SMART MONITORING AND CONTROL OF DIGITAL ENERGY METER BY USING IOT

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Abstract: The inspiration and extent of the work introduced in this thesis. The energy efficient communication strategies for Internet of Things (IoT) with the objective to minimizing of the energy consumption and quality of service is introduced. The problem statement and a brief overview of the strategies along with a compact report of results and contributions are covered. In forthcoming wireless sensor networks play major role in the data intelligent and gathering. These are made possible by the availability of sensors that are slighter, inexpensive and perceptive. Sensors communicate with each another in a network with the assistance of wireless interfaces. Due to tiny devices has limited battery energy for communicating wirelessly. Limitation can be contingent heavily on the application and associated factors such as the, cost, hardware, environment and system constraints. In this thesis explores the energy efficient communication by using the green computing approaches. The idea behind the IoT is to allow things to communicate directly with each other, e.g., to share related information from different systems and to present the information to users in a more useful manner, allowing humans to focus on decisions and actions rather than filtering and combining information from different sources.

Keywords: Micro controller (ARDUINO), Relay with driver, Digital Energy Meter.

I . INTRODUCTION

The energy efficient communication strategies for Internet of Things (IoT) with the objective to minimizing of the energy consumption and quality of service is introduced. The problem statement and a brief overview of the strategies along with a compact report of results and contributions are covered. In forthcoming wireless sensor networks play major role in the data intelligent and gathering. These are made possible by the availability of sensors that are slighter, inexpensive and perceptive. Sensors communicate with each another in a network with the assistance of wireless interfaces. Due to tiny devices has limited battery energy for communicating wirelessly. Limitation can be contingent heavily on the application and associated factors such as the, cost, hardware, environment and system constraints. In this thesis explores the energy efficient communication by using the green computing approaches.

Introduction To Internet Of Things (IoT)

Internet of Things provides wireless infrastructure with distinctive identifiers and the capability to discussion information over a network. The world of electrical, communicating devices is growing at a rapid pace as a result of the growth of consumer electronics in the 1980's and 1990s, the Internet in the 1990s and the 2000s, and the increasingly mobile connected devices of the 2000s and 2010s. The growth is expected to continue over the next decades with the breakthrough of the Machine-to-Machine (M2M) and IoT correspondence; it is assessed by Cisco to achieve more than 50 billion associated gadgets by 2020 Evans (2011), and others expect numbers that differ somewhat depending on the interpretation of "devices" and focus on different markets Perera et al (2015).

The IoT is proposed to be a cornerstone in the connected, comfortable, efficient, and productive society of tomorrow. Figure 1.1 illustrate the time line of IoT the technology changes from passive radio frequency identification to today's pervasive computing starting from the year 1990. The idea behind the IoT is to allow things to communicate directly with each other, e.g., to share related information from different systems and to present the information to users in a more useful manner, allowing humans to focus on decisions and actions rather than filtering and combining information from different sources.

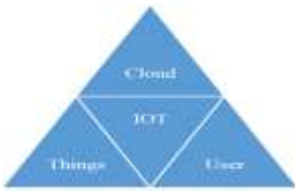

Figure 1 Internet of Things (IoT) basic concept

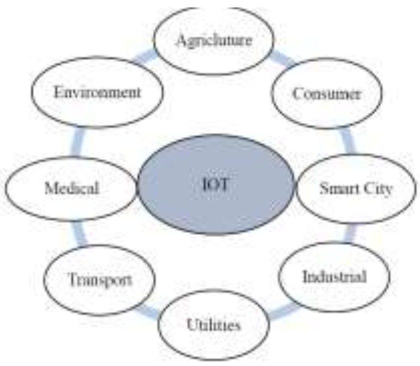

Figure 2 Internet of Things (IoT) Applications

"IoT is an assembled some bit of expected web additionally be showed as a component overall framework base with self-organizing capacities considering standard and interoperable correspondence traditions. Figure 1.2 represent the IoT covering the connectivity, computing, data collection, convergence of all the elements in the all field. All over the place physical and in addition virtual "things" have characters, virtual personalities physical attributes use adroit interfaces and are reliably organized into the information framework.

