Software Platform for Security Alarm System

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Abstract – **The concept of the proposed paper is to develop a software supporting the operation of security alarm system. The system was presented in a previous report at a scientific forum [1]. The main tasks are highlighted in the paper and they are: the choice of language and platform for application of the security system; choice of language and platform for the mobile application management of alarm systems; compilation of applications and test applications in a real environment.**

Keywords – **firmware, security alarm system, mobile application, programming environment.**

I. Introduction

We are witnesses of the continuous development of microcontrollers and microprocessors, as an integral part of embedded systems, which are increasingly used in a variety of areas: automation, telecommunication, wireless telecommunications, handheld devices, cars, automated vehicles, telematics, medical systems, monitoring and control and more. The application for the monitoring and control is the subject of development, described in this paper.

We live in an innovative society in which the technology accompanies every aspect of our daily life. Along with that comes the need for safe and effective methods of protection for our homes, properties, expensive equipment, on which the business depends, and other aspects of our everyday life. In order to achieve an effective protection we need a system that combines fast notification when there is an intrusion into the protected object or when dangerous conditions arise. The system must have a possibility of control and management from any remote point.

Nowadays, the manufacturers of security alarm systems offer a variety of interesting solutions for security of objects. There are some solutions that are closer to the development, which are described in the paper, but the idea for the realization of this project is up to few questions:

- Is it possible to create a system, which will perform its requested objectives and needs, only with the knowledge and skills of the students acquired in the process of training at the Technical College – Smolyan?
- Is it possible to realize an application for remote control of signal - security system? Most of the available systems are enabling the possibility of control by sending an SMS with a specific content.

But what would happen if the owner of this system forgets what the content and the syntax of the message should be.

- Is it possible to realize the project with hardware and open source software, in order to be as competitive as the commercial products of the same kind on the market?

The security system which was constructed, works on the basis of the modern microcontroller Atmega 2560. It has capabilities for a wide range of sensors, adequate differentiation, separation of the signals and timely communication with the user via GSM module [2, 5].

II. Software Platform Selection

Before the realization of the system, a detailed selection of the hardware components has been made. This description is given in a previous report of the authors. It is a fact that development environment and programming language must work well in this kind of development.

It is also necessary to take into account the following circumstances when choosing a software platform:

- The implementation of the hardware platform must be able to realize the basic functions, i.e. it contains relevant inputs for monitoring and corresponding outputs for control;
- The choice of software platform must be reduced to a suitable programming language and development environment that supports the microprocessor system, from which the alarm systems are built.

III. Environmental Development and Programming Language Selection

Considering the above circumstances, for the realization of the system is used an Arduino platform, whose programming environment is similar to the language Processing / Wiring. It is known that the software is an open source and completely free, which allows us its modifying and usage without any licensing agreements.

The developmental environment of Arduino includes a text editor for writing code, a message box, a text console toolbar for main functions and a variety of menus to facilitate users. The environment allows a communication between hardware and Arduino environment, testing the program and uploading the executable file in development board.

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Another key point is that the Arduino IDE is written in JAVA, which makes it a multiplatform application that enables us to use it on different operating systems: Windows, Mac OS X and Linux [3, 4 and 5].

It is logical to use Arduino frameworks for the realization of the software part. The main advantages are:

- Arduino`s developmental environment, which enables writing a code and uploading an appropriate hardware very easily;
- it is written in JAVA, which allows it to be run by different operating systems;
- there is an integrated test editor with coloring of the source code;
- there is an integrated compiler, which converts the source code into machine;
- there is an integrated debugger for checking the code;
- there is an excellent compatibility with Arduino`s hardware.

The basic structure of the language for Arduino is relatively simple and is consisted of at least two parts - function setup() and loop(). These two required parts (or functions) "wrap" the block`s statements. Besides that, external functions may be declared. If necessary they are called out from one of the two main functions subsequently, so the external functions appear as components of the basic functions.

IV. Block Diagram of the Software Platform

The program structure is illustrated by the block diagram in Figure 1.

There are described the characteristic variable declarations at the beginning of the program (and they are not only for that language). The libraries, that are used, are defined at the beginning too. Behind their definitions a description of the two statutory functions Arduino platform, setup() and loop() is made. In the course of their work these two functions call out other external actions that are described. These are the AutoTurnOn() and the GSMSetup() functions for The Function setup() and temperature() and sendSMS() for the Function loop () . Foreign functions that are called out from setup(), are unconditionally executed. There are no circumstances in the body of this function, due to the fact that it is performed only once, when the device starts working. Foreign functions in the body of the loop() can depend on some conditions, i.e. they can or cannot be called out, although they are described in the program [3, 4, 5].

A. The function AutoTurnOn()

Typical of the GSM module, which is used in this project, is that it cannot be switched after the supply of the power system until the moment you press and hold the button S_PWR for two seconds. This action can be performed programmatically, through the terminal of the GSM module, which is responsible for this task and is connected to terminal 23 digital pin on the Arduino Mega 2560. Part of the code is as follows:

```
/***this function turn on the GSM module***/
void AutoTurnOn(){
  pinMode(23, OUTPUT);
  digitalWrite(23,LOW);
  delay(1000);
  digitalWrite(23,HIGH);
  delay(2000);
  digitalWrite(23,LOW);
  delay(3000);
}
```

While analyzing the algorithm of the function AutoTurnOn() we can notice that it describes programmatically the actions that would be applied if the module was used manually.

