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APPLICATION OF THE MINI COMPUTERS IN THE AUTOMATION

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ABSTRACT
This paper presents two mini computers Raspberry Pi and Arduino. These devices are widely used due to their small dimensions and configurations. Mini-computers are used in education, programming, household, industry, etc. They are credit-card sized single electronic circuit board computers with different types of components. Paper describes the main characteristics of two computers as well as methods of application of these devices.
Keywords:

1. INTRODUCTION
Automation is use of control systems such as computers and other devices in order to control certain processes to replace human participation. At the present time there is an inevitable development, significant role and application of automation. The new technology is used to reduce the equipment and keep the performance. Nowadays, there are a growing number of workstations that come in mini-sizes. Mini-computers are types of computers that have more possibilities than standard computers. Due to the small dimensions and configurations of these devices, they are widely used in the control and automation of certain processes.

2. ARDUINO
Arduino is designed for an easy creation of applications and interactive objects. The hardware is consisted of tiles designed around Atmel AVR microcontroller. The main characteristic of the current model Arduino board is interaction with computers via USB. Arduino platform is a set of electronic and software components that can be easily linked to more complex units and is intended for educational purposes, as a simple tool for rapid prototyping [3].
Due to the simple and accessible user experience, Arduino microcontroller encountered a great application outside technological framework. Arduino is the brain of various applications, from simple everyday routines to the systems of scientific instruments. There are various characteristics of Arduino platform that differentiate Arduino from usual microcontroller:

- Very cost-effective tool;
- It comes with free Arduino development environment (IDE);
- Easy to use, connects to a computer via USB, and communicates using standard serial protocol;
- It has the support of a large number of source codes;
- It is flexible, has a large number of digital and analog inputs, SPI, I2C, serial interface and digital and PWM outputs [3].

The main parts of Arduino are: power connector, TX and RX LEDs, USB port, reset button, digital input/output, power LED, on-board LED, microcontroller, analog input/output.
The best known representatives of the Arduino platform are: Arduino Duemilanove/UNO, Arduino Mega, Arduino Nano, Arduino Mini, Arduino Leonardo, LilyPad Arduino.
Before connecting Arduino with USB to a computer it is necessary to install the free open-source Arduino Software.

3. RASPBERRY PI

Raspberry Pi was developed in the UK by the humanitarian and educational organization "Raspberry Pi Foundation". What makes it distinguished from the other similar devices is that it is a general-purpose computer with affordable price, small dimensions and with the possibility of connecting the non-standard equipment. It has a low costs because it requires external parts of its work, such as power supply, keyboard, monitor, housing, etc. Raspberry Pi has a Broadcom BCM2835 system that includes ARM1176JZF-S processor, VideoCore IV GPU. It has no built-in hard drive, but it uses SD cards for boot and data storage. It also has the ability to connect with other auxiliary components, even those non-standard via GPIO (General Purpose Input / Output) port [1].

The main parts of the Raspberry Pi are: 3.5 mm analog audio connector, composite RCA jack, USB port, HDMI port, SD card, CPU (Central Processing Unit), GPU(Graphics Processing Unit), Ethernet port and GPIO [4].

The best known representatives of the Raspberry Pi are: RPi Model B, RPi Model A, RPi Model B+, RPi Model A+, RPi 2 Model B, RPi – compute module, RPi Zero and RPi 3. The Raspberry Pi Foundation recommends Python as a language for learners. Also, any language that will compile for ARM can be used with the Raspberry Pi.

4. APPLICATION OF THE MINI COMPUTERS IN THE AUTOMATION

The use of mini-computers in education enables writing the first lines of program code for the youngest generations. Also, it is possible to integrate knowledge from various fields such as electronics, information technology, programming, etc.

Currently, the most widely used application of Arduino and Raspberry Pi is in the field of home automation. The home automation is control and driving of various sensors and household appliances with a view to improving the quality of life. Some of the processes to be controlled at home using mini computers:

- Lights control;
- Control of heating, ventilation and air conditioning;
- Control of natural lighting (control curtains or blinds);
- Audio and video surveillance;
- Control of the front and garage doors;
- Alarm systems.

Mini computers can be used in automation projects, telecommunications and remote control in industrial facilities. Using these miniature devices represents possible solution for wireless monitoring and control indicators, sensors and regulators in the industrial facilities [4].

