CHAPTER 1
INTRODUCTION

The term INTERNET plays a very important role in everyone's life. The industrial revolution is depending on the evolution of technology and its connection with the internet. Here comes the term Internet of Things which connects any system with the internet so that it can be accessed from any part of the world and anytime. The technology relates to sensors, modems, and many internet connecting modules, hence data transfer between system and cloud becomes easier. Various protocols are made to help such kind of connectivity and give real-time monitoring features to the physical system. Smart devices network is connected by internet of things which are engaged with the feature of real time data transfer to cloud using wireless technology. It means that IP addresses have been assigned to the objects for collection of information and transfer that information without manual interference over the network.

Smart meters are an electronic device to measure energy consumption accurately, at precise time intervals. The cost of electricity consumption measured by fixed charges, after that, a measuring device as "Electric Meter" came into the market. This meter has some limitation such as precision value of meter reading, missing of date and time and kilowatt per hour etc. This was the major concern for both the electric consumer and provider to know the exact value of the electric consumption with other essential information. To overcome these issues, several technologies have been developed and a new concept of measuring device was introduced "smart meter" introduced for an accurate result. In this paper, we discuss things that can overcome the limitations of the existing smart devices. A system that can monitor customers' electrical energy consumption remotely automatically. The electricity consumption can be displayed through FIREBASE Server which can be used by both administrator and consumer. The administrator can disconnect the power supply when the energy consumption exceeds a certain limit.

This smart energy meter system is capable to monitor and show current, voltage, power, energy etc. Esp-32, microcontroller is used to make communication between the Server and energy meter. Esp32 processes faster as compared to other controllers as compared to other controllers and comes with inbuilt WIFI module. The information that reaches consumer is accurate and error free, unlike the data obtained through manual meter reading. The power utility companies could offer concession for electricity usage during light load hour. The consumers could

schedule their heavy load operation accordingly. This enables the utility companies to follow a more systematic procedure in controlling the energy produced from conventional sources of energy and make consumers use energy efficiently by avoiding overloads.

1.1: ENERGY CONSUMPTION:

Electricity consumption represents the amount of electrical energy that been consumed over a specific time, in units of kWh.

APPLIANCES	**WATTAGE (MIN)**	**WATTAGE (MAX)**	**MIN UNITS CONSUMED (**IN AN HOUR**)**	**MAX UNITS CONSUMED** (IN AN HOUR)
LED light bulb	**7**W	10 W	0.007 KWh	0.01 KWh
Tube light	22W	22W	0.022 KWh	0.022KWh
Wall-mounted fan	45W	60 W	0.045 KWh	0.06 KWh
Refrigerator	100W	200W	0.1KWh	0.2KWh
Washing machine	500W	500W	0.5KWh	0.5KWh
Laptop	40W	120W	0.04KWh	0.12KWh
Electric kettle	1200W	3000W	1.2KWh	3KWh
Oven	1000W	2150W	1KWh	2.15KWh

TABLE 1.1: Power and and energy consumptions of home appliances

CHAPTER 2

LITERATURE SURVEY

[1] Landi, C.; Dipt. di Ing. dell"Inf., Seconda Univ. di Napoli, Aversa, Italy; Merola, P. ; Ianniello, G", "ARM-based management system using smart meter and Web a. server",2011. In this paper they described such as a low cost real-time ARM-based energy management system is proposed. It is conceived as part of a distributed system that measures the main power system quantities and give the possibility to manage the whole power plant. An integrated Web Server allow to collect the statistics of power consumption, and power quality and is able to interface devices for load displacement. The device is characterized by easy access to the information and the combination of a smart meter and data communication capability allow local and remote access.

[2] "Garrab, A.; Bouallegue, A.; Ben Abdallah" , "A new AMR approach for energy saving in Smart Grids using Smart Meter and partial Power Line Communication" , 2012. In this paper they described such as the growing demand for energy, the capacity limitations of energy management, one-way communication, the need for interoperability of the different standards, the security of communication, and the greenhouse gas emissions, which leads to emerging a new infrastructure grid: Smart Grid. Smart Meters are one of the proposed solutions for the Smart Grid. In this paper, an AMR solution that provides enhanced end-to-end application. It is based on an energy meter with a low-power microcontroller MSP430FE423A and the Power Line Communication standards. The microcontroller includes an energy metering module ESP430CEl solution is with great interest from an economical and low carbon society point of view.

[3] "B. S. Koay, S. S. Cheah, Y. H. Sng, P. H. Chong, P. Shum, Y. C. Tong, X. Y. Wang, Y. X. Zuo and H. W. Kuek" , "Design and implementation of Bluetooth energy meter", 2012. In this paper they described such as Presently electronics energy measurement is continuously replacing existing technology of electro-mechanical meters especially in China and India. By the year 2004, digital meter has start replacing electromechanical meters in Singapore. A wireless digital energy meter would definitely offer greater convenience to the meter reading task. Bluetooth technology is chosen as a possible wireless solution to this issue.

[4] DzDarshan Iyer N, Dr. KA Radhakrishna Rao M Tech. student, Dept. of ECE ,PES College of Engineering, Mandya, Karnataka, Indiadz , Dz IoT Based Energy Meter Reading, Theft

Detection and Disconnection using PLC modem and Power optimization dz , Vol. И, Issue 7, July, 2015. This paper describes PIC18F46k22 Microcontroller based design and implementation of energy meter. The proposed systemincludes theft detection system. The Buyer needs to pay for the usage of electricity on schedule. Theft detection unit connected to energy meter will notify company side when meter tampering occurs in energy meter and it will send theft detect information through PLC modem and theft detected will be displayed on the terminal window of the companyside.

