Journal of Electrical Engineering, Electronics, Control and Computer Science
JEEECCS, Volume 2, Issue 5, pages 11-14, 2016

Monitoring System for Environmental Parameters

Richard ANDRONACHE
Electronics, Telecommunication and Information Technology Faculty
Politechnica University of Bucharest
Bucharest, Romania
richard_georgian@yahoo.com

***Abstract* – The work shows a set of hardware-software which monitors from distance using a serial transmission, asynchronous using Bluetooth, four sensors. The hardware connection, voltage conversion in the recommended through step-up/down regulators, the structure of frame for data transport and interface HTML/PHP for data base MySQL represent few of the constrains and achievement's project. By identifying viable solutions, the result is exciting.**

Keywords-Arduino Uno, MySQL, PHP, sensors, Bluetooth

I. INTRODUCTION

The project includes knowledge from electronics area and informatics highlighting C, SQL, HTML, PHP elements which the knowledge from high school's classes for a branch of mathematics computer are comply. Research purposes was identification solution for data acquisition from four different sensors, remote transmission, and storage respectively for presentation all these sensors on a magnetic support. I used Arduino Uno for data acquisition from all four sensors (temperature, gas/smoke, alcohol, gyroscope), two step-down regulators, a step-up regulator for voltage conversion and a Bluetooth device for distance transmission. The project doesn't realize statistics and neither good observations on values received (gas, alcohol) this mean my object for a future research. A simulation in Proteus, a prototype of PCB and a GPRS's transmission for my future research too.

II. HARDWARE ARCHITECTURE

My project includes a hardware module and a software module consists of three distinct applications. The hardware ensemble showed in figure 1, include an Arduino Uno [1] with ATmega 328 microcontroller [2], a Bluetooth device [3], a LiPo battery of 3.7V and 1400mA, a step-up regulator to 9V [4], two step-down regulators with output for 5V [5], a temperature sensor, a tilt sensor, a gas/smoke sensor, an alcohol sensor and two radiators.

The assembly can be supply directly from the battery consuming 390 mA or partial from USB (Arduino, a Bluetooth module, tilt and temperature sensors) and partial from battery (gas/smoke and alcohol sensors). Data transmission made by two serial channels, asynchronous with parameters 9600, 8, 1, N, proper USB's and Bluetooth's.

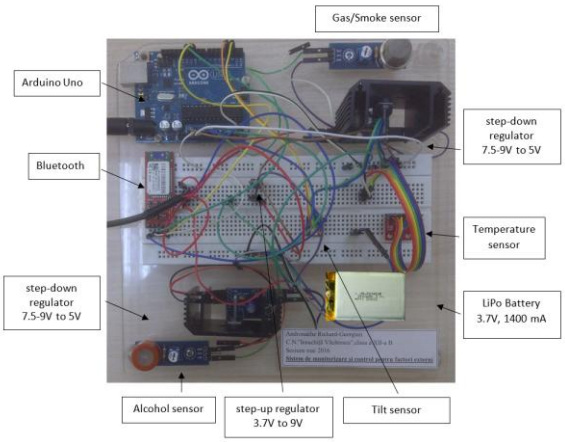

Figure 1. Electronic system

- The temperature sensor communicates with Arduino through I2C using the pins SDA (A4) and SCL (A5), being supply to 3.3V. In this protocol orders are sent by Atmega483 and se receives which states the temperature (binary values).
- Tilt sensors communicate with Arduino through digital pins, set as input, D2 și D3, is supplied to 5V.
- Smoke/gas sensor communicate with Arduino through analogic pin A0 (range values: 0-1023) being supply with a step-down regulator.
- Alcohol sensor communicate with Arduino through analogic pin A1 (range values: 0-1023) being supply with a step-up regulator.
- Bluetooth module communicate with Arduino through pins 10 (Rx) și 11 (Tx) being supply from 5V.

Digital temperature sensor (TMP102) [6], produced by "Sparkfun Digital" has a resolution of 0.0625°C, and is accurate up to 0.5°C (-25^{0}C to +85^{0}C). The device is specified for operation over a temperature range of -40^{0}C to +125^{0}C. This is a very handy sensor that requires a very low-current. Communication with the TMP102 is achieved through a two-wire serial interface. There is no on-

board voltage regulator, so supplied voltage should be between 1.4 to 3.6VDC.

Tilt sensor (RPI - 1031) [7], produced by "Sparkfun Digital" is capable of sensing a change in orientation in four different directions: forward, back, left or right. This board will work at either 3.3 or 5V.

Gas and smoke sensor(MQ-2) [8], produced by "Polulu - Robotics & Electronics" detects the concentrations of combustible gas in the air and ouputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 0 to 300 to 10.000 ppm (combustible gas). The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5V.

