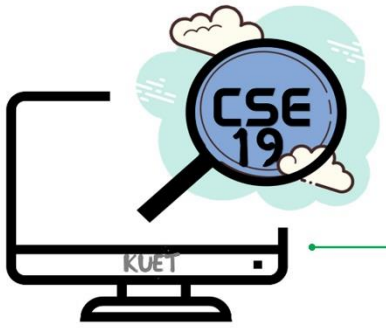
Khulna University of Engineering and Technology

**Course Name: Peripheral Interfacing and Laboratory** **Course Code : CSE 3104**

# Project : Digital Smart Meter


| | |
|---|---|
| Name :Md Sakib Hasan | Name: Proloy Karmakar |
| Roll :1907052 | Roll : 1907051 |
| Section : A<br>Batch: 2k19<br>Dept: CSE | Section: A<br>Batch: 2k19<br>Dept: CSE |

# Index

## ❖Objectives:

- To implement digital multimeter
- To measure ac voltage, current, Power, Frequency and Power factor using implemented multimeter
- To display them on 16*2 LCD Display
- To know the safe use of this multimeter

## ❖Introduction:

- A multimeter, also known as a VOM ,is an electronic measuring instrument that combines several measurement function in one unit. A typical multimeter can measure voltage, current, resistance and power etc. Digital multimeters (DMM, DVOM) have a numeric display and may also show graphical bar representing the measured value. Digital multimeters are now far more common due to their cost and precision, but analog multimeter is preferable in some case, for example when monitoring a rapidly varying value.
- A multimeter can be a hand-held device useful for basic fault finding and field service work, or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies, and wiring systems
- In our project we have implemented a smart digital multimeter. The component used in this multimeter are:

## ❖ Components:

### ❖ PZEM-004T:

PZEM-004T is the best for the purpose of the DIY project, where we need to measure the voltage, current and power using Arduino, ESP8266, Raspberry Pi like opensource platform.


This module serves all these basic requirements of measurement PZEM-004T as a separate board. The physical dimension of the PZEM-004T board is 3.1×7.4 cm, The pzem-004t module is bundled with 33mm diameter current transformer coil.

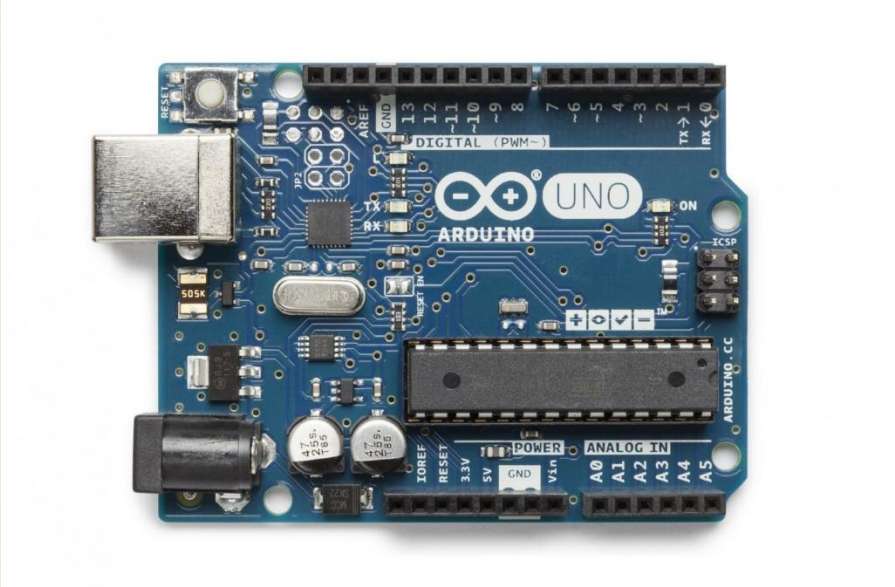
The main part of the PZEM-004T module is the SD3004 chip from the SDIC Microelectronics Co., Ltd. In addition, the board having the EEPROM from Atmel (now microchip) 24C02C which is a 2K bit Serial Electrically Erasable PROM with a voltage range of 4.5V to 5.5V. with More than 1 Million Erase/Write Cycles and 200+ Years Data Retention. Two optocouplers PC817, providing galvanic isolation of the serial interface.

