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Development of New Monitoring System for Field Information of Real Time Power Consumption in Malaysia.

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Abstract: World is currently suffering from energy crises affecting even developed countries like USA and European countries. Rapid increase in electrical energy demand for a developing country like Malaysia is a constant threat for "*Energy Plan 2020*". This paper introduces a new energy strategy for electrical vendors in Malaysia, a way out to this growing challenge, *an energy management system*. This system consist of a new energy calculation algorithm, offering electricity packages with a intelligent monitoring system for daily power consumption connected to base-station via GSM network. A smart meter is back bone for this algorithm generating automatic bill, providing a necessary help to decrease peak curve line for electric consumption. Our proposed solution will be a very easy and updated system for monitoring companies and also offering the users,(mostly on industrial level which is almost 37.7% of total power consumption) a friendly packages surely resulting in change in energy sector.

Key words: Power Monitoring, Smart meter, Peak demand, Load forecasting.

INTRODUCTION

As a developing Asian Nation, Malaysia has a very interesting energy profile, both in past and for the future. In 2000, the total primary energy supply was 49.47 Mtoe (million tons of oil equivalents) (Extract, 2001; International Energy Agency, 2000). The fuel mix consisted of 71.4% Petroleum, 11.6% hydroelectric power, 8.8% natural Gas, 7.6% coal, 0.5% biomass, and 0.1% distillate (includes processed oils, fuel, etc). Energy in Malaysia is consumed mainly in the transportation and industrial sectors, 41.8% and 37.7% respectively, followed by commercial and residential sectors combined at 13.4 % and the agricultural sector, which consumes 0.39% of the energy. While in 2020 this energy demand is expected to be more than 100 Mtoe, (Trends in Malaysia's, 2020) which is more than 200% of the demand in 2000.This high rise in energy curve strongly need a system to be managed to avoid any major failure.

In the past few years, fixed networks have witnessed a tremendous growth in data traffic due in good part to the increasing popularity of the Internet. Consequently new data applications are emerging and are reaching the general public. At the same time the market is witnessing a remarkable explosion of cellular and mobile technologies leading to demand that data applications become available to mobile users. Global system for mobile communications (GSM) Mouly, M.B. Pautet, (1992) is the European standard for cellular communications developed by the European Telecommunications Standards Institute (ETSI). Throughout Europe and the rest of the world (including North America), GSM has been widely adopted. It has already been implemented in over 100 countries Rapeli, (1995). There are many interesting applications of GSM in power control and monitoring system and in load management. A latest is home electric control. Today a wide variety of home appliances are required to support our quality of life, however those appliances are not fully controlled. If a GSM communication system is applied, the functionality can be improved Petrick *et al.,* (1998).

Traditionally industrially applied wire transmission media to transmit remote monitoring data. However due to wide distribution of power equipments, poor flexibility and questionable stability will rise by using wire configuration. This paper focus on advance monitoring device which can monitor automatically and in real time the electric consumption of a house in premises or in any other building, monitoring the total consumption of all installed appliances consist of Source Input, measuring means, control and processing means, selection and

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storage means, indications means, communication section to server/master meter, electrical circuitry for any decision to be implemented from vendor, some means of encryption/coding. Hence this research design a wireless real time monitoring system by using power monitor chip with conversion components to get the data including voltage, three phase current and GSM mobile module to send this data. Some extensions might be included in this system like key-pad for data entry for units, password input etc. Also after implementing future enhancements, this system will be able to create an intelligent network connected to a central station.

Related work:

A deep comparison between Malaysia and its neighbor Taiwan shows some similar threats to both countries Yun-Hsun Huang, (2009). i.e.

- *The lack of indigenous energy resources*: Dependence on imported energy resources
- *The use of fossil fuels as the primary energy sources*:
- *Current limited utilization of renewable energy*:

Despite ongoing development the utilization of renewable energy is presently limited due to technical constraints, high unit cost and comparative instability. The cost of renewable energy is still too expensive to be widely applicable for domestic power generations.

***Improvements in energy intensity*:**

The aim of Taiwan energy policy is to create awareness among all sectors to manage this growing challenge through public awareness campaign. Our algorithm offers using some source of energy monitoring device to get actual consumption awareness, surely resulting in positive achievements. Designed pro-type is highly target oriented and successful in achieving the EMS (energy management system) and it proved to be very convenient in real time pricing.

