WIRELESS OFFICE WEATHER STATION

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"I acknowledge that I have read this document, and in my thought it is appropriate in term of scope and the quality for the conferment of Bachelor of Electrical Engineering (Power Industry)"

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FOR MY FATHER AND MOTHER

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ABSTRAK

Dengan bertambahnya kepesatan pembangunan bangunan, yang akan mempengaruhi struktur binaannya yang mana ke arah rekabentuk yang lebih moden dan juga mempengaruhi elemen-elemen perkhidmatannya seperti penghawa dingin, alat pemanas dan system pengaliran udara. Kesan daripada struktur bangunan yang lebih kompleks ini turut menjejaskan pengawalan cuaca didalam pejabat. Sebagai penyelesaiannya suatu sistem pengumpulan cuaca yang lebih efisyen dan mampu memberikan informasi kpada jurutera atau juruteknik pendingin hawa dan seterusnya membolehkan mereka untuk membuat penyesuaian terhadap sistem pendingin hawa. Projek ini melibatkan pembinaan sistem pengawalan cuaca yang berasaskan mikroproseser yang mana mampu untuk mengukur dan mengumpul data seperti parameter-parameter cuaca seperti suhu dan kelembapan dalam persekitaran pejabat. Sistem pengawaln cuaca tanpa wayar ini menadaptsikan teknologi RF (Radio Frequency) yang mampu untuk berkomunikasi dengan komputer pusat, dimana pada komputer pusat terdapat aplikasi perisiaan untuk menganalisis pengukuran cuaca dan komponen kawalan untuk pengguna. Rekabentuk sistem ini merupakan asas kepada rekabentuk sebuah sistem kaji cuaca yang lebih efisyen serta jitu. Antara kelebihannya ialah rekabentuknya yang ringkas dan efektif yang mana mampu membantu para penggunanya untuk membuat analisa mengenai data cuaca dalam persekitaran pejabat

ABSTRACT

The increase in complexity of office building has meant that building services such as air condition, heating and ventilation system is also becoming more complex. As result of this increased complexity in air condition systems, monitoring the climate condition in offices is becoming more difficult. An efficient weather collection unit (office weather station) is, therefore, essential in providing information to the air conditioning engineer and allowing them to make adjustment on the air conditioning system. This project presents a microprocessor-based weather monitoring system designed to measure and collect the weather parameters such as temperature and humidity in the office environment. The wireless office weather station consists of RF technologies allowing multiple weather measuring units to communicate with a central PC. The central PC provides the software applications for weather measurement analysis and also hardware control for the user. The design of the wireless office weather station presented in this document provides the basis for construction of a more efficient and accurate office weather station. The features included in the design of the system would provide the user with a more convenient and effective way of analyzing climatic data in the office spaces

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CHAPTER 1

LITERATURE STUDY

In order to formulate a realistic set of specifications for the wireless office weather station, a research and analysis of current weather data-logger technology should be performed. This analysis should identify the systems currently available and their attributes that will aid in the development of the wireless office weather station. As there are a wide range of weather stations on the market today, it would be difficult to analysis all of them, instead several product that has similar features and application to the wireless office weather station will be analyzed in the following.

1.1 Introduction

With increasing emphasis being placed upon the cost-effective use of office space and the need to maintain office spaces within comfortable parameters, regulating and maintaining comfortable and efficient climatic conditions within the office space is becoming more important and more difficult. As a result this has placed a heavy reliance upon the buildings air conditioning system. In most office buildings today, the level of comfort is often determined by how well the air conditioning system adapts to the micro climatic changes within the office spaces. Factors that influence the stresses placed upon the system include such things as any shading structures (ie. Louvers, air walls and heat sinks) or a particular design feature

of the building, which may contribute to the comfort level of the space. Therefore, monitoring and analysing the climatic changes within the office space is essential for a more efficient application of the air conditioning system. An efficient air conditioning system would provide several benefits. These benefits include a reduction in power consumption within the building and a more comprehensive and cost effective control of the office environment. In turn this will lead to increased worker comfort and stemming from this, increased worker productivity. The basis of the problem facing most high rise buildings is that most air conditioning systems are inefficient in their application and generally have little reserve capacity in times of need. This system seeks to remove any subjective analysis of the internal climate by using sensors to monitor temperature and humidity to more efficiently regulate the internal space. A further problem associated with setting the internal environment within a space is the subjective input of the occupants. What this system can provide is a more scientific approach in assessing temperature and humidity changes uninfluenced by the subjective views of the occupants. The data collected from the sensors will allow the air conditioning engineers to make adjustments based on sensor measurements and not highly subjective reports by staff working in each zone.