Alcohol gas sensor (MQ-3) [9], produced by "Polulu – Robotics & Electronics" detects the concentration of alcohol gas in the air and outputs its reading as an analog voltage. The concentration sensing range is 0.04 to 4mg/l alcohol. This sensor has the same technology like flammable gas and smoke sensor. The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

Supply should be as scheme from figure 2. It can be observing that a voltage conversion from 3.7V to 9V, through step-up regulator, necessary for Arduino board, this offering 5V for Bluetooth module and tilt sensor and 3.3V for temperature sensor respectively voltage conversion from 9V to 5V through step-down regulators necessary for gas/smoke sensor and alcohol sensor.

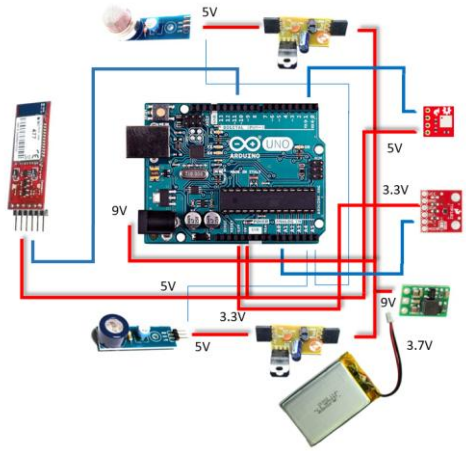

Figure 2. Supply scheme

III. SOFTWARE ARCHITECTURE

Software assemble include three applications (figure 3) which using diverse software products.

For Arduino board was developed in IDE a software module which: *initialize COM to parameters 9600,8,1,N* both Serial profile and mySerial, *initialize I2C, initialize D2,D3 pins as digital inputs, read sensors, assembles the information in a frame structure, send the frame through USB and Bluetooth.*

For PC/Laptop was developed in NetBeans JSE [10] a module which *read the serial port COM* (USB or Bluetooth), *extracts the information of the frame structure, open connection to data base, score data and closes the connection*. In case of the option's user was for simulator, the application *generates random date* in intervals indicate (0-1023 for smoke/gas sensor respectively alcohol, 0-for tilt sensor, -25 - +85 for temperature sensor), *data which write them in data base.*

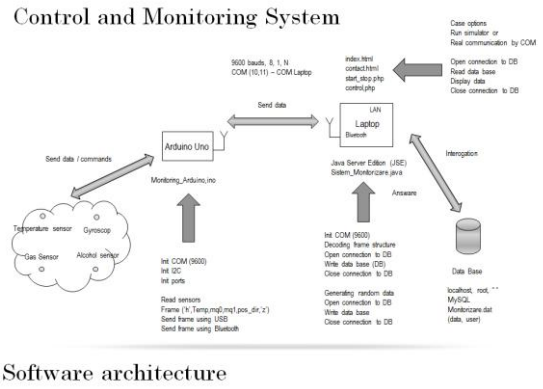

Figure 3. Software structure's application

For server (in this case Apache and MySQL [11] through XAMPP) was created a website with four pages whereby *select an option – monitorizare COM or simulator* (in each case user table from data base keep the information about the choice which we made), *displays last 25 records from data base, communicated an email application designer* respectively *download specific files from project.*

A. *Software module for Arduino board*

The flowchart from figure 4 shows the structure of the program.

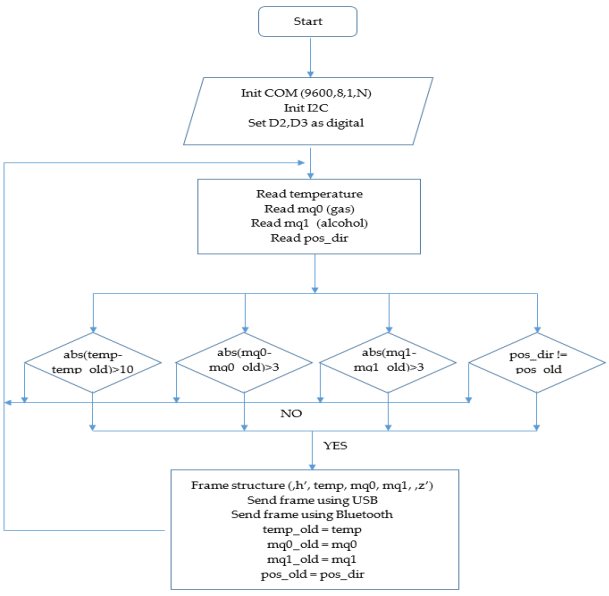

Figure 4. The flowchart for Arduino board program

B. WEB software module

For server (in this case Apache and mySQL through XAMPP) was created a website with four pages.

