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Domestic Energy Meter Interfacing Using Avr Open Source Microcontroller & Matlab

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ABSTRACT

The recent worldwide methods for energy conservation, call for a larger awareness of the household energy consumption, as it is a significant contribution of domestic load to the national energy balance. The objective is to aim high potential energy savings solution by impacting the behavior habits of individual in their households. . As an objective to solve this scenario it requires that consumers do have a sophisticated feedback system, which provides better understanding and comparison of, how their action relates to their energy consumption, and by doing so they can optimize the use of electricity. To optimize the use of electrical energy, it is necessary to provide a sophisticated interface of energy consumption, with feedback system for motivating household to save it.. This paper propose an idea that how household electrical energy meters can be interfaced with AVR open source microcontrollers by interfacing it with MATLAB.

KEYWORDS: AVR microcontroller, energy meter, monitoring, serial interface

NTRODUCTION

General Citizens are more and more sensitive to the environmental dimension linked to their behaviors. Beyond the current conservation trends, interests are also economical due to the raising prices of energy. It is reported that energy feedback is a good solution to make people gain awareness of their energy consumption and hence reduce it [1]. An efficient feedback should be grounded in real consumption, provided with a short delay and include opportunities for historical and/or social comparison. Unfortunately, nowadays the exceptional feedback that most of the people have is their monthly electricity bill, which provides little information to interpret the sources of consumption. Automated monitoring of the electricity consumption in a house is quite a recent topic [2].

The electronic meters for electricity (smart meters) are undergoing an increasing deployment in private homes all over the world, which is mostly triggered from the government decisions in order to fulfill energy-saving targets. As a consequence, an ever growing physical communication network, made up of millions of local meters, has been established, whose considerable advantages are so far in favors primarily for energy distributors, since they can be used as simplified, more efficient, and less costly dealings with the customers, e.g., for meter reading, billing, and energy supply administration.

By its nature, however, a digital communication network has, among its features, the flexibility and extensibility of the structure, so that new applications can also be provided [8]. Therefore, it seems reasonable to assume that the meters themselves, by increasing their capabilities, become players in a more extended and different network, which is available to the domestic energy users, by providing them with useful services [7].

DOMESTIC ENERGY METERS

Domestic energy meters are used to measure total energy consumption (KWh) in order to provide billing purpose, for utility facility. These meters can also be used to know total energy consumed, as and when any household attempts to monitor the energy usage. However we will see that households feel shorthanded to do that when actually, they pretend to use electrical energy.

The energy meters for electricity are a necessity for electricity providers/distributers as mentioned above. But till date in India domestic energy meters could not be used properly for interfacing households to manage their own energy consumption. We will see two basic types of domestic electricity meters being used by utility and has very high deployment in India.

DIGITAL ENERGY METERS

The digital type energy meters are more reliable and accurate to measure various energy parameters like voltage, current, power consumption, instantaneous power, power factor and they are capable to store measured data for reviewing purpose. Normally LCD screen is provided on meter itself to review measurements.

The LCD screen used in such meters is not large enough to display all the parameters simultaneously hence it flashes all the parameters one by one, which ultimately increases the utilization factor of the screen size. On the front side we can see a round shaped door which protects the infrared port of communication which is the one used to interface, with meter to communicate or to download the history stored in the meter. Similar to analogue meter, in which we can see the disc revolution which indicates 1 kWh for 750 revolutions, here in digital meters an LED is provided to demonstrate 3200 impulses for each kilowatt-hours. That means interval between two blinks (or impulses) shows 1/3200 kWh = 0.0003125 kWh. The figure given bellow shows a digital type of energy meters which uses digital signal processor.

HOUSEHOLD'S REACH TO ENERGY MONITORING

As the metering devices are always being provided by local energy distributers they are sealed to detect any tempering and avoid theft of electricity. The location of the meters are always favoring for meter reader person, who can easily read the meter for energy consumed science last date of bill and can give a new billing amount to the consumer. Generally in row houses, the location for meters can be found near to main door of the house or near to main gate to furnish the comfort. Where as in multi-storey buildings these utility meters are provided at ground floor or at the most first floor of the building.

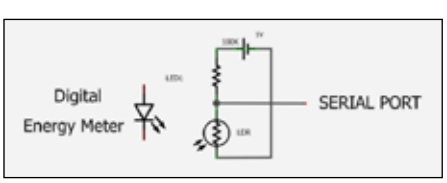
Such locations of meters are really not comfortable for domestic consumer of electricity as they are always utilizing energy inside the house. Even if a consumer wishes, to have an idea that how much energy is being consumed in his/her house, he/she may have to go to metering location to do that. In such scenario, a regular monitoring of energy consumption is not comfortable and even if consumer is loyal to save energy bills rather than energy it is impractical to monitor the utility meter that way. Hence, as the consumer we fail to realize that what amount of energy is being consumed even after putting on more loads [7]. To equip households with comfortable monitoring can significantly help them to cut their electricity bills, at the same time directly/indirectly they can increase the utilization factor of electricity by doing that [8].