This report consists of eight chapters. This introductory chapter outlines the problem and requirement for the wireless office weather station. Chapters 2 overviews current weather Data-loggers and provide an analysis of their associated advantages. Chapter 3 Outlines problem associated with design the wireless office weather station and discusses factors concerning the design of the system. Chapter 4 combines the knowledge base developed in Chapter 2 and Chapter 3 to develop a comprehensive set of specifications for the wireless office weather station. Chapters 5 and 6 describe the implementation both on the hardware and software of the system. Chapter 7 evaluates the performance of the wireless office weather station implementation. Finally, Chapter 8 discusses the future directions of the wireless office weather stations and summarises this document.

1.2 Commercial Climate Data Loggers

The following section aims to introduce some of the weather data logger available today. A brief description of the product and its features and application will be discussed in the section 1.1.1.to 1.1.3 and 1.2 Comparison (Table 1) based on the specification and the features of the products will be review at the end of this section. Based on the common features of the following review product, a set of core feature can be identified and be used as minimal specification for the wireless office weather station.

1.2.1 MicroDAQ HT510 Climate Data Logger

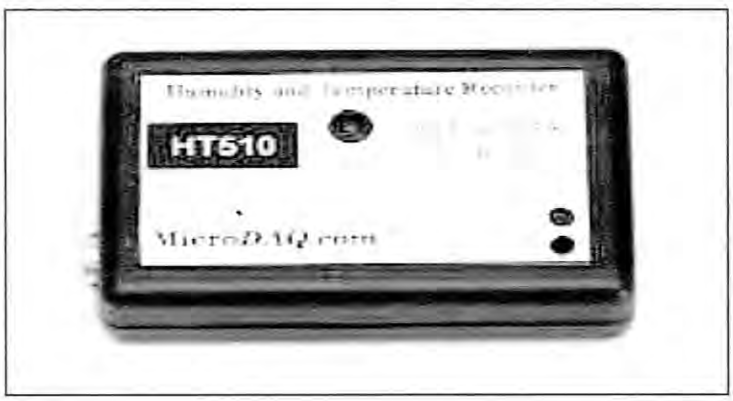

Figure 1: MicroDAQ

The HT510 is a miniature, battery powered, stand-alone, temperature and humidity recorder about the size of a 9-volt battery. The device is capable of recording 4,096 humidity and 4,096 temperature measurements simultaneously. The typical application of the MicroDaq system is primarily focused on providing real time weather information for a more efficient analysis of the office environment. Its integrated real time clock enables all data to be time and date stamped. Additional features of the device include programmable starts time, programmable calibration, alarming and real time monitoring. This system provides some very attractive features, which could aid the development of the wireless office weather station. Features such as non-volatile memory would provide data protection against power failure and real clock allowing data to be time stamped.

1.2.2 MonoLog MLH Data Logger

Application:

1. Monitoring environment in laboratories.
2. Heating and ventilati monitoring.

Feature:

1 accurate temperature and humidity logger
2 Windows software download and analysis
3 5 year battery life
4 Large memory over 16000 readings - up to one year of data

Figure 2: MLH Monolog Data Logger

The Monolog MLH is a compact temperature and humidity data logger designed for unattended operation over long periods of time. The device self-contained with battery life spans up to 5 years. The built in memory of the MLH can hold up to 8184 data point pairs which at the longest logging interval would represent almost one year of data. The communication interface is a standard RS232 COM port. Additional feature of the device includes a software based sensor calibration. The device can also be programmed to check for the calibration itself on a regular basis.