5. PRACTICAL EXAMPLES

A few practical examples has been done with mini computers (Arduino and Raspberry Pi) using various components of electrical equipment, such as resistors, wires, photoresistors, LEDs(diodes) and solderless breadboard. These examples are presented hereinafter.

5.1. I example – ON/OFF LED, simulation of signalling traffic lights

The LED is connected via a positive electrode in series with a resistor whose other end is connected to the pin on Arduino or RPi board. Other electrode (cathode) is connected to the pinGND=ground. Program code defining time interval switching LED on and off.

Slightly more complex example of the switching one LED can be done with simulated traffic light signalling. Three diodes are connected to the board, each individually, as described in the first example. Red, yellow and green diode connects the selected pins, and that pins used in the code. Program code sets the duration of each light.

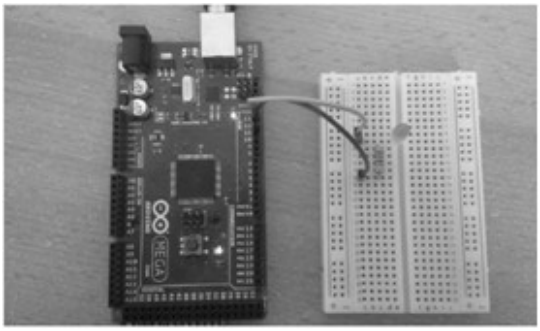

Figure 1. ON/OFF diode

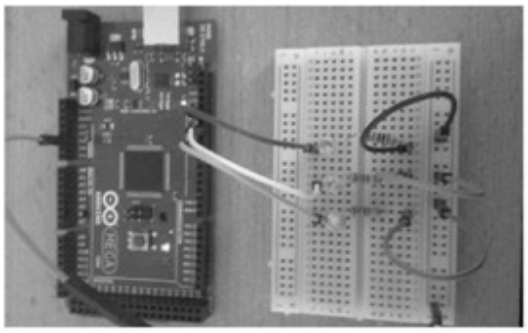

Figure 2. Simulation of signalling traffic lights

5.2. II example – Pushbutton and photoresistor

In the next step LED and pushbutton are connected on board properly. When the pushbutton is not pressed there is no connection between the two legs of the pushbutton, so the pin is connected to GND (ground), LED is off. When the button is pressed, it makes a connection between its two legs; the pin is connected to 5V so that we read a HIGH, LED is on. Also, it can appropriately connect photoresistor and LED. Depending on the light quantity falls on photoresistor, LED will be on or off. By increasing the intensity of light the resistance is reduced. When the lines of code are set the brightness LED will turn on.

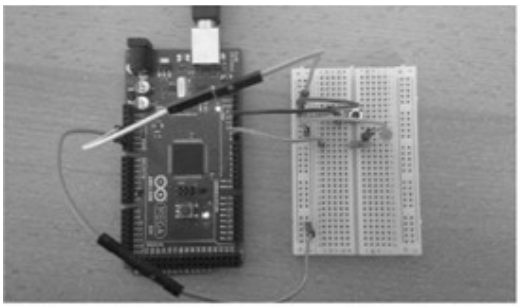

Figure 3. Pushbutton

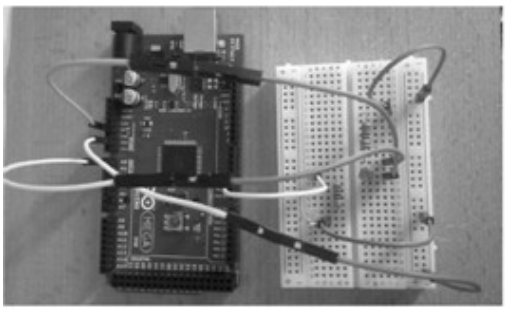

Figure 4. Photoresistor

5.3. III example – Digital humidity and temperature sensor and PIR motion sensor

DHT11 sensor temperature and humidity is very simple and has sufficient basis to collect and log data. It is characterized by low cost and availability in the market. The sensor is calibrated at the factory and does not require additional components. It is consisted of capacitive sensors humidity, thermistor for temperature measurement and electronics to communicate with the microcontroller. Three pins DHT11 sensors are connected to 5V, the selected pin on the minicomputer board and ground. The measured values of temperature and humidity can be displayed on the screen.

PIR (Pasive Infrared) sensor is enabled to detect movement in the range of sensor. PIR sensors are small, low power consumption and easy to use. There are made of pyroelectric sensors that can detect different levels of infrared radiation. PIR sensor detects the condition and the minicomputer reads it,and if presence is registered, LED lights are on.