CONCEPTUAL SYSTEM DESIGN

It should estimate the final billing amount also, so that in case user is not really able to maintain constant routine. It may also include the feature of notifying households for current levels of energy consumption for that period, by any physically observable means [6]. This feedback can be given by in house monitoring display, buzzer for indicating over consumption, different illuminating indicator lights to show current conditions of energy consumption etc [3]-[5]. as per suited. In the figure bellow, it is shown a block diagram for the conceptual system which consist the blocks for an energy meter, data logger system, data processing unit, and a feedback system

As domestic energy management is concerned it would be more economic to use already available digital energy meter, which are obviously installed by utility provider (Energy Distribution Company) at our home and offices. We can easily interface with these already available meters by detecting impulse of the calibration LED provided in front of it. This LED impulses shows, how much energy is consumed in between two impulse of it. These LED's are normally provided in front of the meter itself. Hence we can record the counts of LED impulse to emulate the energy consumed over that period. This will untimely solve the purpose of metering equipment, ultimately reducing the cost of separate meter.

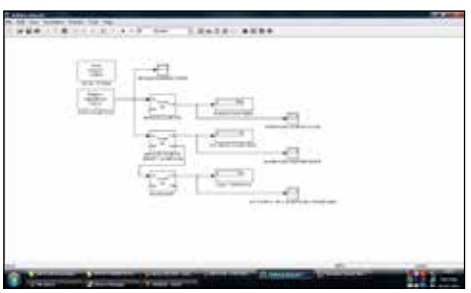
The serial port here is emulated with Arduino Prototyping Development Board. It requires bellow mentioned Program to perform the task.




```
/* Program Starts */
void setup()
{
 Serial.begin(115200); // start serial connection
 pinMode(A0, INPUT_PULLUP); // assign Pin A0 as input with pull-
up
}
void loop()
{
 int sensorVal = digitalRead(A0); //read LDR at Pin A0 into a vari-
able
 if (sensorVal == LOW)
 {
 Serial.println(HIGH);
 }
 delay(10);
}
/* Program Ends */
```

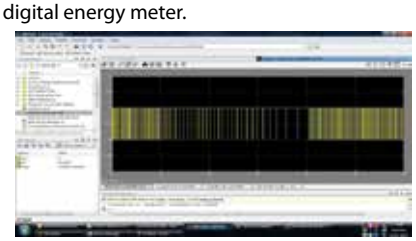
METER INTERFACING USING THROUGH MICROCONTROLLER & MATLAB SIMULINK

MATLAB Simulink is another user-friendly simulation technique. Simulink can be used to simulate many mathematical models using Simulink Blocks. A set of block diagrams can be formed to simulate the inputs and required process can be carried out on the inputs to observe the system response. Simulink can also be used to analyze input signals for interested outcomes (responses) of the system.



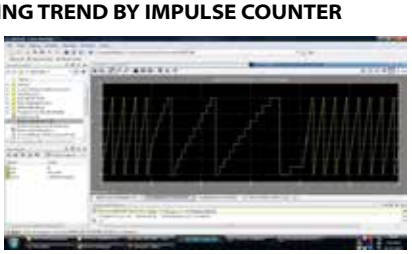
Here bellow the Simulink model for analyzing incoming impulse data is created so as it can be possible to visualize and calculate the energy being consumed. Simulink Display Block and Simulink Scope Block are helpful for doing the job. Simulink Counter Block is also incorporated here so as to count the incoming impulses and give 'Hits' over specified period of the count

Bellow figures are the results obtained in Simulink for duration of 30 seconds. The POT values are varied to emulate loading condition of digital energy meter.

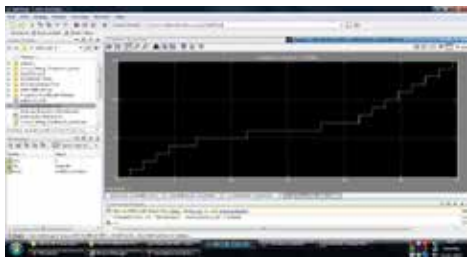


IMPULSE SCANNER SCOPE

LOADING TREND BY IMPULSE COUNTER



LOAD DISTRIBUTION OVER TIME BY COUNTER RESET (/10)



QUANTIZATION OF INCREASING ENERGY CONSUMPTION

FUTURE WORK:

As up till now it had been possible to interface digital energy meter with MATLAB Environment, we can see further development towards analyzing data obtained via serial port and represent it in an effective form to enhance the reorganization of power being consumed to interface the users of electrical energy. This can be achieved by proper manipulation of serial port incoming data and representing it. A calculation for billing amount of the month can be approximated and incorporated in feedback system. User may be given with facility to set limits of his/her target, to be achieved to conserve energy. A continues tracing algorithm can help users to notify threshold of energy being used.

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