Thus, the page *index.html* (figure 5) we meet 8 options: *Home* (go to index.html), *Start/Stop* (startup page Start_Stop.php), *Contact* (startup contact.php), *Control* (startup page control.php), *Hardware* (download for user information's about the hardware), *Software* (download for user information's about the software), *My Project* (download for user actual project) and *Download program* (download for user resource's the project).

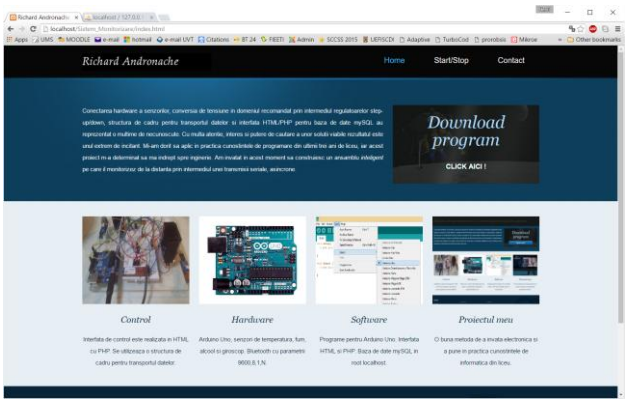

Figure 5. WEB Interface – Home page

In Start_Stop.php page (figure 6) the user benefit from four buttons and a tag for introducing the number of serial port. The page by a refresh. For Start buttons, in case of they are still active, it launches the application *Sistem monitorizare.jad* with the parameter COM nr (communication with hardware) or without parameter (simulator). For Stop buttons, in case of they are still active, closes the application execution *Sistem monitorizare.jad*.

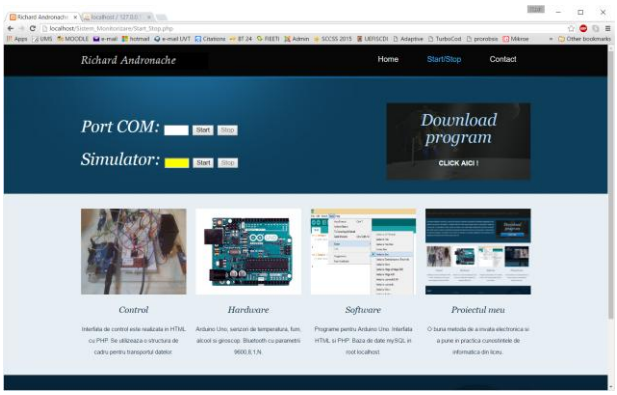

Figure 6. WEB interface – Start and Stop page

I used a PHP script [12] to read the database and print the results. In control.php page (figure 7) are show the latest 25 of recordings from data base. For this will open the connection which data base *monitorizare* situated by *localhost*, *root* in this case without password, the table *data*, select the latest 25 recordings and in a loop *while* these are displayed.

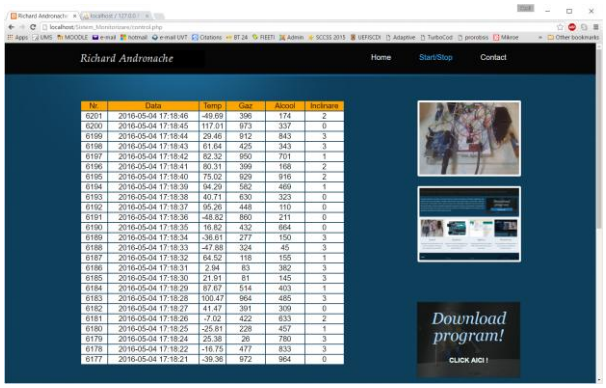

Figure 7. WEB interface – Control page

Starting monitoring application, this will run in background without being seen by the user. It can switch to any other page in the application, can close the browser, you can run any action on your computer, monitoring application is executed. To close monitoring returns in page Start/Stop and press the suitable button Stop (the currently active, depending on the action initiated by the user).

C. Structure of data base

Data base was build using phpMyAdmin, Appache server and mySQL service. Everything is being managed by the utility XAMPP. In some situations, like in that situation when Skype is active, XAMPP won't work properly because mySQL using the port 3306. XAMPP installation is fast and this is available free of charge.

I realized that *localhost*, *root*, a data base *monitorizare* with two tables *data* și *user*. Table *data* contains 6 fields *Nr, Data, Temp, Gaz, Alcool, Inclinare.* Field *Nr* is primary key and increments too. Table *user* has 3 fields *Nr, buton, simulator.* Field *Nr* primary key and increments too.

In my approach, I was inspired by the activity and results of the authors of thesis [13].

