Global Scientific JOURNALS

GSJ: Volume 5, Issue 11, November 2017, Online: ISSN 2320-9186
www.globalscientificjournal.com

GNSS INTEGRATED GSM MDI SYSTEM

Rizwan Ashfaq
Department of Aeronautics & Astronautics
Institute of Space Technology
Islamabad, Pakistan
rizwanashfaq807@gmail.com

Saad Babar Abbasi
Department of Aeronautics & Astronautics
Institute of Space Technology
Islamabad, Pakistan
saadbabarabbasi@gmail.com

Nisar Ahmad
Department of Aeronautics & Astronautics
Institute of Space Technology
Islamabad, Pakistan
nisarphd5@gmail.com

***Abstract*— in a developing country like Pakistan, power saving, and power management is a big challenge. Maximum Demand Indicator (MDI) is intended for measuring the maximum mean load. MDI allows the maximum load to be compared with the sanctioned load and this value should be less if the original analysis was performed correctly. In this paper our aim is to design an instrument that will measure load and voltage of the power circuit. As soon as the load exceeds the allowed limit, instant short message service (SMS) will be generated through Global system for Mobile Communication (GSM) to alert the unit owner or the controlling authorities and after described time of no action, the system will automatically shut down the secondary load. The paper is based on controlling the transformer using GSM integrated with Global Navigation Satellite System (GNSS) based system. The low power continuous monitoring system will be implemented with the transformer for industrial load and in residential areas it is implemented with power meters to enable the technician to control the system anywhere in world and keep it up-to-date. In this paper the main theme is to bring satellite based automation in power sector which is equally implemented in industry as well as in residential areas which facilitate the power distributors like Water and Power Development Authority (WAPDA) and consumers as well. This paper is to enables the system to record the power use in Peak hours and Off-Peak hours to maintain consumer bill on real time, which will improve the consumer billing, avoiding losses in case of short circuit, minimize the errors related to meter reading, avoid the transformer from the over loading, provide the real time power management for the distributor, avoid the consumer from the fine in term of MDI unit for commercial consumer, avoid corruption in term of billing and also useful in avoiding the electricity theft which is the most serious issue that is now a days we are facing in Pakistan.**

***Keywords*—GNSS; GSM; Power; Continious monitoring system; load management; MDI; Peak hours; GPS; Penalty; WAPDA.**

I. INTRODUCTION

The term MDI stands for the Maximum Demand Indicator that is used by power distribution companies like WAPDA to monitor the industrial and commercial loads.

A. Background Information

Initially the MDI limit was 70KWH, after that the technique was modified and revised by WAPDA and a new limit was adopted by WAPDA that was 40KWH. The technique was still not more efficient and it is again modified and new limit is set by WAPDA that is 5KWH. WAPDA uses the standard MDI value that is 5KWH. On the basis of this MDI limit WAPDA monitor the industrial and commercial loads and on overloading consumer have to pay a lot money in terms of fine, WAPDA charges are 400 PK.R./unit. This is interesting information in a sense that both parties i.e. WAPDA and as well as consumers have to bears the loss. Consumer has to pay a lot of money in terms of fine, while on the other hand WAPDA spent a lot of revenue to purchase new transformers because overloading causes the burning of transformer. In this paper, that is "GNSS integrated GSM MDI System" we use MDI technique to overcome the above situation so that both the consumer and WAPDA takes the equal benefits.

B. Research aims and objectives

The paper is based on controlling the transformer using GSM integrated with GNSS based system. The low power continuous monitoring system will be implemented with the transformer for industrial load and in residential areas it is implemented with power meters to enable the technician to control the system anywhere in world and keep it up-to-date.

In this paper the main theme is to bring satellite based automation in power sector which is equally implemented in industry as well as in residential areas which facilitate the power distributors like WAPDA and consumers as well. This paper is to enables the system to record the power use in Peak hours and Off-Peak hours to maintain consumer bill on real time, which will improve the consumer billing, avoiding losses in case of short circuit, minimize the errors related to meter reading, avoid the transformer from the over loading, provide the real time power management for the distributor, avoid the consumer from the fine in term of MDI unit which is charged about RS.400/unit in Pakistan by WAPDA for commercial consumer, avoid corruption in term of billing and also useful in avoiding the electricity theft which is the most serious issue that is now a days we are facing in Pakistan.

