CONTINUOUS BATTERY MONITORING (CBM) SYSTEM FOR EARLY BATTERY FAILURE DETECTION

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Tajuk Projek : Continuous Battery Monitoring (CBM) System for Early Battery Failure Detection

Sesi Pengajian :

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ABSTRACT

This project is a new project to identify condition of battery in order to detect early battery failure detection. A concept of an efficient continuous battery monitoring system for early battery failure detection is proposed in this project. In this era, battery become the main power to supply system using in our daily life. So, it is important to make sure that the battery can function at any time when needed. The concept of the continuous battery monitoring system is to monitor the voltage and capacity of the battery. Continuous battery monitoring system is integrated with the real time clock function to allow the system to operate at real time basis, as well as monitor the battery status continuously. Operational of the system will detect the connected battery's parameter, if the system detects the battery have any bad defect then the system will update the user about the battery's condition. Measuring the voltage and current capacity of the battery is one of the system's special functionality for early battery failure detection. Measuring the capacity of the battery can tell us how much capacity left in the battery.

ABSTRAK

Projek ini merupakan projek baharu bagi mengenal pasti keadaan semasa bateri untuk mengesan awal kerosakan bateri. Konsep memerhati bateri secara berterusan adalah teknik yang diaplikasikan di dalam projek ini. Di zaman era ini, bateri menjadi sumber kuasa untuk menjana kuasa aplikasi yang digunakan dalam kehidupan seharian. Oleh itu, menjadi kepentingan kepada kita untuk memastikan bateri boleh berfungsi pada setiap masa apabila diperlukan. Konsep memerhati bateri secara berterusan adalah satu teknik untuk memerhati voltan dan kapasiti bateri. Sistem memerhati bateri secara berterusan ditingkatkan lagi dengan jam yang berfungsi untuk memastikan system ini dapat berfungsi pada masa setiap masa sepertimana memerhati voltan bateri secara berterusan. Sistem ini berfungsi untuk mengesan keadaan bateri yang dipasang pada system. Jika system ini mengesan bahawa bateri tersebut hampir rosak, system ini akan menyalurkan informasi tersebut denagn segera kepada pengguna. Mengukur voltan dan kapasiti semasa bateri adalah keistimewaan dalam system ini. Melalui mengukur kapasiti bateri, ianya dapat memberi tahu kepada kita tentang baki kapasiti bateri tersebut.

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INTRODUCTION

1.1 Introduction

In the industry application, battery always used as power backup for certain application. Battery failure is the biggest problem in the scope of industry or many application that using battery as backup power. When battery failure occur, it will cause a big problem to the system. Thus, it need maintenance that can ensure the battery can supply the power when needed. The most important elements of concern for battery maintenance are typically time requirements, man power and skill elements needed to enhance the battery maintenance. In this era, company field technicians do not have time testing batteries “for battery maintenance”, while in case of failures. They need training,

tooling, test equipment and work experience to become knowledge and effective in safe handling, operating and maintaining battery system. If the company cannot maintain the battery systems then one of the method is to oursource their battery maintenance to organizations that specialized, but by doing this method, it will involves high cost for maintenance. So,the company should specialized the maintenance battery system and then it will no need to for pay for another organizations that were specialized in battery maintenance system. But, some of these users believe that the investment into maintenance is worthless, since no matter how much labour is expended. This project aim to ensure that all application that using battery as their power to run smoothly at all the time, such as the elevator. The elevator using battery as it main backup power. During emergency or power loss, the power for elevator will switch to the batttery backup. If the backup battery is cannot operate or not sufficient to supply power for the elevator, it could be the big problem to the elevator system. This project will continously measuring the battery parameter to identify any factor that can cause battery failure. If the battery fail or damage or cannot peroform well, this device will inform to the user about the problem and the user need to replace the battery.

1.2 Objective

The goal of this project is to design and develop a Continous Battery Monitoring (CBM) System for battery application. This system is able to check the battery parameter every time and will confirm the condition of the battery. Two way communication should be integrated in the proposed system in order to inform the user about the current condition of the user.

1.3 Problem Statement

Batteries are being installed in increasing numbers by cable and communications companies around the globe as an insurance policy against the riskc associated with disruptions or temporary loss of the commercial power grid. Proper preventive maintenance and monitoring of batteries is essential to optimize the considerable investment and assure the highest level of network quality of service. The conventional system only implementing a battery monitoring and maintenance program based on performing open circuit voltage combined with a long duration load testing is the highest quality state of health measurement technique. By using this technique, the technician must physically disconnect the battery string from service. discharge the batteries at a fixed rate and measure the time to reach the end voltage to determine the available capacity. After the test, the battery string must be reconnected and recharged before it is available for service. As a consequence, many operators do not implement a battery monitoring and maintenance program.

