Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

DTMF based Automatic Electricity Billing

K.V. G. S. Kethan , K. Bhargavi , G. Rambabu
[#]Department of Electronics and Communication Engineering
S.R.K.R Engineering College, Bhimavaram
Andhra Pradesh, India

K. N. V. Satyanarayana
[*] Assistant Professor
Department of Electronics and Communication Engineering
S.R.K.R Engineering College, Bhimavaram
Andhra Pradesh, India

Abstract— This paper **presents a new efficient, simple, low cost model of Automatic Meter Reading System (AMRS). This model uses Dual Tone Multiple Frequency (DTMF) signals for communication between energy provider and energy meter. In this system, there is no need to replace the existing energy meters i.e. this system can be attached as an additional hardware to existing analogue energy meters. This additional hardware consists of a DTMF decoder (IC MT8870) that can be interfaced with any microprocessor or microcontroller. Here we are using 8085 Microprocessor Unit (MPU). This system can be programmed as both prepaid and post-paid. We programmed it in prepaid model. In prepaid case, it enables the user to know the used amount and recharged amount in a display at the energy meter and desired amount can be recharged from any type of mobile phone without using internet and the energy meter is immediately updated with the recharged amount.**

***Key words*- Automatic Meter Reading System (ARMS); Dual Tone Multiple Frequency (DTMF); 8085 Microprocessor Unit (8085 MPU).**

I. INTRODUCTION

Automation Meter Reading and billing is to reduce the physical work involved to take meter readings and billing. The proposed system involves Dual Tone Multiple Frequency (DTMF) signals for automation in energy meter reading and billing. The system can be programmed as both prepaid and post paid also. In prepaid case, the recharged amount and energy consumed by the user is displayed in watts at the energy meter itself. Now when the recharge is needed, the user calls to the energy provider and then gives the details of the amount to be recharged, used watts and remaining amount through DTMF signals by pressing keypad of mobile phone and then user connects the mobile phone to the energy meter using earphone jack provided at the energy meter. By the mode of payment specified by the user, the energy provider will recharge the defined number of used watts through the DTMF signals to the user. Then the DTMF decoder (IC MT8870) decodes the signals and proceeds to microprocessor connected to the energy meter. If the used watts are exceeds the recharged amount, then the power supply to the home is off. In post paid case, the user calls to the energy provider and send the used watts. Then the energy provider sends the amount through the DTMF signals and the bill must be paid before the specified period programmed or else the supply will be off.

II. ARCHITECTURE

When a new system is proposed, it should be such that it is compatible with the old practices with additional advantages. The proposed system does not require any replacement of existing energy meters. It just requires some addition of hardware to the present energy meters. The functional block diagram of the suggested model is shown in the below Fig. 1. This system makes automatic billing so that no physical work is required and the user can pay the bill as mentioned.

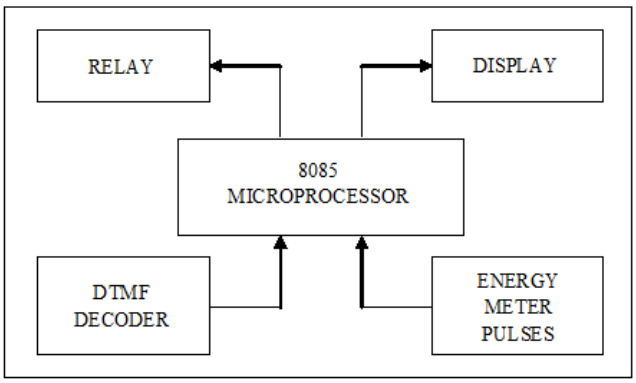

Fig. 1. General block diagram

III. DETAILED DESIGN

The design of this system involves addition of some hardware to the existing energy meter. This hardware mainly contains 8085 microprocessor unit, DTMF decoder (IC 8870), counter (IC 7493) and display unit. A brief description of the components is as follows.

A. 8085 Microprocessor unit

It is a 40 pin IC which includes a logic circuitry for performing computing tasks and for communicating with peripherals. Here 8255A, a programmable parallel

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

Input/output (I/O) device, is interfaced with 8085 Microprocessor Unit (8085 MPU) for connecting energy meter, DTMF decoder and display unit to it. 8255A is a 24 pin IC whose pins can be grouped as two 8 bit parallel ports A and B and the remaining 8 bits as port C whose bits can be used individually or as C upper (4 bits) and C lower (4 bits). In this system 8255A is operated in mode 0 in which all the ports function as simple I/O ports. Here we are using port A and port B as output ports and port C as input port.

