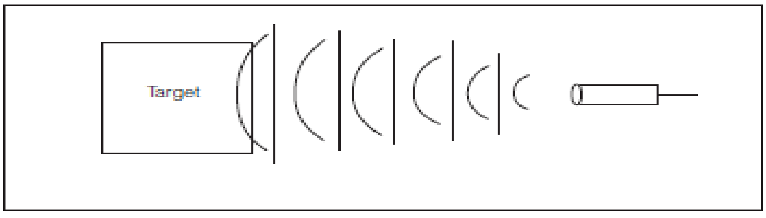

Figure 7: The ultrasonic sensor can detect target over long distance.

4.2 Sensor Circuit

For this ultrasonic sensor, it requires its own circuit to integrate with the main circuit for the project. For designing the sensor circuit, the need of choosing the suitable components is very important in order for the sensor to work accordingly to the desired result. Figure 8 is the circuit diagram for the sensor.

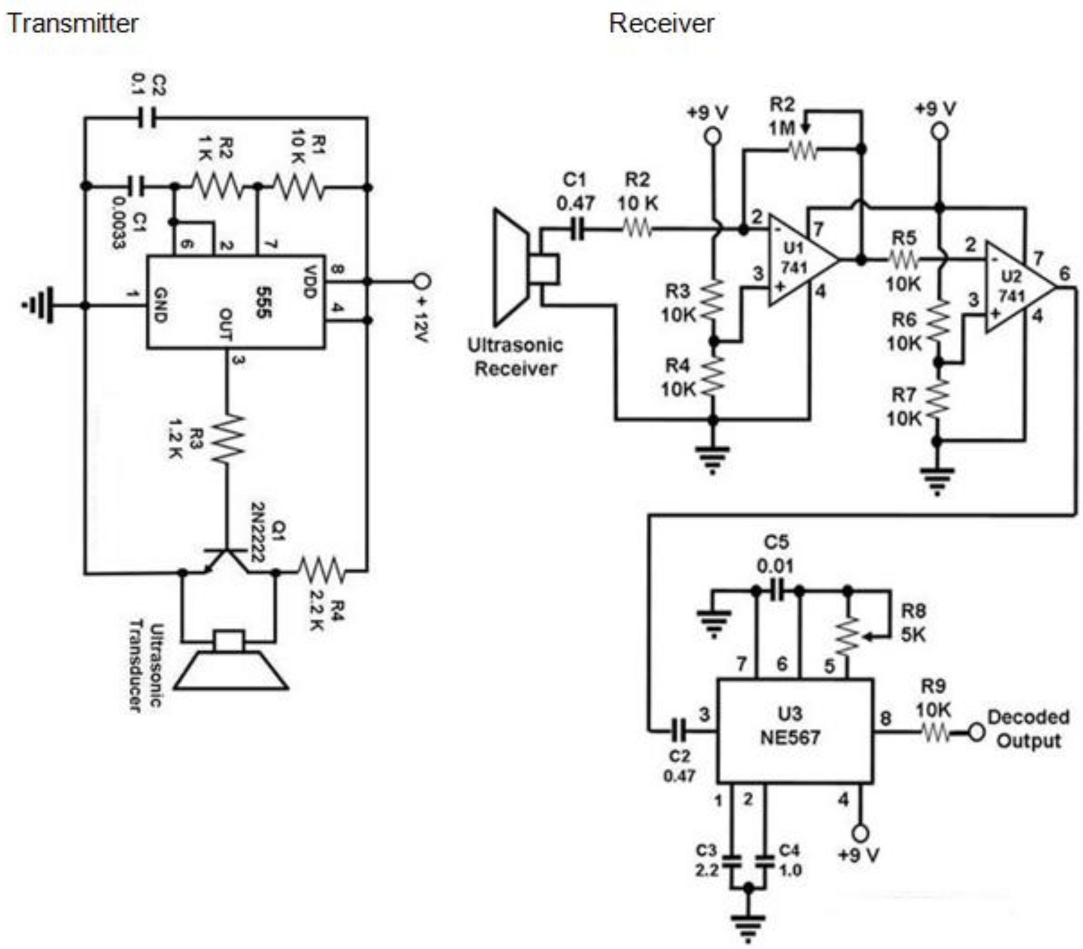

Figure 8: Ultrasonic Sensor Circuit

4.3 Testing of Ultrasonic Sensor

The environment models which are created from laser range finder data now serve as a basis to derive a simulation model for the ultrasonic sensing system. First, the detection ranges for the direct and cross echoes are defined. Direct echoes are when the transmitting sensor also receives the signal beside the receiver sensors, and cross echoes is when one of the sensors receives it. An environment model from real ultrasonic sensor data is created by detecting straight line elements as follows. First all circular and elliptic echo arcs are represented within the attainable distance detection range by a predefined number of points on the arc. Then, it assumes that an echo could originate from the surface of an object located at each discrete point on the arc and having a perpendicular reflection line to the sensor. The potential reflecting surfaces has to be vertical and is represented by horizontal lines on the level of the sensor, thus implying horizontal echo paths between the sensors and the objects.

