Smart energy meter [based on GSM module and database]

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Introduction

Electric energy consumed by the power devices is measured by a gadget known as an energy meter. Since 1980s, the energy meter's journey started. When there were large energy meters which have been made with lots of innovations in energy meters to reduce its size and also the weight. Particularly, enhancement in accuracy, specifications and features of energy meters has been a topic of discussion.

Nowadays digital energy meters can measure all parameters with small package and with accurate.
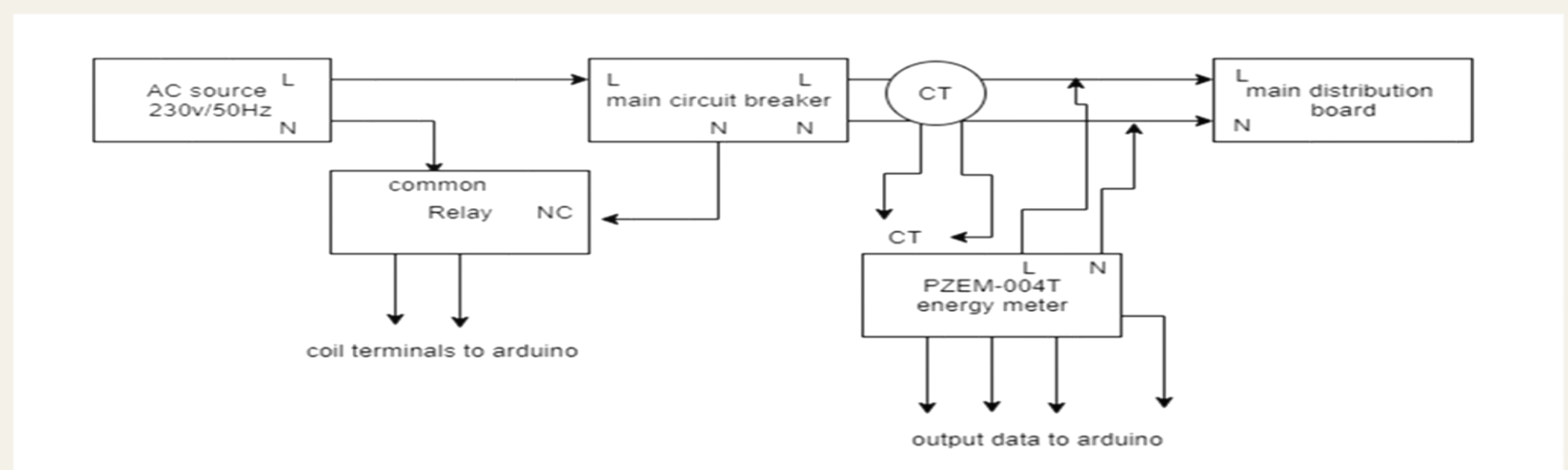

Methods and materials

❖listing hardware which the project needs (tools) and their work needed:

√Arduino (Uno R3).

√Arduino GSM Shield (SIM 900).

√ LCD display

√ volt DC source

√Relay.

√PZEM-004T.

