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Electricity Meter Data Logger

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Abstract:
The goal of this project is reviewing the past work of automatic meter reading and improve the existing system to an Electricity meter data logger. The system will be read power consumption through help of current sensor, process it and calculates power consumption and send it to server. It is a combination of a current sensor and a GSM (Global System for Mobile Communications) module. The module chosen is having capability of doing high speed data processing and complete stack of GSM communication. It's an integration of two system having communication through ADC (Analog-to-digital converters) port for reading the analog current value through the load. The consumption information will be sent through email on registered email ID. The registered email and other parameters will be configurable through SMS. This project can be divided into two main blocks hardware and software development. The hardware development includes connection of microcontroller with ADC module and power supply. The software development includes writing the microcontroller source code, configuring the ADC, GPRS and GSM stack of the module. The product improvement incorporates choice of fitting stage which gives appropriate learning and advancement stage for programming advancement. Gives essential programming framework to begin and concentrate on application advancement. The picked stage is Sierra Wireless Open AT application stage which depends on Open AT RTOS. It gives bland drivers to begin with and appropriate troubleshooting support. The stage itself is industry standard and gives a decent chance to figure out how to build up an Industry standard item. The choice of ADC module is critical being the accuracy of ADC will help to calculate exact power consumption. It's a 12-bit ADC working with ADC sensor ACS712 30A Hall current sensor. The system developed is a fundamental electricity power consumption data logger unit with the help of above technologies.

Keywords: Electricity meter data logger, ADC, RTOS, GSM, UART, SMS, NMEA, GPRS.

1. INTRODUCTION

Current Sensor

A sensor is a device which detects and converts current to get an output voltage, which is directly proportional to the current in the designed path. When current is passing through the circuit, a voltage drops across the path where the current is flowing. Also, a magnetic field is generated near the current carrying conductor. These above phenomena are used in the current sensor design technique.

These sensors are these days being used widely in almost all the industries because of their vast applications and the type of output they provide which can be controlled and can be used for different applications.

Pros:
- Low cost
- High measurement accuracy
- Measurable current range from very low to medium
- Capability to measure DC or AC current

Cons:
- Introduces additional resistance into the measured circuit path, which may increase source output resistance and result in undesirable loading effect.
- Power loss due to power dissipation. Therefore, current sensing resistors are rarely used beyond the low and medium current sensing applications.

GSM Modem

The electronics device consists of a ADC sensor and a GSM modem. GSM was developed by the ETSI(European Telecommunications Standards Institute) with the aim to back the mobile communication, has now become worldwide accepted standard. The transmission of data is done as GSM communication protocol on a specific frequency band. The data is sent through GPRS over

registered mail ID. SMTP protocol is used for sending mail.

The system is itself responsible for configuring itself remotely for parameters like changing owner information, changing registered mobile numbers, changing registered mail ID etc.

2. RELATED WORK

Various approaches to vehicle tracking, monitoring and alerting system has been proposed so far.

The present system of energy metering uses electromechanical [1] and somewhere digital energy meter [2] have poor accuracy and lack of configurability and also consumes more time and labour. The conventional electromechanical meters are being replaced by new electronic meters to improve accuracy in meter reading. Still, the Indian power sector faces a serious problem of bill amount collection for energy supplied that leads to energy thefts and network losses.
One of the prime reasons is the traditional billing system [3] which is inaccurate many times, slow, costly, and lack in flexibility as well as reliability. Still accuracy cannot be guaranteed as there can be errors in human reading. Also is a postpaid scheme makes the consumer to consume more amount of power than required and still refrain from paying the bill and nothing can be done to severe the electric power supply.
Even though digital technologies like Power line communication and ZigBee technology are used for meter reading [4] still the problem of deliberately making a false reading can exist (political reasons). Number of research works has suggested prepaid Automatic meter reading (AMR) system [5-9] provides better customer services, by sending alert of power cuts and consummation updates. Recent developments in this direction seem to provide opportunities in implementing energy automatic metering reader technologies that are easier to collect, accurate, error free, etc.

Poly phase prepaid energy metering systems have also been proposed and developed based on local prepayment and a card reader [10]. Wireless prepaid energy metering system has been proposed which incorporate RF based system [11].

Digital energy metering system as an alternative for the electromechanical system has been proposed [12]. The above said energy meters which had been implemented are prepaid but it needs Smart card to recharge it.
Forimplementation, it needs internet and the computer interface.
With the development of GSM infrastructure, which has national wide coverage, can be used to request and retrieve power consumption notification over individual houses. This technology provides energy meter [13-15] with improved billing scheme.

In reference to the above work the system is focused to increase its capability and make it a complete data logger unit for electricity power consumptions.

3.Methodology

The below diagram gives a pictorial representation of the system.

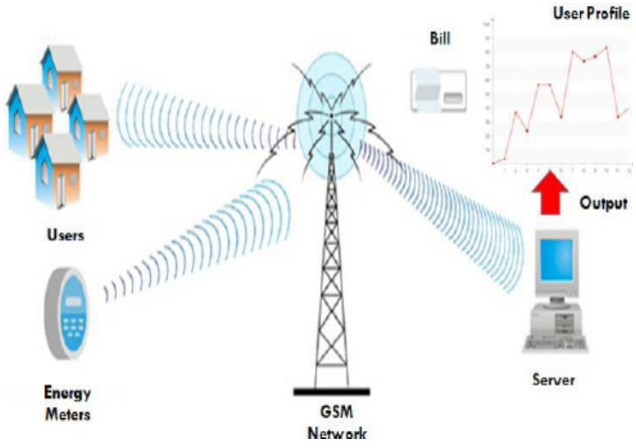

Fig. 1 Proposed system.