4.4 The Circuit Design

In this process, the flow of the whole circuit design is being recorded. There are several circuit needed to complete this project. The first circuit is the sensor circuit that operates with the ultrasonic sensor and the second circuit is the LCD circuit where the available parking spaces are displayed. These two circuits are using two separate microcontrollers. Figure 9 shows the flow of the design.

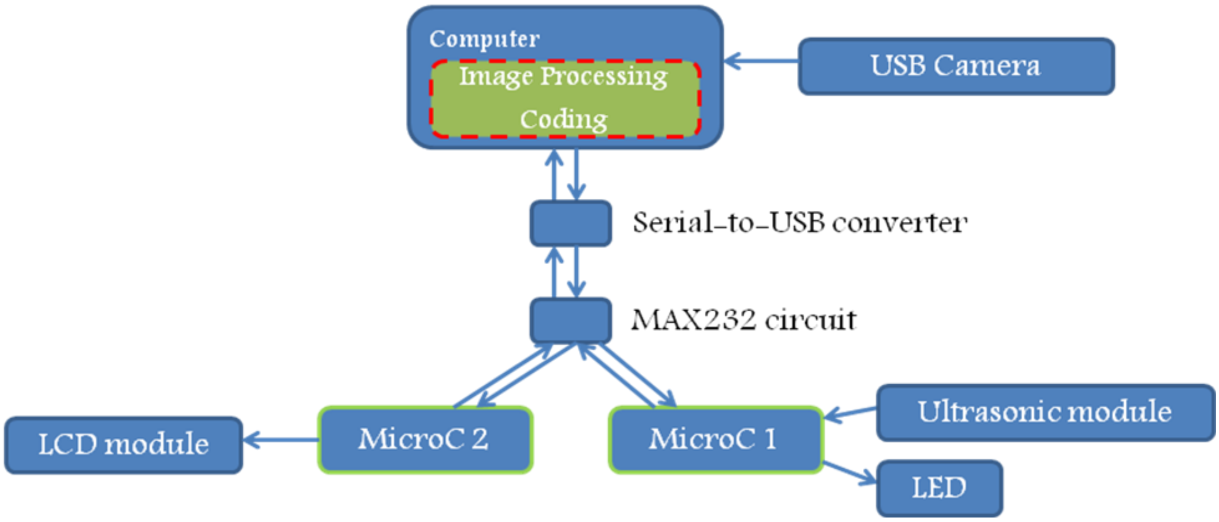

Figure 9: Whole Project Design

The USB camera will capture the number plate of the car entering the parking area. Then, it will be processed by the Matlab coding. At the same time, the information about the available parking spaces detected by the ultrasonic sensors is being sent to the computer. After that, the available parking spaces and the designated parking for the entering car will be display at the LCD.

4.5 Circuit Operation Process Flow

The circuit operation is divided into 2 main operations:

1. Microcontroller 1 and interface hardware.
2. Microcontroller 2 and interface hardware.
3. Communication between the computer (Visual Basic coding) with microcontroller 1 and microcontroller 2.

The reason for using 2 microcontrollers is to maintain a simple coding structure; microcontroller 1 is related to the interface between the ultrasonic range sensor, sensor LED status and serial communication. Microcontroller 2 interfaces between the LCD and serial communication.

4.5.1 Microcontroller 1 and Interface Hardware

Microcontroller 1 is interfaced with the following hardware:

1. 4 Ultrasonic range sensor
2. 8 status LED
3. Serial communication

The features of the ultrasonic range sensor is that it is provided with and interface module where the range is converted into analogue voltage values ranging from 0.07V until 2.2V where the sensitivity is 0.01V/inch and the datasheet states that the minimum detection range is at 7inches equivalent to 0.07V. To interface this analogue voltage value with the microcontroller, the Analogue-to-Digital Converter feature of the microcontroller is used where voltage values from 0-5V are converted to 10-bit representation, the equation is:

$$\text{Digital Value } (0-1023) = \frac{\text{Analogue Value } (0-5V)}{5V} \times 1023 \ldots\ldots\ldots(1)$$

As in an actual parking space, the range detected by the sensor will decrease when the presence of a vehicle is detected, therefore the microcontroller will need to indicate a parking space as occupied or vacant depending on the analogue values registered by the ultrasonic range sensor, to do this a threshold value is required and based on the experiments that have been done the digital value for this simulation is set to 16 which corresponds to the analogue voltage level of:

Rearrange equation (1)

$$\text{Analogue Value } (0-5V) = \frac{\text{Digital Value } (0-1023)}{1023} \times 5V$$

$$\text{Analogue Value } (0-5V) = \frac{16}{1023} \times 5V = 0.078V$$

$$\text{Range (inches)} = \frac{0.078V}{0.01} = 7.8\,\text{inches}$$

The status LED's are fixed pairs of Red and Green LED for each sensor and shall change status based on the threshold value assigned. The LED status is stored in a temporary memory location in the microcontroller which will be used during communication with the computer.