1.2.3 VeriTeq Spectrum 2000

Application:

1. Process Verification
2. Critical product shipping and storage
3. RH/Temperature Mapping

Feature:

1. Self-contained memory and 10 year battery
2. Adjustable logging intervals with multi-year data capacity
3. Wireless communication interface

Figure 3: Spectrum 200 Data logger

operated data-logger with internal sensors and memory. This device is primary design for high precision temperature and humidity monitoring. Each unit features a real time clock operating within two second per day accuracy and wireless RF technologies allowing for data retrieval from a central PC, without the need for cables or wiring networks. Data can also be downloaded to a PC via a RS232 Com port on the device. Each unit has an embedded digital serial number to provide unique identification for traceability in quality and regulatory records.

1.2.4 The Ezlogger from Pinnaclet technology

Application:

1. Ideal for monitoring living space
2. RH/Temperature Mapping

Features:

1. Measure Temperature and Relative Humidity
2. Ethernet Interface
3. Non-Volatile Memory Storage

Figure 4: Ezlogger Data Logger

The TRH-100 is designed to monitor, record, store and transmit via the Internet the ambient temperature and relative humidity of interior living, working and storage spaces. Its main feature includes, Ethernet Interface allowing the data to be transmitted and displayed on the Internet. Ethernet Interface also provides the user to access the data virtually anywhere, as long as there is an Internet connection. This device also features an E-mail alarm function where the device will sent out notification e-mail to the user when event of an out-of-tolerance temperature or relative humidity reading occurs.

1.3 Product Comparison

Data loggers	**MicroDAQ HT-510**	**VERITEQ Spectrum 2000**	**Pinnaclet TRH-100**	**TOPAC MLH**
Sensor Accuracy °C, %RH	TEMP.: ± 0.5 Humidity: ± 3	TEMP.: ± 0.15 Humidity: ± 2	TEMP.: ± 1 Humidity: ± 2	TEMP.: ± 0.3 Humidity: ± 2
Sensor Range °C, %RH	TEMP.:-40 - +80 Humidity: 5 - 95	TEMP.:-40 - 85 Humidity: 0 – 95	TEMP.:0 – 85 Humidity: 0 – 98	TEMP.:-25 – 50 Humidity: 0 – 95
Sensor Resolution °C, %RH	TEMP: 0.5 Humidity: 0.5	TEMP: <0.1 Humidity: 0.05	TEMP: <0.1 Humidity: 0.5	TEMP: 0.1 Humidity: 0.1
Sensor Calibration	D	M	D	D
Memory Size	4,096 reading max	32k x 8	15,000+ reading	16k
External Interface	RS232	RF RS232	10Base T RS232	RS232
Battery Life	1 Year	10 years	N/A	5 years
Dimension mm	55x35x15	71x53x18	130x139x41	97x50x16
Price(US)	$199	$430	$625	$499

Table 1 .1: Product Comparison Table

D – Digital calibration available through software

M- Manual Calibration

* All the device above has a real time clock built in

From the product comparison table above, several common features can be found including:

1. RS232 External Interface
2. Minimum of one year battery life
3. Non-Volatile data storage memory

The RS232 external interface is not particularly useful for the wireless office weather station, as it would require cabling and hubs for inter-connecting multiple weather station units. However, the RS232 interface could be used as an alternative for data download. The external interface incorporated in the Spectrum 200 and TRH-1090 provides an ideal solution to the wireless office weather station. The use of RF, as in the Spectrum 200, would allow the user to access the office weather station from remote location. Furthermore, the RF would also enable multiple weather station units to be placed in different areas of the office building. The use of Ethernet interface as in the TRH-1090 would further enhance accessibility of the weather station via the Internet. Battery and memory are important features for a portable system like the wireless office weather station. A system that has long battery life will be more appealing to the market as it minimizes the need of replacing batteries frequently. The non-volatile memory would provide protection to the data when battery becomes discharged. Sensors are the most important features of an office weather station. The accuracy of the sensors required will depend on the environment under investigation. From the product review, it is clear to see that depending on the application of the system, the accuracy and the range of the sensors needed will be different.

