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IOT-BASED ENERGY METER FOR DISPLAYING CONSUMPTION STATISTIC

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Abstract—Energy Meter is widely used a technology. It can be seen in everywhere. It can be found worldwide. It is useable in house or any industrial place also. Generally, it measures all the power consumed by the consumer & it gives the total consumption till that date by the consumer. The main problem is that the consumer can't able to calculate how much he/she is consuming & also can't reduce their misuse. This device will check current consumption & it will store data on basis of daily, monthly & yearly. By this way consumer can understand how much they are consuming & how much they are misusing. Also, they can make a statistic that how much they have consumed in last year summer & in present summer. As we are going to implement IoT it is going to show their consumption & it will give the whole data in excel sheet. Also, in excel sheet it will generate chat & bar diagram where consumption statistics will be clear to all consumers. IoT will help them to generate all data whenever it is needed. By this way they can stop their current m is use.

Keywords — Energy Meter, IoT, Consumption Statistic, Excel Data Sheet

I. INTRODUCTION

In recent years due to the global pandemic situation of COVID 19 modern technology has played an important role in shaping human life. In recent years due to the global pandemic situation of COVID 19 modern technology has played an important role in shaping human life. Everything in our life is going to be smart as well. In this pandemic situation people adjusted them to online platform & others. Basically it is now a habit to use new smart gadgets. For this IoT is present to help all of them. Current consumption is another big issue to all over the world. As in the pandemic situation people lives in their house as much as possible. So there is a chance to increase the power consumption from earlier. But the consumption must not convert to misuse. Basically, three types of energy meters are present right now, Electro Mechanical Induction Type Energy Meter, Electronic Energy Meter, Smart Energy Meter. The energy meter which we used in our daily life basically these meters measure the instantaneous voltage and currents, calculate its

product and gives instantaneous power. Energy Meters may be single phase or three phases meters depending upon the supply utilized by domestic or commercial installation. The most common unit of measuring the electricity is the kilowatt hour, which is equal to the amount of energy used by a load of one kilowatt hour over a period of one hour by consumers. Before the pandemic many researchers tried to implement this type of thing, as they can assume how important this will be to our daily life. Our main target is that, first we will develop an energy meter, then we will record the current consumption in a SD card module, then by implementing IoT this recorded data can be shown by customer from their mobile, also they can download the excel sheet also. Also, the IoT will help to generate some chart & graph by which customer can analysis their uses & misuses.

This model uses various sensors, microcontrollers and relies on the technology of wireless communication. Arduino programming language is also used in this model. This IoT-based device is efficient and of affordable cost, thus it will have good potential in thriving in the modern market. It will be easy to use and manage by the people and will be of low maintenance and deals with day-to-day life problems of common people. So, this model has the potential to be a hit.

II. LITERATURE SURVEY

Earlier many paper on IOT based Energy Meter monitoring systems was published on IEEE explore which monitored different parameters of Energy Meter and updated the user via mobile application. [1] Chandra proposed Smart Energy Meter using IoT. It will help to solve real time smart home/smart building energy profile, user apps for billing data accounting & theft and fault detection. Smart Meter are essential to efficient energy consumption and a key part of the smart grid infrastructure. The smart meter helps consumer stay fully informed about their daily energy use and eliminate wasteful routines or get rid of the inefficient appliance. For utility companies, the real-time visibility into energy consumption process translates into accurate billing data and ability to balance demand against supply via flexible pricing and other policies. With the IoT platform, smart meters can be easily implemented to support these and many other smart grid features. [2] Devadhanishini

proposed Smart Power Monitoring Using IoT that energy Consumption is the very important and challenging issue. Automatic Electrical Energy meter is used in large electric energy distribution system. [3] Mohammed Hosseue presented a paper titled Design and implementation of smart meter using IoT describing the growth of IoT and digital technology. The future energy grid needs to be implemented in a distributed topology that can dynamically absorb different energy sources. [4] Himanshu K Patel demonstrated Arduino based smart energy meter that removes human intervention in meter readings and bill generation thereby reducing the error that usually causes in India. The system consists the provision of sending an SMS to user for update on energy consumption along with final bill generation along with the freedom of reload via SMS. [5] Bibek Kanti Barman proposed smart meter using IoT on efficient energy utilization plays a very vital role for the development of smart grid in power system. Hence proper monitoring and controlling of power consumption is a main priority of the smart grid. The energy meter has many problems associated to it

