Monte Carlo Simulation for Low Voltage Residential Network

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***Abstract* - The prevalent engineering practice (PEP) for demand estimation in Low Voltage electricity networks is based on an After Diversity Maximum Demand (ADMD) modified by a Diversity Factor. This method predicts the maximum likely voltage drop, accounting for diversity. However, it is inconsistent with both the nature of demand, which can be represented as a stochastic process, and with the wording of power quality standards such as BS EN 50160. A programme is undertaken to meter residential electricity demand. Using this data a generalised mathematical model is developed. The model is applied in a Monte Carlo simulation of the three-phase Low Voltage network. A house that was the subject of a power quality complaint, which resulted in network reparation, is chosen for the case study. A retrospective analysis is performed to hindmost the power quality received before the reparation, using both the Monte Carlo method and PEP; this is compared with a voltage trace recorded at the time of the complaint. The analysis is then used to model the power quality for the present network design and compared with measurements. The model is also used to examine phase unbalance, and the effect of sampling interval on measured demand.**

***Keywords* - Energy Metter, Relay, Microcontroller, RS232, Energy Metter.**

I. INTRODUCTION

The Prevalent Engineering Practice (PEP) used by the electricity industry for sizing conductors in Low Voltage (LV) distribution networks can be traced to J Boggis in the 1950's. The methodology is based upon estimating the maximum demand that is likely to be placed by a group of customers inside of a time window that is commonly taken to be a year. From this the greatest likely voltage drop to occur in normal operating conditions can be calculated.

When analysis of electricity demand is made from a risk based perspective where statistical coherence is necessary this method is found wanting. Further, newer design standards that have been written that require a greater understanding of the nature of the demand and the estimation of the time duration curve for received voltages. Electricity demand placed by individual consumers is a fluctuating function of time. The demand (household load profile) is made up by operation of appliances that are activated either by consumers or by control systems such as thermostats; both of these are stochastic processes. As such, appliance actuations are largely independent, as are the loading patterns placed by neighboring houses.

There are some overall driving factors that will increase the tendency for appliances to be used coincidently, such as the time of day and the ambient temperature. However, the result is that residential electricity demand is largely a stochastic process and therefore exhibits diversity.

Infrastructural networks benefit from diversity since the maximum demand placed by a group of customers is less than the sum of the maximum demands of the individuals; in other words peak demands are very unlikely to be co-incident. Network designers use this to their advantage by being able to reduce capital investment. This is embedded within PEP. we seek to develop and demonstrate a better method for estimating residential electricity demand. This method uses the assumption that the demand is a stochastic process, and a Monte Carlo simulation is used to calculate the expected voltage profile.

The Monte Carlo method is shown to be flexible and give added benefits through the prediction of conductor losses, and phase unbalance. An analysis is also undertaken to demonstrate the effect that sampling interval has on the aggregate demand placed by a group of customers.

II. LITERATURE SURVEY

The smart grid vision has resulted in many demand side innovations such as nonintrusive load monitoring techniques, residential micro-grids, and demand response programs. Many of these techniques need a detailed residential network model for their research, evaluation, and validation. In response to such a need, this paper presents a sequential Monte Carlo (SMC) simulation platform for modeling and simulating low voltage residential networks. This platform targets the simulation of the quasi-steady-state network condition over an extended period such as 24 h.

It consists of two main components. The first is a multiphase network model with power flow, harmonic, and motor starting study capabilities. The second is a load/generation behaviour model that establishes the operating characteristics of various loads and generators based on time-of-use probability curves. These two components are combined together through an SMC simulation scheme [1].