B. IC 7493

This s a 4 bit ripple type binary counter. It consists of four Master –slave JK flip flops and additional gating to provide divide-by-two counter and divide- by-eight counter. Each section has a separate clock input to change the initial state of the counter. State changes do not occur simultaneously because of internal ripple delays. Its count frequency is 42 MHz, power dissipation is 130MW and supply current is 28mA. Here this counter is used to count the pulses from the energy meter and the output is given as input to 8085 MPU through port C upper of 8255A.

C. IC MT8870

When any key on mobile phone is pressed a particular signal is transmitted. This signal consists of sum of two frequencies among which one is higher frequency and the other is lower frequency. To decode this signal, a DTMF decoder is used. The MT-8870 is a full DTMF receiver that receives both band split filter and decoder function into a single 18 pin dual in-line package (DIP). It offers low power consumption and precise data handling. Its filter section uses switched capacitor technology for both high and low group filters and for dial tone rejection. When any DTMF signal has been received at mobile phone, it is audible through earphones. So to decode this DTMF signal, earphone output is forwarded to IC MT8870 through ear phone jack. Its decoder uses digital counting techniques to detect and decode DTMF code and gives 4-bit digital output Q1, Q2, Q3 and Q4 according to the received key and sends them to 8085 MPU through port C lower of 8255A. The following table shows the combinations of the frequencies and their equivalent digital output for respected keys.

D. Display unit

The display unit is 8 Digits of multiplexed 7 segment displays. In this 4 digits of the display unit are used to display the number of used watts and the other 4 digits are used to display the amount remained at the energy meter. This unit consists of IC 74LS47 and IC 74LS138.

Fig. 2. Multiplexed 7 segment display used

TABLE.1 DTMF DECODED FREQUENCY OUTPUT TABLE

Button	Low DTMF frequency (Hz)	High DTMF frequency (Hz)	Binary coded output			
			Q1	*Q2*	*Q3*	*Q4*
1	697	1209	0	0	0	1
2	697	1336	0	0	1	0
3	697	1477	0	0	1	1
4	770	1209	0	1	0	0
5	770	1336	0	1	0	1
6	770	1477	0	1	1	0
7	852	1209	0	1	1	1
8	852	1336	1	0	0	0
9	852	1477	1	0	0	1
0	941	1336	1	0	1	0
*	941	1209	1	0	1	1
#	941	1477	1	1	0	0

1) *IC 74LS47:* It is a Binary Coded Decimal (BCD) to 7-segment decoder/driver IC. It accepts a BCD as input and converts it into a pattern to drive a seven segment for displaying digits 0 to 9. It accepts four lines of BCD input data and generates 7 segment output. The data is decoded with seven AND/OR gates to drive indicator LEDs of 7 segments.

2) *IC 74LS138:* It is a high speed 1-of-8 Decoder/Demultiplexer. Here it is used as decoder to select required 7-segment in the multiplexed 7-segments display. The display unit takes input from 8085 MPU through port B of 8255A.

E. Buzzer, Relay, Light Emitting Diodes (LEDs)

A buzzer is connected to the 8085 MPU through port A of 8255A. This buzzer buzzes for few seconds at regular intervals when the power remained is below 10 watts in the pre paid case. In post paid case, the buzzer buzzes when the time available to pay the bill is few days, when the available time is over then the buzzer and the relay that is connected to the Serial Output Data (SOD) pin of 8085 MPU turns off. Two LEDs (LED1, LED2) are used in this system. LED1 blinks during the time of access and LED2 blinks when the security codes are accepted.

The overall design of the system is shown in Fig. 3.

IV. IMPLEMENTATION

A. General working

In general inside energy meter a rotating disk is present and it produces pulses for each rotation and a specific number of rotations are counted a one watt. In this system these pulses are given as clock input to the counter (IC 7493) and its output i.e. the count of pulses, is given as input to 8085 MPU which is programmed to count specific number of pulses as one watt, then 8085 MPU resets the counter and adds the count to

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

previous used watts and displays used watts at the display unit. This process repeats continuously.

B. Process of payment

Payment can be either prepaid or post paid.

1) Prepaid Payment:

a) Role of user: In this case the user calls the energy provider and gives the details of used watts, amount to be recharged and remaining amount by pressing the keys of the mobile phone. This information is send to the energy provider through the DTMF signals that are generated according to the data entered. The energy provider receives the amount by the mode of payment specified by the user. Then the user connects the mobile phone to the energy meter through the earphone jack in the time specified.