C. Real Time Load monitoring

As soon as the load exceeds the allowed limit, instant SMS will be generated through GSM to alert the unit owner or the controlling authorities and after described time of no action, the system will automatically shut down the secondary load.
The system will keep record of the used unit along with the accurate GPS time which is helpful for maintain the consumer bill with a great accuracy and on real time bases.

II. CONTROLLER BASED MDI

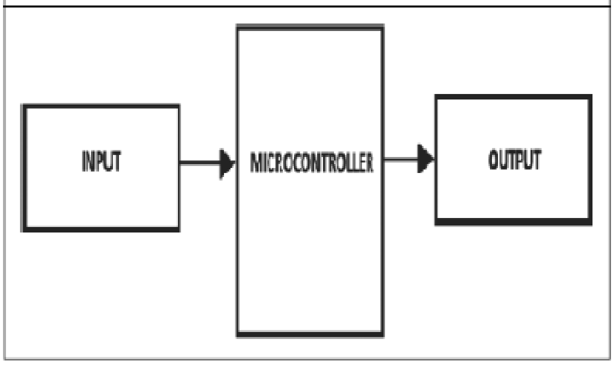
The traditional measurement of maximum demand uses conventional meters having current transformers. Instrument works within 15 minutes on average indicating a pointer since the last maximum of pointer reset. It has several disadvantages, such as:

- Not fully correspond to the flow meter because the count value of the supply mechanism in the mean time difference, and differences in the reset time.
- The meter could not monitored maximum sustained high demand value which is often a problem occurred in the mill and the operator has no privilege to detect excessive maximum demand.
- It is very difficult to find out what time the demand has exceeded the maximum in the absence of any records.
- The effect of adding or removing load was difficult to predict.

For the above mentioned reasons Controller based MDI is used.

It calculates the value and power kilo volt-ampere (KVA) approximately every minute and displays them on the display of the power station attendant or shift electrician to look. Every half hour, after the end of each measurement (reset has been occurred), the KVA, kilo watt (kW) and power factor during this time recorded. [1] [2]

Figure 1: Controller Based MDI



III. GNSS INTEGRTED MDI

Maximum load controller is a device designed to meet the needs of industry conscious of the value of load management. In this paper our aim is to design an instrument that will measure load and voltage of the power circuit. As soon as the load exceeds the allowed limit, instant SMS will be generated through GSM to alert the unit owner or the controlling authorities and after described time of no action, the system will automatically shut down the secondary load. The paper is based on controlling the transformer using GSM integrated with GNSS based system.

The low power continuous monitoring system will be implemented with the transformer for industrial load and in residential areas it is implemented with power meters to enable the technician to control the system anywhere in world and keep it up-to-date. In this paper the main theme is to bring satellite based automation in power sector which is equally implemented in industry as well as in residential areas which facilitate the power distributors like WAPDA and consumers as well.

The aim of this paper is to enables the system to record the power use in Peak hours and Off-Peak hours to maintain consumer bill on real time, which will improve the consumer billing, avoiding losses in case of short circuit, minimize the errors related to meter reading, avoid the transformer from the over loading, provide the real time power management for the distributor, avoid the consumer from the fine in term of MDI unit. On the other hand the GNSS module in the system continuously provide the accurate time for the off peak and off peak hours.

The system will keep and transmits the record of the consumer load to a centralized locality point along with accurate Global positioning System (GPS) time. This will help in maintaining the consumer bill on real time and with a great accuracy, and the consumer get the bill details on his/her mobile with a simple request through SMS. The system will helpful to convert the existing system of distribution as post paid or pre pay.

Because the system is continuously monitoring the load of a certain area so it enables the feeder to manage the load shedding periods in different areas.

Feeder load shedding may be based on a result of several logical developments of different strategies for the controller based MDI.

There are three main strategies for calculation of MDI;

A. Fixed priorty strategy

It sheds the least important load first and most important load at last. Advantages of fixed priority policy maintain a high priority area's supply "ON" while the low-priority areas will be "OFF" in the periods of peak demand.

