UPGRADING PERFORMANCE OF WIRELESS WIND SENSOR

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This report is submitted in partial fulfilment of the requirements for the award of Bachelor of Electronic Engineering (Computer Engineering) with Honours

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Dedicated, in thankful appreciation for support, encouragement and understandings to my
beloved mother, father, brothers and sisters.

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ABSTRACT

Wind sensors are widely used to measure wind speed and direction for such as weather forecasting or for other purposes including measuring wind flow in space. Due to its wide applications, many wind sensors are commercially available off the shelf. This study concerns wind sensors that able to transmit data globally using GSM modem and it is self powered by solar system. Therefore, it is highly demanded to have a wind sensor that has higher transmission range, more efficiency and less power consumption. In this report, from the design of the wind sensor down to the post- processing of the sensor reading data are presented. The results shows that the wind sensor performance is satisfactory and can be implemented as an independence sensor node with low maintenance needed in operation.

Keyword: Wind Sensor, GSM Modem, Solar System, Less Power Consumption, High Transmission Range, Independent Sensor Node, Low Maintenance.

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CHAPTER I

INTRODUCTION

In this chapter, discusses regarding the introduction of wireless wind sensor and describing the technique used to upgrade it using several additional devices. The block diagram gave the general ideas on this project. In addition, objectives, problem statement of the project and the intended audience is included as well.

1.1 Introduction To Wireless Wind Sensor

Nowadays, there has been a growing demand for deployment of autonomous sensors in various applications areas like weather sensor, wireless wind sensor and remote area sensing. Mostly, in these applications, there is a need to deploy multiple sensors during a single deployment. Considering the case when many sensors are placed far apart from the digital reader or even control center, therefore self powered and low power consumption sensors is needed. Moreover, the frequently maintenance for the sensor is quite troublesome and costly and hence the sensors that designed must be able to operate independently and capable to self power. By doing so, the sensor node would then be truly autonomous and can operate for an extended period of time.

The data transmission of the sensor node is frequently citied as the primary limiting factor in the performance of the autonomous sensor network. For this reason, wireless device is added to replace the traditional wiring sensor. In wireless sensor

network, several wireless devices can be found in market such as radio frequency transmitter, Zigbee transmitter and global system for mobile communication (GSM). Among this device, radio frequency transmission is the most frequently used devices because it is cheaper compare to other devices. But the major problem of this device is it has limitation in transmitting range and transmission is up to 100 meter but below 200 meter. Apart from that, a lot of distortion noise is found in the signal that might effect the accuracy of data occurred.

The focus of this study is on upgrading the performance of the sensor by improving it transmission range through changing its wireless device. Sufficient research works has been done in order to find a suitable wireless device that able to transmit the data globally and data is more accuracy. Global system for communication mobile is choosing cause of its characteristic that able to transmit data globally and less noise.

Another research study is also done to design a sensor with less power consumption. The sensors might place in the area that is hard to reach by human being. For this reason, self powered techniques have become an important area of research to meet the power needs of the wireless sensor networks (WSNs). In WSN, there are many independent sensor nodes and each of these sensor nodes requires independent energy source. In order to power a sensor node to function properly, there are various ways of harnessing energy from the environment depending on the ambient operating condition where sensor has to be deployed, for wind sensor are designed for outdoor operation. Solar energy and wind energy sources will be the main choice in this report.

Wireless wind sensor that using solar powered technique in order to transmit data globally has been proposed in this paper. There are three main steps in operation of wireless wind sensor using solar panel: (a) covert the mechanical energy generated by the sensor to an electrical signal, (b) processing and storage of the electrical energy through solar system and (c) transmitting the signal data globally.