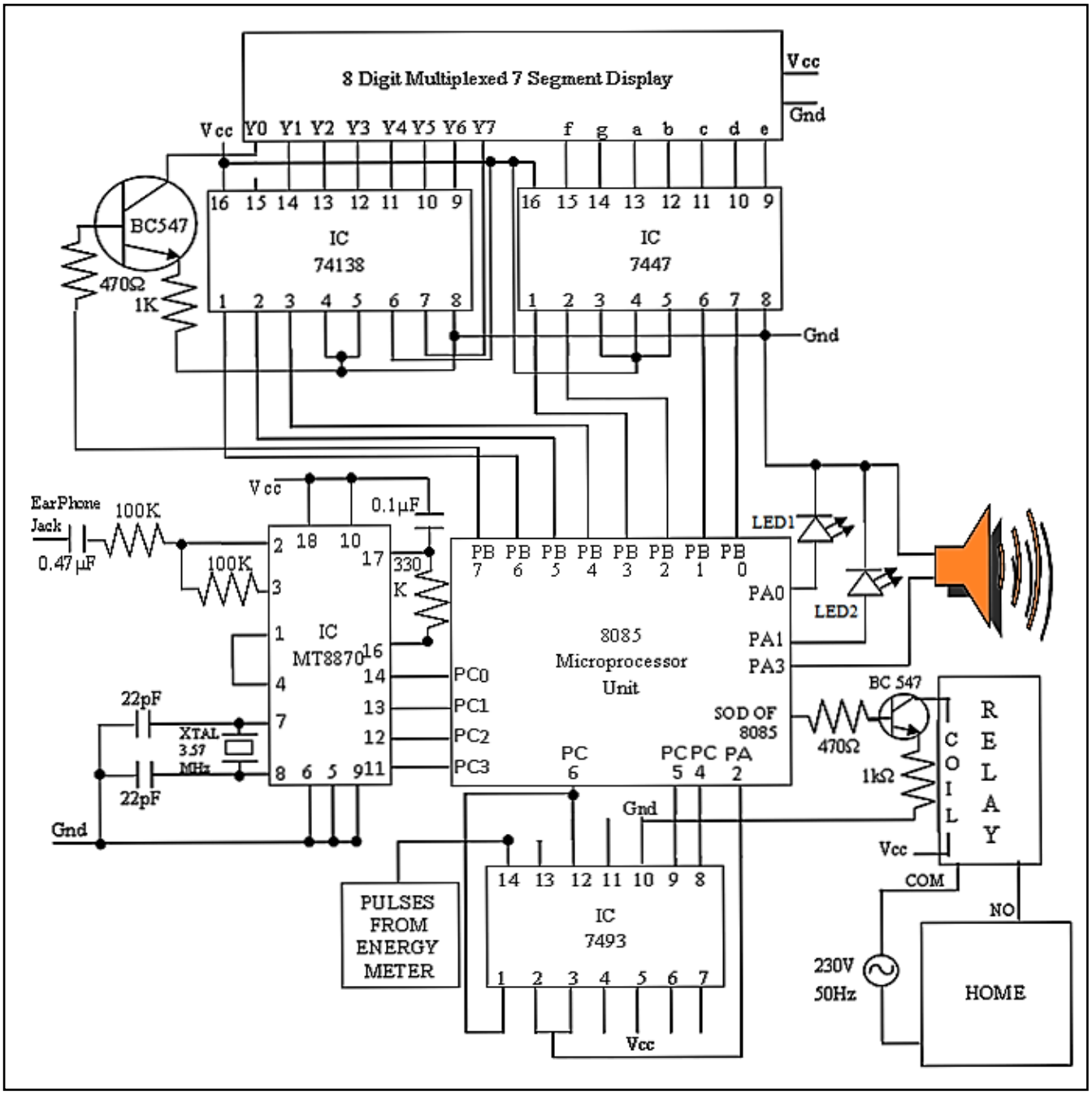

Fig. 3. Overall design of the system

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

b) Role of energy provider: After connecting mobile phone to the energy meter, the energy provider sends security codes and number of watts to be recharged through DTMF signals. The DTMF decoder decodes and sends them to 8085 MPU where the security codes are checked. If the security codes are correct then MPU computes the remaining number of watts by deducting used watts from the previously recharged watts and adds the newly recharged watts to it.

c) Security codes: Initially the energy provider sends two security codes during recharge as mentioned earlier. The first security code is fixed for a given energy meter. This means the security code is same for every recharge. But the second security code varies from recharge to recharge for a given energy meter. This second security code is generated by MPU and energy provider by adding number of times of recharge done until then to the first security code. If the first security code matches and the second security mismatches then the meter is identified as hacked so that the supply to the home is turns off.