CHAPTER 2

DESIGN ISSUE

The Wireless Weather Station is composed of a remote station and base station. The remote station wakes up once per minute to collect and transfer data. The base station receives and buffers the incoming data and then transfers it via an RS-232 connection to a PC for processing. Within each of the stations is a dedicated circuit card as well as a separate RF circuit card.

2.1 Problem Analysis

The main objective in designing the wireless office weather station is to provide a tool for monitoring office climatic conditions. In order to achieve these objective several important factors need to be considered, within the design process. One of the most important factors is the consideration of the user's need. The design process, allows design decisions to be made on different aspects, such as the type of interface, sensor accuracy and battery life. Generally, there would be two main users of this product, the professional air conditioning engineer and the office occupant. Whereas the air conditioning engineers are more concerned with the technical aspects of the system, the office occupants are more concerned with their working environment rather than the technical aspect of the system. Since the needs of these two types of users are different, they will be considered separately (Fig. 5).

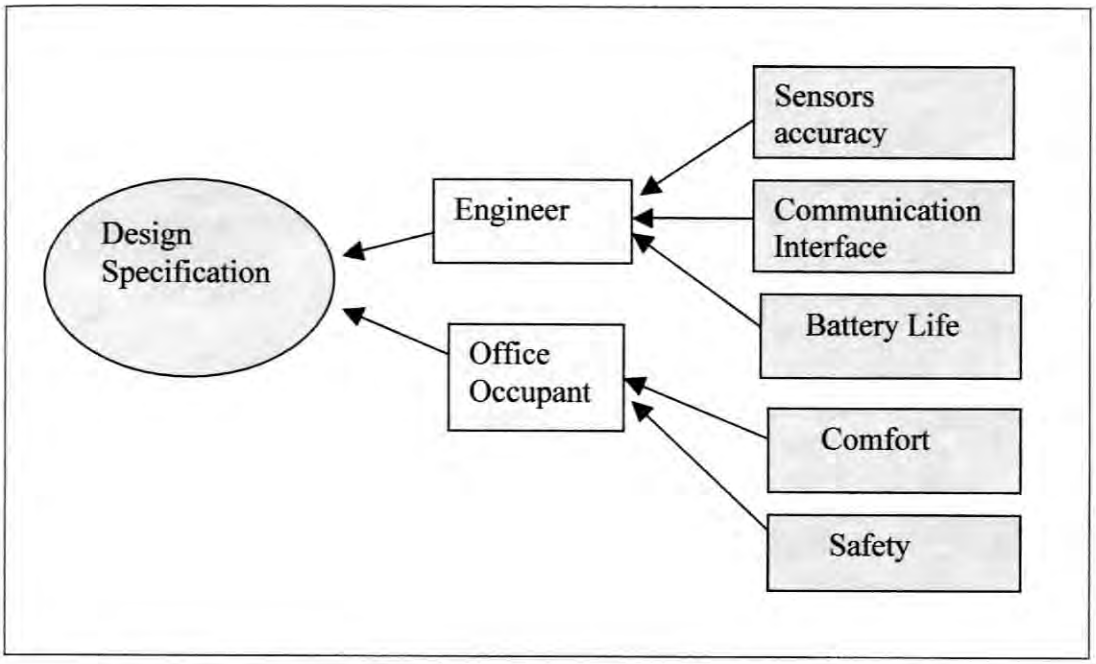

Figure 5: Showing the process of design with the need of the users in mind.

2.1.1 Air Conditioning Engineers

Air conditioning engineers maintain and service the air condition system as well as regulate the environment of the building. In order for the engineers to regulate the internal environment of the building, they require information about the internal temperature and humidity. The wireless office weather station is designed to not only provide meaningful data to the engineer but also integrated features allowing for easy control of the device. The following specifications cover several technical aspects of the device, which from engineer's point of view are essential features

- Performance
- Portability
- Sensor resolution and accuracy
- Battery life