ICEST 2019 Conference

SMART SYSTEM FOR DOMESTIC POWER CONSUMPTION MEASUREMENT

Vasil Shterev[1], Hristiyan Kanchev[2] and Eltimir Stoimenov[3],

[1]Faculty of Electronic Engineering and Technologies, Technical University - Sofia
8 Kliment Ohridski bul., 1000 Sofia, Bulgaria, phone: +359 2 965 2620, e-mail: ipandiev@tu-sofia.bg, e_stoimenov@tu-sofia.bg

[2]Faculty of Metallurgy and Material Science, University of Chemical Technology and Metallurgy - Sofia
8 Kliment Ohridski bul., 1000 Sofia, Bulgaria, e-mail: hristo.antchev@gmail.com

I. Introduction

A multitude of devices for data acquisition and logging exist on the market for metering the consumption of natural gas, water, electricity and other communal services essential for the modern society. Smart meters of electrical energy exist for metering of single or three phase power supply. Having in mind the popularity of single phase power supply of domestic consumers, the study is focused on this type of smart meters, although the functionality of the device described in this paper is not dependent on the number of phases. The one thing necessary for its correct operation is an electrical or optical signal output for external metering of the already installed power meter.

II. Implementation

The proposed system architecture is composed of a master controller and several slave-devices (called nodes) connected to the power meter, ensuring a safe communication channel with the concentrator (hub) device. Every node communicates data from the actual metering interface to the concentrator. As a concentrator can serve either a dedicated Raspberry PI-based computer or every smartphone featuring Bluetooth LE communication.

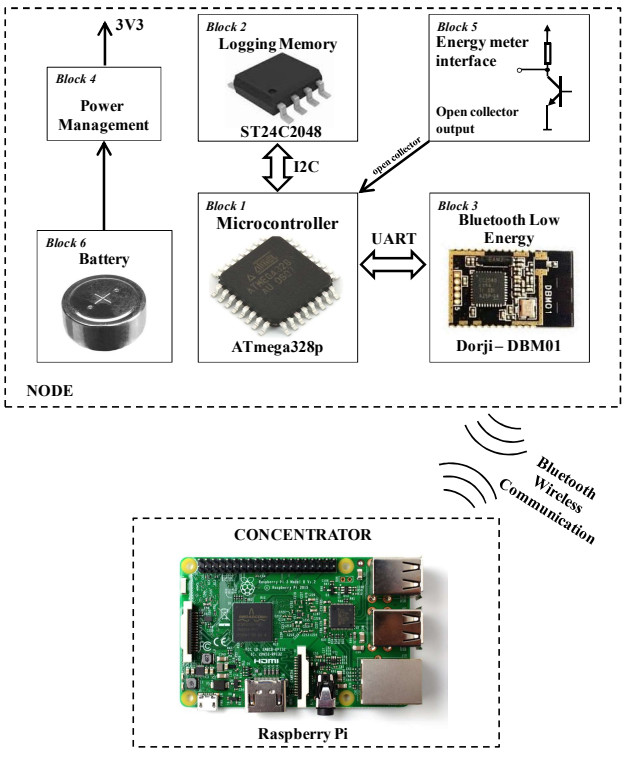


Fig. 1. Block diagram of one node and the concentrator

Block 1 "Microcontroller" is implemented by an ATmega328P microcontroller of the Atmel Company. The choice of this microcontroller is based mainly on its compatibility with the Arduino system developer environment and the power supply of 3,3V.

The Block 2 - "Logging memory" is an external memory module EEPROM, type 24C1014 of the ST Microelectronics Company. The memory size is 1 Mb, which is completely enough for storage of the electrical consumption data for more than one year.

Block 3 of the system diagram is responsible for the wireless communication between the node and the concentrator. The block is implemented by an integrated module DBM01 of the "Dorji" company. The module is compliant with the Bluetooth 4.0 specification and communication is performed by standard AT commands on the microcontroller UART interface.

Block 4 - "Power Management"ensures is actually a buck/boost DC-DC converter. This is necessary because the voltage of a fully charger lithium-ion battery exceeds 3,6V and a step-down conversion is required. At contrary, by a partially discharged Li-ion battery the voltage may drop below 3,3V and the converter has to work in “boost” mode.

Block 5 of the presented block diagram is the interface to the power metering device.

III. Data Format

Fig. 2 presents the data array format, recorded in the node’s external memory. By request this data is sent to the concentrator by the Bluetooth communication channel. The data array itself is composed by smaller 6-byte blocks of data that contain information about the number of recorded pulses, as well as timestamps defining the period over which the pulses are recorded.

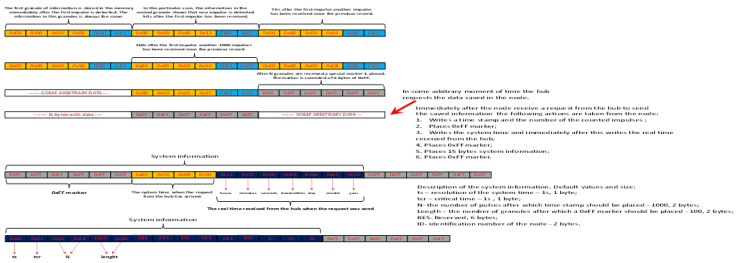
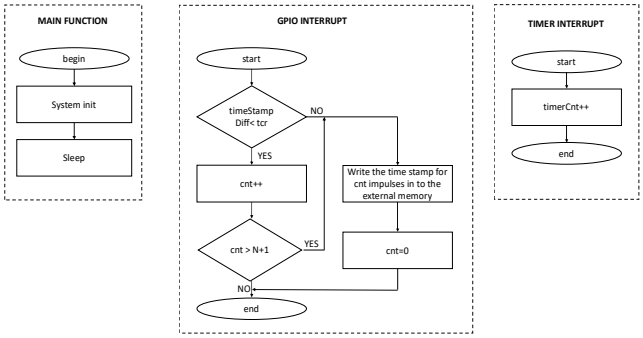


Fig. 2. Data format

VI. Block algorithm



V. Conclusion and future work

A smart system for monitoring, recording and graphical representation of information about the consumption of electrical energy. The main objectives for this device implementation are: maximum duration of device operation without the need for battery replacement/charging, intuitive user interface featuring the option for visualization of multiple values related to the instantaneous power, average power over a given time period (including historical data). A protocol was developed (including the format of the recorded data) for exchanging data between the nodes and the concentrator. Last, but not least the developed software can give advices for energy saving without influencing the consumers comfort. Future developments of this system include the options for user control over a distant node (by the use of an internet connection), remote data acquisition and logging to a remote server.

Acknowledgement

The research is conducted under the grant of project 191ПР0018-07 “Optimal management of energy flows in electric vehicles through artificial intelligence”, TU-Sofia, Bulgaria.