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Power Theft Detection and Monitoring using GPRS Technology

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ABSTRACT

Electricity losses during transmission and distribution are extremely high in India. One of the reason for this the presence of non-technical energy losses (NTL) that is energy losses caused due to theft, meter malfunction etc. Wireless network based architecture is proposed in this paper for monitoring optimizing the electric transmission &distribution system in India. The system consists of two area consumer side & supplier side. The proposed module incorporates electricity measuring & information transmission footmarks. This design incorporates effective solution for power theft &save large amount of electricity & thereby electricity will be available for more no. of consumers than earlier in a highly populated country such as India.

***Keywords*- Power Theft Detection System, GSM/GPRS Technology.**

I. INTRODUCTION

Electricity is vital for our everyday life & a backbone for the industry. While technology is on the raising slopes, we should also note the increasing immoral activities. With a technical view power theft is a non-ignorable crime that is highly prevented & at the same time it directly affected the economy of a nation. Power consumption & losses have to be closely monitored so that the generated power is utilized in a most efficient manner. The system prevents the illegal usage of electricity. There are four main ways that electricity can be accessed illegally. Electricity can be fraudulently accessed through illegal hook-ups Fig.1, meter tampering or bypass, billing irregularities & unpaid bills. Illegal hook-ups occur when electrical wires are directly connected to the grid system from the individual's premises. Meter tampering can be done by inserting a reading on the meter. Billing irregularities is a manifestation of corruption in the utility company through bribes to utility officials.

Figure1: Tapping electricity directly from the distribution feeder -bypassing the meter.

III. THE PROPOSED ARCHITECTURE

The whole proposed system architecture based on GSM/GPRS network. The architecture consist of two areas namely consumer side and supplier side. The proposed system architecture shown in Figure 3. It consist of power supply, GSM/GPRS Modem, Microcontroller (LPC2141/48), current tester WCS2702 & LCD display etc.

A. *Microcontroller:*

The LPC214148 microcontrollers are based on a 16-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, which combine microcontroller with embedded high speed flash memory ranging from 32 kb to 512 kb. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate.

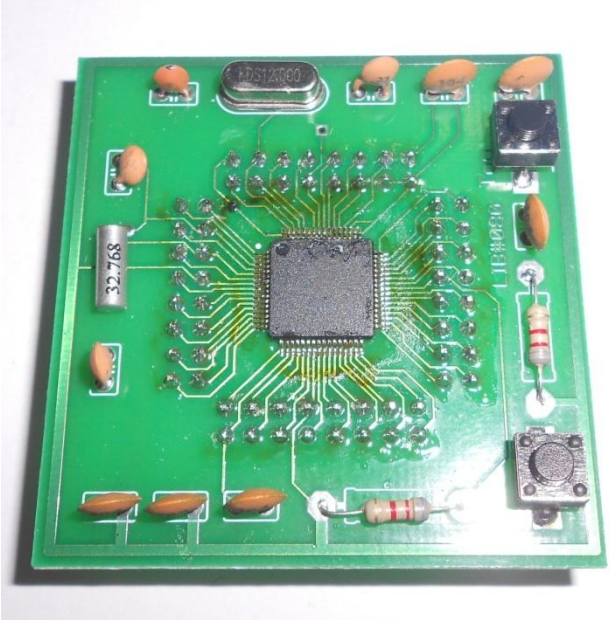


Figure2: LPC2141/48 Microcontroller

For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

Due to their tiny size and low power consumption, LPC2141/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kb up to 40 kb, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power.

Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems [3].

The ARM7TDMI-S processor is a member of the ARM family of general purpose 32-bit microprocessors. The ARM family offers high performance for very low -power consumption and gate count. The ARM7TDMI-S Processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to the high volume applications with memory restrictions, or applications where code density is an issue.

The key idea behind thumb is that of a super-reduction instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

--The standard 32-bit ARM set
--A 16-bit Thumb set

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code.