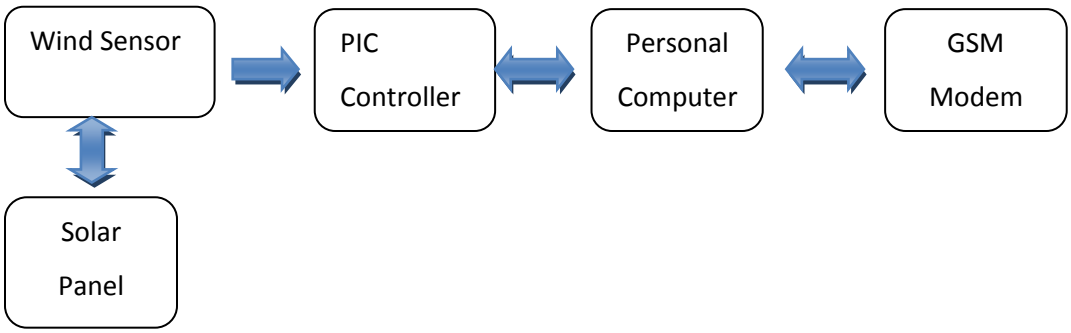

Figure 1: Block Diagram

1.2 Project Objectives

The objectives of this project are:

i. To develop a wind sensor that is high accuracy in data collected.
ii. To create a wind sensor that able to transmit data globally using cell phones.
iii. To analysis the data that collected with personal computer.
iv. To design a solar self powered wind sensor that is eco- friendly and save budget in operation.
v. To enable the data collected by the sensor saved automatically.

1.3 Problem Statement

Wireless wind sensor has been used in industrial area, station meteorological and even in airport. However, the adoption of wireless wind sensor has encountered several obstacles. Below are some of the obstacles:

i. Most of the wireless wind sensor only has digital reader. So data will only show every second the data changing. User might not be able to track the history of data.

ii. For electricity supplied wireless wind sensor problem might occur when electricity breakdown. Data might be lost due to lost of power supply.

iii. Upgrading the product through low power consumption. So even the product just using the backup battery it still can operate continuously and stand for a long time.

iv. Lastly, the usually transmission range for the detector only up to 100 meter. Over that range the signal can't reach, data might not be occurs by user.

The problems above have limit the performance of the wind sensor and have to be resolved in order to allow more people or institutions to gain benefits of using it. In this project, we examine how to resolve or at least minimize the performance problems by using additional technology.

1.4 Scope Of Work

The scope of work in this project is started as given:

1. Familiarization on the wind sensor operation.
2. The PIC Programming Code is required to enable the analysis of data and transmission of data to personal computer or GSM modem.
3. GSM modem has been chosen to replace the Zigbee or common transmitter receiver device.
4. Apart from digital reader, Visual Basic 2005 is used to create software that displays data on pc.
5. Solar system is used as power source for wind sensor operation and circuit that built is low power consumption.

1.5 Report Structure

This thesis is a document report of the ideas generated, the theories and concepts applied, the activities performed and the final product of this project produced. The thesis consists of five chapters and each chapter is described as below:

Chapter 1, the introduction of wireless wind sensor and describing the technique used to upgrade it performance. The block diagram gave the general ideas on this project. In addition, objectives, problem statement of the project and the report structure is included as well.

Chapter 2, the background study of the project along with the literature review is performed and document about the theoretical concept applied in completing the project. Background studies on the PIC and operation method are stated throughout this project.

Chapter 3 is the introduction of the methodology for the project, design flow and construction of the project. Brief description is given about each procedure in the completion of the project.

Chapter 4 shows overall result and discussion of the result on current project. The developed of wireless wind sensor and the ordinary data collect form station meteorological is compared. The created electric diagram block diagrams about the project are shown in order to strengthen the result.

Chapter 5 is the final part of the thesis which concludes the Final Year Project. This chapter includes the application of the project and the recommendation that can be implemented for future references.

1.6 Intended Audience

The audience for this project is meteorological department. It is important for the workers to understand the operation of the sensor and how the sensor helps them in collecting the data. Through the high accuracy of data that collected, the problem or nature disaster can be estimated and announcement can be done to public immediately.

In the civil engineering field, the speed and the direction of the wind have a great influence on the development of the structures. It is necessary to know the pressure applied by the wind to the constructions and the atmospheric turbulences that it will generate.

However, this project is also suitable for anyone else who working environment is related with the wind flow.