[5] Anitha PrathikM, Anitha.V V. Smart Energy Meter Surveillance Using IoT. In: International Conference on Power, Energy, Control and Transmission Systems (ICPECTS), IEEE Conference Proceedings; 2018 proposed a system - an IoT-based energy meter that gives information about the consumed energy on an hourly basis, details of billing, and payment. The IoT kit is implemented by the NodeMCU, which has inbuilt ESP 8266 module which establishes the communication to serve page. If any abnormal condition is observed, the module sends an SMS to the appropriate person.

[6] Kamal Visalatchi S, Sandeep K. In: Smart Energy Metering and Power Theft Control using Arduino & GSM "2017 2nd International Conference for Convergence in Technology (I2CT). IEEE; 2017. proposed a method based on Arduino-Uno. It is used to identify and control power theft in the energy meter. An algorithm is proposed to connect and disconnect the meter when the malfunction is detected. The relay logic method is used to connect and disconnect the meter with the utility devices. It is possible to send SMS automatically to the customer from the energy meter and central authority server through the GSM module.

[7] Kumar Anirudh, Thakur Sreyasi, Bhattacharjee Partha. In: Real time monitoring of AMR enabled energy meter for AMI in Smart City - An IoT Application" International symposium on smart electronics systems; 2018 proposed a new approach to efficiently monitor the energy consumption of an automatic meter reading system with the help of LDR. The utility organization possesses the energy meter, so it is not possible to modify/tamper with this energy. Every AMR energy meter operates on frequency, and for every frequency, LED will glow or flash. This frequency is directly proportional to the energy consumption recorded in the memory card. The flashing of LED is used to calculate the utilization factor in power consumption. Estimated energy data will push the server through HTTP protocol and ESP 8266 module.

[8] Abhiraj Prashant Hiwale, Deepak Sudam Gaikwad, Akshay Ashok Dongare, Prathmesh Chandrakant Mhatre, "IoT based smart energy meter", 2018. It is based automatic meter reading is the technology of automatic collecting data energy meter and transferring data to the server for billing process. The internet connected to the meter collect the data and display data on the LCD by which we can read and understand the things that are going on the system. It includes Wifi module for internet connectivity, Current Transformer to calculate drawn, LCD etc.

[9] Rishabh Jain, Sharvi Gupta, Chirag Mahajan, Ashish Chauhan, " Smart Energy Meter Monitoring and Controlling System", 2019. In this paper Wifi module provide internet connectivity to the system, readings are processed. Arduino UNO board is based on ATmega 328p processor.

[10] Faisal M, Karim Tahia Fahrin, Ridwan Pavel Abu, Hossen MdShahadat, HossainLipu MS. Development of smart energy meter for energy cost analysis of conventional grid and solar energy. In: International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST); 2019 proposed a new innovative method to implement the energy meter. This energy meter comprises the controller and sensor modules that can monitor energy utilization in wide dissimilar appliances. This prototype model consists of a PIC microcontroller (PIC16F877), a CT sensor, and voltage divider circuits for voltage and current measurements. The sophisticated energy meter can control the consumers' supply and utilization accurately according to the load requirement.

"Net metering" or "net billing" system is generally used to process the electricity billing in a grid connected system. In this system, if there is any surplus energy from the solar power after meeting the demand of load, then this power can be sent to the utility grid. On the other hand, if the power produced from the solar system is less than the required amount, the rest of the power can be accessed from the grid. The major problem arises when consumers are unaware of their daily behavior. Monthly feedback given to the consumers is not sufficient as the consumers will not have knowledge on how much energy each appliance consumes individually. To address the above challenges, this paper aims to fulfil the following two objectives; (i) To develop an improved model designing a smart energy meter for household appliances in order to control the consumption economically and (ii) To analyse the energy cost of electricity produced from conventional grid and solar energy in order to choose a reliable and cost-effective power supplier. II. SMART ENERGY METER MODEL The

proposed model for designing an energy meter is divided into various parts. They are classified below; (i) Utility connection, (ii) solar power generation and meter input for the generated electricity connection, (iii) current sensing unit, (iv) voltage regulator, and (v) microcontroller unit. An AC main power is used which is then rectified by a bridge rectifier. Then, the output of the rectifier is converted to DC. Later, a voltage regulator is used to step down the voltage to the level of microcontroller input. The load is connected to the microcontroller through the current sensor. For solar power generation, a solar panel is used. Solar panel stores maximum amount of energy into battery cells using a charge controller. Then the conversion of the DC output voltage of the battery to AC voltage takes place using an inverter. Two voltage transformer and current transformers are used for measurement of the solar generation. The factors related to the development of 2019 International Conference on Robotics, Electrical and Signal.

CHAPTER 3

EXISTING SYSTEM

This project has been created after analyzing the existing meter reading techniques on different energy measuring instruments. In the existing system either an electronic energy meter or an electro-mechanical meter is fixed in the premise for measuring the usage. The meters currently in use are only capable of recording kWh units. In this system man in the powerhouse goes to the consumer house and take the reading of consumption and accordingly power consumption bill is being prepared. It may have many errors. Hence the solution for this problem is only smart energy meter system with real time data monitoring and recording.

DRAWBACKS OF EXISTING SYSTEM:

- Time consuming Process
- Human Observation is needed
- Possibility of manual error while taking the reading information
- No data transparency about daily usage
- Extra Manpower engaged
- Real-Time data monitoring feature is not available.