III. RESEARCH METHODOLOGY

A. Hardware Requirements

- Raspberry Pi Pico (Fig 1) - A Raspberry Pi Pico is a low-cost microcontroller device. Microcontrollers are tiny computers, but they tend to lack large volume storage and peripheral devices that you can plug in (for example, keyboards or monitors).
- Arduino Uno (Fig 2) - The Arduino microcontroller is the main aspect of this device. It is typically used in most of the IoT devices. Considering its low cost and performance, it's far appropriate for many IoT additives that have lots of parameters. Physically, Arduino is very inflexible and its coding process is very smooth.

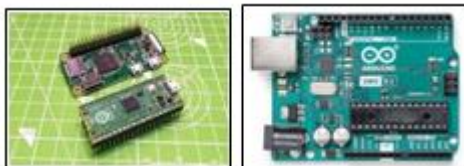


Fig1.Raspberry Pi Pico Fig2. Arduino Uno

- Micro SD Card Module (Fig 3) - The module is a Micro SD card reader module and the SPI interface via the file system driver, microcontroller system to complete the Micro SD card read and write files. Users can directly use the Arduino IDE comes with an SD card to complete the library card initialization and read- write.
- RTC Module (Fig 4) - DS3231 Module is a Bread Board friendly extremely precise I²C real time clock Module. This module made using DS3231 RTC and AT24C32 EEPROM integrated with temperature compensated crystal oscillator. AT24C32 provides

32,768 bits of serial EEPROM organized as 4096 words of 8 bits each.

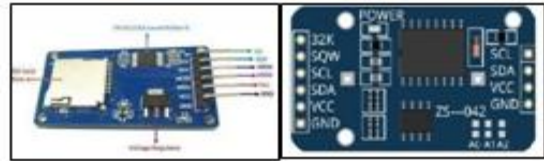


Fig3. SD Card Module Fig4. RTC Module

- 12v Transformer (Fig 5) - A centre-tapped transformer also known as two phase three wire transformer is normally used for rectifier circuits. When a digital project has to work with AC mains a Transformer is used to step-down the voltage (in our case, to 24V or 12V) and then convert it to DC by using a rectifier circuit.
- Current Sensor (Fig 6) - A current transformer is a type of transformer that is used to reduce or multiply an alternating current. It produces a current in its secondary which is proportional to the current in its primary. Current transformers, along with voltage or potential transformers are instrument transformers.



Fig5.12v Transformer Fig6. Current Sensor

- Voltage Sensor (Fig 7) - Voltage Sensor is a precise low cost sensor for measuring voltage. It is based on principle of resistive voltage divider design. It can make the red terminal connector input voltage to 5 times smaller.
- LCD Display (Fig 8) - This is a basic 16character by 2 line Alphanumeric display. Black text on Green background. Utilizes the extremely common HD44780 parallel interface chipset . Interface code is freely available. It includes LED backlight. Works in 4bit and 8 bit Mode.

