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Iot Based Energy Meter

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Abstract:*Imagine A Day Without Electricity ? The World Would Come To A Halt. Industries, Financial Sector, Health Services, Agriculture Even Our Daily Chores Are Dependent On Electricity. However, Electricity Is A Paid Service And Must Be Used With Caution. Currently, Electromechanical Energy Meters Are Used To Measure The Electricity Consumption. They're Susceptible To Errors Due To Environmental Factors And Can Be Tampered Easily. In This Paper, We Have Come Up With A Solution To Use An Iot Energy Meter To Solve This Issue. An Iot Energy Meter Uses Current And Voltage Sensors [1] To Measure The Power And This Information Is Read Using ADC In A Microcontroller. Energy Consumption Is Estimated From The Power By Using Integration Algorithms Such As Trapezoidal Rule[2]. The Consumption Information Is Transmitted Using HTTP Protocol Over TCP/IP To The Server For Recording. The Iot Energy Meter Was Tested And It Measures The Consumption With Better Accuracy Than A Conventional Energy Meter.*

Keywords *–ADC, Current And Voltage Sensor, Iot, Microcontroller, TCP/IP, Trapezoidal Rule*

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I. INTRODUCTION

A Rapid Advancement In Computer Networks And Internet Has Led To The Development Of Technologies Such As Computerized Billing And Record Management. Although The Assessment Of Electrical Energy Consumed Is Still Being Performed Manually And This Requires Huge Manpower. Performing These Tasks Is Not Only Tedious But, Expensive To Electricity Distributors, Which Will Be A Huge Revenue Loss. This Problem Can Be Overcome Usinginternet Of Things, Also Known As Iot. Iot Enables Us To Sense And Control Any Object Via Any Existing Network Infrastructure, Thus Allowing Better Integration Of Hardware And Software Systems Resulting In An Efficient Use Of Resources And Other Economic Advantages.

The Iot Based Energy Meter Consists Of Four Major Parts: The Microcontroller, Currentsensor, Voltage Sensor And The Ethernet Controller. The Current And Voltage Sensors Help In Gathering The Data On Consumption Of Energy. The Microcontroller Performs Arithmetic For Estimating The Energy Usage And Sends This Information To The Server For Billing Via The Ethernet Controller. The Microcontroller Can Gather Information From Multiple Loads At A Time. This Information Can Also Be Stored, And The Consumer Can Learn Which Of His/Her Appliances Consumed Maximum Power. This Capability Has Been Demonstrated In The Project.

II. METHODOLOGY

The Designed Iot Energy Meter Consists Of A Voltage Sensor, Current Sensor, An Atmel Atmega-328PAVR Microcontroller, A W5500 Ethernet Controller. The Project Has Been Built Using Arduino IDE Using C++ As The Source Code Language.

2.1 PROCESS OF DATA ACQUISITION

The Avratmega324p Microcontroller Consists Of 6x10-Bit ADC Channels, With The Voltage And Current Sampled At Every 30 Second Interval On The ADC. Each Power Measurement Channel Requires Two Analog Channels, One For Voltage And One For Current, Thus Our Energy Meter Can Measure The Power Of 3 Individual Loads. An ACS712 Hall Effect Current Sensor Has Been Used For Sampling The Current Values Of The Load, It Can Measure Currents Up To 10 Amperes And A PEVMAC2C Voltage Sensor Break Outboard Has Been Used To Measure The AC Voltage.

Instantaneous Power Has Been Calculated Using The Following Formula P= V*I

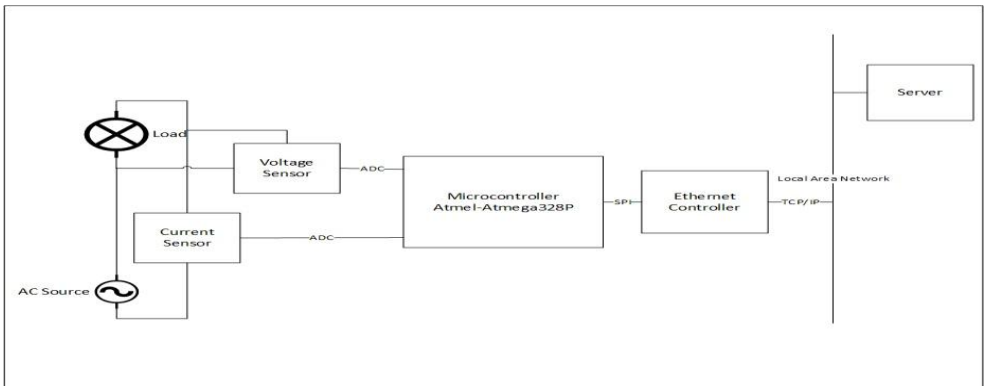

Figure 1: Architecture Diagram

2.2 Estimation Of Energy Consumed

The Amount Of Energy Consumed Has Been Determined From The Measured Instantaneous Power By Performing Integration.

