

Prepaid Multifunction Controlled Metering System using MATLAB GUI

Shruti S. Sonone, R. M. Autee

Abstract: The system of Prepaid Multifunction Controlled Metering System using MATLAB GUI is developed for monitoring Electricity, Water & Gas consumption. Accurate billing is an important factor to manage household finances especially in difficult times. It is a tool that records amount of energy, water & gas used by a residence or Organizations. This system consists of Energy Metering IC module, Water flow sensor and Gas Detector at customer side. Prepaid services are concept of “First Pay & then use it” done using GSM module which sent SMS of low Balance Energy Meter, Water meter and Gas alert. Similarly using MATLAB GUI, real time readings of Energy Meter, Water meter and Gas alert are displayed on Graphical User Interface and LCD. This reduces wastage of Energy, Water & Gas and helps to keep a track on average domestic & commercial usage.

Index Terms: Energy Metering IC, Water Flow Sensor, Gas sensor, ARM7, GSM, MATLAB GUI.

I. INTRODUCTION

The proposed system is based on embedded system. The basic aim of this system is to monitor metering system in industrial & domestic environment. For meter reading there is always need of humans to visit door to door to take consumption readings of individual meter. This process is time consuming requires more number of humans' employees. Human operator billing are prone to reading error, also has errors while recording what was read and during data entry. It is hard to access meters at rural accounts, indoor meters. Saving electricity & water helps to preserve environment, we cannot live without Electricity & water. By installing a meter may reduce household electricity & Water bills. As well as if we save Electricity & water now, we are helping to ensure Electricity & water supply adequately for future generations. This Prepaid Multifunction Controlled Metering system using MATLAB GUI have been generated from and adopted for the different applications to overcome the drawback in previous system.

II. SYSTEM MODEL

This system consists of three major part Energy Metering IC ADE7757 module, Water flow sensor YF-S201 and Gas Sensor MQ-6 at customer side. Microcontroller ARM7 LPC2138 is interfaced with ADE7757 Energy Metering IC module, Water flow sensor YF-S201, Gas sensor MQ-6,

LCD, GSM module, Load (230V, 50Hz) & Relay driver module. Using MATLAB GUI, real time readings of Energy Meter, Water meter and Gas alert are displayed on Graphical User Interface and LCD. This information coupled with the analysis helps both costumers & providers for better and controlled use of Energy, Water, Gas usage and consumption. A Relay system is used to shut down or disconnect Energy Meter & load through mains supply when recharge amount is zero. Indication of no balance is made on MATLAB GUI and SMS is also sent for low balance. An arrangement is made to shutoff solenoid valve if interface with water meter using Relay Module when no balance. Similarly, to avoid High leakage of Gas flow we are consistently sensing flow using Gas Sensor alerting to the customer.

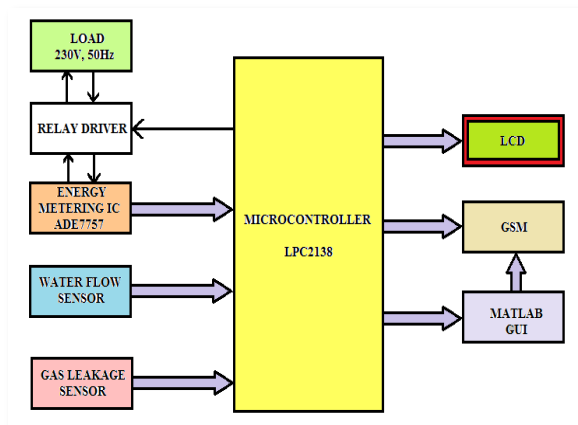


Figure.1. Block Diagram of Multifunction Meter

A MATLAB GUI (graphical user interface) is a graphical display which contains many sub windows, enables user to interface many real time parameters & control systems to perform interactive task with hardware. It is interfaced with Energy Meter, Water Meter & Gas Alert System & provides real time information of these three parameters on consumption of electricity, Water & Gas. Also GSM module send message to user when receives the information from GUI and makes user alert about Low balance.

III. ENERGY METERING MODULE

ADE7757 is a highly accurate IC for electrical energy measurement. The ADE7757 reduces the cost of an external crystal or resonator, thus reducing the overall cost of a meter by operating only with ac input. It supplies average real power information on the low frequency outputs F1 and F2 which is used for interfacing with an MCU. Energy metering IC ADE7757 is interfaced with microcontroller LPC2138 input is Single phase supply provided to IC ADE7757 of 230V, 50Hz at V1P, V1N and V2P, V2N input pins.

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Prepaid Multifunction Controlled Metering System using MATLAB GUI

Voltage and Current transformer is at input supply to provide voltage & Current channel proportional to line. The output of Energy Metering IC is proportional to average real power which is turn to Average real energy Information by Counter & taken from pin no.14, instantaneous real power information is provided at logic output CF (calibrated Frequency). Finally it is given to Microcontroller LPC2138 pin no.P0.10 (35) which stores & display consumption of energy on LCD &MATLAB GUI.Following equation is used to measure the power consumed by the load,

$$1 \text{ watt sec} = 1 \text{ kW sec}/1000 \quad (1)$$

$$1 \text{ watt sec} = 1 \text{ kWh}/(1000*3600) \quad (2)$$

$$\text{Therefore, Energy} = P * \text{Sec}/(1000*3600) \quad (3)$$

IV. WATER METER MODULE

Water flow sensor consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the sensor, rotor starts rotating which is directly proportional to the flow rate & change in speed. The sensor has three wires: power supply of 5-24VDC (red), ground (black) and output Pulse signal (yellow).Each pulse consumes approximately 2.25 millilitres of water. The output of sensor is directly given to microcontroller LPC2138 pin. no P0.11 (37) & is stored simultaneously

V. GAS LEAKAGE ALERT MODULE

The system uses MQ-6 gas sensor which is highly sensitive to propane, butane & LPG. It has SnO₂ sensitive material & is low conductive in air. Sensor continuously senses gas & interrupts to microcontroller when output level is beyond set limit. This system then alerts user by sending the SMS of Gas leakage information.