II LITERATURE SURVEY

The utility sector in India has one National Grid with an installed capacity of 330.86 GW as on 30 November 2017. Renewable power plants constituted for 31.7% of total installed capacity. During the year 2016-2017, the gross electricity generated by utilities in India was 1,236.39 TWH and the total electricity generation in the country was 1,433.4 TWH. In the year 2016-2017, the gross electricity consumption was 1,122 kWh per capita. India is the third largest producer of electricity in the world and stands fourth largest in the electricity consumption. The electric energy consumed by the agricultural sector was recorded 17.89% in 2015-16 among all countries. Despite cheaper electricity tariff in India, the per capita electricity consumption is low compared to many countries.

The power generation capacity in India is surplus but the adequate infrastructure for supplying electricity to all needy people is lacking. In order to develop the infrastructure to supply adequate electricity to all the needy people in the country by March 2019, the Government of India launched a scheme called “Power for All”. This scheme will ensure continuous and uninterrupted power supply to all industries, households, and commercial establishments by improving necessary infrastructure. It’s a joint responsibility by the Government of India with states to share funding and create overall growth of the economy.

The electricity sector in India is dominated by fossil fuels, particularly coal, which produced about two thirds of all electricity in the year 2016. However, only the investment of renewable energy is increased by the Government. The Draft National Electricity Plan of 2016 prepared by the Government of India states that the country does not need additional nonrenewable power plants in the utility sector until 2027, with the commissioning of 50,025 MW coal-based power plants under construction and achieving 275,000 MW total installed renewable power capacity. India became the third largest producer of electricity in the world with 4.8% of global share. Out of the total power generated the renewable energy constituted for about 28.43% and the non-renewable energy constituted for about 71.57%.

III BLOCK DIAGRAM AND HARD WARE IMPLEMENTATION

The block diagram of the and design aspect of independent modules are depicted as follows

Figure 3 Block diagram of proposed system

Figure 3 shows the overall system with proposed IoT based smart meter. A typical domestic household is considered and the conventional energy meter is replaced with the proposed smart meter. The parameters measured by this meter are Active Power (P), Reactive Power (Q), Apparent Power (S), Power Factor (PF), frequency (f), voltage Sag and voltage swell. Further this meter communicates with the IoT cloud through available home routers. The data stored in these servers can be visualized by the user either through smart phones or web browsers. In this development, ThingSpeak IoT platform is chosen as it offers secure, flexible and easy way to send and visualize data. One of the main reasons for going to ThingSpeak is that it offers MATLAB support for processing and analysing the stored data. Fig. 2 shows the block diagram of Smart Meter. It consists of a voltage sensor, current sensor, zero crossing detector, signal conditioning circuit, ATMEGA4809 microcontroller, and integrated ESP32. The High Voltage (HV) and Low Voltage (LV) circuits are isolated by optocouplers. A protective circuit is built for voltage and current sensors using Op-Amps for protecting the sensors from getting damaged, in the event of fault. LEM based voltage and current sensors are used, as these sensors offer high precision readings. The microcontroller chosen is ATMEGA4809 based Arduino- UnoWi-Fi Rev v 2. It is a low power multipurpose board which has 14 digital input/output pins, 6 analog pins, 5 PWM pins, 48 kb of flash memory, 6144 bytes of SRAM, 256 bytes of EEPROM with clock speed of 16MHz. the board has an ADC sampling rate of 9615 Hz which is sufficient for precise calculation. Apart from this, the board have System on Chip (SoC) ESP 32 module for Wi-Fi communication. Zero crossing detector circuit is built using Op-Amps and XOR gates. This circuit is used for calculating the frequency and phase shift.

Figure 4 Hardware implementation of proposed system

An auxiliary supply of 5V is built using 7405 IC for providing regulated supply. The designed prototype device can measure RMS Voltage and Current, Peak Voltage and Current, Frequency (f), Power factor (PF), Active power (P), Reactive Power (Q), Apparent Power (S) and can detect events of Voltage Swell/Sag. This section gives the details of measurement techniques used.