$$Energy = \int Pdt$$

The Discrete Integration Has Been Performed Using Trapezoidal Integration Method.
For A Data Buffer For Power Of Length N:

$$Energy = \int_0^n Pdt = \frac{\Delta t}{2}[P(0) + \sum_{i=1}^{n-1} 2 * P(i) + P(n)]$$

Where Δt Is The Sampling Time, I.E. 30 Seconds

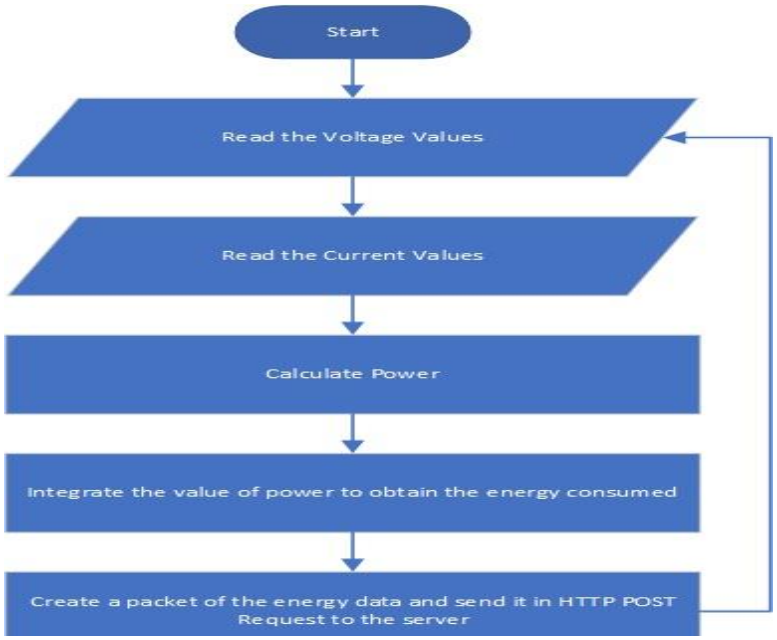

Figure 2: Flow Chart Explaining The Logic Of The Firmware

2.3 Transmission Of Data To Server

The Data Is Transmitted Via HTTP Packets To The Server, The Process Of Packetizing The Data And Transmitting It On The Physical Layer Is Performed By The Whizchipw5500 IC, Which Is An Ethernet Controller And It Receives The Instructions From The Atmega324P By SPI Bus. The HTTP Packet Contains The Information Of The Signal Source, Channel Number, Energy Consumed By The Respective Channel. This Packet Is Transmitted Using The POST Method To A PHP Script On The Server. This PHP Script Disseminates The Data And Stores The Data Into A Table In Mysql Database, Which Can Be Used For Further Processing, Analysis And Billing.

III. .FIGURES AND TABLES

The Primary Goal Of Recording Power And Estimation Of Energy Has Been Successfully Achieved. The Microcontroller Measured The Voltage And Current Provided By The Sensors Via ADC And Calculated The Power. The Trapezoidal Integration Formula Estimated The Energy Consumed From The Power With A Better Accuracy Than The Current Available Electromechanical Energy Meter.

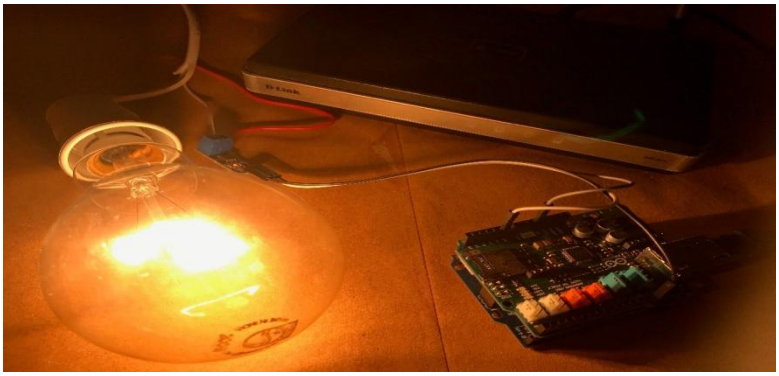

Figure 3: The Hardware Setup With Lamp Load

The Image Below Demonstrates The Raw ADC Voltage Generated By The ACS712 Current Sensor When The Load Is Turned On.