√Regulated

overall flow chart system
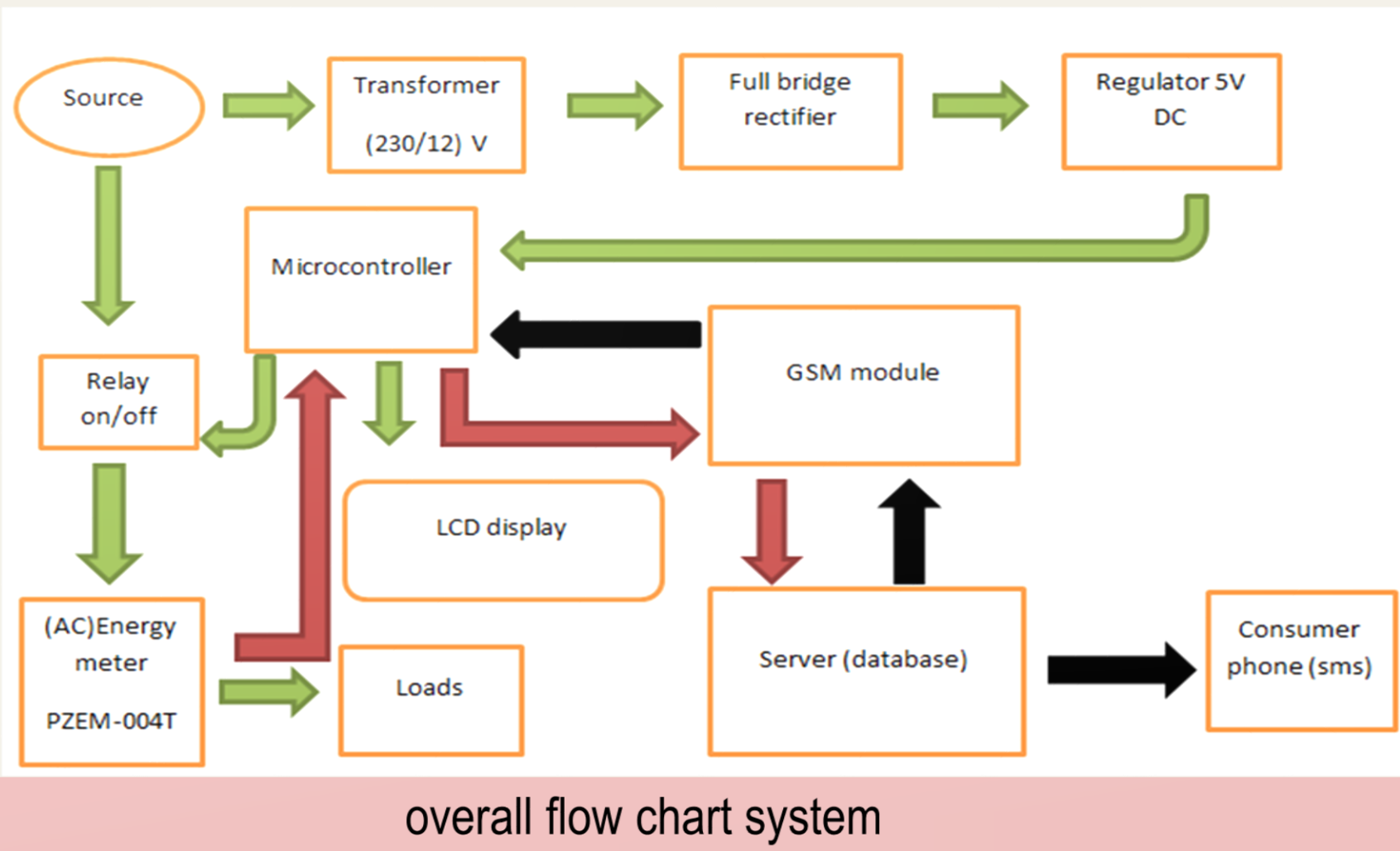
transportation of data in the system

block diagram of AC hardware design

Comparing the smart energy meter with other meters

| Idea/type	Disk meter (Only staff)	Egyptian (card)	Holly(card)	Holly(code)	Smart meter
Payment method	Monthly	Prepayment	Prepayment	Prepayment	monthly
Human reader	needed	No needed	No needed	No needed	No needed
automatically cutting electricity off	Not available	available	available	available	available
Physical component for users	No need	Needed card	Needed card	Needed card and code	No need
safe from stealing	Not safe	Not safe	Not safe	Not safe	safe
Controlled by the company	Not controlled	Not controlled	Not controlled	Not controlled	Controlled
Deal with consumer	Easy	Hard	Hard	Hard	Easy
Deal with charging centers	Easy	Hard	Hard	Hard	Easy