VI. RESULT ANALYSIS

The figure.2 (a, b) Shows MATLAB GUI of Energy Meter, water meter and gas alert windows. It displays Customer Number, Name, Date of Recharge, Units Consumed, Balance & status of Mains Supply. Energy Meter &, Water Meter block indicates previous unit consumption & current unit consumption. In gas alert block gas leakage is indicated.

After initialization of all COM ports, system then checks for sufficient balance. If recharge is sufficient of Energy Meter &Water Meter, green colour is indicated by mains supply showing "ON" on MATLAB GUI. Else if recharge is less than threshold value of energy meter & water meter, red colour is indicated by mains supply showing "OFF" on MATLAB GUI. Gas alert block gives whether leakage of Gas is lower or higher than threshold value. SMS is send using GSM module when remaining balance is low as shown in figure.3.

Table 1: Energy Meter Consumption

Time (Sec)	Energy Output from Measurement (Wh)
0	0
20	0.54
40	1.10
60	1.68
80	2.24

Table 2: Water Meter Consumption

Time (sec)	Flow Rate	Water Consumed in liters
60	105	6
120	180	12

Table 3: Gas Leakage

Gas Consumption (ppm)	Gas Flow	SMS Alert
Greater than 200ppm	High	Gas Leakage is High
Less than 200ppm	Low	---

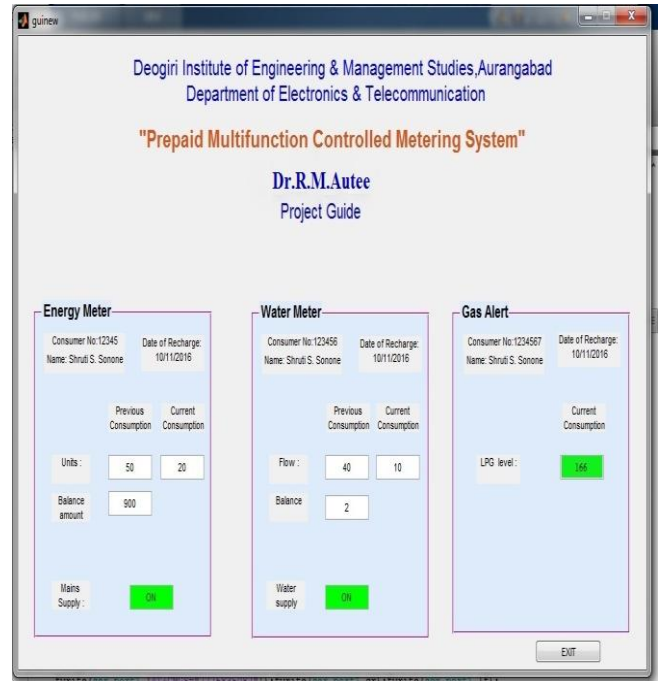


Figure.2 (a). GUI of Proposed System when Sufficient Balance



Figure.2 (b). GUI of Proposed System when Balance is low

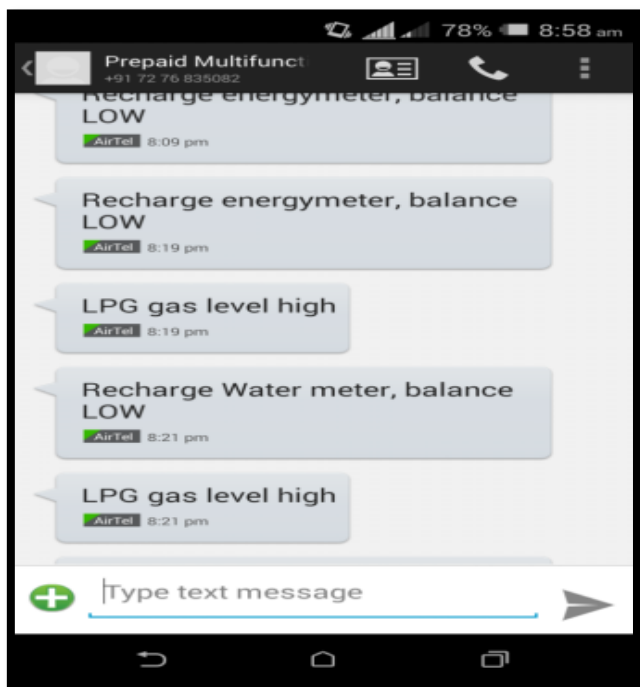


Figure.3. Inbox of User showing Low Balance SMS

VII. CONCLUSION

To avoid human intervention while collecting readings of meters, wastage of water & hazardous accidents due to gas leakage which are mostly occurred in domestic life therefore this project is implemented using above proposed system. User becomes aware of electricity, water & gas consumption. Hence project is tested in various conditions & validated to work efficiently, cost effectively with ease.

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