INTRODUCTION

Wireless communication is the transfer of information over a distance without the use of electrical conductors or "wires". The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometers for radio communications). Wireless operations permits services, such as long range communications, that are impossible or impractical to implement with the use of wires.

Industries are implementing automation within a blink of eye. Automation through innovative ways are always accepted everywhere. Nowadays, KSEB appointing persons to read the energy consumption of consumers. This results excess wastage of money and human effort. In order to provide a solution for this wireless transmission of energy meter reading may be thought. In this project, there will be an energy meter, a microcontroller and a communication module. The microcontroller will transmit the current meter reading whenever demanded by the authority. At the KSEB side, there should be another communication module display to demand the meter reading and view the reading.
BLOCK DIAGRAM

METER PART

KSEB PART

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THEORY OF THE CIRCUIT

MICROCONTROLLER

Heart of the circuit is a microcontroller. The microcontroller used here is the PIC 16F877A. PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1640 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller".

PICs are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

FEATURES OF PIC MICROCONTROLLER

High-Performance RISC CPU:

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input
- Universal Synchronous Asynchronous Receiver
GSM BASED ENERGY METER

- Transmitter (USART/SCI) with 9-bit address detection

**Analog Features:**

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module

**Special Microcontroller Features:**

- 100,000 erase/write cycle Enhanced Flash program memory typical
  1,000,000 erase/write cycle Data EEPROM memory typical Data EEPROM
  Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
BLOCK DIAGRAM OF PIC 16F877A

<table>
<thead>
<tr>
<th>Device</th>
<th>Program Flash</th>
<th>Data Memory</th>
<th>Data EEPROM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC16F84A</td>
<td>4Kwords</td>
<td>182 Bytes</td>
<td>128 Bytes</td>
</tr>
<tr>
<td>PIC16F877A</td>
<td>8Kwords</td>
<td>308 Bytes</td>
<td>256 Bytes</td>
</tr>
</tbody>
</table>

Note: Higher-order bits are from the Status register.
PORTA and the TRISA Register

PORTA is a 6-bit wide, bidirectional port. The corresponding data direction register is TRISA. Setting a TRISA bit (= 1) will make the corresponding PORTA pin an input (i.e., put the corresponding output driver in a High-Impedance mode). Clearing a TRISA bit (= 0) will make the corresponding PORTA pin an output (i.e., put the contents of the output latch on the selected pin). Reading the PORTA
register reads the status of the pins, whereas writing to it will write to the port latch. All write operations are read-modify-write operations. Therefore, a write to a port implies that the port pins are read, the value is modified and then written to the port data latch. Pin RA4 is multiplexed with the Timer0 module clock input to become the RA4/T0CKI pin. The RA4/T0CKI pin is a Schmitt Trigger input and an open-drain output.

PORTB and the TRISB Register

PORTB is an 8-bit wide, bidirectional port. The corresponding data direction register is TRISB. Setting a TRISB bit (= 1) will make the corresponding PORTB pin an input (i.e., put the corresponding output driver in a High-Impedance mode).

Fig: Block diagram RB3:RB0 pins
Clearing a TRISB bit (= 0) will make the corresponding PORTB pin an output (i.e., put the contents of the output latch on the selected pin). Three pins of PORTB are multiplexed with the In-Circuit Debugger and Low-Voltage Programming function: RB3/PGM, RB6/PGC and RB7/PGD. Each of the PORTB pins has a weak internal pull-up. A single control bit can turn on all the pull-ups. This is performed by clearing bit RBPU (OPTION_REG<7>). The weak pull-up is automatically turned off when the port pin is configured as an output.

PORTC and the TRISC Register

![Block diagram of PORT C](image)

**Note:**
1. I/O pins have diode protection to VDD and VSS.
2. Port Peripheral Select signal selects between port data and peripheral output.
3. Peripheral OE (Output Enable) is only activated if Peripheral Select is active.

**Fig:** Block diagram of PORT C
PORTC is an 8-bit wide, bidirectional port. The corresponding data direction register is TRISC. Setting a TRISC bit (= 1) will make the corresponding PORTC pin an input (i.e., put the corresponding output driver in a High-Impedance mode). Clearing a TRISC bit (= 0) will make the corresponding PORTC pin an output (i.e., put the contents of the output latch on the selected pin). PORTC is multiplexed with several peripheral functions. When enabling peripheral functions, care should be taken in defining TRIS bits for each PORTC pin. Some peripherals override the TRIS bit to make a pin an output, while other peripherals override the TRIS bit to make a pin an input.

PORTD and TRISD Registers

![Block diagram of PORT D](image)

Note: I/O pins have protection diodes to VDD and VSS.