CHAPTER 4

PROPOSED SYSTEM

The energy meter is a common device found in every home, namely a kWh meter. Obviously, it is inefficient for KSEB officers to take readings manually. Our project aims to design a smart energy meter to optimize energy consumption. This project uses an experimental method of designing system hardware and software. The RS485 port is used to read all the data from the meter, this data is processed and sent this data to the firebase server. The system uses ESP32 as a microcontroller having features of controlling the energy meter and also having the capability of connecting with the internet. The collected data in the firebase is then connected to an app that is created by using kodular creator. The created app is exported to personalized smartphone. The app can be controlled by both consumer and the administrator. It can display the current, voltage, power, and energy which can be observed by the user. A dedicated page for admin login is incorporated through which power and energy consumption can be monitored as well as can be disconnected when energy exceeds the specified limit. Admin can control the system by a pair of switches that is directly biased with a relay that mediates the control of the system. As the relay activates the load is disconnected from the system.

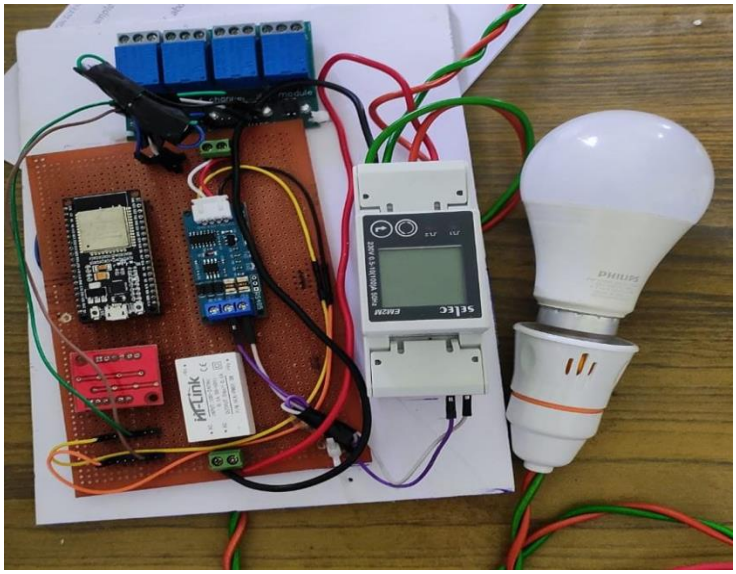
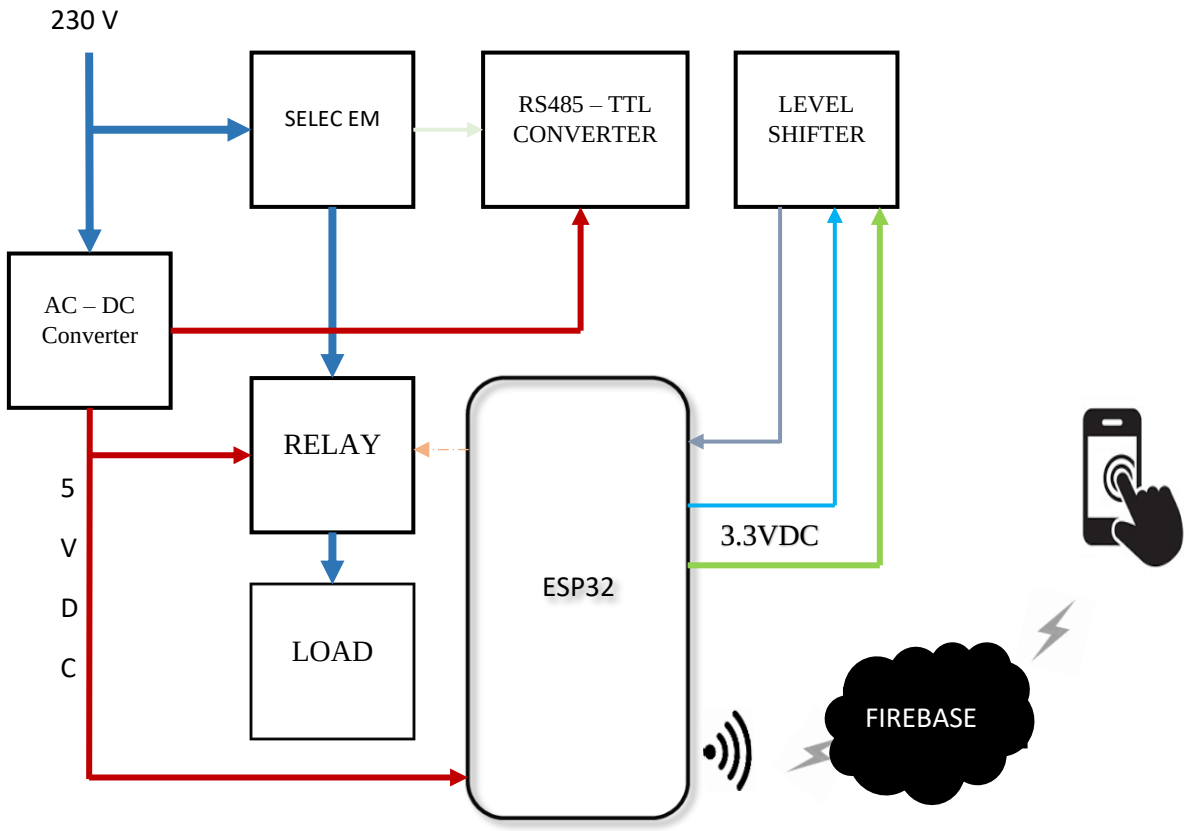


FIGURE 4.1: proposed system

4.1: BLOCK DIAGRAM



- **AC-DC CONVERTER (HI LINK):** It converts an AC voltage to DC voltage.
- **SELEC ENERGY METER:** It is used to measure and display current, voltage, active power, reactive power, and apparent power.
- **RS485-TTL CONVERTER:** Converts RS485 protocol into logical output
- **LEVEL SHIFTER**: It is used to translate signals from one logic level or voltage domain to another. It translates 5V DC to 3.3V DC.
- **ESP-32**: It is a microcontroller used to control the energy meter. It also helps to communicate with the cloud.
- **FIREBASE**: It is google-backed application development software that enables developers to develop ios and android apps.
- **KODULAR:** It is an online tool that allow any person to create their own app.

