IoT Based Fullscale Battery Monitoring System

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Abstract— The Battery management System (BMS) refers to the process of maintaining the battery and its temperature conditions optimum for maximum performance of them. BMS system for huge industries has been managed to give backup supply the critical loads and to save Diesel Generator running time and cost. The main components which are to be taken care are charging current, discharging current, weight, temperature with respect to time. Implementation of fullScale measurement, calculation, prediction and representation with easy perspective User interface and also reducing the usage of Diesel Generator by making the battery system available always to supply back up power. Furthermore, stimulating an alarm responding to the battery leakage and reducing the risk of accumulation of hazardous and inflammable H2 gas. Finally, the product includes remote calculation and display, in a pictograph on an Android Application.

Keywords: BMS, IoT, DCS System

I. Introduction

A battery is device in which electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of battery whereas the conversion of chemical energy into electrical energy for supplying the external load is known as discharging of the battery. During charging of battery, current is passed through the battery which causes some chemical changes inside the battery. This chemical change absorbs the energy during their formation. When the battery is connected to the external load, the chemical changes happen in reverse direction, throughout that the absorbed energy is discharged as current and equipped to the load.

In Certain huge industries the DC source is fed to some critical loads which should not be shut down. In such cases they suggest the usage of battery or diesel generators. In the case of diesel generator the efficiency will be less as compared to renewable energy source which produce DC source. Diesel generator also has a major disadvantage of producing pollution on its combustion. To overcome these drawbacks they used battery to feed the critical loads. As battery is feeding Critical loads which has not to be shut down. One has to keep on monitor the battery performance. Monitoring the battery parameters like SOC, DOD, temperature, charging current, discharging current, terminal voltage, open circuit voltage, short circuit current, individual cell voltage, weight of battery and so on is a tedious process. In existing method these parameters are monitored by DCS Systems. But we could not monitor all the parameters and also we cannot analyse and transmit the data.

In our Battery observation system ensures the optimum usage of energy within the battery powering the merchandise. It well operates by preventing expensive time period because of surprising battery failures. Traditional estimates, with correct management system will create battery life reach the extent of style expectations.

One can effectively avoid the over-charging or under-charging of batteries to maintain uniformity among batteries to increase its shelf life. Analysis of knowledge permits remedial action for individual cells to increase their life. Enables procurement of batteries though planned schedules, not emergency replacement. It can be left unattended at sites for data collections, or, by its integrated alarm features that assists the user to initiate the charge/discharge cycles. Monitors functions that involve the mensuration of battery voltage, charge status or load activity. Control functions act on the charging and discharging processes of the battery supported these measured parameters. We can monitor the battery from remote location using IOT

II. Existing System

Industrial type Lead Acid batteries like Plante are managed by DCS systems which measures only the terminal voltage and load current at present as a part of Industry 3.0. More the usage of Diesel Generators as other systems lack Real time monitoring of Charging current, Discharging current, SOC, SOH, working life, weight of the battery are not measured and displayed remotely. Each reading must be taken by the personal locally. This is not the way to handle the backup systems which handles more the ultimate loads like DC Seal oil pumps, DC lube oil pumps, Communication systems, etc. in critical situations. Consumption of Diesel (For example: 100 kVA DG will consume 7.3 Gallons/ Hour of the Diesel) and other hydrocarbon fuels are large in the alternatives of Battery power. Thus to reduce this consumption and also to reduce the pollution caused by their exhaust, our product helps in giving maximum possible care on batteries. The process of the batteries in real time with SOC, Cycle life, identify faulty battery in pack are usually considered to be the tedious processes because of improper approaches and also it should involve human work which is the disadvantage and this project idea is to overcome this problem

III. IoT Based Fullscale Battery Monitoring System

The proposed idea is to replace to replace the usage of diesel generator in huge industries feeding supply to certain critical loads which should be turned on always. Since diesel generator has less efficiency, Causes pollution. Battery system replaces the diesel generator in wide range. As battery is replacing the diesel generator, which supplies the critical loads it has to be kept in 100% working efficiency. So, one has to monitor the battery parameters routinely and act on it. In Industry 3.0 the battery is monitored using DCS system. In that system we can only monitor the terminal voltage and charging current. So, we move on to IOT based monitoring system.

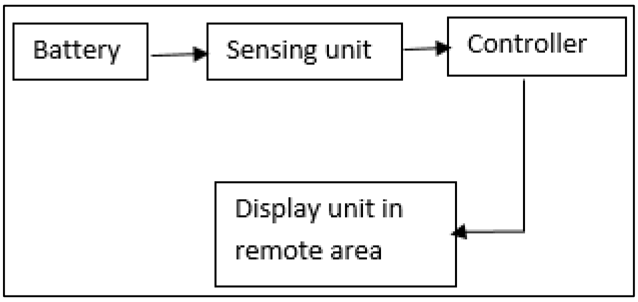

Fig. 1: Block diagram of IOT Based Fullscale Battery Monitoring System

The first step is to monitor the essential and conventional parameters of the Lead acid battery. Then the state of charge, cycle life are calculated and predicted consecutively in DSP processor with the parameters being sensed continuously. The calculated and predicted data is transmitted through ESP module to the remote area. LABVIEW will process the calculated and predicted information from the Local ESP module and present the results in a pictorial representation either in graph or pie chart to the end user. For the specified charging current and discharging current, the system notifies that the batteries are fully charged when their SOC reaches 100% and they need to be charged if their SOC reaches 10% to make the battery performance batter. The project is robust to adopt itself to any type of the lead acid batteries of any voltage level with constrain that their datasheet has to be pumped as reference data in the database. Current sensor, operational amplifier, load cell, temperature sensor are imparted in this project as the primary sensing units.