**Fig:** Block diagram of PORT D

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PORTD is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORTD can be configured as an 8-bit wide microprocessor port (Parallel Slave Port) by setting control bit, PSPMODE (TRISE<4>). In this mode, the input buffers are TTL.

**PORTE and TRISE Register**

![Block diagram of PORT E](image)

**Fig:** Block diagram of PORT E
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PORTe has three pins (RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7) which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers. The PORTe pins become the I/O control inputs for the microprocessor port when bit PSPMODE (TRISE<4>) is set. In this mode, the user must make certain that the TRISE<2:0> bits are set and that the pins are configured as digital inputs. Also, ensure that ADCON1 is configured for digital I/O. In this mode, the input buffers are TTL.

ENERGY METER

Electricity is a clean, convenient way to deliver energy. The electricity meter is how electricity providers measure billable services. Every house, small factory, business establishment, shops, offices etc. need at least one energy meter to register power consumption. The supplier of electrical raises the bill on the basis reading shown by this meter. The producers of electricity sale the electricity to the electricity boards and boards have to sale this energy to the consumer. Consumer needs to pay the amount against the bill raised by the supplier. The data generate by the energy meter is the base to raise the bill by power supplier.

The most common type of meter measures kilowatt hours. When used in electricity retailing, the utilities record the values measured by these meters to generate an invoice for the electricity.

Modern electricity meters operate by continuously measuring the instantaneous voltage (volts) and current (amperes) and finding the product of these to give instantaneous electrical power (watts) which is then integrated against time to
GSM BASED ENERGY METER

give energy used (joules, kilowatt-hours etc). The meters fall into two basic categories, electromechanical and electronic.

Modern solid-state electronic energy meters (also known as kilowatt-hour meters, etc.) employ recently developed electronic components to measure electrical energy. Basic electronic meters are not just more cost-effective than mechanical meters, but offer further benefits: measurement accuracy of the electronic meter is about an order of magnitude better than that of a mechanical meter, while power consumption is lower by about two orders of magnitude. The electronic energy meter is also better protected against tampering than its mechanical predecessor, and units for prepaid operation (e.g., card readers) and remote meter reading (e.g., wireless, telephone line, or internet) can easily be included.

GSM

GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in Europe and other parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band.

GSM is the de facto wireless telephone standard in Europe. GSM has over one billion users worldwide and is available in 190 countries. Since many GSM network operators have roaming agreements with foreign operators, users can often continue to use their mobile phones when they travel to other countries.

<table>
<thead>
<tr>
<th>Mobile Frequency Range</th>
<th>Rx: 925-960; Tx: 880-915</th>
</tr>
</thead>
</table>

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### GSM Based Energy Meter

<table>
<thead>
<tr>
<th>Multiple Access Method</th>
<th>TDMA/FDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplex Method</td>
<td>FDD</td>
</tr>
<tr>
<td>Number of Channels</td>
<td>124 (8 users per channel)</td>
</tr>
<tr>
<td>Channel Spacing</td>
<td>200kHz</td>
</tr>
<tr>
<td>Modulation</td>
<td>GMSK (0.3 Gaussian Filter)</td>
</tr>
<tr>
<td>Channel Bit Rate</td>
<td>270.833Kb</td>
</tr>
</tbody>
</table>

### The Future of GSM

GSM together with other technologies is part of an evolution of wireless mobile telecommunication that includes High-Speed Circuit-Switched Data (HSCSD), General Packet Radio System (GPRS), Enhanced Data rate for GSM Evolution (EDGE), and Universal Mobile Telecommunications Service (UMTS).

### GSM Network Operators

T-Mobile and Cingular operate GSM networks in the United States on the 1,900 MHz band. GSM networks in other countries operate at 900, 1,800, or 1,900 Mhz.
GSM SECURITY

GSM security issues such as theft of service, privacy, and legal interception continue to raise significant interest in the GSM community. For information on GSM security, visit the GSM Security portal.

GSM/GPRS MODEMS AND MODULES

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.
OPTO COUPLER

An opto-isolator (or optical isolator, optical coupling device, optocoupler,) is a device that uses a short optical transmission path to transfer an electronic signal between elements of a circuit, typically a transmitter and a receiver, while keeping them electrically isolated—since the electrical signal is converted to a light beam, transferred, then converted back to an electrical signal, there is no need for electrical connection between the source and destination circuits.

The opto-isolator is simply a package that contains both an infrared light-emitting diode (LED) and a photo detector such as a photosensitive silicon diode, transistor Darlington pair, or silicon controlled rectifier (SCR). The wave-length responses of the two devices are tailored to be as identical as possible to permit the highest measure of coupling possible. Other circuitry—for example an output amplifier—may be integrated into the package. An opto-isolator is usually thought of as a single integrated package, but opto-isolation can also be achieved by using separate devices.