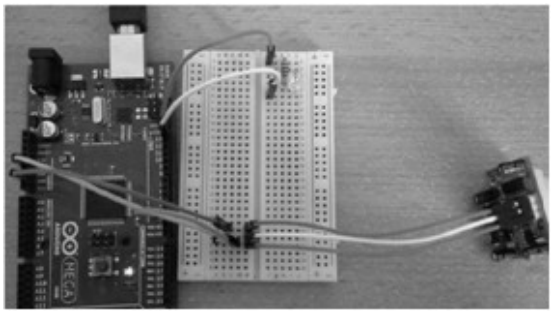

Figure 5. PIR motion sensor

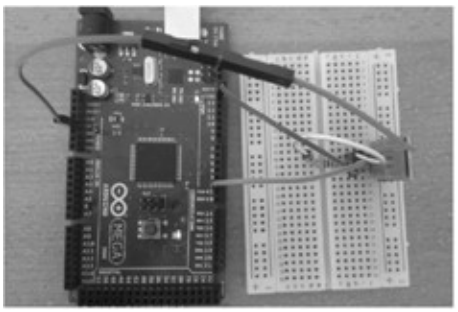

Figure 6. Temperature and humidity sensor

5.4. IV example – Control the stepper motor using mini computers

In practice we have three types of motors that are operated via devices such as Raspberry Pi or Arduino. These are: DC motors, servo motors and stepper motors. Connecting these motors on Arduino and Raspberry Pi requires knowledge of the principles of operation of each of these motors that we can understand and properly write program code. This paper will present stepper motor control. Stepper motors perform the conversion of electrical energy into mechanical or electrical excitation pulse converted in step, and provide required discrete shift, which is necessary in assemblies and systems that are needed to control precise mechanical parts. Position of the rotor is changed in steps because the stator coils are powered current pulses necessary arrangements, and also polarity controlled by binary signals. The direction of rotation can be changed by changing the pulse sequence and speed rotation by changing the frequency of pulses and angle (the number of steps), it dependents on the total number of received pulses. Stepper motors are indispensable elements for precise handling and positioning of the movable mechanisms in practical devices and systems. The main parts of the stepper motor are: the rotor, the stator and a set of gears.

There are three modes to control stepper motors:

- Wave drive - included 1 phase, the simplest case, is rarely used;
- Full step - included two phases, creates more torque;
- Half-step - included one or two phases, the smallest angular step, and the middle momentum.

In the first two modes angular step is 11.25 ° and takes 32 steps to make one rotation of the rotor. The last mode angular step is 5.625 ° or 64 steps for one rotation. Another essential part is motor driver which represents the electronic circuit which powers stepper motor from the microcontroller by control signals. Four phases are connected to 4 digital pins. Power Arduino is connected via USB port, and depending on the needs of the motor power it can be external or can be attached to the Arduino (+ pole to pin 5V, and - half the ground pin). The better understanding of the operation of the stepper motor and its operating mode it is possible to manage by writing code that control the motor in both directions of rotation, and by being able to perform the rotation of a certain arc.

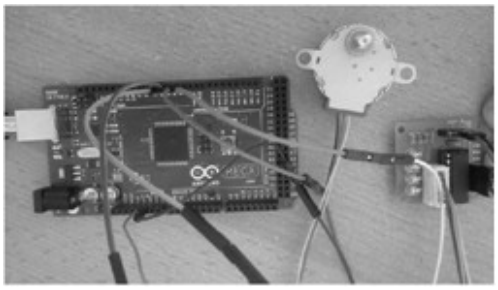

Figure 7. Stepper motor

6. CONCLUSION

Small size devices with better performance are taking up more and more attention by each year. Because of their many benefits they have found wide application, in education by helping young programmers and computer scientists to make their first steps to the multifunctional projects in household and industry. Currently, these devices are the most common in home automation projects. Various devices and sensors can be connected on pins such as lamps, cameras and motors, also different sensors like temperature and humidity sensor, smoke and gas sensor, motion sensor, and so on. In this way it manages lighting, video surveillance, alarm systems, ventilation, air conditioning, TV, garage doors, etc. All these parameters can be controlled via application on the phone, computer or tablet wherever you are. In the future we expect newer models of these devices with more powerful specifications and ideas for their application.

7. REFERENCES

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