The ARM architecture is based on Reduced Instruction Set Computer (RISC) principals. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs. This simplicity gives:

--a high instruction throughput
--an excellent real interrupt response
--a small, cost-effective macrocell.

B. ***Current Tester:***

Figure4: WCS2702 Current Sensor

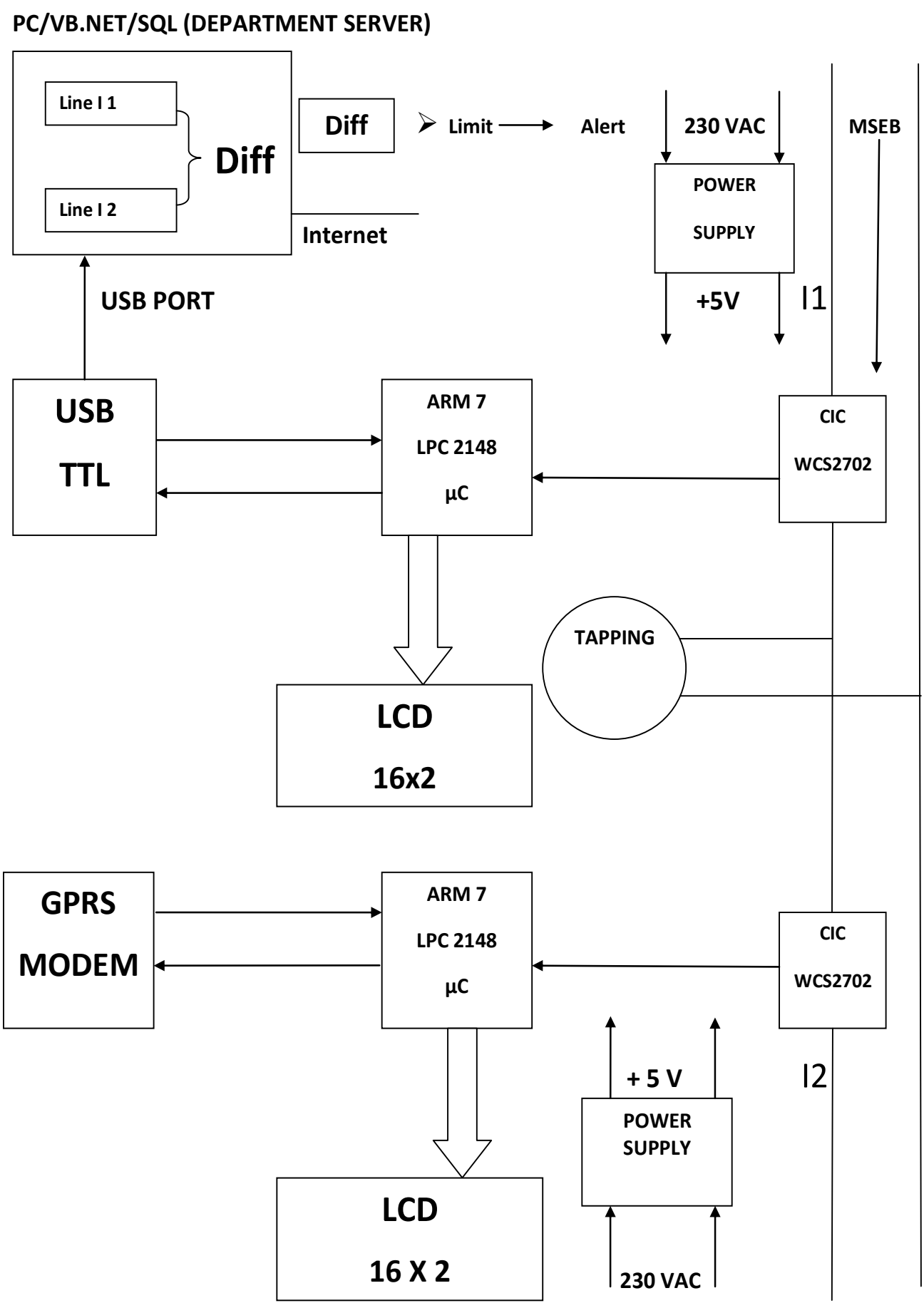

PC/VB.NET/SQL (DEPARTMENT SERVER)
Line I 1
Line I 2
Diff
Diff
Limit
Alert
230 VAC
MSEB
POWER
SUPPLY
Internet
USB PORT
+5V
I1
USB
TTL
ARM 7
LPC 2148
µC
CIC
WCS2702
TAPPING
LCD
16x2
GPRS
MODEM
ARM 7
LPC 2148
µC
CIC
WCS2702
+ 5 V
I2
POWER
SUPPLY
LCD
16 X 2
230 VAC

Figure3: Block Diagram of Proposed System

The Winson WCS2702 provides economical and precise solution for both DC and AC current sensing in industrial, commercial and communications systems.

The WCS2702 consists of a precise, low-temperature drift linear hall sensor IC with temperature compensation circuit and a current transformer with 110 mΩ typical internal conductor resistance. This extremely low resistance can effectively reduce power loss, operating temperature and increase the reliability greatly. Applied current flowing through this conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage [4].

The terminals of the conductive path are electrically isolated from the sensor leads. This allows the WCS2702 current sensor to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques and make system more competitive in cost.

C. ***GSM Modem:***

Figure5: GSM/GPRS MODEM