### Configuration variables:

- **Current** (*Optional*): Use the current value of the sensor in amperes. All options from Sensor.
- **Energy** (*Optional*): Use the (active) energy value of the sensor in watt*hours. All options from Sensor.
- **Power** (*Optional*): Use the (active) power value of the sensor in watts. All options from Sensor.
- **Voltage** (*Optional*): Use the voltage value of the sensor in volts. All options from Sensor.
- **Frequency** (*Optional*): Use the frequency value of the sensor in hertz. All options from Sensor.
- **Power factor** (*Optional*): Use the power factor value of the sensor. All options from Sensor.

## ❖ Arduino UNO:

Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pins and 14 digital I/O pins that allows the user to attach various extension boards.



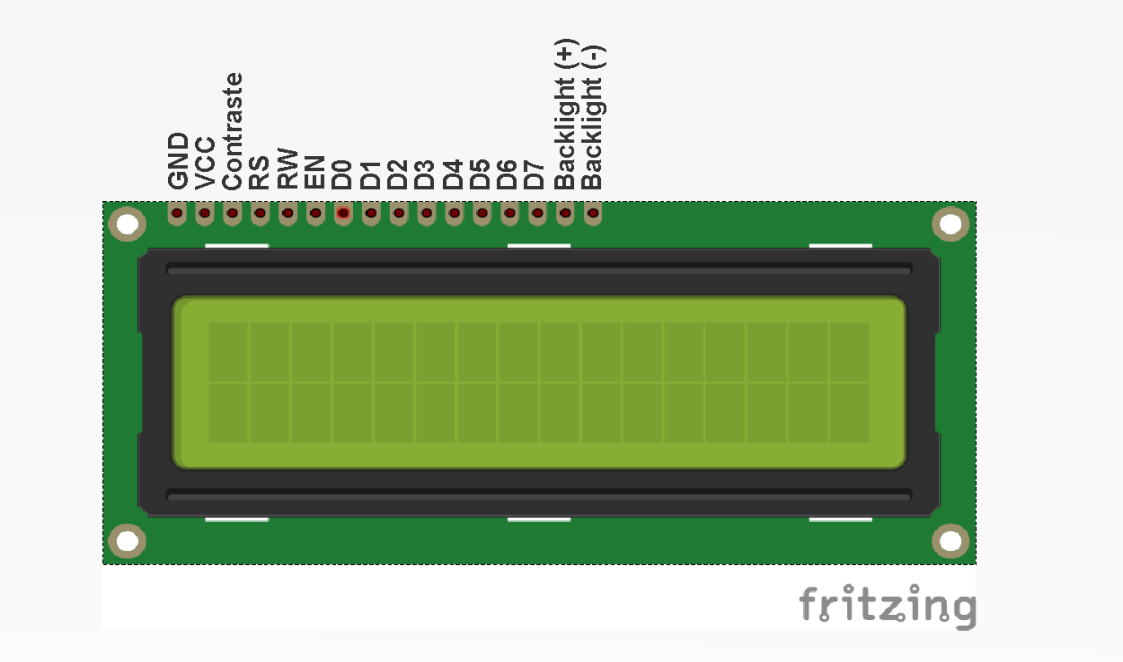

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to-DC adapter or battery.

Arduino was created in the year 2005 by two Italian engineers David Cuartielles and Massimo Banzi with the goal of keeping in mind about students to make them learn how to program the Arduino uno microcontroller and improve their skills about electronics and use it in the real world.

Arduino uno microcontroller can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing).

## ❖ 16×2 LCDs:

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly.




Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pinouts have already been visualized above now let us get a bit technical.16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots

| Pin No. | Function | Name |
|---|---|---|
| 1 | Ground (0V) | Ground |
| 2 | Supply voltage; 5V (4.7V – 5.3V) | Vcc |
| 3 | Contrast adjustment; the best way is to use a variable resistor such as a potentiometer. The output of the potentiometer is connected to this pin. Rotate the potentiometer knob forward and backwards to adjust the LCD contrast. | Vo / VEE |
| 4 | Selects command register when low, and data register when high | RS (Register Select ) |
| 5 | Low to write to the register; High to read from the register | Read/write |
| 6 | Sends data to data pins when a high to low pulse is given; Extra voltage push is required to execute the instruction and EN(enable) signal is used for this purpose. Usually, we make it en=0 and when we want to execute the instruction we make it high en=1 for some milliseconds. After this we again make it ground that is, en=0. | Enable |

| | | |
|---|---|---|
| 7 | 8-bit data pins | DB0 |
| 8 | | DB1 |
| 9 | | DB2 |
| 10 | | DB3 |
| 11 | | DB4 |
| 12 | | DB5 |
| 13 | | DB6 |
| 14 | | DB7 |
| 15 | Backlight VCC (5V) | Led+ |
| 16 | Backlight Ground (0V) | Led- |

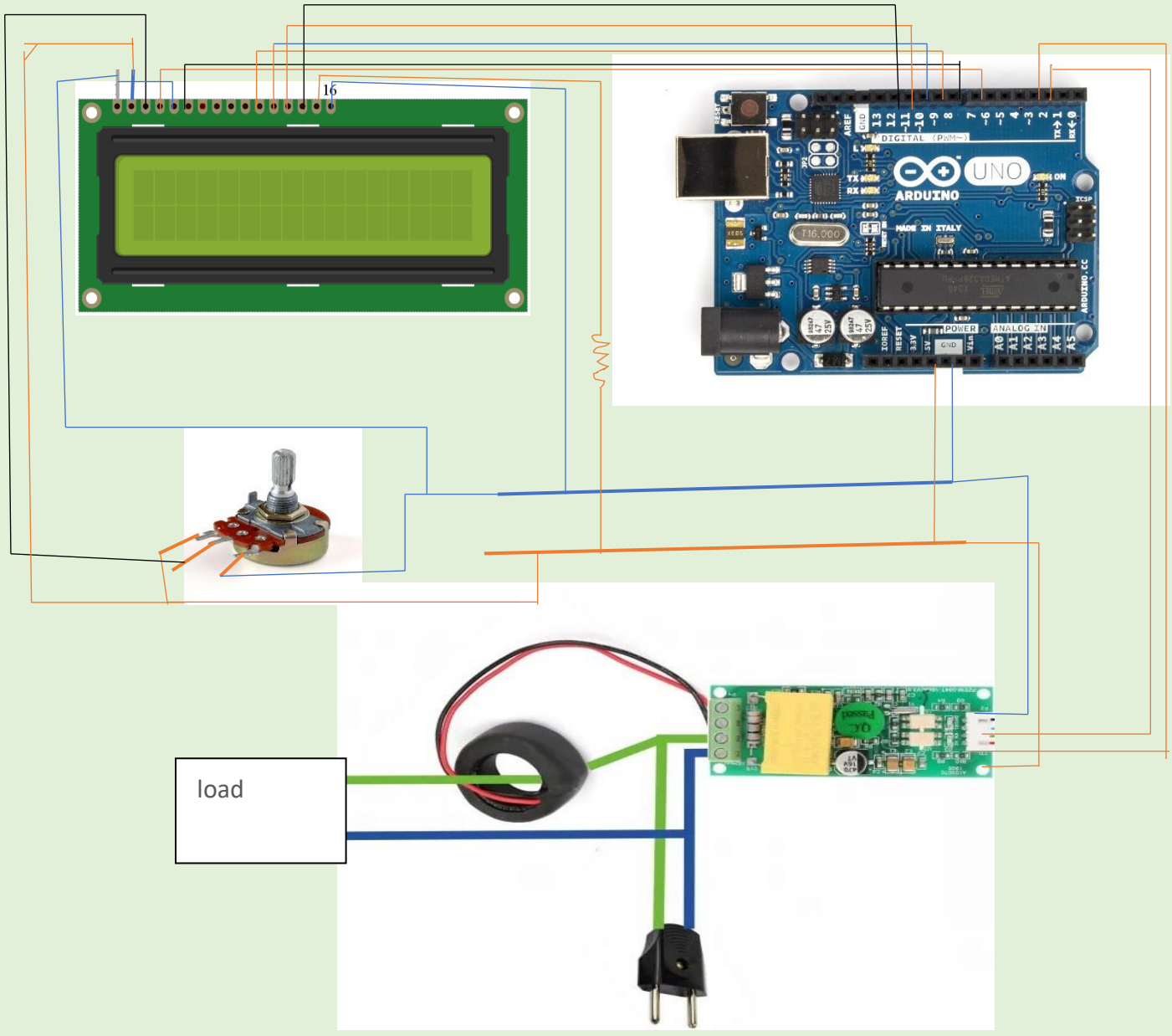
## ❖ Variable resistor (10k POT):