4.5.2 Microcontroller 2 and Interface Hardware

Microcontroller 2 is interfaced with the LCD and the computer via the serial communication port. The LCD module has 6 digital pins which are interfaced with the microcontroller where 4 pins are used to choose the character to be displayed, 1 pin to turn between read or write mode and the final pin is used to switch to the next character. The circuit function starts when the data for the LCD is received through the microcontroller serial port and is stored in a temporary memory in the microcontroller, another command is then received through the serial port and the microcontroller interprets the command as permission for the microcontroller to display the data in the temporary memory to the LCD.

4.5.2 Communication between the Computer (Visual Basic Coding) with Microcontroller 1 and Microcontroller 2

The computer which is the Visual Basic coding communicates with the microcontrollers via the serial port, since the communication port is a common line between the microcontrollers therefore the command characters must be distinct. The main task for the Visual Basic coding in interfacing with the circuit is gathering data from the ultrasonic range sensors through microcontroller 1 and characters from the vehicles license plate. Then this data is arranged accordingly to be sent to microcontroller 2 so that the data can be displayed at the LCD. The program consists of two buttons that can be chosen which is the “Display LCD” button and the “Clear LCD” button. Upon starting the program, the user will need to setup the serial communication link with the microcontroller which is to identify the COM port assigned and set the bit rate to 9600kps.

The next step is to click the “Display LCD” button, doing this will prompt the program to load the notepad file containing the vehicle registration number, since the notepad also contains other words the VB program will identify the start of the registration number by reading the final line in the notepad file, the final line is read because it is the most updated data from the MATLAB program. The VB program then transmits the registration numbers one character at a time in a sequence then sends the character signal to instruct the microcontroller to display the vehicle registration number and also the vacant and assigned parking lot.

After that, the user can either press the “Clear LCD” button to clear the LCD screen or press the “Display LCD” to turn on the LCD screen once again. To redisplay the previous vehicle registration number, ensure that there is no new vehicle registration number being saved to the notepad. Figure 10 shows the development of whole circuit design on a printed circuit board.