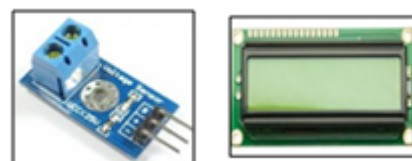


Fig7.Voltage Sensor Fig8. LCD Display

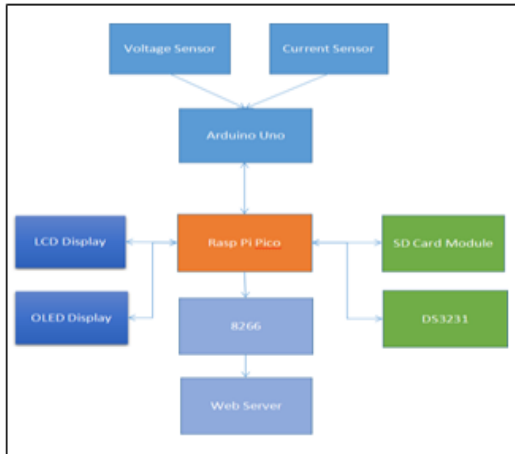


Fig9. Workflow diagram

V. CIRCUITDIAGRAM

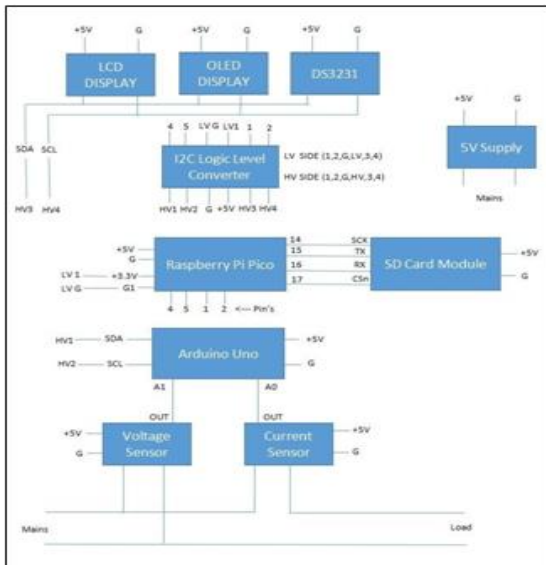


Fig10. Circuit Diagram

VI. WORKING PRINCIPLE

Here we need to measure how much voltage is present and how much amps is flowing through the wire. So we are going use ZMPTB101 AC for voltage sensing and ACS712 5A for current sensing purpose. We are going record every second data into an array. And when a minute is over, an average of all the data which is collected over a min is calculated for the 'minute data' which is how much power is consumed in a minute. Secondly we are going get the hour data in a similar way, which is collect minute data over an hour and take the average to get 'hour data' or also known as W/h. But the catch is, since we're using arduino uno here. Which is not very fast, and the functions to calculate voltage and current data per sec is quite heavy, so it take few mill-

seconds more per sec. So we have reached conclusion that for every hour we log here, we miss out 40-45 sec of data. So when we have all the data required which is minute data, hour data. It is saved to an SD card through pico-sdcard module interface. So that later we can use those data files to calculate and get hour and minute graphs from excel sheets, which will help us get better grasp of the electricity consumption over different time spans. Later we can upload those files to a cloud server, so that website we host on there, can use those files to show the data on the site. Since it an website, which we can use or get access to IoT Based Energy Meter For Displaying Consumption Statistics Page 9 it from anywhere around the world, which will help keep track of electricity consumed even if we're away from the physical meter itself.

VII. RESULT AND DISCUSSION

Whenever the consumer consumes electricity this module will track that. First Arduino will take electricity & raspberry Pi pico will store the amount of electricity in SD card module. Thus the whole recording will be saved. We have here run the module for few hour. Then we have listed the output in respectively minute, hour & total power time frame format. By this way after doing our experiment we have got the minute graph (Fig11) of consumption. In Table I we have listed output of minute format. In Table II we have listed output of hour format. Accuracy of table I is 98% and accuracy of table II is 97%. So, the accuracy of model is 97.5%

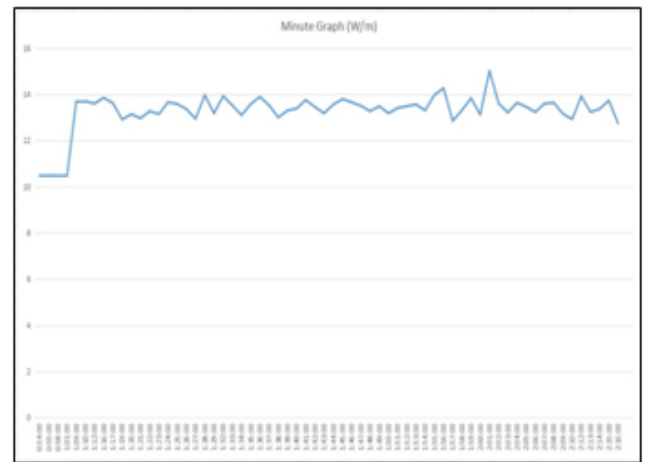


Fig11. Minute Graph (Consumption Of Every Minute)

When there is a load, we're able to measure the power drawn by the load instantaneously. And the instantaneous power is recorded over a min and an average is taken and it is shown on the LCD display for ease of knowing the power consumed over that min time frame. Like that user can select the time frame of the power which is to be displayed. It has min, hour, total power time frame for now. And the respective data is saved to respective files for later to be



uploaded to a web server which is yet to be implemented for ease of viewing data from anywhere.