B. Rotating strategy

In the rotation policy, the average distribution power is supplied to all controlled load. The policy is suitable when all region needs equal share of power.

C. Combination fixed/rotate strategy

This is the most flexible and powerful strategy because there are so many possible combination. LOADING Policy allow rotation load to becomes group with or without a fixed priority programming load. This will lead to the greatest energy efficiency and cost savings.

When the rate of electricity is charged on the basis of maximum demand of consumers and the consumption units, it is then called two-part tariff.

In this scenario total charge is divided into;

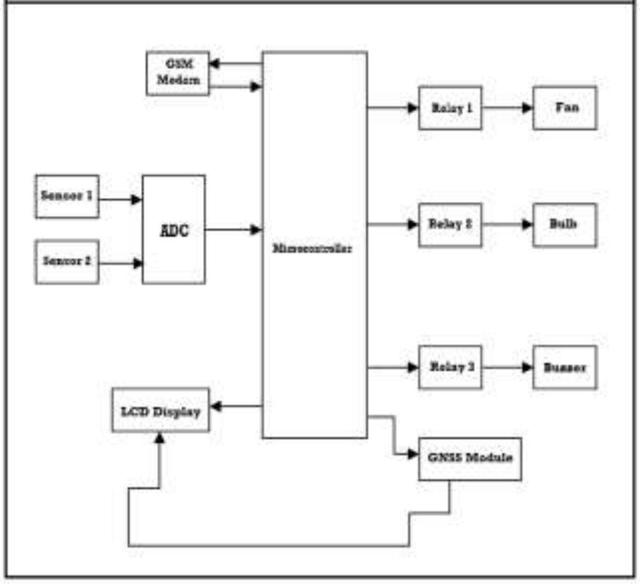
a. Fixed charge

It depends on the consumer's maximum demand.

b. Running charge

It depends on the unit consumption and is measured through maximum demand (MD) meter. The charging is on the basis of MD in KVA rather than KW. The GNSS integrated GSM MDI system is shown in figure 3,

Figure 3: GNSS Integrated GSM MDI System



The MD is further divided into 4 types;

1- Daily maximum 0530 h to 1630 h and 1830 h to 2100 h

2- Restricted maximum 1630 h to 1830 h

3- Night maximum 2100 h to 0500 h

4- Weekend maximum Saturday 0500 h to Monday 0500 h

There are different tariffs of MD and usually as an average of 30 minutes period (this time may vary from country to country); the maximum 30 minute average reached during the running month gives the monthly MD charge. It should be noted that, when the MD is recorded, it should not be instantaneous demand drawn, because it is often misunderstood, but comprehensive time demand over predefined recording period.[3][4]

For example, if an industry drawl over 30 minutes recording cycle is:

3600 KVA for 6 minutes

2500 KVA for 8 minutes

4200 KVA for 4 minutes

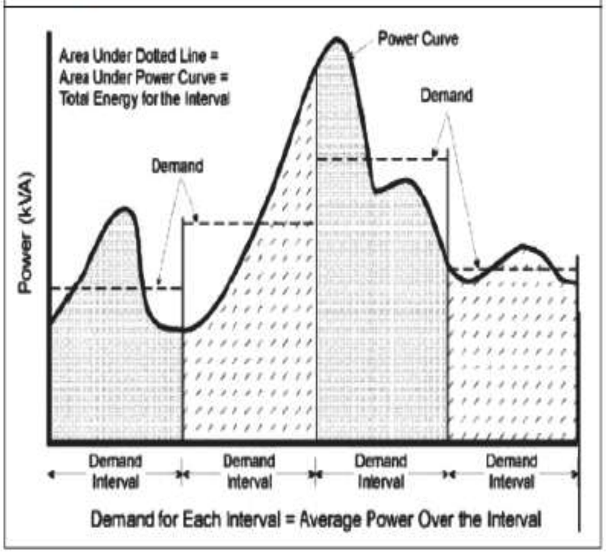
3300 KVA for 12 minutes

Then the MD recorder will be computing as:

$$\frac{3600*6 + 2500*8 + 4200*4 + 3300*12}{30} = 3266.7 \text{ KVA}$$

As shown in figure 2 the demand changes time to time and is measured over predefined time interval, and averaged out as shown by dotted horizontal line.

