

## **MULTI-MICROPROCESSOR SYSTEM FOR REMOTE MONITORING AND CONTROL OF ELECTRIC POWER OBJECTS**

**George Pavlov, Radoslav Katsov, Ivailo Nenov**

**Abstract.** Strategy adopted by the European Commission “Europe 2020” pose serious challenges facing the world, environmental, green energy production and reduce consumption of it. The implementation of these objectives is related to energy efficiency and production of renewable energy. The modern trend is to build energy efficient public and residential buildings equipped with intelligent systems for power and control.

This report shows the block diagram, discussed are the main functions, parameters and characteristics of the microprocessor system for remote monitoring and control of electric power objects in public and residential buildings and transportation facilities. Deploying and create conditions for increasing the energy effectiveness of controlled objects, because that enables continuous remote monitoring and optimal control of controlled objects.

### **Introduction**

The European Committee adopted strategy “Europe 2020” and set certain objectives and tasks to the European countries and the whole world. One of the main objectives is achieving „20/20/20.[1, 2]

The last part of this objective concerns limiting and reducing by 20% the energy consumption till 2020. This task is difficult to be implemented, given the contemporary generation lifestyle and the growing energy needs. Regarding this the so- called “intelligent” buildings that use all innovative technologies in the field of construction, energy equipment and control, which humanity has created in recent years are created. The main objective is to achieve healthier and comfortable microclimate at minimal consumption of energy resources.

The systems for remote and automatic control, a combination of software and hardware solutions, are accepted to be one of the key elements of the intelligent building. Their main task is to provide reliable and safety remote control of all installations in exploration in the building. [3, 4]

Regarding this at Department of Electric Power Supply and Electrical Equipment in Transport a research project was developed by a team including lecturers and students from Power Engineering and Electrical Equipment Programme. Under this project was designed and developed multi-microprocessor device for remote monitoring and control (MMSRMK) of electrical objects in public and residential

buildings. There is provided an opportunity for achieving optimal energy efficiency and safety in the buildings, where we work and live. The system allows monitoring and controlling the used systems for heating, lighting, safety, etc in public and residential buildings, as well as separate systems in transportation facilities.

The main objective of the project is associated with the use of the advantages of the contemporary microprocessor equipment for creating innovative technical solutions in the field of intelligent control of transportation and electric power objects.

The designed system is applicable for residential and public buildings (Todor Kableshkov University of Transport), as well as for integration in electric transport systems. The application of the microprocessor system for remote monitoring and control will allow via GSM handset from unlimited distance to be achieved optimal control of electrical and mechanical objects in the Todor Kableshkov University of Transport buildings and thus higher energy efficiency.

Besides this the tasks to be solved by the project implementation are specifically associated with achieving higher energy efficiency of electric power objects (heating, lighting, water supply and sewerage, etc) at Todor Kableshkov University of Transport. There will be created additional opportunities to improve the theoretical and practical training of the students from Power Engineering and Electrical Equipment Programme and Electrical Vehicles Programme. The quality of the research work with regular and PhD students will be increased. There will be created innovative technical solutions and opportunities for implementing contracts with external contractors.

The implementation of the project tasks will allow the laboratory equipment of the Department of Electric Power Supply and Electrical Equipment in Transport to be improved by increasing the laboratory models, where various laboratory classes can be implemented. The training will be focused in the field of microprocessor systems for monitoring and control in electric power engineering and electric transport and opportunities for their design and parameter definition.

### **Main functions and characteristics of MMSRMK**

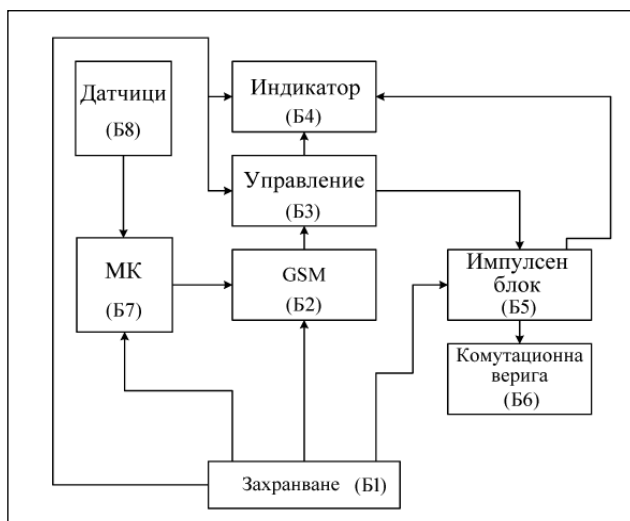
The remote system includes certain number of electric units with specific functional purpose, operating by predefined algorithm. Its purpose is to enable remote switch-in and switch-out of various electric and electronic devices using a GSM handset. In every-day life the module can be used as wireless switching circuit. The power circuit of the device is connected in series in the electric circuit of the controlled object (consumer) thus allowing monitoring and control of this object via GSM handset.