The controller we are using here is dsPIC30F4011.The technology used in this controller is the flash technology so that data is retained even when the power is switched off. Easy programming and Erasing are other features of dsPIC30F4011.It follows Modified Harvard architecture. It has 24-bit wide instructions, 16-bit wide data path and Two, 40-bit wide accumulators with optional saturation logic.

The Current sensor ACS 712, OPAMP LM 201A, load cell, Temperature sensor are used to monitor the battery parameters and the sensed values are updated to the controller.

A. *Calculation of State of Charge*

$$SoC = \frac{\text{Remaining capacity}}{\text{FCC (Temp, present charge or discharge rate)}}$$

$$SoH = \frac{\text{FCC (25C, Design charge or discharge rate)}}{\text{Design capacity}}$$

$$Q_{MAX} = \frac{Q_{PASSED}}{(SoC_1 - SoC_2)}$$

$$R_{BAT} = \frac{(V - OCV)}{I}$$

Fig. 2: SOC calculation formula

IV. EXPERIMENTAL RESULTS

A 9V adaptor is connected to the dsPIC controller. The input of current sensor is connected to the battery positive terminal and output is connected to the controller. The current sensor is excited by 3.3V supply. The terminals of the battery are connected to the voltage measuring unit embedded by operational amplifier and opto-coupler. Which measures the terminal voltage and sends the data to the controller. Load cell is connected to 24 bit analog-to-digital convertor for weigh scale purpose which is the connected to the controller. Temperature sensor LM35 is used to measure the temperature. The reference data of the particular battery which we are monitoring has to be entered into the controller for reference data. These parameters are found on the look back table of a battery.

The measured and calculated values are send to the remote location via ESP module we it is analysed and plotted in graphical representation using LABVIEW.

Figure 3, Figure 4 shows the hardware product of our monitoring system.

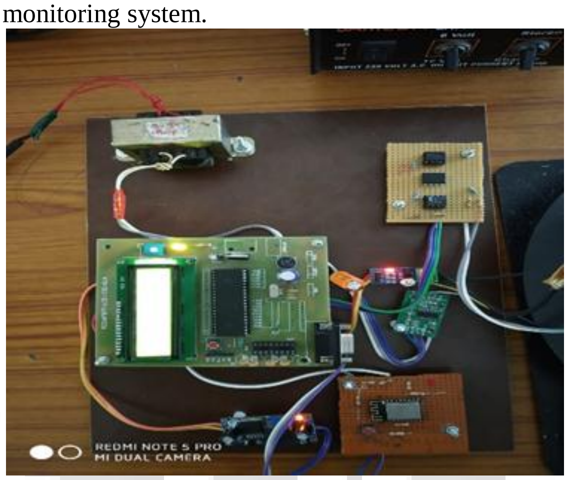

Fig. 3: Hardware Kit of Battery Monitoring System

Fig. 4: Full Setup of Battery Monitoring System

Approximate SoC	Average Specific Gravity (SG)	Open Circuit Voltage (OCV)
100%	1.265	12.65V
75%	1.225	12.45V
50%	1.19	12.24V
25%	1.155	12.06
0%	1.12	11.89V

Table 1: Approximate SOC Value

V. CONCLUSION AND FUTURE SCOPE

By this product one can enable some of the critical loads to get operated by the power supply entirely from the Battery avoiding the pollution (carbon emission) caused by Diesel Generators in the Industries. Maximum possibilities of making the battery system ready always, by maintain them efficiently and identifying where the fault occurred. Avoiding the presence of a personnel to monitor locally, thus reducing workmates time of making the log on their parameters. Reducing the risk of life when the critical loads need to be operated in blackout situations, thus avoiding the accidents.

There are a number of interesting possible directions for future work based on the research in this project, as discussed below.

The BMS optimization algorithm could be further improved by considering the cost of each charge and discharge cycle of battery to prevent excessive activities that could shorten the battery life.

Algorithms can be developed to predict power usage and generation in the microgrid, such algorithms can be integrated with optimization-based power flow control method for real time energy management in the microgrid.

New transmission capacity and better operating practices, such as greater automation controller, forecasting, renewable energy visibility, and transmission planning methods, market integration and implementation of smart battery management systems can resolve the problems and challenges for grid operators, often circumventing the need for curtailment. With this, the report may guide future policies which to lead Indian power system to take several steps to implement smart grid with RES integration.

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