The prevalent engineering practice (PEP) for maximum demand estimation in low-voltage (LV) electricity networks is based on an After Diversity Maximum Demand (ADMD) modified by a diversity factor. This method predicts the maximum likely voltage drop accounting for consumer diversity. However, this approach does not take into account the stochastic nature of the demand

and is inconsistent with international power quality standards. We present a Monte Carlo simulation model of consumer demand taking into account the statistical spread of demand in each half hour using data sampled from a gamma distribution [2].
Estimating voltage regulation on Low-Voltage (LV) networks is “bread and butter” work for many electricity network engineers. Despite a universal appreciation that voltage quality, to the consumer, is a statistical problem driven by uncertainty in consumer coincident demands, general industry practice still uses empirical formulae based on the concept of an After Diversity Maximum Demand (ADMD). Lack of understanding of the distributional nature of consumer demand and the impact of this on four-wire LV networks restricts innovative and least-cost solutions to voltage regulation problems. Solving these problems will also lead to better understanding of the impacts of fuel switching and consumer side distributed generation. In three summarizes research work on Monte Carlo modelling of residential electricity demand and its application to LV regulation problems. Validity of the method is demonstrated by comparison of predicted distribution of delivered voltage to actual voltage recordings for three case studies. The relevance of this modelling technique is discussed, and its application to fuel switching and distributed generation problems are promoted [3].
A probabilistic model for residential loads is proposed in this paper. The model differs from other similar models in that it uses a beta probability distribution function to describe the load uncertainty. It further models the load parameter uncertainty as a bivariate distribution of load current means and standard deviations. By separating the probabilistic load uncertainty and the load parameter uncertainty, the model becomes very useful for the analysis of distribution systems where primarily residential consumers are connected, e.g., electrification projects. The model was tested using a Monte Carlo-type simulation and the results are sufficiently accurate for practical design purposes [4].
A Monte Carlo simulation method for generating stochastic load profiles for models of low voltage (LV) electricity grids to support middle- and long-term strategic asset planning processes. Models that calculate aggregated loads in a deterministic way using a coincidence coefficient (simultaneity factor) do not give insight in the probability of an overload and eventual asset failure. Analysis of minute-to-minute load data obtained with Monte Carlo simulation, based on the characteristics and behaviour patterns of different household types, can provide more accurate probabilities of peak loads, especially for subordinate grids where individual consumption behaviours have relatively high impacts. Calculating this indicator for different future scenarios can help improve LV distribution grid capacity planning down to the component level [5].

III. OBJECTIVE

- Study of voltage and current rating for low voltage residential equipment.
- Application of monte carlo simulation for low voltage network.
- Load dispatch with the help of monte carlo simulation for low voltage residential network.

IV. PROPOSED SYSTEM

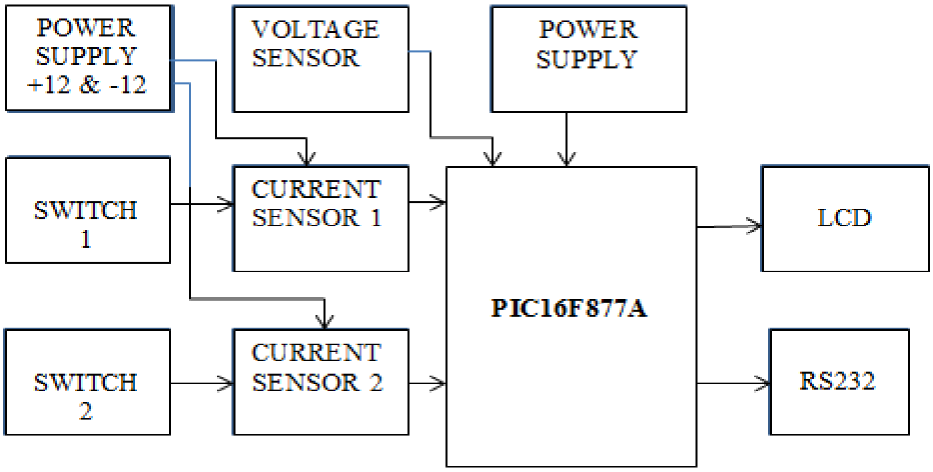

Fig 1. Home Section model

The increasing number of home appliances and consumer electronics causes the growth of home energy use. Therefore, reducing energy use in homes is a very challenging target to energy crisis and the environmental problem. The technology to reduce and manage home energy use is known as Monte carlo technology.