The application of the remote system is broad and determined by predefined criteria and requirements that define the parameters of its logical functionality. Through it can be controlled by predefined algorithm of the microprocessors different electric circuits, electric devices, household appliances, heating elements and systems, air-conditioning installations, etc. In the industry the remote module can be used as power disconnecter for commutation and control of different electric

devices that use switching circuit. By microcontrollers the communication between the controlled object and the device is implemented.

*Block Scheme of MMSRMK*

On fig. 1 is given block scheme of the device, showing the main functional modules and the connection between them.



**Fig. 1.** Block Diagram of Module for Remote Control

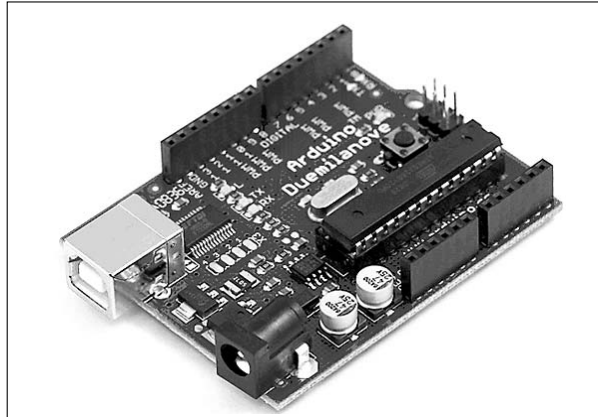
Б1 – supply unit; Б2 – GSM handset; Б3 – control; Б4 – indicator; Б5 – impulse unit; Б6 – switching circuit; Б7 – power switching circuit; Б8 – receivers;

The supply unit (Б1) provides the necessary stabilized and filtered voltages to the different modules of the electronic system. The unit Б2 is GSM (input-output device) with controlling and transmitting functions. After entering the access code and transmitting control signal is triggered unit Б3. It is a combination of optronic and switching elements and logical devices. The Б3 unit impacts Б5 (impulse unit). Its function is to cipher and decipher the processed signal. The Б5 unit activates Б6 (power switching circuit). The Б4 unit shows the current state of the system. The feedback for the functionality of the controlled objects is implemented via Б7 and Б8 units. The Б7 unit is microcontroller platform with open code. The necessary input information is received via Б8 unit (set of receivers and sensors).

*Application of the main components in the system*

In fig. 2 is shown module echelon. It provides a connection with the input and output ports of the system. The electronic component D2800 is memory and D2200

is functioning as driver for control of input and output connectors. In the scheme integration in the device are used only some of the connectors: output connectors of vibration motor (Vibra), input output connectors of the lithium-ionic battery (Bateriy connector), SIM connector and standby.



Фиг. 2. Scheme of input and output connectors

Another integrated scheme is the control panel in the audio amplifier. By the chosen control panel is provided direct control of the device and due to Atmega 328 microcontroller this can be done remotely. Besides this the data can be transmitted to the consumer via 3j network.

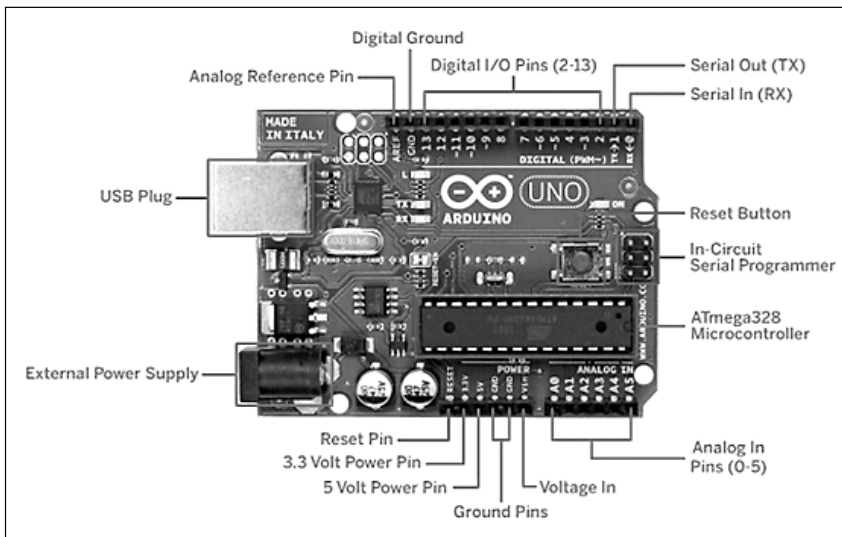


Fig. 3. Arduino microprocessor system

The main platform here is the Arduino microprocessor system (fig.3). This plate is input-output device, operating with open code or in environment for programming Processing/Wiring. This platform can interact with external software programmes as Flash, Processing, MaxMSP, PureData. By Arduino platform the distant module can extend its functions in different aspects, which results in higher effectiveness of the device.

In fig.4 is shown the main scheme, where all mentioned above scheme solutions are integrated. The scheme is filled with different sets of triggers, impulse units, timers, stabilizers, optronic circuits, controllers, etc. The system allows flexible functionality and safety operation of the device.