Optocoupler typically come in a small 6-pin or 8-pin IC package, but are essentially a combination of two distinct devices: an optical transmitter, typically a gallium arsenide LED (light-emitting diode) and an optical receiver such as a phototransistor or light-triggered diac. The two are separated by a transparent barrier which blocks any electrical current flow between the two, but does allow the
Usually the electrical connections to the LED section are brought out to the pins on one side of the package and those for the phototransistor or diac to the other side, to physically separate them as much as possible. This usually allows optocoupler to withstand voltages of anywhere between 500V and 7500V between input and output. Optocoupler are essentially digital or switching devices, so they are best for transferring either on-off control signals or digital data. Analog signals can be transferred by means of frequency or pulse-width modulation.

#### LCD DISPLAY

**Liquid crystal display (LCD)** is an electronically-modulated optical device shaped into a thin, flat panel made up of any number of color or monochrome pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector. It is often utilized in battery-powered electronic devices because it uses very small...
amounts of electric power. Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no actual liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

The surfaces of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is unidirectional rubbed using, for example, a cloth. The direction of the liquid crystal alignment is then defined by the direction of rubbing. Electrodes are made of a transparent conductor called Indium Tin Oxide (ITO).

**16 X 2 ALPHANUMERIC LCD MODULE**

**Description**

The JHD162A dot-matrix liquid crystal display controller and driver LSI displays alphanumeric, Japanese kana characters, and symbols. It can be configured to drive a dot-matrix liquid crystal display under the control of a 4- or 8-bit microprocessor. Since all the functions such as display RAM, character generator, and liquid crystal driver, required for driving a dot-matrix liquid crystal display are internally provided on one chip, a minimal system can be interfaced with this controller/driver.

The JHD162A character generator ROM is extended to generate 208 5×8 dot character fonts and 325×10 dot character fonts for a total of 240 different character fonts. The low power supply (2.7V to 5.5V) of the JHD162A is suitable for any portable battery-driven product requiring low power dissipation.
Fig: 2-Line by 16-Character Display

Features:

• 5 × 8 dot matrix possible

• Low power operation support: 2.7 to 5.5V

• Wide range of liquid crystal display driver power: 3.0 to 11V

• Liquid crystal drive waveform

• A (One line frequency AC waveform)

• Correspond to high speed MPU bus interface

• 4-bit or 8-bit MPU interface enabled

• 80 × 8-bit display RAM (80 characters max.)

• 9,920-bit character generator ROM for a total of 240 character fonts
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- 208 character fonts (5 × 8 dot)

- 32 character fonts (5× 10 dot)

- 16-common × 40-segment liquid crystal display driver

- Programmable duty cycles

- 1/8 for one line of 5 × 8 dots with cursor

- 1/16 for two lines of 5 × 8 dots with cursor

- Wide range of instruction functions:

  - Display clear, cursor home, display on/off, cursor on/off, display character blink, cursor shift, display shift

WORKING OF THE CIRCUIT
The circuit consists of an energy meter, a microcontroller and a communication module. An electric meter or energy meter is a device that measures the amount of electrical energy supplied to or produced by a residence, business or machine. The most common type is a kilowatt hour meter. When used in electricity retailing, the utilities record the values measured by these meters to generate an invoice for the electricity. They may also record other variables including the time when the electricity was used. Modern electricity meters operate by continuously measuring the instantaneous voltage (volts) and current (amperes) and finding the product of these to give instantaneous electrical power (watts) which is then integrated against time to give energy used (joules, kilowatt-hours etc). An opto coupler is connected in between the energy meter and MCU. It consists of an input LED and output transistor. As the two are electrically isolated, this gives a fair amount of flexibility when it comes to connecting them into circuit. All we really have to do is work out a convenient way of turning the input LED on and off, and using the resulting switching of the phototransistor to generate an output waveform or logic. The collector pin of the transistor is connected to the microcontroller. The microcontroller then counts the pulses. The microcontroller will transmit the current meter reading (counter value) whenever demanded by the authority. A GSM module is connected to the microcontroller to transfer the data. At the KSEB side, there should be another GSM module and a PC (optionally) to demand and view the reading.
PCB LAYOUT
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#define del 50

unsigned short j, reading, charge;
char data, txt[3], msg[3];

void gsm_msg()
{
    usart_write('A');
    delay_ms(100);
    usart_write('T');
    delay_ms(100);
    usart_write('+');
    delay_ms(100);
    usart_write('C');
    delay_ms(100);
usart_write('M');