Need of Energy Management System:

To meet increasing requirement of electrical load, highly requires new generation, making current resources more efficient and output oriented. Sometime Upgrading or replacing the transmission lines is also necessary. Replacing some of the infra structure need 10-15 years (SMART GRID: http://www.oe.energy.gov/smartgrid.htm 2009). While peak demand is projected to increase over the next ten years by 19%, meanwhile transmission miles are projected to increase less than 7%. This gap is a red zone resulting into huge crises strongly needs some management to minimize this gap until requirement is fully achieved.

From a load-forecast survey made in one town in India, the expected peak load in first year of operation is 26.48 kW which increases every year. The peak demand at the end of tenth year shall be about 50 kW. It means if the installed capacity of SHP is 50 kW then it will operate up to ninth under capacity and from tenth year onward it will operate at is installed capacity (Shri, 2004; Ikhupuleng Dube, 2003).

Peak hours are one of the critical situations at substation, in Malaysia afternoon time is normally peak time. Peak causes shut down normally if supply side hasn't enough capacity and also create a huge loss of fuel in term of putting in operation all backup system. To produce normalize and stabilize voltage electro mechanical system at grid need a long startup time, causing loss of resources. And this is a daily problem also affecting power equipments installed at grid by rapid up and down spikes due to irregular usage reducing equipment life.

Table 1: Per hour comparison between overall demand and supply of Malaysia, recorded at Central control room, Kuala Lumpur, on 29 Dec 2009.

Time	System generation	System requirement
0:00	10230	10252
1:00	9664	9557
2:00	9230	9338
3:00	8883	8904
4:00	8767	8785
5:00	8619	8668
6:00	8787	8785
7:00	9107	9151
8:00	9943	9871

Table 1: Continue

9:00	11536	11519
10:00	12431	12395
11:00	12870	12878
12:00	12969	12963
13:00	12777	12741
14:00	13027	13024
15:00	13337	13314
16:00	13301	13286
17:00	12813	12859
18:00	11900	11971
19:00	11880	11950
20:00	12516	12627
21:00	12267	12243
22:00	11822	11933
23:00	11298	11341
0:00	10812	10902

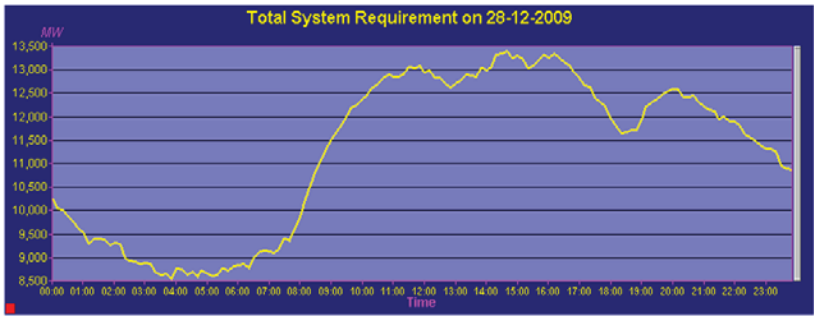

Fig. 1: High rise in peak, also showing Off-time and peak times recorded on Dec 2009, control room in Malaysia.

As discussed above, research has shown (A review of DEFRA) that the best way to reduce the wasteful consumption of electrical energy is to provide usage information to the consumer in as direct a way as possible. If the consumer is made aware of his usage and if high consumption areas are highlighted, the consumer will react and there is a greater possibility of reduction in energy consumption. The proposed way to inform the consumer and enable him to react to reduce his energy consumption is Smart metering. Smart metering is a tool and a solution to reduce the wastage of electricity. In this way a domestic consumer can save electricity by reducing demand, resulting in lower energy bills and fewer power cuts.

Smart meters are already in use in Europe and in the USA. In these parts of the world, one of the objectives is to show the consumer his consumption of electricity in real time (Intermediate Energy , 2007).

System design and implementation:

From a practical point of view, it is possible to have several of these subsystems sharing the same package, so that various types of these sensors can be considered. The system described in the present work belongs to the most complete smart sensor type. Analog Devices Company has recently designed a series of integrated circuits of increasing complexity and better capacity, specifically to measure the energy transferred to a load connected to an AC line (Travis, Smart Sensors, EDN, 1996; Pallás and Webster, 1993). These circuits (energy monitors) are mixed processors (digital/analog) which provide information of the energy used (active, reactive and apparent), and then transmit it using output pulses of variable frequency or standard serial protocol. All the circuits of the family have two inputs, one is proportional to the voltage across the load and the other one is proportional to the current that circulates through the load. The concept of this sensor is extended to a higher level when the presence of digital microcontrollers or processors of the signal, as a processing subsystem, is taken into account. The basic functioning consists in digitalizing the signals which are related to the voltage and current in the load and multiply them, so that the result is proportional to the power in the load.