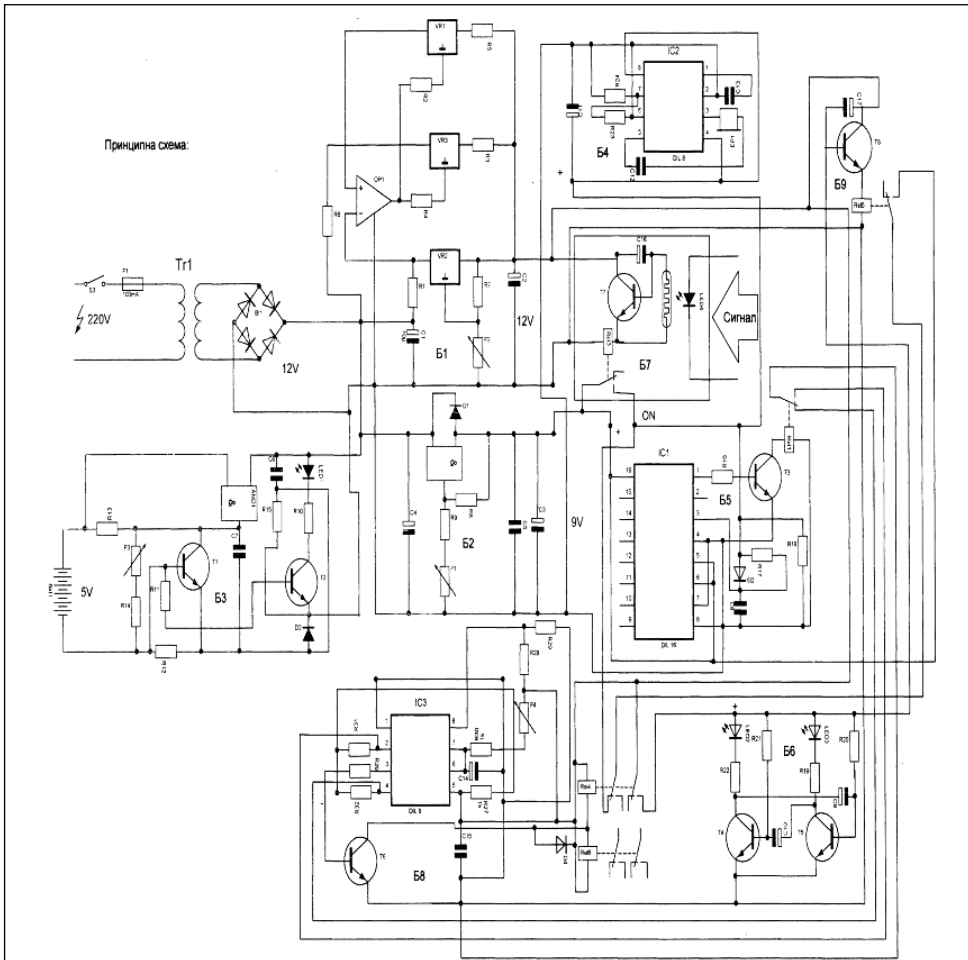


Fig. 4. Schematic diagram of MMSRMK

## **Conclusion**

The developed system is protected by Utility Model № 2234 dated 29 June, 2012. In this version it is envisaged for monitoring and control of household appliances in residential buildings. These are different types of heating and cooling systems (convertors, air-conditioners, and radiators), systems for water heating, washing machines and dishwashers. For the last mentioned, besides all standard protections, is established control for running fluid at non operating technique. This protection is introduced because if there is pressure in the plumbing system, often defects in the input electromagnetic valves results in problems for the owners (floods).

For a feedback with the system are used suitable receivers and sensors, controlling the main parameters, determining the reliable functionality of the controlled objects. The controlled parameters are rated current and voltage, rated power, current temperature, pressure, processes duration, receivers for fluid presence, etc.

The advantages of the used scheme are high reliability, unlimited range, low cost, opportunities for switching power circuits, rapid adaptation to different electric circuits and opportunities for energy efficient monitoring and continuous control. The opportunity for continuous monitoring or unexpected control of unlimited distance (remotely) of the controlled objects create safety, save time and financial resources.

## **NOTES**

1. <http://www.bulcraft.com>
2. <http://enigma-bg.eu>
3. <http://smarthomebg.net>
4. <http://www.shneider-electric.bg>

### **Georgi Mitkov Pavlov, Assoc. prof. , PhD,**

Head of Department of Electric Power Supply and Electrical Equipment in Transport,  
„Todor Kableshkov“ University of Transport,  
Sofia, Bulgaria  
e-mail: [g\\_pavlov61@abv.bg](mailto:g_pavlov61@abv.bg)

### **Radoslav Ivanov Katzov, student**

Power Engineering and Electrical Equipment Programme,  
„Todor Kableshkov“ University of Transport,  
Sofia, Bulgaria  
e-mail: [ivonenov89@abv.bg](mailto:ivonenov89@abv.bg)

### **Ivaylo Radkov Nenov, student**

Power Engineering and Electrical Equipment Programme,  
„Todor Kableshkov“ University of Transport,  
Sofia, Bulgaria  
e-mail: [ivonenov89@abv.bg](mailto:ivonenov89@abv.bg)