Figure 2: Power and Demand Curve



The fining of MDI can be avoided by improvement of power factor and by using efficient appliances. MDI fining is also be avoided by shifting the peak load to a time of day when the load is less.

There are two techniques of MD calculation:

1- Normal or block method

This is a defined time intervals (typically every 15 minutes) to calculate maximum demand period. If the recorded value is greater than the existing value then it is stored as the maximum demand.

2- Sliding Window method

At the end of a sub integrating period the average power is calculated for one integrating period. If the recorded value is greater than the existing value then it is stored as the maximum demand. The integrating period slides by a window of the sub integrating period.[5][6]

MD No	*Method*	*Intg. Period*	*Sub Intg. period*
MD1	Sliding	30 min	15 min
MD2	Block	30 min	30 min

Assume a load pattern of following type:

T = 10:00, T = 10:15, T = 10:30, T = 10:45, T = 11:00

30 KVA, 20 KVA, 20 KVA, 30 KVA

15 min, 15 min, 15 min, 15 min

For MD 1 sliding window method

Demand- 10:00 t0 10:30 block

$$= \frac{30*15 + 20*15}{30} = 25\ KVA$$

Demand- 10:15 to 10:45 block

$$= \frac{20*15 + 20*15}{30} = 20\ KVA$$

Demand- 10:30 to 11:00 block

$$= \frac{20*15 + 30*15}{30} = 25\ KVA$$

MD1 at the end of 11:00 = 20 KVA

For MD 2 block method

Demand- 10:00 t0 10:30 block

$$= \frac{30*15 + 20*15}{30} = 25\ KVA$$

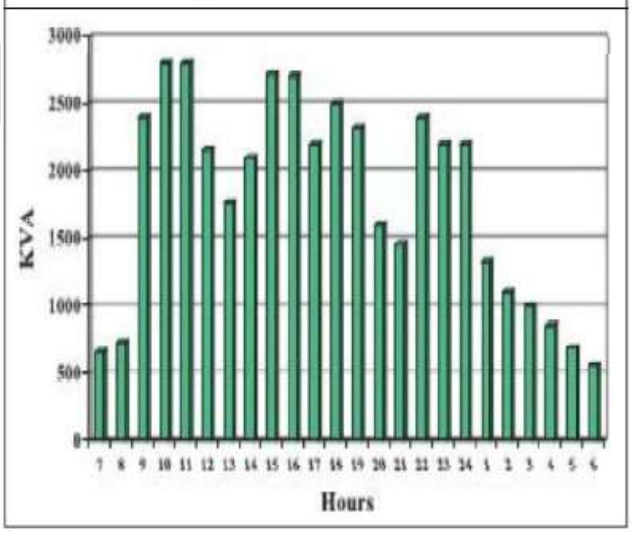
Demand- 10:30 t0 11:00 block

$$= \frac{20*15 + 30*15}{30} = 25\ KVA$$

MD 2 at the end of 11:00 = 25 KVA

A curve presenting a load demand of consumers for the time of day is called "load curve". If it is drawn as a single 24-hour for a single day it is called "hourly load curve", and if it is drawn for daily demand over a month then it is called "daily load curve". These curves are very useful for predicting pattern of drawl peaks, and trends of energy use in an industry or in a distribution network as shown in figure 4 below.[8]

Figure 4: Load Curve



When the maximum demand tends to reach preset limit, shedding some non-essential loads, it can help to reduce the load temporarily. Advanced microprocessor can also be used to control the system, which provides a variety of control options such as: [1] [7]

- Accurately forecasting the demand.
- Graphical representation of load demand limit.
- Audible and visual alarms.

- Automatic load shedding in a predetermined order.
- Restoration of load automatically.
- Metering and recording.

In all industrial electrical power distribution system, the main loads are resistive and inductive. Resistive loads incandescent lighting and hence resistance heating. In the case of pure resistance, the relationship of load, voltage (V), current (I), resistance (R) is linear.

i .e.,

Voltage (V) = IR

Power (KW) = VI

Typical inductive loads are induction furnaces, Ac motors, ballast type lighting and transformers.