delay_ms(100);
usart_write('G');
delay_ms(100);
usart_write('S');
delay_ms(100);
usart_write('=');
delay_ms(100);
usart_write('"');
delay_ms(100);
usart_write('"');
delay_ms(100);
usart_write('+');
delay_ms(100);
usart_write('9');
delay_ms(100);
usart_write('1');
delay_ms(100);
usart_write('9');
delay_ms(100);
usart_write('9');

delay_ms(100);
usart_write('6');
delay_ms(100);
usart_write('1');
delay_ms(100);
usart_write('6');
delay_ms(100);
usart_write('1');
delay_ms(100);
usart_write('6');
delay_ms(100);
usart_write('1');
delay_ms(100);
usart_write('6');
delay_ms(100);
usart_write('0');
delay_ms(100);
usart_write('8');
delay_ms(100);
usart_write('5');
delay_ms(100);
void interrupt()
{
    if (INTCON.INTF)
    {
        j++;
    }
}

delay_ms(100);
usart_write(0X0D);
delay_ms(500);
usart_write(msg[0]);
delay_ms(100);
usart_write(msg[1]);
delay_ms(100);
usart_write(msg[2]);
delay_ms(100);
usart_write(0X1A);
if (j == 4)
{
    reading = reading + 1;
    Eeprom_Write(1, reading);
    j = 0;
}

INTCON.INTF = 0;
return;

} 

if (PIR1.RCIF)
{
    lcd_chr(2, 7, 'X');
    while(!Usart_Data_Ready());
    data = Usart_Read();
    while(!Usart_Data_Ready());
    data = Usart_Read();
    while(!Usart_Data_Ready());
    data = Usart_Read();
    while(!Usart_Data_Ready());
    data = Usart_Read();
}
```c
msg[0] = 0x30; msg[1] = 0x30; msg[2] = 0x30;

if(data == '+')
{
    msg[2] = (reading % 10) + 0x30;
    reading = reading - (reading % 10);
    if(reading)
    {
        reading = reading / 10;
        msg[1] = (reading % 10) + 0x30;
        reading = reading - (reading % 10);
        if(reading)
        {
            reading = reading / 10;
            msg[0] = (reading % 10) + 0x30;
        }
    }
}
```
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```c

gsm_msg();
```

```c

usart_write('A');
delay_ms(100);
usart_write('T');
delay_ms(100);
usart_write('+');
delay_ms(100);
usart_write('C');
delay_ms(100);
usart_write('M');
delay_ms(100);
usart_write('G');
delay_ms(100);
usart_write('D');
delay_ms(100);
```
```c
    usart_write('=');
    delay_ms(100);
    usart_write('D');
    delay_ms(100);
    usart_write('E');
    delay_ms(100);
    usart_write('L');
    delay_ms(100);
    usart_write(' ');  
    delay_ms(100);
    usart_write('A');
    delay_ms(100);
    usart_write('L');
    delay_ms(100);
    usart_write('L');
    delay_ms(100);
    PIR1.RCIF = 0;
    Eeprom_Write(1,0);
    lcd_chr(2,8,'O');
    delay_ms(500);
    lcd_cmd(lcd_clear);
```
```c
void main()
{
    TRISD = 0; TRISB = 0x01;
    Lcd_Init(&PORTD); Lcd_Cmd(Lcd_CLEAR);
    Lcd_Cmd(Lcd_CURSOR_OFF);
    Lcd_Out(1, 1, "UNIT:");
    Lcd_Out(1, 7, "TAFF=2");
    Lcd_Out(2, 1, "CHARG=");
    Usart_Init(9600);
    OPTION_REG.INTEDG = 1; INTCON = 0xD0;
    Delay_ms(3000);
    PIE1.RCIE = 1;
    while(1)
    {
    
```
reading = Eeprom_Read(1);
ShortToStr(reading, txt);
Lcd_Out(1, 6, txt);
delay_ms(1000);
charge = reading*2;
ShortToStr(charge, txt);
Lcd_Out(2, 6, txt);
} }
ADVANTAGES

- Reduces human effort.
- Highly reliable and efficient.
- Inexpensive and easy to maintain.
CONCLUSION

The present proposal is a model to modernize the KSEB at optimum expenditure. Using this system, manpower, time etc. can be saved. It leads to reliable consumption record and ultimate profit to both KSEB and citizens. If this system is implemented, efficient meter reading can be done. The project is successful with this design. Various features can be added with little change in program. Since cost is very less, it will be widely acceptable.
REFERENCES

➢ “Microcontrollers- theory and applications” By Ajay V Desmukh

➢ www.microchip.com

➢ www.national.com