4.2: WORKING OF SMART ENERGY METER:

The hardware of the smart energy meter consists of selec energy meter, esp32 dev kit, TTL-RS485 converter, Hi-Link AC-DC Power Module. A 230 V power supply is provided to AC-DC converter as well as selec energy meter. Energymeter calculates the current, voltage, reactant power, apparent power etc. AC-DC converter is used to convert 230 V power supply to 5V. The energymeter communicates with the microcontroller using RS485 protocol but to make it in a suitable form for the microcontroller to process, RS-485 to TTL converter is used. The data is transmitted to Level Shifter which translates it from 5V DC to 3.3 V for the microcontroller. The controller controls the relay which is connected to load. As ESP-32 is bidirectional it also controls Energymeter.

A particular user ID and password of the user is stored through programming in controller so that only an authenticated user can see the data of a specific user ID. To store the data and represent it on the internet FIREBASE platform is used. As mentioned ESP32 is provided with WI-FI facility, it will upload the data such as voltage, current, power consumed, and energy consumption on FIREBASE. Using kodular, it is an online tool that allows any person to create their own app. So that users can see it anytime from anywhere on their mobilephone. This app can be controlled by using a pair of switches that can turn the relay on thus, disconnecting the load to the system.

A separate admins portal is also provided for the KSEB administrators to access and monitor consumer’s energy consumption and disconnect as it exceeds the predefined limit. Multiple devices can also be connected to the relays to control other loads during heavy load hours.

4.3: COMPONENTS USED

The various components used are:

4.3.a: AC-DC CONVERTER(HLK-PM01):

Hi-Link AC-DC Power Module HLK-PM01 230V to 5V is PCB mounted plastic enclosed isolated switching step-down power supply module.This makes it perfect for small projects that need a 5 volt supply from mains. There are many advantages to these modules, such as low-temperature rise, low power, high efficiency, high reliability, high-security isolation, low noise,and short circuit protection, high efficiency,low power consumption. It is widely used in smart home, automation and control, communication equipment, instrumentation and other industries etc.

SPECIFICATIONS:

- All voltage inputs (AC:90~264V)
- Power rating:3Watt
- Operation Temperature: -20 to 60C
- Rated input voltage:100-240Vac
- Maximum input current: 0.2A
- Input current surge: 10A
- Maximum input voltage: 270VAc
- Input Low Voltage Efficiency: Vin=110Vac
- Output full-load: 69%
- Input High Voltage Efficiency: 220Vac
- output full-load: 70%
- Load rated output voltage: 5 -0.1
- Short-term maximum output current: 1000Ma
- The maximum output current for a long time: 600mA
- Shell maximum surface temperature does not exceed 60C
- Weight: 20g
- Size: 33 * 19 * 15mm

FIGURE 4.3.a: HLK-PM01

4.3.b: SELEC ENERGY METER (EM2M-1P-C-100A):

It is a self-powered single phase energy meter with LCD backlight display. It can calculate and display current, voltage, active power, reactive power, apparent power. It can do bi-directional measurement.

SPECIFICATIONS:

- Input voltage range: 176- 276V AC
- Input Current: 5A AC
- Frequency: 45-65Hz
- Pulse output: Voltage range: 5 to 24 V
    - Pulse Duration: 0.05 to 2 sec.
    - Pulse Width: 1/10/100/1000
- Transmission: Mode: Half duplex
    - Speed: 9600 (bps)
- Power Consumption: 8VA max
- Memory Retention: 10 years

FIGURE 4.3.b: SELEC energymeter

4.3.c: RS485-TTL CONVERTER:

- It has Auto Direction control and can be used for long distance communication, twisted pair cable can work upto1.2 km. This provides bidirectional signal conversion between RS485 to and from aTTL. It supports point-to-multipoint.
- TTL to RS485 converter wide operating voltage range is DC 3.0V-30V. 3.3V & 5V Signal: 3.3v with 5.0v power supply perfectly compatible; 3.3V with 5.0V signal perfectly compatible.
- TXD & RXD Indicator: the TTL to RS485 Adapter is designed with Transmit Data indicator light and Receive Data indicator light, convenient for your monitoring.
- Long Transmission Distance: transmission distance can be up to kilometers (test with 850 meters of 2 * 1.5 cable, it is recommended to use within 800 meters, more than 800 meters please add repeaters).
- Special Function: the 485 bus is with lightning protection and anti-jamming function, with high EMC, EMI performance.