The system will be installed in house. It will accomplish its task with the help of a mobile device, ADC and GSM communications.

3.1 Hardware Required.

The chosen hardware Q2686 is an ARM9 based GSM module manufactured by Wavecom now Sierra wireless.
It's an automotive grade power pack module having robust design to sustain in harsh automotive environment.
It has facility of interfacing various peripheral with supported UART, I2C, SPI communication.

It has 42 GPIOs for general purpose uses.
It provides an easydebugging interface by communication through UART and doesn't requires extra hardware for code burning or debugging.

The supplier supports product development through there developer forums by discussing the issues and suggesting solutions.

Fig. 2 Q2686 development board.

3.2 Software Required

The waveform provides a proprietary RTOS platform for the application development which is OpenAT.
It has built in stack for GSM and GPRS communication. It supports wide range of communication interface like SMS, FTP, HTTP etc.

The software is developed using Embedded C.
The IDE used is Developer studio provided by Sierra wireless which provides an easy way of code editing compiling and debugging.

The platform supports GNU GCC compiler and hence provides a chance for full use of Embedded C to develop wide range of application.

4.PRACTICAL MODEL

The implementation starts with creating a OpenAT project inDeveloper studio for microcontroller Q2686.

The work is divided in below segments.

4.1 ADC driver development.

The ADC module is needed to interfaced using ADC PORT so first target is to make ADC communication possible.
12 bit ADC is configured command and data handler activated through OpenAT API.

Once any data is received in data handler it sends the data to internal processing unit for further checks.

ADC senses the current flowing through the wire and provides a value in mv as per the current flowing the wire. The equivalent mv value is used to calculate the final power consumption.

4.2SMS configuration

The system is required to provide data to a registered number hence SMS functionality is activated.

It receives SMS from a valid number only so a password mechanism is developed to match the password in received message and only valid message can change the configuration e.g. Speed limit, registered mobile number etc.

4.3 Functionality development

Individual functionality is developed with Embedded C logics.For detecting over power consumption.

1. Start
2. Subscribe the UART for debugging.
3. Register SIM on the network and make it ready for GSM communications.
4. Receive the ADC value of current sensor.
5. Process the ADC value to calculate power consumption.
6. Subscribe a timer to check continue if new request is received.
7. Monitor the time to take new value at every one minute.
8. Subscribe SMS functionality.
9. Process the configuration SMS if received and update the email ID.
10. Verify the SMS for Control center and update the setting request made.
11. Create an email with last 5 minutes data and send it to registered mail ID.
12. Continuously do above task in main function.

4.4 Results

The load is taken as a 60 W consumption bulb and the supply wire is connected to the current sensor.
The current sensor provided the equivalent ADC reading in mv to the module. Again, we connected two bulb of 60 W each then we checked the ADC value and found a relational between the wattage change and ADC value

changes. That ratio is used finally to calculate power consumption.
The module reads the value at every 5th minute and sends it through mail at 5th minute.
The mail detail contains detail of meter ID, Date and time and consumption value.

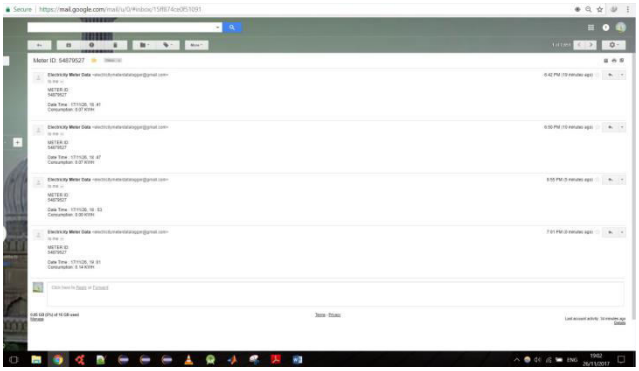

Fig. 3 Screenshot of received mail having detail of power consumption.

The GSM modem opens a SMTP channel with port 25 It login into a pre-created mail ID with all the user details saved in its memory.

Once the channel got opened successfully it writes the data on the given data channel and once the communication got completed successfully it closes the channel.

If any error occurred during the channel creation It checks the SIM is whether activated or not. If the SIM is not registered or it has lost registration due to any signal problem it re registers the SIM again and try for connection again.

5Conclusions

In this project, we have done review of various existing techniques of automatic meter reading, monitoring and alerting system. We have gone through various useful technologies, algorithms and methods used.

Every system has their own importance; different authors have tried different methods based on applications.
The proposed system is implemented and tested with different scenarios. As the system development is done on a widely used OpenAT GSM platform we get a chance to get into GSM GPRS domain.
Present system provided an entry point for use of GSM GPRS application in various domain which can be widely elaborated in future.

5.1 Future perspective of Work

- The data can be sent to a dedicated server instead of Gmail.
- A python script software can be developed on server side which will automatically read the mail and created a day wise power consumption for specific meter.
- The system can be connected to relay and power can be disconnected through SMS if bill not payed.
- The system can be improved by using a dedicated ADC which will increase the accuracy of ADC.
- The system can be enabled to communicate with other local meter through RF communication and collect their data instead of using GSM module on every meter

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