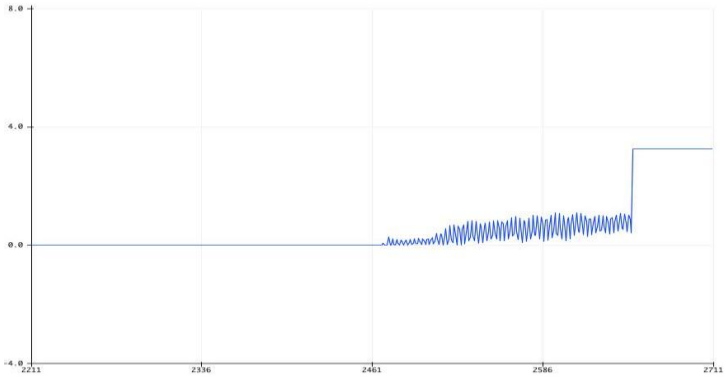

Figure 4: Raw ADC Values Of Current Sensors

tmpstmp	srcid	consumption
2018-04-05 01:09:41	420	0.28
2018-04-05 01:10:11	420	0.28
2018-04-05 01:09:11	420	0.28
2018-04-05 01:08:41	420	0.28
2018-04-05 01:08:23	420	0.27
2018-04-05 01:07:53	420	0.25
2018-04-05 01:07:23	420	0.24
2018-04-05 01:06:53	420	0.22
2018-04-05 01:06:23	420	0.2
2018-04-05 01:05:53	420	0.19
2018-04-05 01:05:23	420	0.17
2018-04-05 01:04:53	420	0.15
2018-04-05 01:04:23	420	0.14
2018-04-05 01:03:53	420	0.12
2018-04-05 01:03:23	420	0.1
2018-04-05 01:02:53	420	0.09
2018-04-05 01:02:23	420	0.07
2018-04-05 01:01:53	420	0.05
2018-04-05 01:01:23	420	0.04
2018-04-05 01:00:53	420	0.02
2018-04-05 00:55:31	420	0
2018-04-05 00:54:31	420	0

Figure 5: Energy Consumption values received from the host

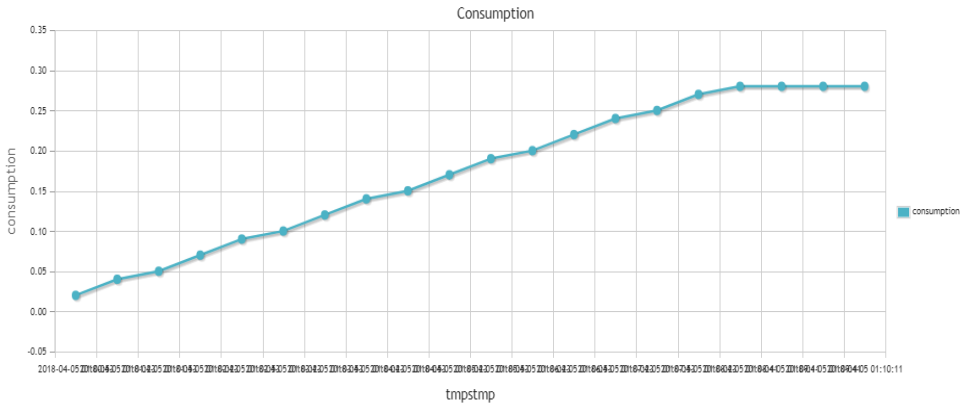

Figure 6: Graphical Representation Of The Received Data

The Above Images Demonstrate That The Data From The Host Has Been Successfully Transmitted To The Server, Disseminated And Processed For Further Usage.

IV. CONCLUSION

Our Primary Goal Of Networking The Energy Storage Devices Has Been Achieved And This Can Aid In The Reduction Of Manpower And Provide Economic Benefits To The Power Distributors. The Iot Energy Meter Successfully Replaces The Conventional Energy Meter And Is Much More Accurate And Stable Than The Conventional Meter Which Is Usually Affected By Parameters Such As Creep And Ambient Temperature. The Link Between The Energy Meter And The Database Server Was Established And The Data Was Successfully Recorded In The Database.

V. FUTURE SCOPE

The Prime Aim Of The Project Is To Make A Fully Automated System With Maximum Accuracy And Minimal Human Supervision. A Networked System Is Always Vulnerable To Tampering And Can Be Misused, To Prevent This A Theft And Tampering Detection System Can Be Implemented. The Current System Needs To Be Networked With The Help Of LAN Networking Which Requires Cables And Some Manpower To Install, Which Can Be Expensive. To Make It Economical We Can Use Technologies Such As Wifi And GSM To Transmit The Data. In The Current World Every Device Is Being Automated, The Iot Energy Meter Can Also Be Used For Automated Switching Of Devices And Monitor Their Status And Faults. The Consumption Data Can Also Be Used, Not Just For Billing But Also By The Power Distributors For Forecasting The Consumption And Plan Their Resources Accordingly Using Data Mining Techniques.

REFERENCES

Journal Papers:

[1] Iot Based Energy Meter, International Journal Of Advanced Technology And Innovative Research (IJATIR)
[2] Weijing Zhao And Zhaoning Zhang, Derivative-Based Trapezoid Rule For The Riemann-Stieltjes Integral, Hindawi Publishingcorporation

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