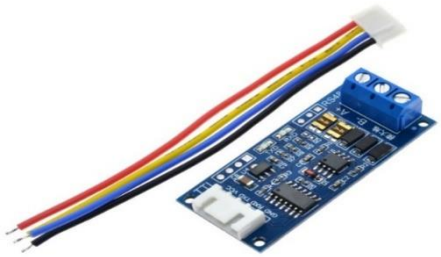


FIGURE 4.3.c: RS485-TTL CONVERTER

4.4.d: LEVEL SHIFTER:

It is high speed, bi-directional channels that allows safe communication between devices operating at different logic or voltage levels. In digital electronics, a level shifter, also called logic-level shifter or voltage level translator, is a circuit used to translate signals from one logic level or voltage domain to another, allowing compatibility between integrated circuits with different voltage requirements, such as TTL and CMOS. Modern systems use level shifters to bridge domains between processors, logic, sensors, and other circuits. In recent years, the three

most common logic levels have been 1.8V, 3.3V, and 5V, though levels above and below these voltages are also used.

Since level shifters are used to resolve the voltage incompatibility between various parts of a system, they have a wide range of applications as well. Level shifters are widely used in interfacing legacy devices and also in SD cards, SIM cards, CF cards, audio codes and UARTs.

SPECIFICATIONS:

- Number of channels: 4
- Power: 2.8-6kW
- Dual-supply bus translation:
- Lower-voltage (LV) supply: 1.5 V to 7 V
- Higher-voltage (HV) supply: LV to 18 V
- Small size: 0.4″ × 0.5″ × 0.08″ (13 mm × 10 mm × 2 mm)
- Breadboard-compatible pin spacing

FIGURE 4.3.d: LEVEL SHIFTER

4.3.e: ESP-32:

It is a series of low cost, low power system on a chip microcontrollers with integrated wifi and dual mode Bluetooth.It has 2 processors. It operates 32-bit programs and has a clock frequency that can reach up to 240MHz This particular board has 30 or 36 pins, 15 in each row. It also has wide variety of peripherals available, like ADCs, DACs, and much more. It is a High performance- ratio, small volume, easily embedded to other products, easily to develop.

SPECIFICATIONS:

- Single or Dual-Core 32 bit

- SRAM: 520 KB
- ROM: 448KB
- Wifi speed: 150Mbps

FIGURE 4.3.e: ESP 32

4.3.f: 4-CHANNEL RELAY INTERFACE BOARD MODULE:

A **relay** is an electrically operated switch. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. The relay is of single pole double throw type. The 4 Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc.

Applications:

- Switching mains loads
- Home automations
- Battery backup
- High current load switching

This relay module is 5V active low. Low Active Means Relay will Get Trigger when Low Voltage/Signal Supplied to IN Pin. This Is A 5v 4-Channel Relay Interface Board,Be Able ToControl Various Appliances, And Other Equipments With Large Current. It Can Be

Controlled Directly by Microcontroller(Arduino , 8051, Avr, Pic, Dsp, Arm, Arm, Msp430, Ttl Logic) .It has the fixed Bolt Hole And Easy Installation Small Board Power Indicator (Green), Two ways of Relay Status Indicator Light (Red) standard interface That Can Be Controlled Directly By Microcontroller (Avr, Pic, Dsp, Arm, Arm, Msp430, Ttl Logic) Indication Led'S For Relay Output Status

SPECIFICATIONS:

- Supply voltage – 3.75V to 6V
- Trigger current – 5mA
- Current when the relay is active - ~70mA (single), ~300mA (all four)
- Relay maximum contact voltage – 250VAC, 30VDC
- Relay maximum current – 10A
- Size : 54mm * 75mm
- Pcb Size: 7.2 Cm * 4.8 Cm

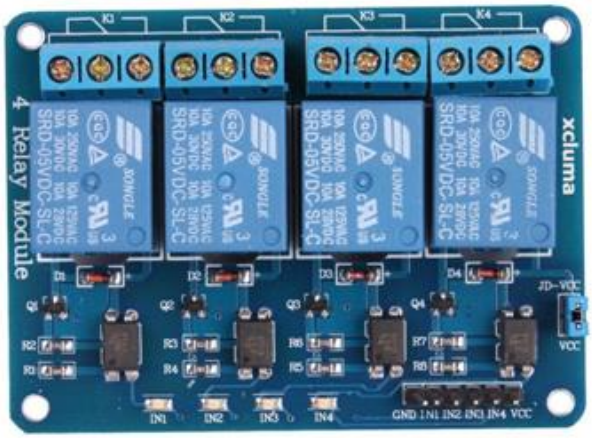


FIGURE 4.3.f: Relay module

4.4: SOFTWARE USED:

4.4.a: FIREBASE:

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiment. The Firebase Realtime Database build rich, collaborative applications by allowing secure access to the database directly from client-side code. Data is persisted locally, and even while offline, realtime events continue to fire, giving the end user a responsive experience. When the device regains connection, the Realtime Database synchronizes the local data changes with the remote updates that occurred while the client was offline, merging any conflicts automatically.

The Realtime Database provides a flexible, expression-based rules language, called Firebase Realtime Database Security Rules, to define how your data should be structured and when data can be read from or written to. When integrated with Firebase Authentication, developers can define who has access to what data, and how they can access it.

4.4.b: KODULAR CREATOR

Kodular is a free online suite for mobile apps development. It mainly provides an online drag-and-drop Android app creator, on which everyone can create any kind of app without programming a single line of code.