The main issue that actually become the idea to create this project is the system that using backup's battery always fail because of battery failure. Other than that, battery need a manpower in order to ensure the performance of the battery by visit sites. In addition, it will consumes high cost to pay the service.

1.4 Scope of Work

This project involves developing a battery monitoring system that divided into software and hardware components. This project is divided into four components which

are Voltmeter, Capacity Tester, Real Time Clock and Global System for Mobile Communication (GSM). The software components consists of microcontroller software to become the heart of this project which will control all the hardwares and make this project more intelligent. The microcontroller will be programmed by using CCS compiler. This project will concentrate on how to detect the parameter of the battery and inform the user about the current condition of the battery.

CHAPTER 2

LITERATURE REVIEW

2.1 Battery

Batteries are the most common power source for basic handheld devices to large scale industrial applications. A battery can be defined as; it is a combination of one or more electrochemical cells that are capable of converting stored chemical energy into electrical energy.

2.1.1 Working of Battery

A battery is a device, which consists of a various voltaic cells. Each voltaic cell consists of two half cells connected in series by a conductive electrolyte holding anions and cat ions. One half-cell includes electrolyte and the electrode to which anions move, i.e. the anode or negative electrode; the other half-cell includes electrolyte and the electrode to which cat ions move, i.e. the cathode or positive electrode.

In the redox reaction that powers the battery, reduction occurs to cations at the cathode, while oxidation occurs to anions at the anode. The electrodes do not touch one another but are electrically connected by the electrolyte. Mostly the half cells have different electrolytes. All things considered every half-cell is enclosed in a container and a separator that is porous to ions but not the bulk of the electrolytes prevent mixing.

Each half cell has an electromotive force (Emf), determined by its capacity to drive electric current from the interior to the exterior of the cell. The net emf of the cell is the difference between the emf of its half-cells. In this way, if the electrodes have emf and in other words, the net emf is the difference between the reduction potentials of the half-reactions.

2.2 Battery Maintenance

To maintain the battery in good condition, battery equalization is necessary. Due to aging, all the cells do not charge similarly and some cells accept charge extremely fast while others charge gradually[1]. Equalization can be done by marginally over charging the battery to allow the weaker cells also to charge completely. The terminal voltage of a completely charged battery is12V, automobile battery shows 13.8V in its terminals while a 12 volt tubular battery will show 14.8V. Automobile battery should be firmly

fixed in the vehicle to avoid shake. Inverter battery should be placed on a wooden plank if possible.

2.3 Types of battery

Each battery have their own characteristic. Batteries were design to suite several application.

a) Primary Batteries

As the name indicates these batteries are meant for single usage. Once these batteries are used they cannot be recharged as the devices are not easily reversible and active materials may not return to their original forms. Battery manufacturers recommend against recharge of primary cells. Some of the examples for the disposable batteries are the normal AA, AAA batteries which we use in wall clocks, television remote etc. Other name for these batteries is disposable batteries. Figure 2.3.1 shows different types of Primary Batteries use around the world.

Figure 2.3.1 Types of Primary Batteries

b) Secondary Batteries

Secondary batteries are also called as rechargeable batteries. These batteries can be used and recharges simultaneously. They are usually assembled with active materials with active in the discharged state. Rechargeable batteries are recharged by applying electric current, which reverses the chemical reactions that occur during discharge. Chargers are devices which supply the required current.

Some examples for these rechargeable batteries are the batteries used in mobile phones, MP3 players etc. Devices such as hearing aids and wristwatches use miniature cells and in places such as telephone exchanges or computer data centre's, larger batteries are used. There are several types of secondary battery :

i. Sealed Maintenance Free (SMF)Battery

SMF is a sealed maintenance free battery, designed to offer reliable, consistent and low maintenance power for UPS applications. These batteries can be subject to deep cycle applications and minimum maintenance in rural and power deficit areas. These batteries are available from 12V.

In today's informative world, one can't overlook the requirement for battery systems are designed to recover crucial qualified data and information and run basic instrumentations for desired durations. Batteries are required to deliver instant power. Unreliable and inferior batteries can result in the loss of data and equipment shutdowns that can cost companies considerable financial losses. Subsequently, the Uninterruptible Power Source (UPS) segments calls for the utilization of a reliable and proven battery system.