Potentiometers also known as POT, are nothing but variable resistors. They can provide a variable resistance by simply varying the knob on top of its head. It can be classified based on two main parameters. One is their Resistance (R-ohms) itself and the other is its Power (P-Watts) rating.

## ❖ AC power plugs and sockets:

AC power plugs and sockets allow electric equipment to be connected to the primary alternating current (AC) power supply in buildings and at other sites. Electrical plugs and sockets differ from one another in voltage and current rating, shape, size, and connector type. Different systems of plugs and sockets have been standardized, and different standards are used in different parts of the world.

## ❖Wiring Diagram: (for smart meter)



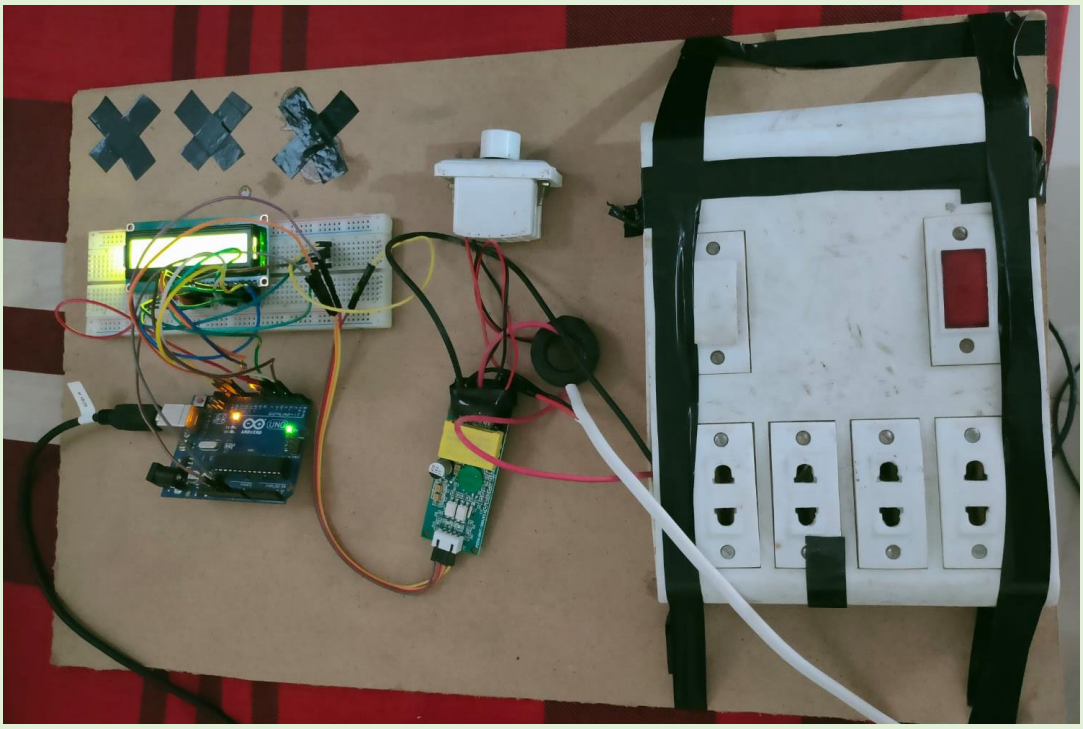
## ❖Working: (For smart meter)