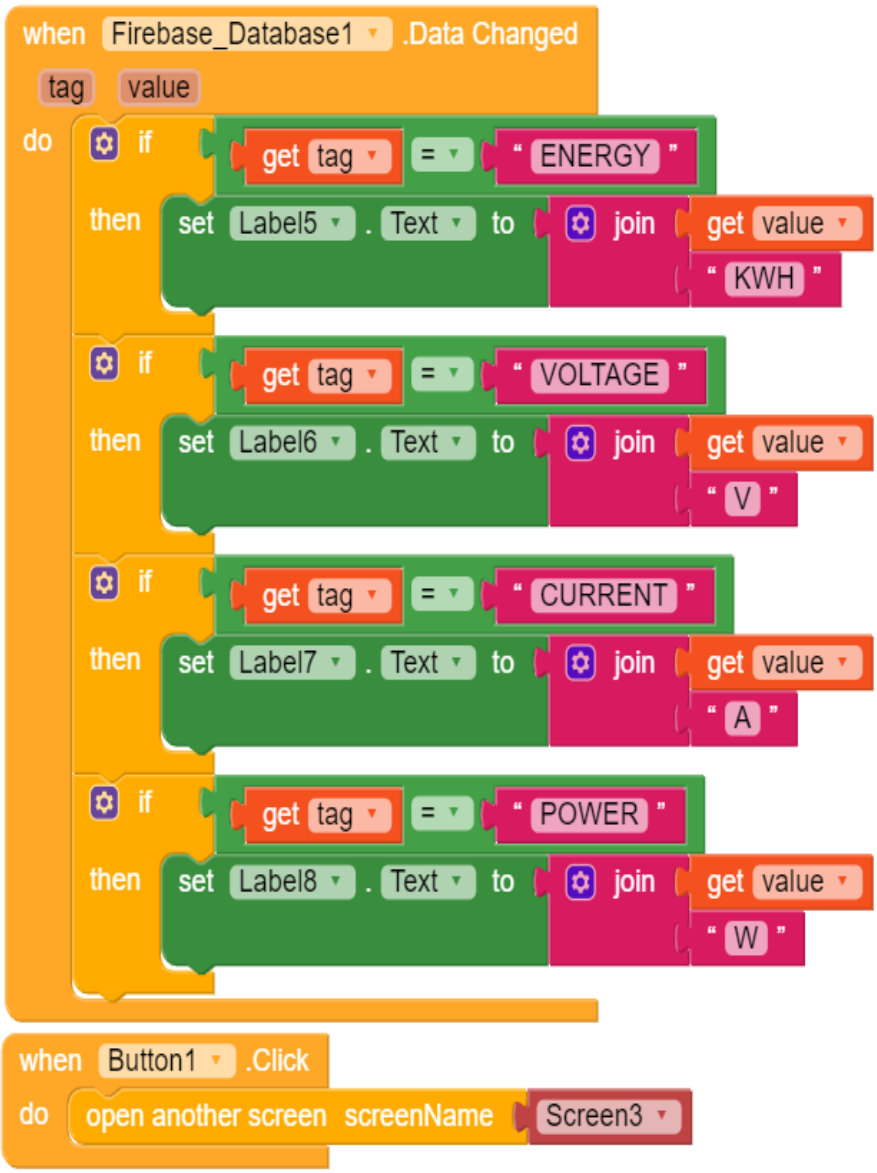


FIGURE 4.4.b.1: kodular blocks for consumer

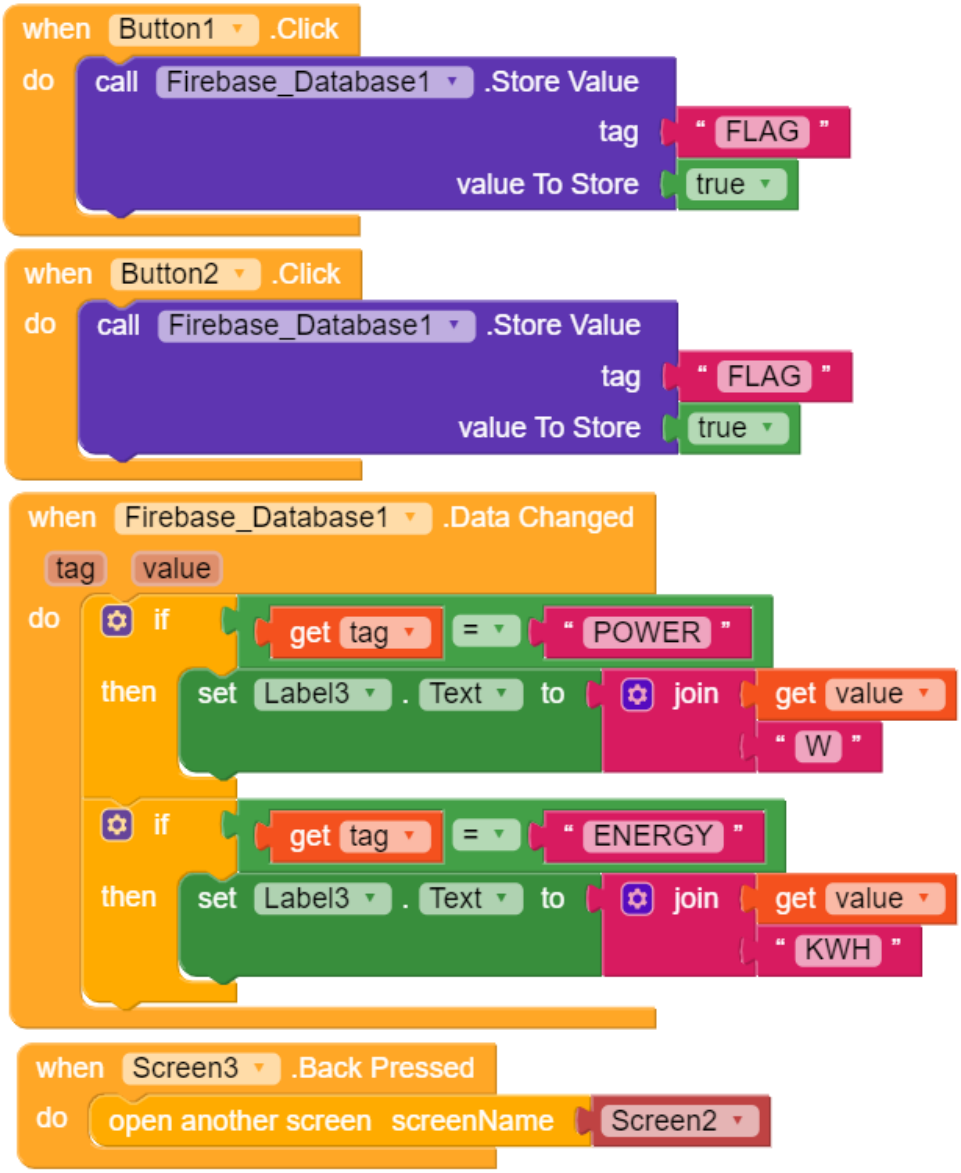


FIGURE 4.4.b.2: kodular block for administrator

4.4.c: PROGRAM FOR ESP32:

```
#include <IOXhop_FirebaseESP32.h>

#include  <WiFi.h>

#include "time.h"

#define FIREBASE_Host "https://energymonitoring-61527-default-rtdb.asia-
southeast1.firebasedatabase.app"                // replace with your Firebase Host

#define FIREBASE_authorization_key "A35Je3W8D1mgaK9pfWKSZx27T1v3v8Yk44LtRAvA" //
replace with your secret key

#define Your_SSID "vs"       // replace with your SSID
```

```
#define Your_PASSWORD "123454321"         //replace with your Password
#define RELAY              13
#define LOAD_1             12
#define VOLTAGE            0x15
#define CURRENT            0x17
#define FREQUENCY          0x1B
#define POWER              0x0F
#define ENERGY             0x0D
////////////////////////////////////
// Energy Meter
#define DATA_ADDR_MSB    0x00;
#define READ_BYTES_MSB   0x00;
#define READ_BYTES_LSB   0x02;
//Function Codes
#define READ_HOLDING_REG   0x03;
#define READ_INPUT_REG     0x04;
#define CLEAR_REG          0x10;
const char* ntpServer = "pool.ntp.org";
const long  gmtOffset_sec = 19800;   //Replace with your GMT offset (seconds)
const int   daylightOffset_sec = 0;  //Replace with your daylight offset (seconds)
void setup() {
 Serial.begin(115200);
 Serial2.begin(9600);
 pinMode(RELAY,OUTPUT);
 digitalWrite(RELAY,HIGH);
 pinMode(LOAD_1,OUTPUT);
 WiFi.begin (Your_SSID, Your_PASSWORD);
 Serial.print("Connecting...");
 while (WiFi.status() != WL_CONNECTED)
 {
   Serial.print(".");
   delay(300);
 }
 Serial.println();
```

```
 Serial.print("IP Address: ");
 Serial.println(WiFi.localIP());
 Serial.println();
 Firebase.begin(FIREBASE_Host,FIREBASE_authorization_key);
 configTime(gmtOffset_sec, daylightOffset_sec, ntpServer);
}

void loop() {

static float voltage = 0;
static float current = 0;
static float power = 0;
static float energy = 0;
unsigned long previous_millis = millis();
struct tm timeinfo;
  while(1)
  {
      if ((millis() - previous_millis) > 2000)
      {
        voltage = emread(VOLTAGE);
        current = emread(CURRENT);
        power = emread(POWER);
        energy = emread(ENERGY);
        Serial.println("Voltage = " + String(voltage) + " V");
        Serial.println("Current = " + String(current) + " A");
        Serial.println("Power = " + String(power) + " KW");