GSM/GPRS TTL -Modem from rhydoLABZ is built with SIMCOM Make SIM900 Quad-band GSM/GPRS engine, works on frequencies 850 MHz, 900 MHz, 1800 MHz and 1900 MHz It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3/5V TTL interfacing circuitry, which allows you to directly interface to 5V microcontrollers (PIC, Arduino, AVR etc) as well as 3V3 Microcontrollers (ARM,ARM Cortex XX, etc).

The baud rate can be configurable from 9600-115200 through AT command. Initially Modem is in Auto baud mode. This GSM/GPRS TTL

Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS as well as DATA transfer application in M2M interface. The modem needed only two wires (Tx, Rx) except Power supply to interface with microcontroller/Host. The built in Low Dropout Linear voltage regulator allows you to connect wide range of unregulated power supply (4.2V -13V). Yes, 5 V is in between. Using this modem, you will be able to send & Read SMS, connect to internet via GPRS through simple AT commands [5].

IV IMPLEMENTATION PLATFORM

Keil Software: Used for Embedded system

VB.NET for PC side coding

SQL server for database

Eagle software for PCB designing

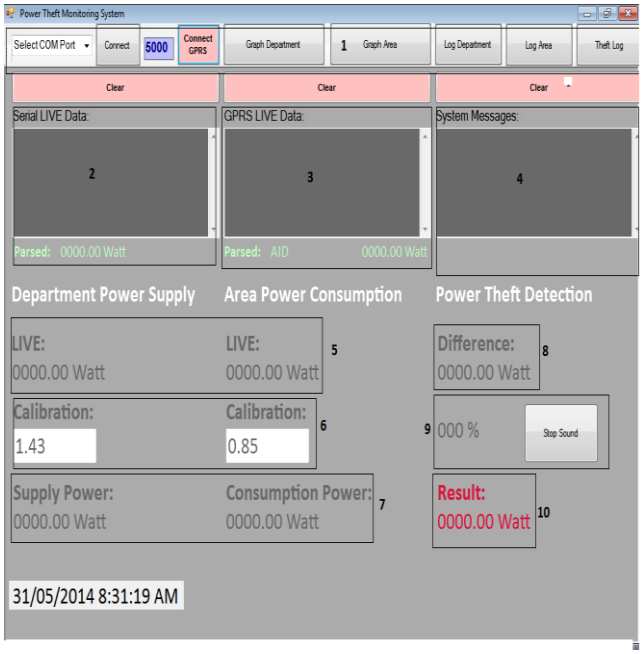
I RESULT:

- Power theft can be calculated by using the following formula:
  Difference= Electricity Supply- Electricity Consumed

- Where, Electricity Consume is stored at sever database transmitted by consumer meter and Electricity supply measured at Department side. If difference is negligible then there is no power theft otherwise there is a power theft.