1.7 Expected Output

At the end of this project, the product that produced will be able to compute with other product at the market. With the transmission range that up to 100 meter and low transmission distortion, the data that occurred will be more precise. To make sure that the product always in well function, a standard maintenance system is provided. The operation and preventive maintenance will be applied to the product and corrective maintenance will only apply when the product was breakdown. Apart from that, the lighting protection and tower grounding are additional protection for the product.

1.8 Summary

Wind sensors are used to detect the direction and the speed of the wind blow. It is a common instrument that used to detect the environment changes. This wind sensor mostly will work fine outdoor, it will used spinning cup style anemometers to sense the wind and convert the data from mechanical into electrical and the data can be read in

digital form. Data is transmitted using the wireless device. A receiver will be connected to the pc so the user can check the data using pc and when the wind speed in the dangerous level (wind blow too fast) the alarm buzz sound will buzzing to alert the user. Apart from that the direction of the wind also will shown on pc.

CHAPTER II

LITERATURE REVIEW

In this chapter, discusses regarding the background study of the project along with the literature review is performed and documented about the theoretical concept applied in completing the project. Physical structure of the wind sensor will be included in this chapter. Background studies on the PIC controller and GSM Modem operation method are stated throughout this project.

2.1 Introduction

Wind sensor is an instrument used to measure the wind speed and direction which contain both anemometer and wind vane. This chapter will discuss various types of wind sensor and the features in each type of sensor. A few existing sensor are reviewed and the features in those system are compared. Apart from that, the structures of wind sensor and its specifications and characteristic will also been discussed.

2.1.1 Operation of the Wind Sensor

In addition to measure air flow at speeds of 1 m/s and lower, the wind sensor design is also aimed to be high transmission range, low power consumption, low computational overhead, robust and low maintenance cost. It is intended that this sensor will be later implemented to meteorological department for wind data analyses and studies.

The design and photo of the proposed wind sensor is shown in Figure 1 below. The circular rod at the top of wind sensor is changeable. Material used in the current design is light weight foam. Larger rod length and cross section area will provide larger surface to maximize the drag that is directly corresponded to the wind flow. This is however limited by the size constraint of the sensor for practical usage. Symmetric shape makes sure the same drag will still be there when wind direction changes.

Figure2.1: Wireless wind sensor

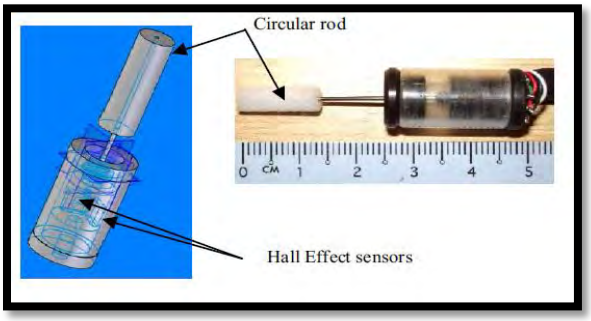

Figure 2.2: The isometric view and photo of the wind sensor design

For Wind direction measurement you will need a circle from some material (you might even use CD disc.) Then stick an arrow on top. One end of arrow should have a fin. Other end of arrow should have piece of magnet. Then put eight magnetic sensors around the circle in the magnets way.

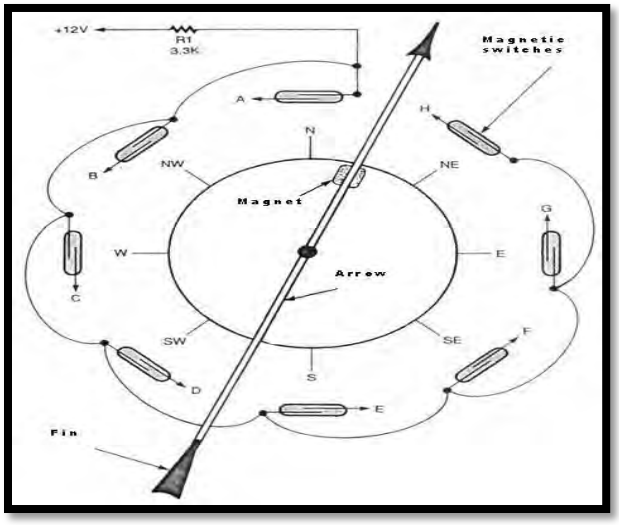

Figure 2.3: Wind sensor in determine the direction.