Fig 2. Monitoring section model

Calculatoins of power supply circuit
V1=230V , V2=12V , P=6VA
Diode Rating
1)P1= V2 I2
6=12*I2
I2=6/12 = 0.5A
2) V1=di/dt
=0.5*50
= 25V
3)Capacitor Rating
C = (I max*T discharge) / (V max- V min)
= (0.2*0.01)/(12-7.5)
= 470 uf

User cannot figure out whether a specific home appliance is energy efficient. It is necessary to compare energy usage of a home appliance to that of the same kind of typical home appliances. The proposed monte carlo energy management system. Home appliances are connected to the electrical outlets.

The electrical outlets have a function of energy measurement of home appliances and the capability of RS232 communication cable. The monte carlo energy management system in the home server gathers the energy information from the electrical outlets and displays hourly, daily, weekly, and monthly energy usage of home appliances with this a user can figure out detailed energy information.

The electrical outlets also identify whether the connected home appliance is turned on or turned off and whether it is on the standby state or the normal state by measuring the consuming power. And comparison of energy usage is done by using reference or typical energy values of home appliances.

The block diagram of the system Here controller will wirelessly communicate with end devices to control them. The power threshold will be set by the controller. The end device will compare this threshold with the power being consumed by the device connected through it and will take the appropriate action.

V. RESULT TABLE AND ANALYSIS

	SWITCH 1	SWITCH 2
POWER	45W	100W
TIMER	ON	ON
BUZZER	OFF	ON

Table 1. Result Table

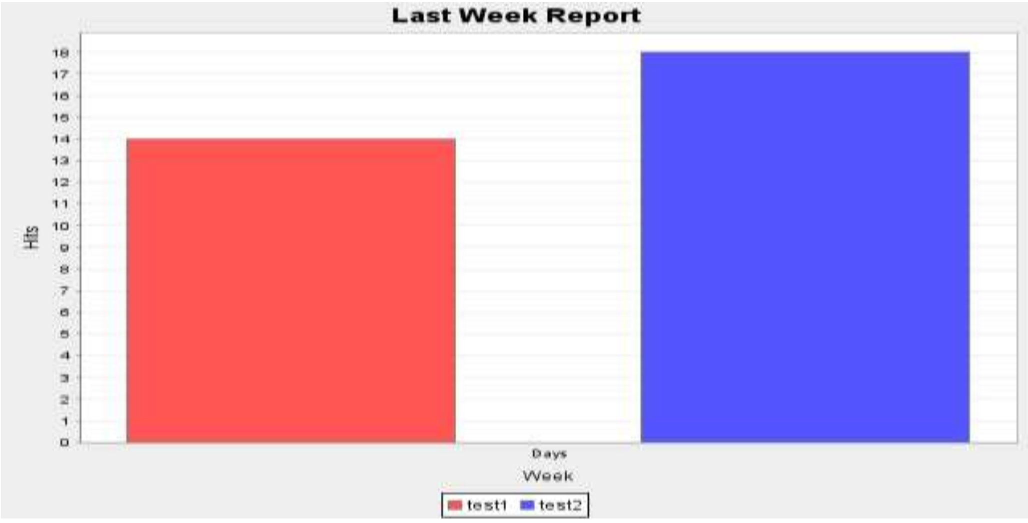

Fig 3. Simulation graph

VI. APPLICATION

- For low voltage residential network
- For industrial low voltage instrument
- For household purpose
- To calculate tariff
- For commercial finance calculation

VII. CONCLUSION

The purpose of using this project based on MONTE CARLO technology is which is used to reduce and manage home energy use. A typical MONTE CARLO TECHNOLOGY for low voltage residential network just shows the energy consumption of the whole home and home appliances. Users cannot figure out how efficient a home appliance is, compared to the others. So it is necessary to compare the energy usage of home appliances to that of the same kinds of home appliances.

VIII. REFERENCES

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