Software design

❖ Arduino codes

Here the flow chart of the code for the project
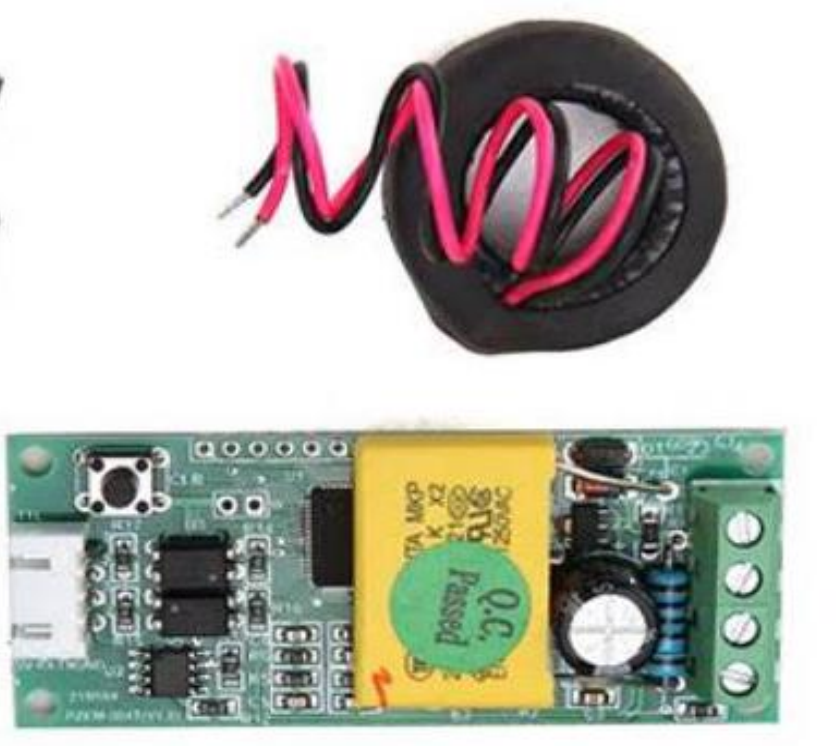