        Serial.println("Energy = " + String(energy) + " kWh");
        Firebase.setFloat("USER_1/VOLTAGE", voltage);
        Firebase.setFloat("USER_1/CURRENT", current);
        Firebase.setFloat("USER_1/POWER", power);
        Firebase.setFloat("USER_1/ENERGY", energy);
        break;
      }
      digitalWrite(RELAY,Firebase.getBool("USER_1/FLAG"));
```

```
      if((timeinfo.tm_hour > 18) && (timeinfo.tm_hour < 20))
      {
        digitalWrite(LOAD_1, LOW);
        Serial.println("LOAD 1 OFF");
      }
      else
      {
        digitalWrite(LOAD_1, HIGH);
        Serial.println("LOAD 1 ON");
      }
  }

}
////////////////////////////////////////////
float emread(int address)
{
  int numberOfBytes = 0;
  int DEVICE_ID = 0x01;
  int bytesRead = 0;
  uint8_t emPacketTX[8];
  byte emPacketRX[9];
  union u_tag
  {
     byte b[4];
     float fval;
  } u;
  u.fval = 0.0;
  emPacketTX[0] = DEVICE_ID;
  emPacketTX[1] = READ_INPUT_REG;

  emPacketTX[2] = DATA_ADDR_MSB;
  emPacketTX[3] = address;

  emPacketTX[4] = READ_BYTES_MSB;
```

```
  emPacketTX[5] = READ_BYTES_LSB;

  int checksum = calcCRC(emPacketTX, 6);
  emPacketTX[6] = checksum & 0xff;
  emPacketTX[7] = (checksum >> 8) & 0xff;
  Serial2.write(emPacketTX, 8);
  delay(30);
  unsigned long previous_millis = millis();
  while (bytesRead < 9)
  {
   while(!Serial2.available())
   {
    if ((millis() - previous_millis) > 200)
    {
     Serial.println("Failed to read");
     return u.fval;
    }
   }
   emPacketRX[bytesRead++] = Serial2.read();
  }
  String ReceivedData = "Received Data : ";
  for (int i = 0; i <9; i++) {
   ReceivedData += String(emPacketRX[i], HEX) + ",";
  }

  u.b[0] = emPacketRX[6];
  u.b[1] = emPacketRX[5];
  u.b[2] = emPacketRX[4];
  u.b[3] = emPacketRX[3];
  double x = u.fval;
  return u.fval;
}
////////////////////////////////////////////////////////////////////////////
//=========================================================
```

```
//          USER DEFINED FUNCTIONS
//============================================================
unsigned int calcCRC(unsigned char *buf, unsigned int n)
{
   int i, j;
      unsigned int CRC = 0xFFFF;
      for (i = 0; i < n; i++)
      {
        CRC ^= buf[i];
        for (j = 0; j < 8; j++)
        {
          if ((CRC & 0x01) != 0)
          {
            CRC = (CRC >> 1) ^ 0xA001;
          }
          else
          {
            CRC = (CRC >> 1);
          }
        }
      }
return (CRC);
}
```