Result analysis:

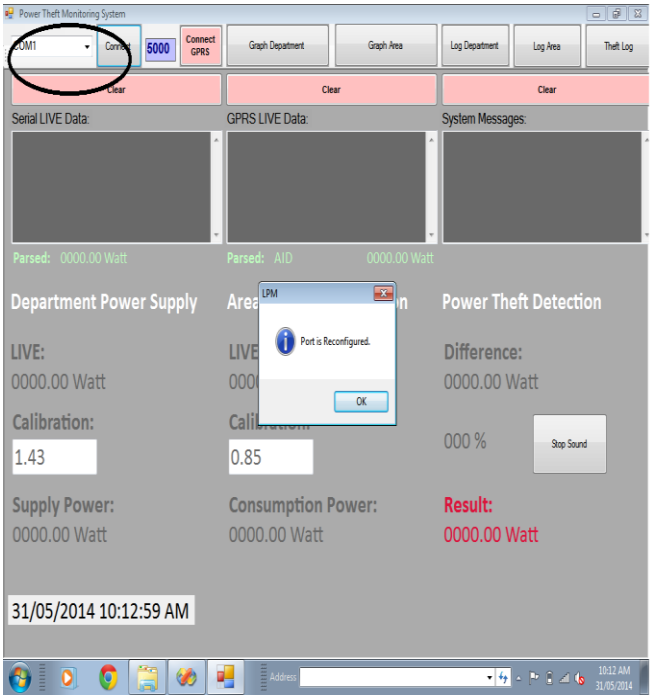
1) Ideal Graphical User Interface (GUI)



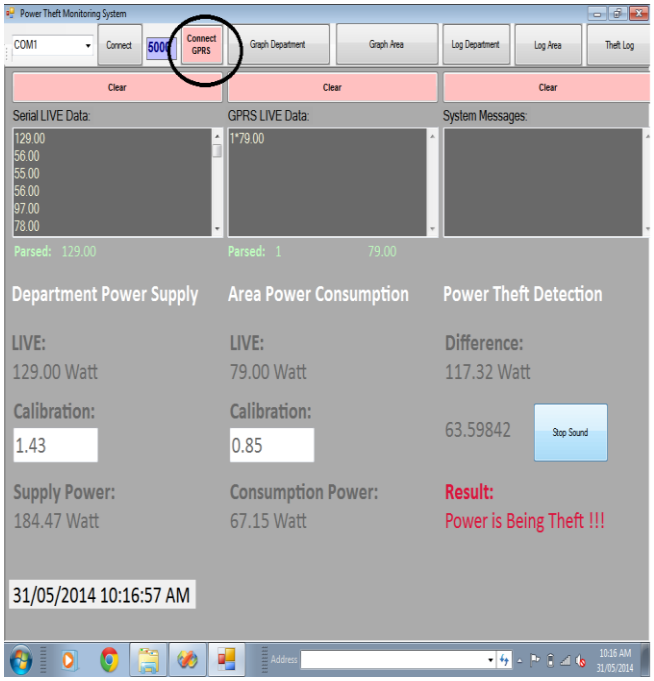
GUI module shows some buttons (1) which is used to configure and connect to GPRs and also shows some reports. It also contains some message box and labels to display data and result. Data received from department side (2), data received from third party server (3) system messages (4) power consume measured at both department and area side (5) calibration factor to calculate power load (6), power consumption at both department and area side (7), power difference between department and area power consume (8) due to losses in transmission and distribution consider some trigger amount (9), final result (10).