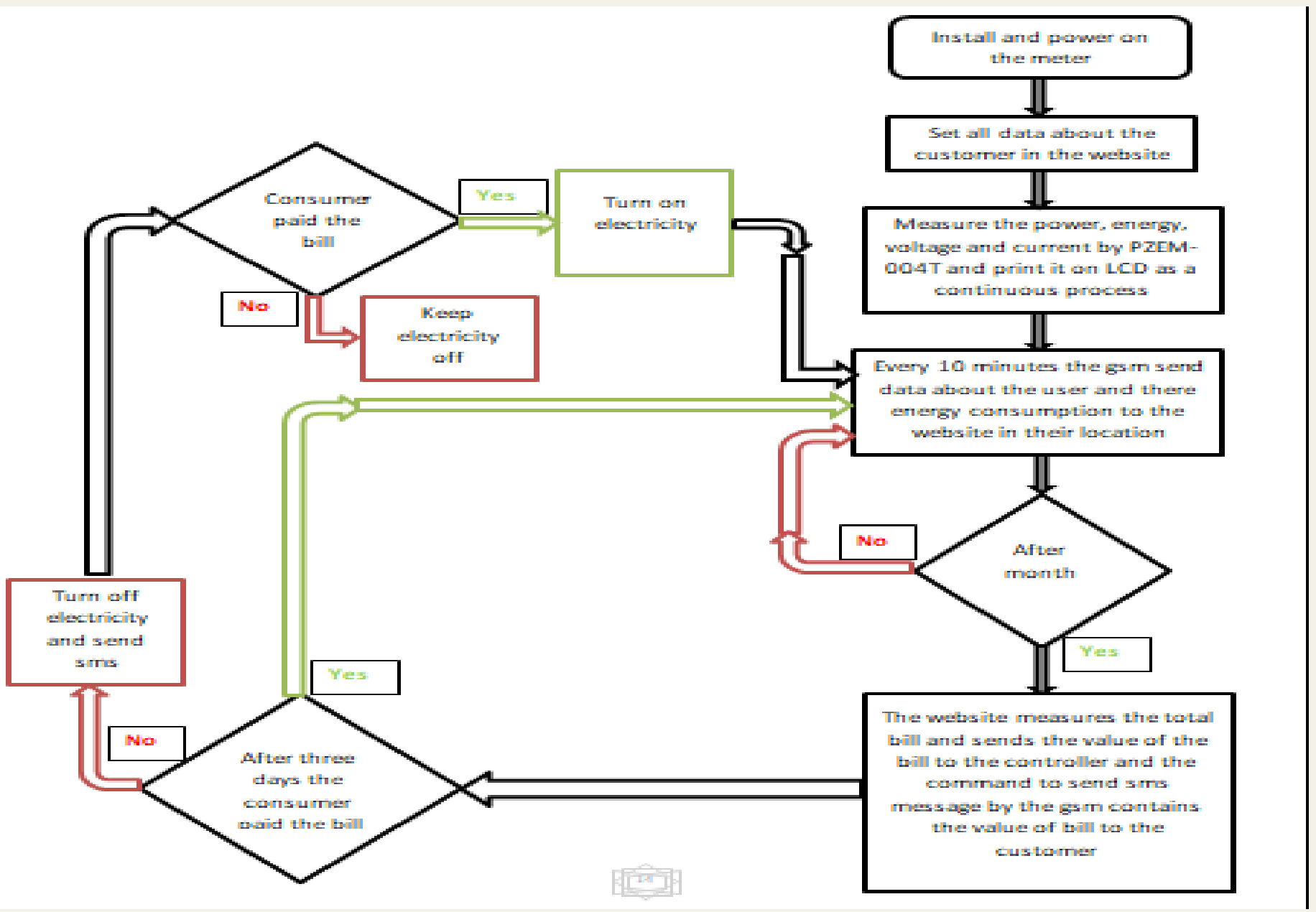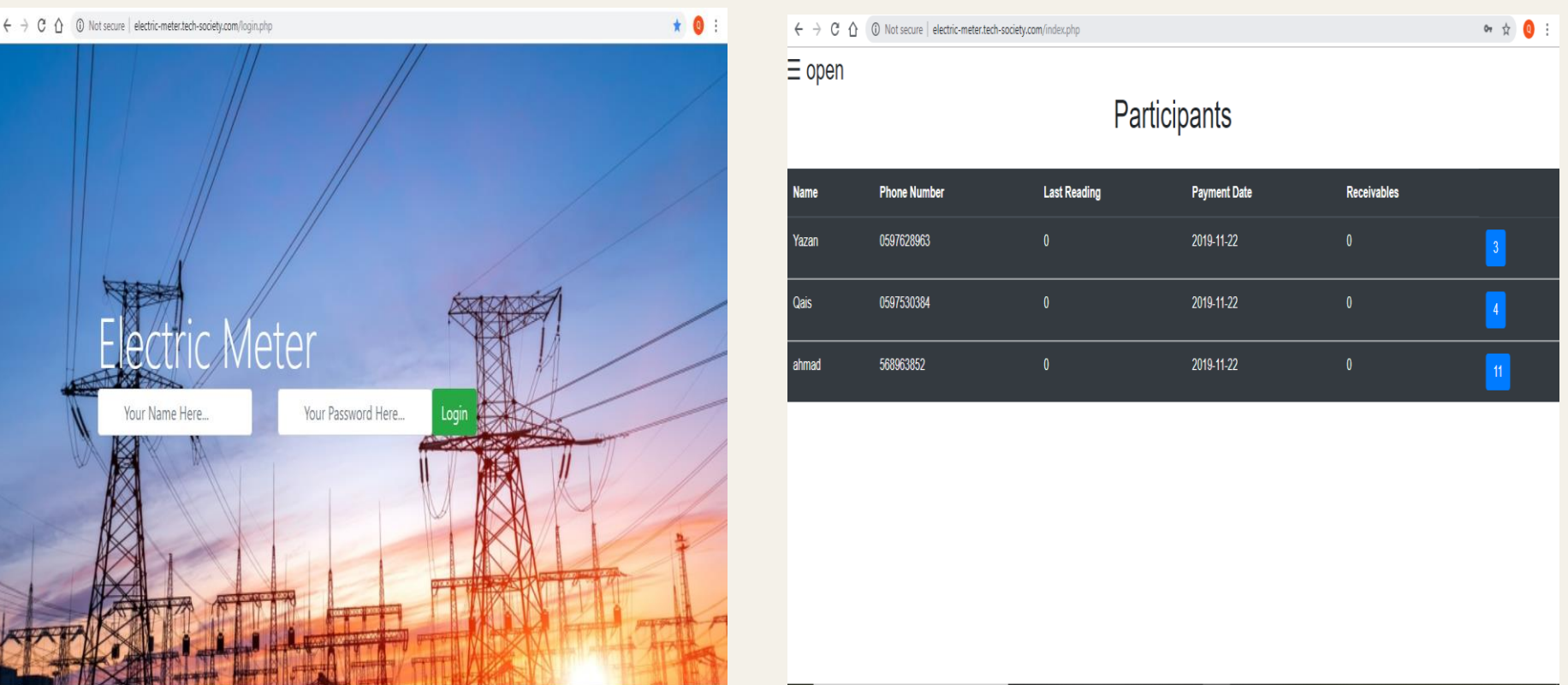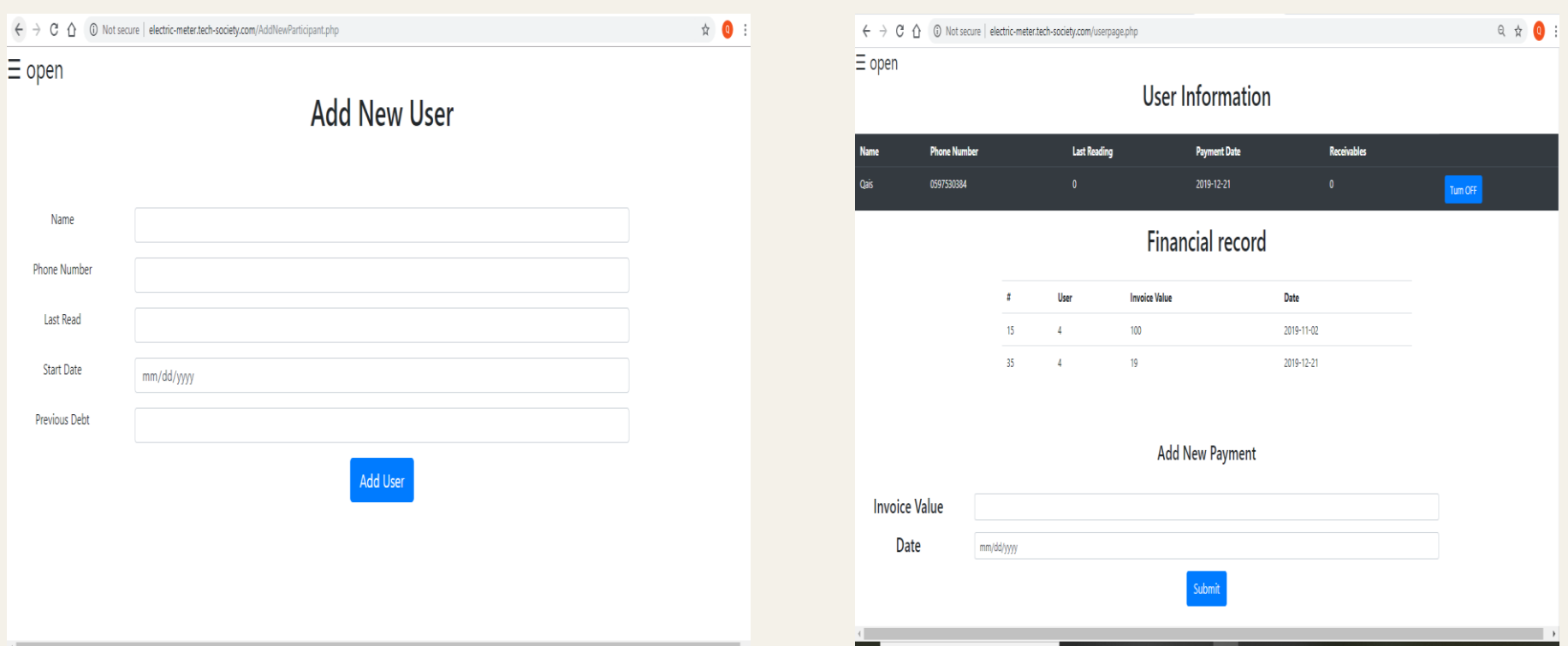