2) Synchronization: In this system the energy meter checks for data from the energy provider once for single loop of the program. The time gap between reading of 1st security MSB and 1st security LSB, 1st security LSB and 2nd security MSB and so on are fixed. If the service provider sends the data as per the time gaps in the program, if the 1st security MSB arrives just before or after the program checks for 1st security MSB the recharge will be failed. So to overcome this 1st security MSB is transmitted for time equal to the time taken to run entire program and at energy meter when the 1st security MSB is accepted then the meter checks for 1st security LSB for a time period equal to time taken to run entire program and at any time this 1st security LSB is accepted then the meter checks for 2nd security MSB. This achieved synchronization between data transmission from energy provider and receiving of energy meter. For instant if the time taken to run entire program is 'N' seconds, if the 1st security MSB occur just often energy meter checks for it as the energy provider sends 1st security MSB for 'N' seconds. So the meter accepts the 1st security after 'N' seconds in next loop and the energy provider sends the 1st security MSB the energy meter also searches for 1st security LSB and accepts it. Thus synchronization is achieved. In another instant, if the energy provider sends the 1st security MSB after 3 seconds, the energy meter checks for 1st security MSB then after 'N-3' seconds. The meter accepts the 1st security MSB and checks for 1st security LSB as the meter continuously checks for 'N' seconds thus after 3 seconds the 1st security LSB is sent by energy provider and the meter accepts and then followed by 2nd security MSB thus synchronization is achieved.

V. SECURITY

As the DTMF signals can be generated by any mobile phone and decoder is also available in the market, it is most important to have very good security so that no one can hack and pay by their own. To have a good security, code is randomly changed for recharge to recharge, so that no one will be able to hack the meter. The way this system used to generate the random security is, this meter stores count of the number of recharges and adds it to security code after every successful recharge.

Old security code + count of recharge = New security code

VI. RESULTS

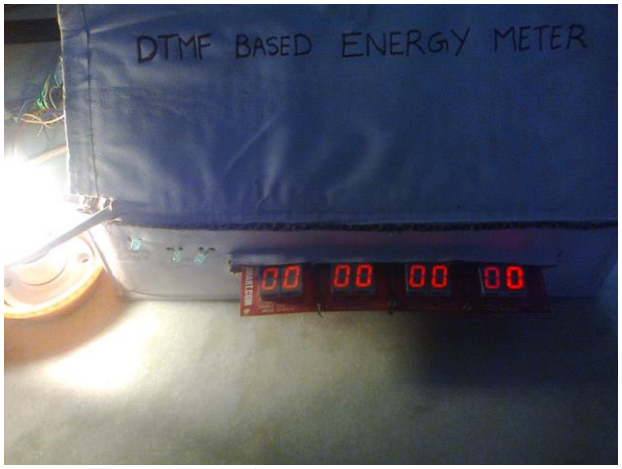

Fig. 4. Initially after code is dumped and executed

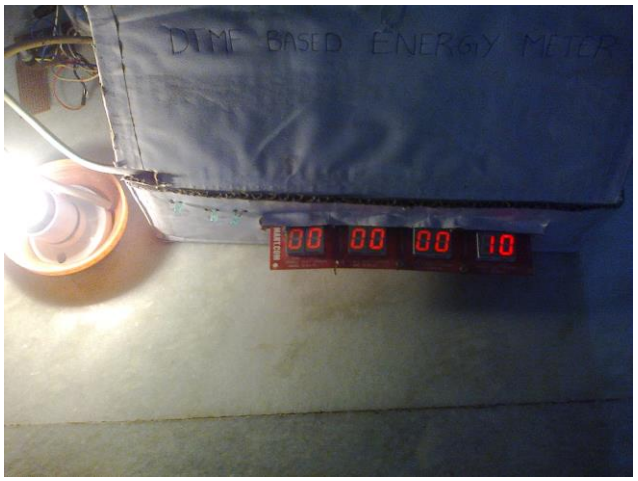

Fig. 5. After recharged with 10 units

Fig. 6. After recharged 10 watts are used

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

VII. CONCLUSION

The use of DTMF signals in this system provides many advantages. There is no use of internet and also the data transmission can be done by any type of mobile phone to a remote station. The security system provided also prevents hacking.

VIII. FUTURE SCOPE

Even though this system lacks the acknowledgement of the sent details by the energy provider, we can overcome this by connecting DTMF generator to the 8085 MPU and can send acknowledgement through it.

REFERENCES

[1] Microprocessor architecture, programming and applications with the 8085 by Ramesh Goankar -5th edition.

[2] Ashna. K, Sudhish N George, "GSM based automatic energy meter reading system with instant billing", IEEE 2013.

[3] Chaitali Khisti, Bhagyashri Kene, Shantanu Kene, "Automatic electrical meter reading system and remote monitoring using zigbee", International Journal of Electrical, Electronics and Computer systems (IJEECS).

[4] Hassan Qayyum, M. Shahan Qadri, M.Hammad, "GSM based automatic energy meter reading", www.superior.edu.pk.

[5] R. B. Hiware, P. Bhaskar, Uttam Bombale, Nilesh Kumar, "Advance low cost electricity billing system using GSM", International Journal of Advanced Engineering Technology (IJAET)