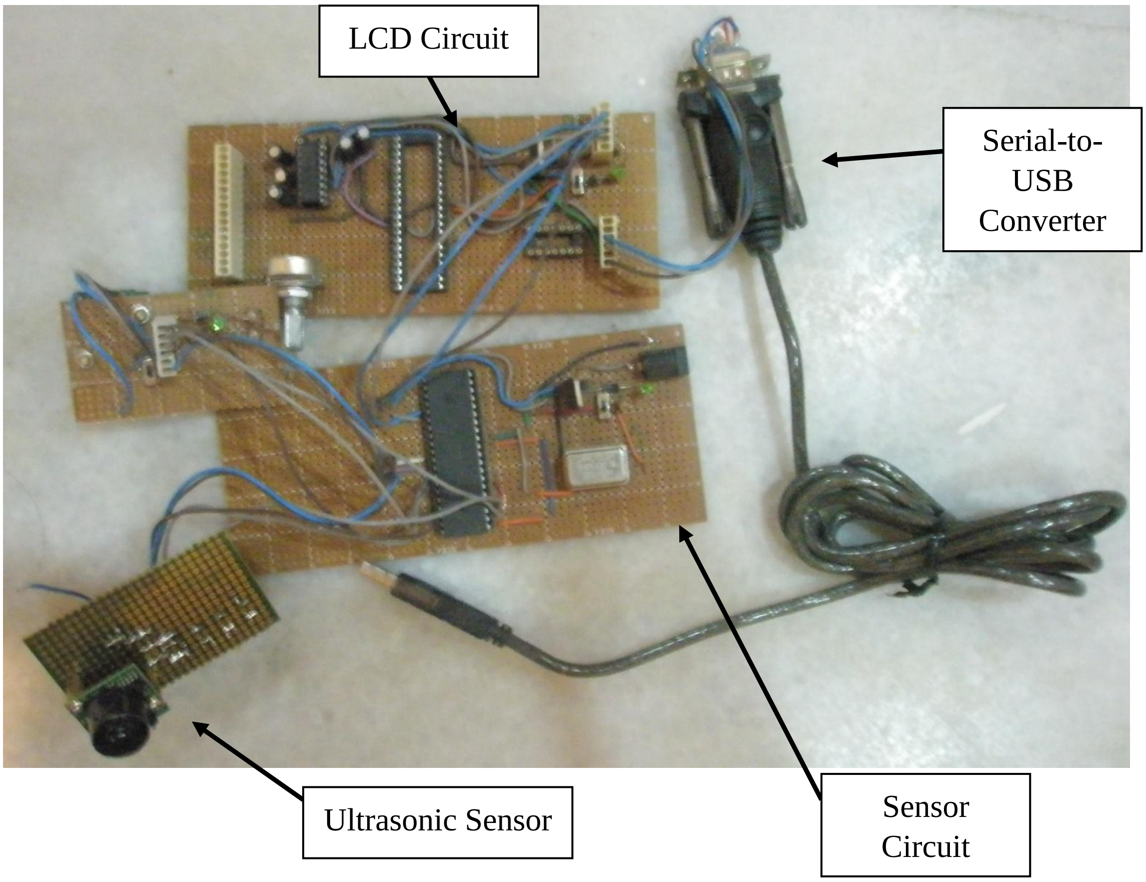

Figure 10: Circuit on Printed Circuit Board

4.6 Image Processing Flow

The image processing operation is consisting of several parts which are:

1. Input image from webcam.
2. Convert image into binary.
3. Detect number plate area.
4. Segmentation.
5. Number identification.
6. Save to file in given format.

The flows of image processing which is the car number plate recognition system are as follow:

1) Input Image from file.

1. Capture image from webcam.
2. Store the captured image into an image file for further processing.

2) Convert image into binary.

1. Identify the intensity of the image.

   If image intensity = high

   Reduce intensity

   Else if intensity = low

   Increase intensity

   Else

   No change.

2. Convert image into grayscale.
3. Calculate appropriate threshold value for the image.
4. Convert the image into binary image using the calculated threshold.

3) Detecting number plate area.

1. Determine width and height of the image.
2. Scan each pixel of line counting number of black pixels in the following system,

   If number of 'black' pixels < x; pixels become 'white'

   Else; no change

   If number of 'black' pixels > y; pixels become 'white'

   Else; no change

   The value of x and y may be changed according the image intensity and plate area.

3. Use the step no. 3 for both horizontal and vertical direction.

4. Check number of possible areas.

   If number of areas > 1

   Select suitable area

6. Logically AND with binary image obtained at “Convert image into binary” algorithm.
7. Crop the required area.

4) Segmentation

1. Filter the noise level present in the image.
2. Clip the plate area in such a way that only numbers of plate area extracted.
3. Separate each character from the plate.

5)Number identification

1. Create the template file from the stored template images.
2. Resize image obtained from segmentation to the size of template.
3. Compare each character with the templates.
4. Store the best matched character.

CHAPTER 5

CONCLUSION AND FUTURE WORK

5.1 Conclusion

In conclusion, the Intelligent Parking System is a system designed to prevent problems usually associated with car parks. It employs advanced technologies to permit efficient use of parking lots. Intelligent Parking System ranges from simple systems that show the number of available parking spaces to complex ones that can guide customers to an available parking space. In addition, it also detects car registration number of the vehicle entering the parking area and assigns them to available parking spaces. The main process in developing this project has been divided into 2 step processes that are research element and prototype development.

The coding for the image processing and the design of the integration with circuit has been done. The circuit for LCD display and the ultrasonic sensor also has been done. From the result obtained on the circuit testing, detected object by the sensor is shown by the red and green LED. When there is object detect by sensor, the LED will turn red and when the sensor is not detecting any object, the LED remain green. This process is important in determining the availability of the parking spaces. In the LCD display, it shows the registration number that has been captured, the assigned parking space for that particular car and the number of available parking spaces in the parking area.

5.2 Future Work

In future, this Intelligent Parking System can add some new features in its design. Security feature is one of the possible add-on. With this security feature, the car that parks at the parking space will be secure by a system that will be monitoring the car using sensor device. The parking space will be monitor by magnetic sensors and the security systems is applied when the user enter the password or take the ticket from the entrance. So, the user must have a password to go out from parking area. This could prevent the car from being stolen or brought outside the parking area by stranger.

Besides that, this system also can add the auto billing feature. This system will detect the period of the car parked in the parking area using sensor and it will directly charge the payment amount in the costumer account. The account is created when the customer entering the parking area based on the captured number plate. This could save the time for the customer as the customer do not need to queue up to make payment for the parking.

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APPENDICES

APPENDIX A

GANTT CHART AND MILESTONE

APPENDIX B

IMAGE PROCESSING SOURCE CODE

APPENDIX C

VISUAL BASIC SOURCE CODE

APPENDIX D

PROTOTYPE MODEL

APPENDIX E

MICROCONTROLLER CIRCUIT DIAGRAM

APPENDIX F

FLOWCHART OF WHOLE SYSTEM

APPENDIX G

DATASHEETS