PZEM-004T kit for measuring
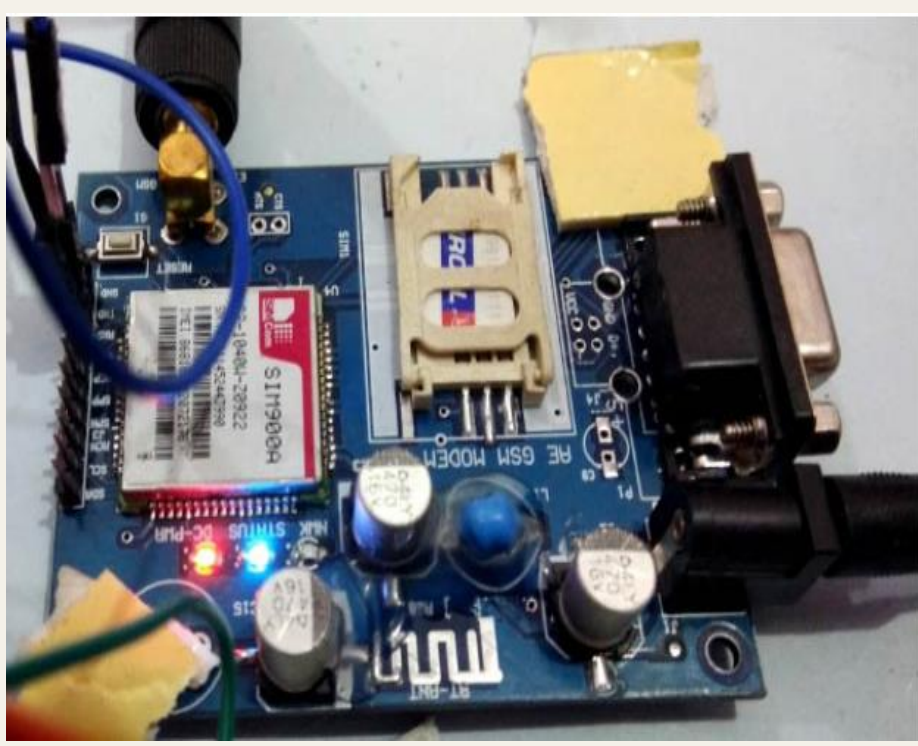
GSM kit for communication