Figure 2.3.2 Example of SMF Battery

ii. Lead Acid Battery

Lead Acid batteries are widely used in automobiles, inverters, backup power systems etc. Unlike tubular and maintenance free batteries, Lead Acid batteries require proper care and maintenance to prolong its life. The Lead Acid battery consists of a series of plates kept immersed in sulphuric acid solution. The plates have grids on which the active material is attached. The plates are divided into positive and negative plates. The positive plates hold pure lead as the active material while lead oxide is attached on the negative plates.

A completely charged battery can discharge its current when connected to a load[2]. During the process of discharge, the sulphuric acid combines with the active materials on the positive and negative plates resulting in the formation of Lead sulphate. Water is the single most important step in maintaining a Lead Acid battery. The frequency of water depends on usage, charge method and operating temperature. During process, the hydrogen atoms from the sulphuric acid react with oxygen to form water.

This results in the release of electrons from the positive plates which will be accepted by the negative plates. This leads to the formation of an electric potential across the battery. The electrolyte in the Lead Acid battery is a mixture of Sulphuric acid and water which has a specific gravity. Specific gravity is the weight of the acid-water mixture compared to equal volume of water. The specific gravity of pure ions free water is 1[3].

The lead-acid batteries provide the best value for power and energy per kilowatt-hour; have the longest life cycle and a large environmental advantage in that they are recycled at an extraordinarily high rate. No other chemistry can touch the infrastructure that exists for collecting, transporting and recycling lead-acid batteries.

iii. Lithium (Li) Battery

We all use it in portable devices such as cell phone, a laptop computer or a power tool. The lithium battery has been one of the greatest achievements in portable power in the last decade; with use of lithium batteries we have been able to shift from black and white mobile to color mobiles with additional features like GPS, email alerts etc. These are the high energy density potential devices for higher capacities. And relatively low self-discharge batteries. Also Special cells can provide very high current to applications such as power tools.

Figure 2.3.3 Example of Lithium Battery

iv. Nickel Cadmium (Nicd) Battery

The Nickel Cadmium batteries have the advantage of being recharged many times and possess a relatively constant potential during discharge and have more electrical and physical withstanding capacity. This battery uses nickel oxide for cathode, a cadmium compound for anode and potassium hydroxide solution as its electrolyte. When the battery is charged, the chemical composition of the cathode is transformed and the nickel hydroxide changes to NIOOH. In the anode, formation of Cadmium ions take place from Cadmium Hydroxide. When battery is discharged, the cadmium reacts with NiOOH to form back nickel hydroxide and Cadmium Hydroxide.

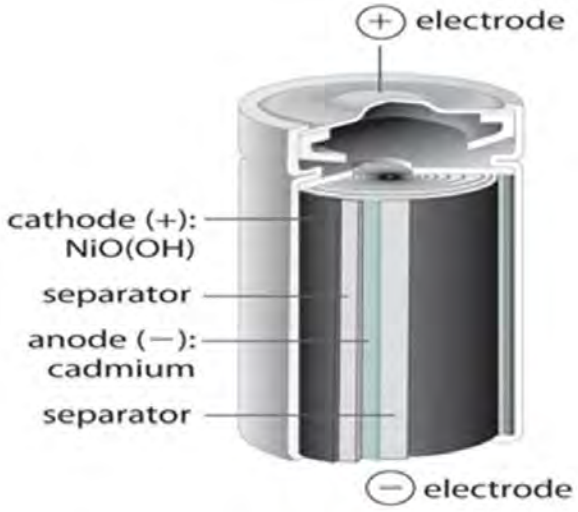

Figure 2.3.4 Nickel Cadmium (Nicd) Battery

2.4 Backup battery

Backup power can also be called as stationary battery. It is the single most reliable power supply at a power generating station. It remains on float charge, waiting until it is called upon to serve in emergency capacity for which it was designed. In order to meet this requirement, proper care is essential. Start from the installation and continuing throughout its life.[4]

2.4.1 Selection Criteria

When selecting a battery for an application, many users concentrate on issues that are readily apparent from manufacturers' literature or quotations. Such subjects are listed here as specification criteria, since they are essential in defining the basic requirements for a battery, such as initial cost, operating life, physical size and whether or not the battery should require water additions. Going beyond these basic needs,the