2) Port Configuration for the system side

First configure port at system side to receive department side measured value. As port is successfully connected it display message for successful connection and start receiving data from department side via port.

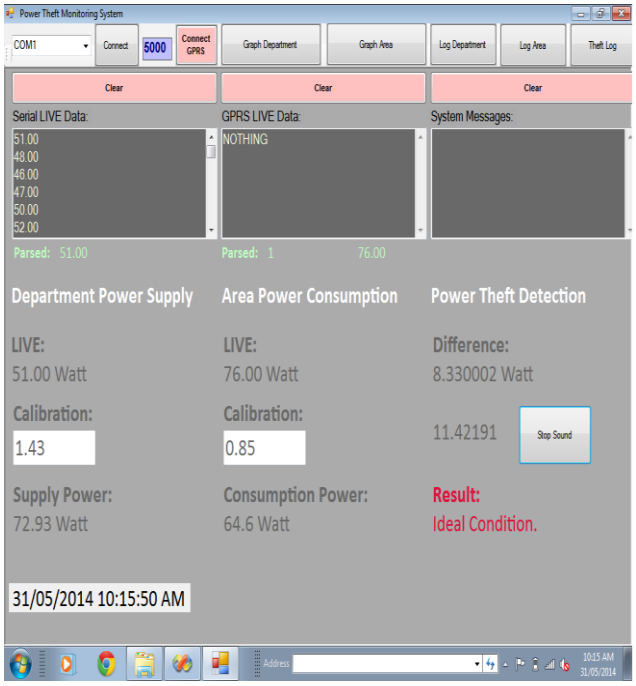


3) GPRS configuration



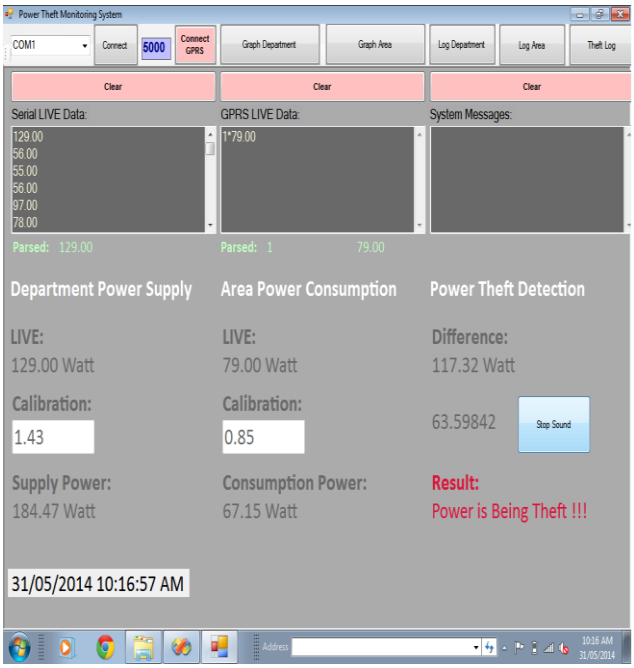
Above figure shows GPRS configuration at system side to receive area side measured value via server. As GPRS is successfully configured it starts receiving data from server. Message box shows receive data from both sides with no load.

4) Ideal load condition



At area side load is connected then data receive from both department and area side value is change, and actual power is calculated after calibration of both sides. The difference between both sides is also getting display and the final result i.e. "Ideal condition" is printed means no power is going on i.e. Power Is Not Being Theft.

5) Extra load condition



When at the supply line extra load is connected, the data received from both department and area side value is different, at that time supply value is more than consumption value at area side. Difference between both sides is also getting display and the final result "Power is being Theft" is printed means Power Theft Is Going On**.**

II CONCLUSION:

This proposed approach aims at solving major problem faced by the existing electric supply system, such as wastage of energy, power theft. This paper is aimed at reducing the heavy power and revenue losses that occur due to power theft by the

customers. The ability of proposed system is to inform or send data digitally to a remote station using GSM/GPRS technique.

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