4.4.d: ALGORITHM:

STEP 1: start

STEP 2: define firebase & wifi credentials

STEP 3: Login to wifi network

STEP 4: Declare the output pins for relay

STEP 5: Initialize serial communication

STEP 6: Read voltage, current, power & energy through serial port

STEP 7: Send the values to fire base

STEP 8: Check for eligibility flag (True/false)

STEP 9: Set the logic value of flag to operate main supply relay

STEP 10: Check for time, if time is in between 18.00 – 20.00 operate relay to disconnect peak loads else connect the peak load

STEP 11: Go to step 5

STEP 12: Stop

CHAPTER 5

ADVANTAGES

- Consumer should be making the track of energy meter.
- The speed of uploading depends on the speed of internet and connectivity.
- Energy is conserved.
- Accuracy is more.
- Time optimization.
- Portable.
- Simple installation
- Reduce the burden on both supplier and consumer.
- Provides real time data.
- Reduces blackouts and system wide electric failure.
- Automatic control is possible in the application of energy meter.

CHAPTER 6

RESULT

Monitoring of energy related parameters such as voltage, current, power KW, Energy, KVA etc. For monitoring, using standard type energy meter brand namely SELEC energymeter. There is one hardware which can read the data over RS485 (MODBUS) from the meter, which is to be consisting of one MCU / microcontroller device which can read the MODBUS RS 485 data and that data is to be sent to the cloud via Wi-Fi Modem. Data is sent to the server, firebase. The main part of project is ESP 32 Wi-Fi chip. This chip is basically going to perform three main tasks, reading an energy meter data from MODBUS RS485 port of energy meter, process this data and send this data to cloud based server. Finally this data is collected to a App known as kodular companion, it gives the numerical values of the energy parameters.

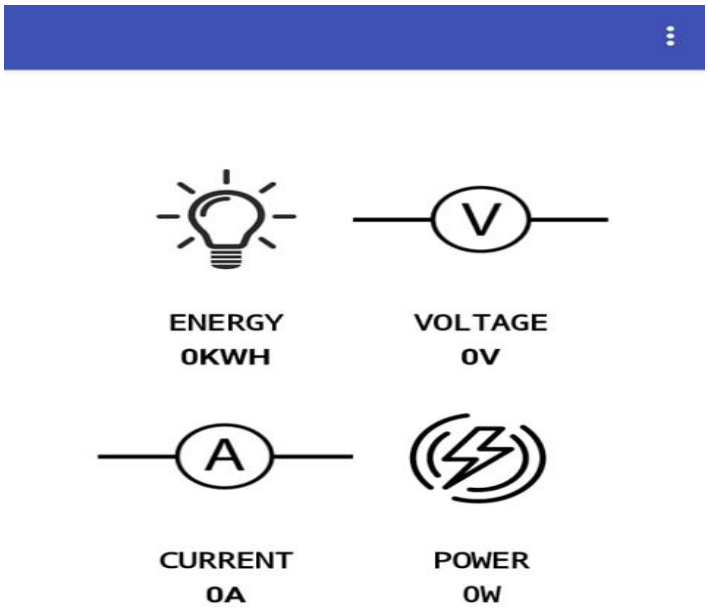


FIGURE 6: Result of the proposed system

CHAPTER 7
CONCLUSION

An improved smart energy meter model has been proposed in this project for the accurate meter reading and cost analysis. By constructing an enhanced energy meter model, a substantial energy can be saved during the peak hours. The proposed meter would certainly help to decrease the energy cost and improve the efficient use of time for appliances. The developed smart energy meter offers some benefits such as it is reliable, cost-effective and has an easy process. Moreover, wireless meter reading can be developed for distant power measurement reading. Energy consumption can be monitored by both administrators and consumers. This system is a cost efficient and user friendly project. This device enables consumers to easily monitor and track their energy usage. Nowadays, people are checking their energy usage by manually reading their electricity meters, which is inefficient and provides very little information. There is a growing concern over the amount of energy consumed and the awareness of the community. By using this device, consumers will be able to use the internet or the smart phone application to monitor and economize their energy consumption. With more information people have about their energy usage, they will be able to reduce their energy consumption and therefore save both energy and money.

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