❖ XAMP design (data base)

Logging in the server

The server interface

Adding a new user in the server

User page

❖ System work mechanism

A smart energy meter works by directly communicating with GSM module and GPRS protocol with company of energy supplier, the data was measured by PZEM-004t and sending to the server each month but all the data appears on the screen (LCD) at the consumer

Advantages

- More technically for users and company.
- It's easy to paying bill.
- Easy to deal with it.
- It's more safe from stealing because they have a connection with a general server contains all consumers.
- The server lets the company to control and monitoring the data of the users and the state of electricity so the detecting theft available and easy to control this cases.
- No need a human to read the energy for each user every month.
- Lower fixed and running cost.

Results

❖ The final results of the project (smart energy meter) are divided into two parts:

Results or measurements parameters values (on LCD screen) in the user side, this screen will display the following parameters :

1. Instantaneous voltage (RMS) (V).
2. Instantaneous current (A).
3. Instantaneous power (Kw).
4. Cumulative Energy (Kwh).
5. Instantaneous power factor.
6. Instantaneous reactive power (KVAR).

❖ All these values which in the previous part will send from Arduino to the php code (database), but php code will calculate what the system need, which are:

1. Average power (Kw).
2. Average reactive power (KVAR).
3. Maximum power.
4. Average power factor.

❖ An important note: the Arduino code is fixed code, but the php code is dynamic code.

❖ Examples of data which maybe need to adjust with time:

1. The cost of (1Kwh) –tariff-.
2. Load management.
3. Maximum demand.
4. Payment method.
5. Penalty.
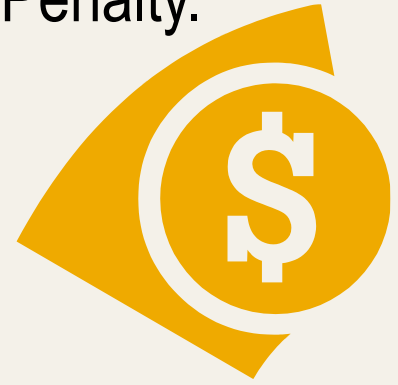
Feasibility study

❖ The list of element prices was made as following

The total price for smart energy meter hardware is equal to 34$ and the server price for all consumers, but it was added to the calculations assume taken one customer only so the total price is 42 $.

So this meter doesn't consume large running cost they decrease it so much, but 5$ is assumed as a maintenance and software updates and so on.

The other meters have a fixed cost not less than 138$ for consumer and need too much maintenance, employees, software updates and the company can't control the loads so the theft is predictable and easy.

NO	element	Price($)
1	Microcontroller	4.22
2	GSM SMI900A	10.95
3	LCD 2x16 I2C	1.82
4	Relay	.74
5	PZEM-004T	7
6	Transformer	6.9
7	Bridge rectifier	.27
8	Regulator LM317	.065
9	2Capacitors	.089
10	2Resistors	.02
11	Server hosting	8
12	Cost of messages	2

Future Vision

❖ Improvement the security of the server.

❖ For more control a detection of electricity theft can made.

❖ For more reliability, a system of energy meter should suet all consumers' meters like meters on PV systems (bidirectional meters) which project two will explain in details.

❖ Also for an on- grid PV systems there are limited output power from solar modules so a power detection can made.

❖ Power management :

- The relation between the consumer and the company should be win-win.
- For three phase systems (large power) the power consume must be limited .
- In the peak period (maximum demand period) make the tariff double from normal for large power consumptions.

Disadvantages

❖ If install this type of meters (smart meter) is needed for three phase source, three (PZEM-004T) are needed or if install this for PV system is needed two (PZEM-004T) are needed for each phase that mean six of (PZEM-004T) for three phase system, so the cost will increase, but its keep low than author meters and graduation project two will describe this cases (three phase and PV systems) clearly.