IV RESULTS AND DISCUSSION

Table 1 Table of observations (R load – 100W & 40 W Incandescent Bulbs)

	V rms	**I rms**	**PF**	**P**	**Q**	**S**
Theoretical	230 V	0.605 A	1	140 W	0 VAR	140 VA
Practical	230 V	0.6 A	0.99	138.21 W	19.63 VAR	139.61 VA

Table 2 Table of observations (RL load – 36 W Fan)

	V rms	**I rms**	**PF**	**P**	**Q**	**S**
Theoretical	230 V	0.15 A	0.9-0.95	32.275 W	10.83 VAR	35 VA
Practical	229.6 V	0.156 A	0.94	33.63 W	12.20 VAR	35.786 VA

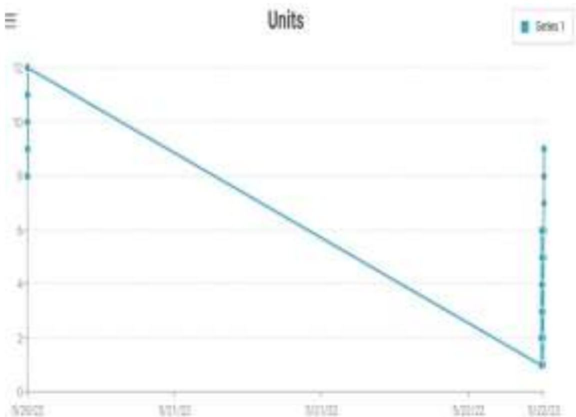

Figure 5 Units generated based on load

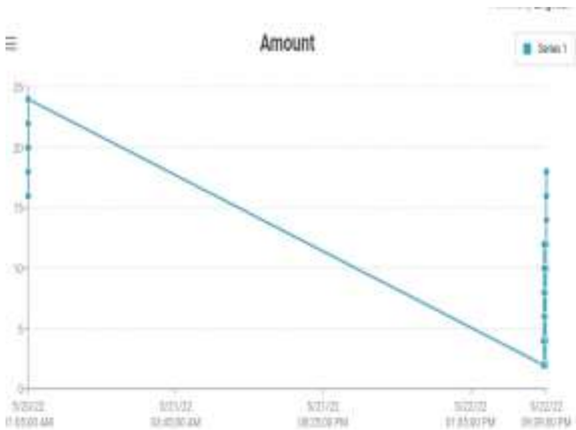

Figure 6 Amount generated based on units

Load1_ON | Load1_OFF | Load2_ON | Load2_OFF

S.No	Units	Amount	Date
1	9	18	2022-05-22 21:38:26
2	8	16	2022-05-22 21:37:38
3	7	14	2022-05-22 21:37:08
4	6	12	2022-05-22 21:36:32
5	5	10	2022-05-22 21:36:09
6	4	8	2022-05-22 21:35:45
7	3	6	2022-05-22 21:34:58
8	2	4	2022-05-22 21:34:34
9	1	2	2022-05-22 21:34:10
10	6	12	2022-05-22 21:22:34
11	5	10	2022-05-22 21:22:04
12	4	8	2022-05-22 21:21:19
13	3	[illegible]	2022-05-22 21:21:00
14	2	4	2022-05-22 21:20:43
15	1	2	2022-05-22 21:20:08
16	12	24	2022-05-20 11:06:39
17	11	22	2022-05-20 11:06:21
18	10	20	2022-05-20 11:06:04
19	9	18	2022-05-20 11:05:47
20	8	16	2022-05-20 11:05:30

Figure 7 Details of units consumed and their amounts generated in server page

V CONCLUSION

Smart metering appended with PQ monitoring will become very significant in the operation of smart grids. This project presents a methodology for measuring and monitoring the PQ parameters and further application of IoT in smart metering at domestic level. The developed meter is in compliance with the IEEE standard for measurements and the experiments done prove the feasibility of this meter to monitor multiple parameters. In addition, the future work lies in extending this meter to measure the harmonics and other power quality parameters along with the direct load controlling feature from the IoT server for demand response management. It was designed based on application of wireless communication. It is very suitable for real-time and effective requirements of the high-speed data acquisition system in IoT environment. The application of ARDUINO UNO greatly simplifies the design of peripheral circuit, and makes the whole system more flexible and extensible.

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