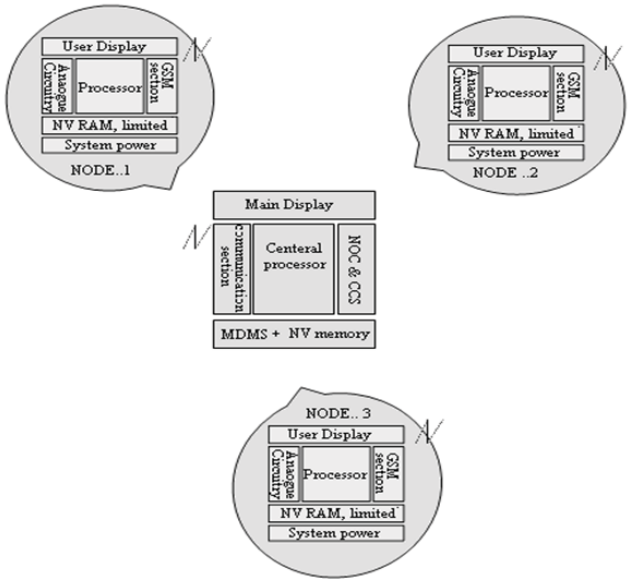

Fig. 2: shows overall system block diagram, including enhancement section.

Hardware Implementation:

Remote slave node:

The remote node can be selectively configured to provide master-slave topology, or to form Stand-Alone, i.e. digital power Monitoring system. In the left side of Fig1, the Current transformer acts as a front-end signal acquisition system, as it provide main input signal to be processed. This signal is digitized in current to voltage convertor, amplifier circuit. This signal is processed in controller according to highly pre-defined program and output through MAX232, a level shifter IC is sent to GSM Modem for further operation.

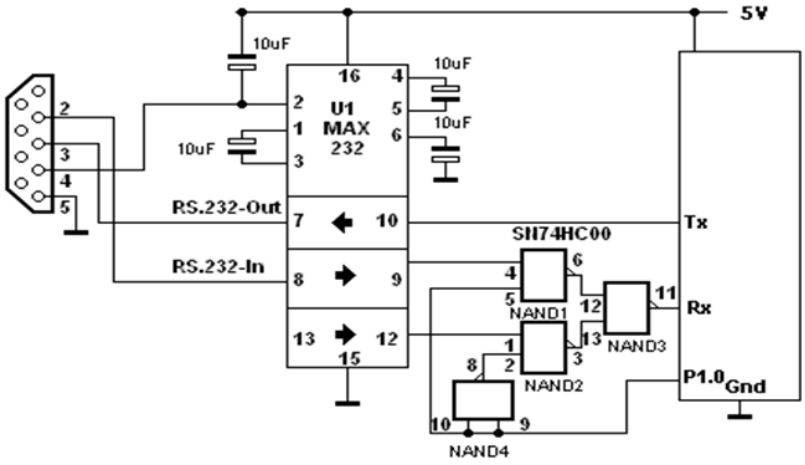

Fig. 3: Shows GSM pin Connection to microcontroller.

GSM modem supported by AT commands is connected to micro controller to transmit data according to pre-described time period to central base station. GSM modem use SMS technology. To send or receive any SMS or to display any SMS in the inbox which is actually the information of the consumption, there are some specific commands.

The job of micro controller is to support two type of operation;

- To perform all calculation, based on I and V pulses and to calculate amount of energy used according to a pre-defined equation, and to generate cost for this consumption taking in consideration the defined electricity packages, i.e. real time monitoring and calculation.
- To support GSM section.