Turning Arrow depending on wind direction turns ON magnetic switches. Circuit has 8 outputs corresponding to wind direction. These outputs can be connected to simple indication circuit:

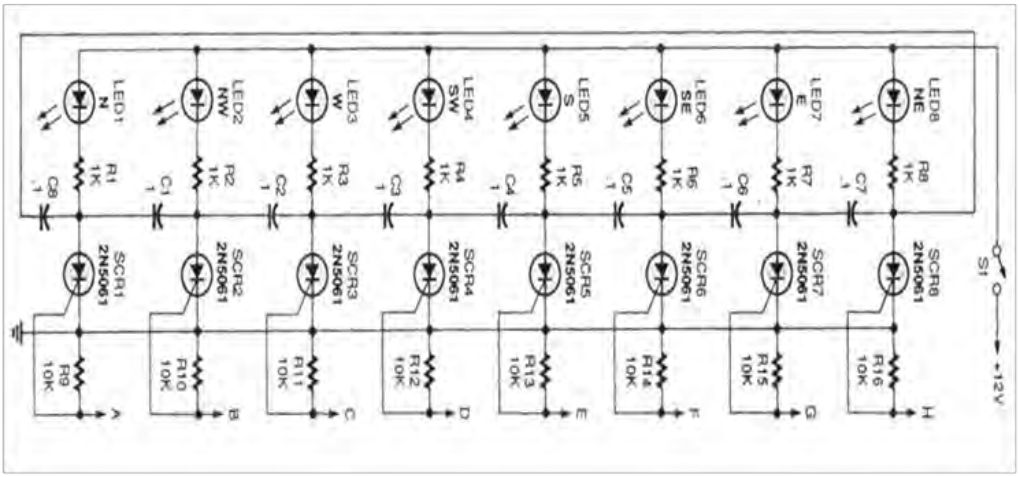

Figure 2.4: Indicator circuit

At the other end of the central bar, there is a small permanent magnet attached as illustrated in Figure 2.2.5. A pivot point is designed and its rough location is indicated in Figure 2.2.5. As a result, the magnet at the end of the bar will therefore swing in the opposite direction of the wind and therefore gets closer to or further away from the two Hall Effect sensors. This will vary the density of the magnetic flux exerted on Hall Effect sensors and therefore the output voltage from these two sensors will vary accordingly. This variation can then be used to potentially determine the wind velocity and direction. This design gives instantaneous response of sensor readings to wind direction and/or velocity changes. There is a transparent casing encloses the small magnet and Hall Effect sensors to prevent them from being directly effected by wind blow.

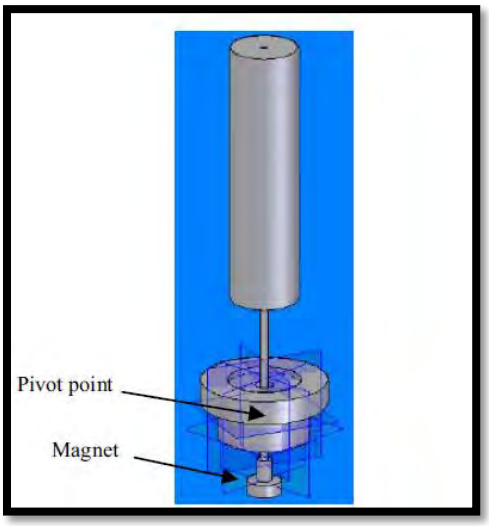

Figure 2.5: Moving part of the wind sensor

Each anemometer contains a small AC generator. The frequency of the AC generator is directly related to the rotational speed of the anemometer cups and likewise the speed of the wind being measured. The signal conditioning circuitry contains an even counter that totalizes the number of whole waveforms occurring in a fixed interval of time, approximately 1 second. Figure 2.2.6 is a block diagram of the generator, solar system and GSM transmitter.