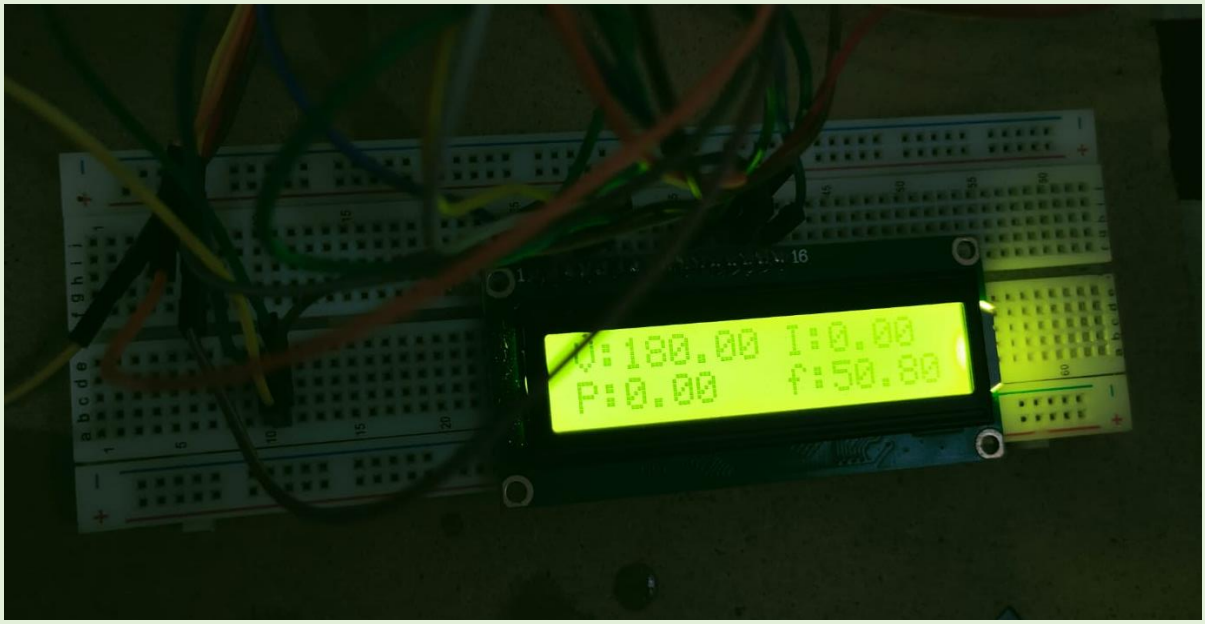
The PZEM-004T module will scan the ac voltage, current, Power, Frequency and Power factor sends this signal to arduino through Rx, Tx. . Here the current sensing and power sensing is done by current transformer coil. Arduino will process these signals and decode the ac voltage, current, Power, Frequency and Power factor from received signal. After that it will print all result in 16*2 LCD display according the program that is given below. Also send all data by hc-05(Bluetooth module) where we create an android app to check voltage, current, frequency, power and power factor. Besides the users can have the notifications of their using of loads.

## ❖Rating:

- Power: measurement range 0 ~ 22kW
- 0 ~ 10kW within the display format of 0.000 to 9.999;
- Within 10 ~ 22kW display format 10.00 ~ 22.00
- Voltage: Test Range 0 ~ 300VAC
- Display Format 0.0 ~ 300.0.
- Current: measurement range 0 ~ 100A
- Display Format 00.00 to 99.99
- Power factor: measurement range 0.0 ~ 1.0A
- Display Format 00.00 to 1.00

## ❖Final view: (smart meter)





## ➢ Connection procedure:

- Connect plug to the supply main
- Connect load to the socket that is on the multimeter
- On the load from meter
- Finally read the desired result.

## ➢ Discussion & conclusion:

Initially, a lot of caution should be taken since this project involves electrical risk or electrocution since 0VAC -300 VAC is used, although some do not consider it high voltage, this does not minimize the danger, it is recommended to have basic knowledge or documentation. Our multimeter is used to measure alternating parameter value. It has very high degree of accuracy. It will provide the feature of measuring ac voltage, current, Power, Frequency and Power factor in a single package. We can remotely monitor our system loads seeing their ac voltage, current, Power, Frequency and Power factor in android devices. We can extend its by changing hc05(Bluetooth module) with GSM or WIFI module. So we can say we were quiet successful in implementing our project and in the fulfilment of objectives of this project. The safety use of this device depends on the user ,so user need to be careful. Specially user need to obey the connection procedure.

# *Thank You !*