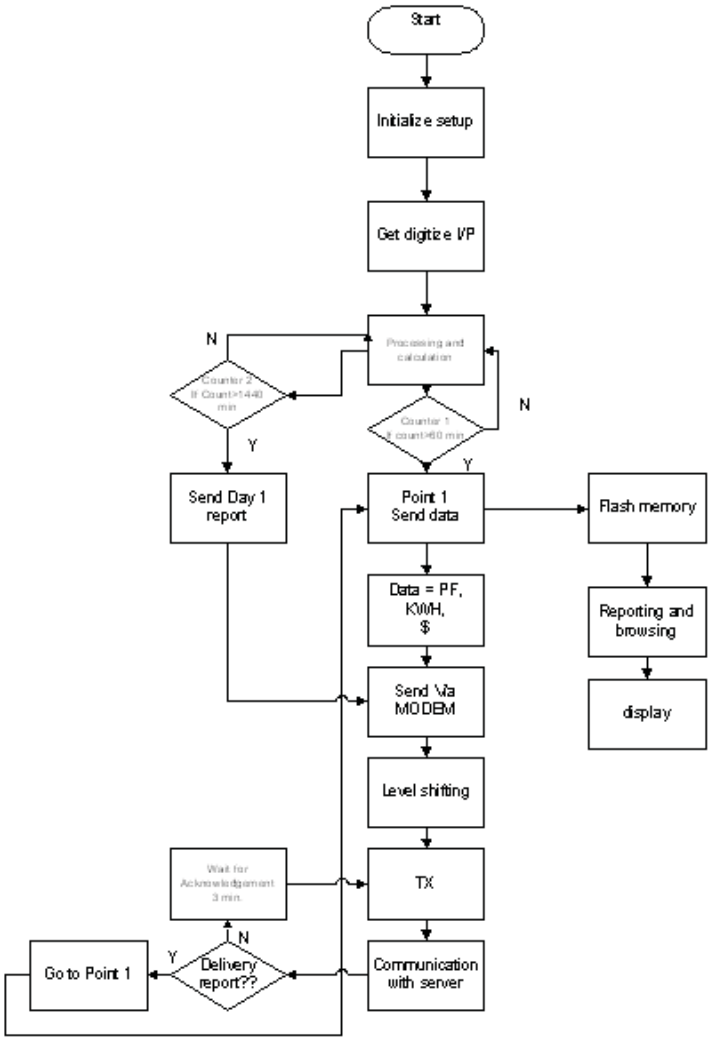

Fig. 4: System Flow chart description at remote end, Calculation and transmission of information.

At Central Node:

Hardware Section:

Hugely designed data base, having capability of updating with any information received. This system is intelligent enough to make implementation of any operation and to detect any fault. The information is received at GSM end, which is forwarded to Main brain of the system, immediately updated in MDMS (metering data management section). The central process is also connected to NOC (Network Operating Center). Load control devices majorly related to future enhancement, to use efficiently back up resources like stand by generator, batteries, fly wheels etc. Also it aims to make intelligent protection system, capable to detect any fault and heal it before it affects the system.

Software Section:

As discussed, the prototyped central Node has two types of operating modes, Stand-Alone and Slave-Master. Thus it has separate program for each mode of operation. It is apparent that both modes require certain common basic support functions, and accordingly the software should be structured modularly. So these supporting routines can be incorporated into any of the programs as a common operational approach to allow minimal power consumption. Any decision for shut down, implementation of a new package, updating and calculation of information, managing all history, uploading the pre-paid units requires a highly designed data base. Security measures for data base are an issue strongly needs high level programming. This central node has two types of jobs to perform, firstly management of all history and currently receiving information.2ndly control and monitoring, ready to make any decision in case of any situation. SO it needs two separate protocols to define these jobs.

Conclusion:

It is becoming important to have such a system which helps to manage consumption on the basis of real time pricing, with a secure and live mentoring device friendly to both user and supplier, especially in case of developing countries because smart grid concept is no doubt overall solution but it is not feasible for low budget economies. Smart Grid technology is still new and has yet to develop acceptable standards.

Our algorithm offers using some source of energy monitoring device to get actual consumption awareness, surely resulting in positive achievements. Designed pro-type is highly target oriented and successful in achieving the EMS (energy management system) and it proved to be very convenient in real time pricing. The prototype is tested for a few users for defined time and after peer monitoring, it showed a healthy response in order to achieve targets.

The technique presented in this work provides a very highly technical monitoring means for the digital measurement of electrical energy, which may be used over a wide range of energy measurement. The results obtained exhibited linear behavior over the range used. The apparatus gave good results under various loading conditions and with a power factor ranging from low to high values. Actual use and result of this system will be obtained after implementation to a specific area but estimated accounts will be eliminated and customers will pay only for what they actually use.

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