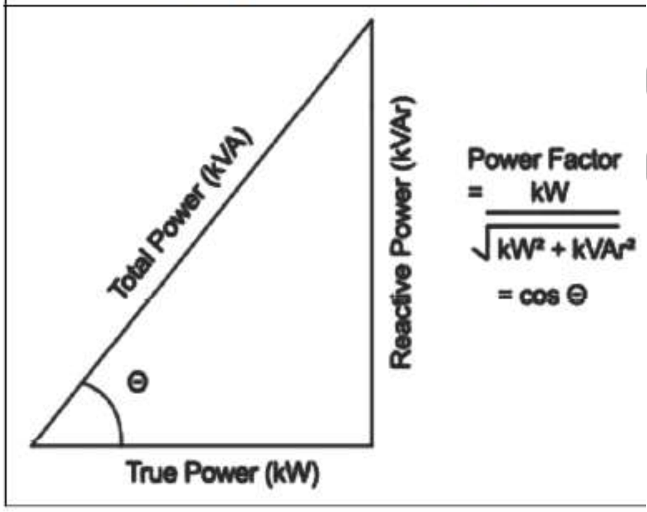
Two kinds of power required for inductive load,

1. Active power to perform the working task
2. Reactive power for creating and maintain the electromagnetic fields.

The active power is measured in KW while reactive power is measured in KVAr.

The vector sum of reactive and active power makes the apparent power as shown in figure 5 below,

Figure 5: Power Triangle



IV. Conclusion

The aim of the paper is to bring the satellite based automation in the field of power sector for avoiding the penalties on MDI. While MDI penalties are avoided by improving the power factor or by using the efficient appliances. The system continuously monitors the industrial load, and comparing it with the defined load at every instant of time. As the load exceeded the desired limit microcontroller will generate a message through the GSM Modem to the owner or any other given number informing about the excess load. The owner will configure the power limit using keypad and liquid crystal display (LCD), and after defined time of no action, system will be shutdown the secondary load automatically. The system will be connected to the main supply. The GNSS module is responsible for maintain the accurate GPS time which is useful for recording the Peak hour and off peak hour usage. This record is helpful in preparing error free consumer bill on real time basis. If the good MDI used there is a great possibility to create awareness of when and where power is used and hence gets better power utilization. Better utilization of electrical energy during the off peak hours. The data that is obtained from the system is very helpful for the designing and development of smart grids that brings automation in the electrical distribution system. The system described in this paper will improve the consumer billing, avoiding losses in case of short circuit, minimize the errors related to meter reading, avoid the transformer from the over loading, provide the real time power management for the distributor, avoid the consumer from the fine in term of MDI unit for commercial consume

Acknowledgment

Thanks to my parents who supported and encouraged me in my whole life and also I would like to thanks my supervisor and fellows for their kind support.

References

[1] Cobus S (2003), Electrical Network Automation and Communication Systems, pp.142-153.

[2] "Microcontroller Based Substation monitoring and Control System with GSM Modem", IOSR Journal of Electrical and electronics engineering (IOSRJEEE), Vol. 1, No. 6 (july-Augest2012), pp. 13-21, ISSN: 2278-1676.

[3] Gaggioli R (Ed.) (1983), Efficiency and Costing, ACS Symposium Series 235.

[4] Clive Beggs (2002), Energy Management supply and Conservation, Butterworth Heinemann.

[5] Capasso A, Grattieri W et al. (1994), "A Bottom-Up Approach to Residential Load Modeling", IEEE Transactions on Power Systems, Vol. 9, No. 2, May.

[6] World Bank, World Development Indicators – Last Updated March 2, 2011 energy Statistics 2012 (19th Issue), Issued by Central Statistics office, Ministry of Statistics and programmed Implementation, Govt. of India, New Dehli.

[7] Calcutt David M, Cowan jFrederick and Parchizadeh Hassan G (1998), 8051 Microcontrollers hardware, Software and Applications, pp. 1-13.

[8] Steve Hsiung, John Ritz, Richrad jones and Jim Eiland (2010), "Design and Evalution of Microcontroller Trainingb System for Hands-on Distance and Campus-Based Classes", Journal of Industrial Technology, Vol. 26, No. 4.