D. Structure of data frame

For data transmission to PC I used a frame structure composed from six fields. The structure is inspired by the M-BUS protocol [14] and it was already used in thesis [15]. When the system with Arduino has data to send, the use of START (1 Byte) and STOP (1 Byte) allows to recognize where is the beginning and the ending of frame. We fixed length fields for all four sensors, Temp (6 Bytes), Gas/Smoke (4 Bytes), Alcohol (4 Bytes), Tilt (1 Byte) help application algorithm from PC to identify all that 4 corresponding values that converts data type, *float, int, int, int* for register them in data base.

IV. RESULTS AND CONCLUSIONS

Connecting hardware sensors, the conversion of voltage in recommended domain through step-

up/down regulators, the frame structure for data transport and HTML/PHP interface for data base MySQL represent a lot of unknown.

Ensemble hardware consumes about 390 mA and Bluetooth communication can be maintained until 20m straight and 10m with walls interposed. The software application from Arduino used specific example from producer, these being modified and adapted to the specific proposed, it raised no special transmit data on two channels – USB and Bluetooth (pins 10,11). WEB interface build in HTML/PHP has a refresh to each 3s, in case of module control.php such that displays from data base in case of *simulator* mode three rows of values, while the simulator JSE write here data with a period of 1 s. To read the received data through COM I used Java/Netbeans. The research will continue by using GPRS technology in data transmission (the experience earned here is presented in thesis [16]), through an embedded system (without development board) and the inclusion of a registry with accumulated data reports.

ACKNOWLEDGMENT

My thanks are for my work coordinator, prof. PhD. Eng. Henri-George Coanda and also to a special person As. PhD. Eng. Ion Căciula, programmer, teachers in Faculty of Electrical Engineering, Electronics and Information Technology, Department of Electronics, Telecommunications and Energy Engineering, University "Valahia" from Târgoviste, who support me in this endeavor, in a lot of moments. In case of software module developed in Java using NetBeans which makes data acquisition, the contribution of two teachers is major and i hope that soon I will learn these programs.

The application was given a special award from the jury of „Sesiunea de Comunicări a Cercurilor Ştiiţifice Studenţeşti în domeniul Inginerie Electrice, Electronice, Control şi Calculatoare", SCCSS 2016 which took place in Ploiesit and the first place at the informatic Olympiad „Infoeducație", section "Software educațional", regional phase, Târgoviște 2016.

REFERENCES

[1] Arduino Uno, Technical documentation, https://www.arduino.cc/en/Main/ArduinoBoardUno

[2] Atmel, "Atmel 8-Bit Microcontroller with 4/8/16/32kbytes In-System Programmable Flash", datasheet, 2015

[3] Roving Networks, "RN-42/RN-42-N Data Sheet – Class 2 Bluetooth Module", 2011

[4] Pololu, "Pololu 9V Step-Up Voltage Regulator U3V12F9", https://www.pololu.com/product/2116

[5] Pololu, "Pololu 5V, 1A Step-Down Voltage Regulator D24V10F5", https://www.pololu.com/product/2831

[6] Texas Instruments, "TMP-102, Low Power Digital Temperature Sensor With SMBus™/Two-Wire Serial Interface in SOT563", 2008

[7] ROHM Co. LTD, "Surface Mount type 4 Direction Detector", 2008

[8] Hanwei Electronics Co. LTD, "MQ-2 Gas Sensor – Technical Data", 2015

[9] Hanwei Electronics Co. LTD, "MQ-3 Gas Sensor / Alcohol – Technical Data", 2015

[10] J. Wexbridge, W. Nyland, "NetBeans Platform for Beginners Modular Application Development for the Java Desktop", 2014

[11] L. Welling, L. Thomson, "PHP and MySQL Web Development", Sams Publishing, Indiana, 2005

[12] S. Suehring, "MySQL Bible", Wiley Publishing, Inc., 2002

[13] H.G. Coanda, E. R. Niculescu, "Access Control System – Solution Based On New Software And Communications Technologies", Scientific Bulletin of the Electrical Engineering Faculty – Year 13 No.4 (24), ISSN 1843-6188, pp.10-15, 2013

[14] H. Ziegler, "The M-Bus: A Documentation Rev. 4.8", http://www.m-bus.com/, 1998

[15] H.G. Coanda, "Designing A Control System for Smart Outdoor Street Lighting Using Advanced Communication Technologies", Scientific Bulletin of the Electrical Engineering Faculty – Year 15 No.1 (29), ISSN 1843-6188, pp.25-30, 2015.

[16] R. Dobrescu, M. Dobrescu, D. Popescu, H. G. Coanda, "Embedded Wireless Homecare Monitoring System", IEEE eHealth, Telemedicine, and Social Medicine, 2009. eTELEMED'09. International Conference on, 10.1109/eTELEMED.2009.22, pp.6-71, 2009