1:34:0013.099
 1:35:00 13.57729
 1:36:0013.8945
 1:37:0013.5265
 1:38:0013.00133
 1:39:0013.30203
 1:40:00 13.39
 1:41:00 13.75866
 1:42:00 13.448
 1:43:0013.18339
 1:44:0013.56467
 1:45:00 13.798
 1:46:00 13.6561
 1:47:00 13.507
 1:48:0013.2735
 1:49:0013.4875
 1:50:0013.18254
 1:51:0013.40933
 1:52:0013.48766
 1:53:0013.56483
 1:54:0013.30051
 1:55:0013.97267
 1:56:0014.26416
 1:57:0012.84746
 1:58:0013.31283
 1:59:0013.83617
 2:0:00 13.118
 2:1:00 15.02
 2:2:0013.60333
 2:3:0013.21483
 2:4:0013.64217
 2:5:0013.45966
 2:6:0013.23467
 2:7:00 13.604
 2:8:00 13.63661
 2:9:00 13.157
 2:10:0012.92384
 2:12:0013.91421
 2:13:0013.23467
 2:14:0013.37117
 2:15:00 13.7395
 2:16:0012.74898
 2:17:0013.29283
 2:18:0013.96999
 2:19:0013.96999
 2:20:0013.96999
 2:21:0013.96999
 2:22:0013.96999
 2:23:0013.96999
 2:24:0013.96999
 2:25:0013.96999
 2:26:0013.96999
 2:27:0013.96999
 2:28:0013.96999
 2:29:0013.96999

TABLE I EXPERIMENTAL DATA FOR HOUR TIME FRAME

1:00:000.0
 1:00:000.0
 1:00:000.0
 2:00:000.0
 2:00:000.0
 2:00:000.0
 2:00:000.0
 2:00:000.0
 2:00:000.0
 2:00:000.0
 2:00:000.0
 3:00:000.0
 21:00:00 0.0

TABLE II EXPERIMENTAL DATA FOR MINUTE TIME FRAME 1:47:000.0

1:48:000.0
 1:51:000.0
 1:53:000.0
 2:31:000.0
 2:32:000.0
 2:33:000.0
 2:52:000.0
 2:56:000.0
 2:57:000.0
 2:59:000.0
 3:0:00 0.0
 21:33:00 0.0
 0:53:00 10.4788
 0:54:0010.48092
 0:55:0010.48092
 0:58:0010.47883
 1:1:0010.47917
 1:9:0013.68615
 1:10:0013.70308
 1:12:0013.60227
 1:16:00 13.855
 1:17:00 13.61678
 1:19:00 12.9103
 1:20:0013.14288
 1:21:0012.96267
 1:22:0013.27333
 1:23:0013.14271
 1:24:00 13.6615
 1:25:00 13.584
 1:26:0013.36034
 1:27:0012.94284
 1:28:0013.972
 1:29:0013.176
 1:32:00 13.92458
 1:33:0013.526



2:30:0013.96999
2:31:0013.96999
2:32:0013.96999
2:33:0013.96999
2:34:0013.96999
2:35:0013.96999
2:36:0013.96999
2:37:0013.96999
2:38:0013.96999
2:39:0013.96999
2:40:0013.96999
2:41:0013.96999
2:42:0013.96999
2:43:0013.96999
2:44:0013.96999
2:45:0013.96999
2:46:0013.96999
2:47:0013.96999
2:48:0013.96999
2:49:0013.96999
2:50:0013.96999
2:51:0013.96999
2:52:0013.96999
2:53:0013.96999
2:54:0013.96999
2:55:0013.96999
2:56:0013.96999
2:57:0013.96999
2:58:0013.96999
2:59:0013.96999
3:0:0013.96999
3:1:0013.96999
3:2:0013.96999
3:3:0013.96999
3:4:00 13.97

VIII. FUTURE SCOPE

For commercial purposes, multiple energy meter stimulation devices can be evolved. That means if an owner wants one or more smart meter, then he/she can access all of those by a single application. Also we can introduce some emergency alarm system to smart meter. Whenever there is a risk of short circuit or for any water leak age, if fire gets into the meter then before that it will give an emergency message to customer registered mobile. Also if possible with this energy meter we can implement a current cut down system. Then if you forgot to switch off the current you can easily done by your mobile also. A Voice feedback system can be included in this system. Users can get voice messages about their daily use of the current. Also, we can include some reminder techniques also. This will help us to stop misuse of current.

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