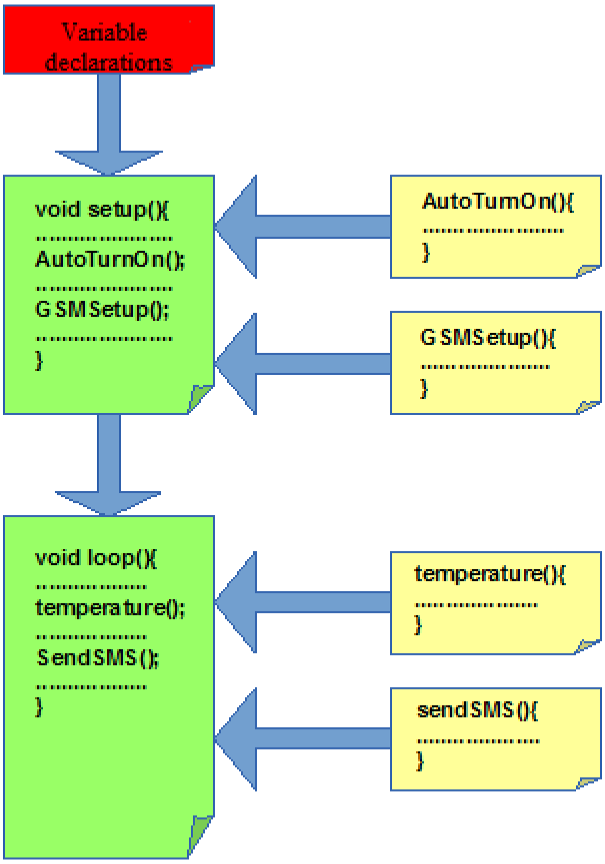

Fig. 1. The block diagram of the program security system

B. The function temperature ()

The value obtained from the temperature sensor at specific analog input from the microprocessor, is converted into a digital form. The software realization is carried out by function temperature(), which performs the algorithm. Part of the code is as follows:

```
/***Temperature function***/
void temperature(){
SensorValue=analogRead(A5);
Sensormilivolts=(SensorValue/1023)*5000;
kelvin=Sensormilivolts/10;
celsius=kelvin-273.15;
fahrenheit= ((celsius * 9)/5 +32);
```

```
  // Serial.print(kelvin);
  // Serial.println(" Kelvin");
  Serial.print(celsius);
      Serial.println(" Celsius");
      // Serial.print(fahrenheit);
      //Serial.println(" Fahrenheit");
      delay(200);
  }
```

C. The function GSMSetup()

This feature adjusts the GSM module according to its necessary needs. The setting is done by sending specific IT commands to the module.

```
  /***This function setup GSM module***/
  void GSMSetup(){
       gsm.println("AT+CMGF=1"); // set SMS mode to
         text
       delay(1000);
       gsm.println("AT+CNMI=2,2,0,0,0");
       delay(1000);
```

D. Description of the function

There are two methods for transmission of SMS. In the first PDU Mode, the message is in the form of a string of hexadecimal numbers. Activated by "AT + CMGF = 0". The second method, which is used, is the Text Mode. In this case the message is in the form of a text that can be read easily. Sending a command "AT + CNMI == 2,2,0,0,0" to GSM module is of particular importance. Thus the incoming messages are not stored by the module in the memory of the SIM card and the module forwards them directly to the TA (Terminal Adaptor).

E. The function "sendSMS ()"

The function "sendSMS ()" sends SMS to a fixed number upon activation of any of the sensors. The microprocessor system detects which sensor is activated and sends a text message with a specified content [1]. For example, if there is a glass breaking, the contents of SMS-s will be "ALARM acoustic", if there is a high temperature in the room; the contents will be "WARNING High Temperature", etc.

```
  /***This function send SMS***/
  void sendSMS(){
       gsm.print("AT+CMGS="); // now send message...
       gsm.write((byte)34);// ASCII equivalent of "
       gsm.print(phoneNumber);
       gsm.write((byte)34); // ASCII equivalent of "
       gsm.println();
       while(gsm.available())
            Serial.write((byte)gsm.read());
       delay(500);
       Serial.println();
       gsm.print(alarm[i]); // our message to send
       gsm.write((byte)26); // ASCII equivalent of Ctrl-Z
       // this will send the
         following:AT+CMGS="phonenumber"<CR>
       // message<CTRL+Z><CR>
       delay(500);
       gsm.println();
       while(gsm.available())
       Serial.write((byte)gsm.read());
       delay(500);
       Serial.println();
       delay(15000); // The GSM module needs to return to
         an OK status
}
```

It cannot be determined to which kind of category belong this software application. Rather, it belongs to another kind of category, which is called software for embedded systems. We would say that for the realization of the program the methodology "writing code and fixing " is being used. The reason for this is that the project is relatively small and the problems are being removed from the beginning of the process of work until the end. This is attractive choice when the time for product development is greatly reduced, because the code writing begins immediately and therefore achieves results quickly.

The disadvantage of the methodology occurs if some serious architectural problems are found later through the development process, because it requires large parts of the code to be rewritten. There are alternative models that can help capturing such problems at an earlier stage, when changes are easier and cheaper to be made.

The next step is the building process. It is known that programming errors are removed at this process, of course, if there are any. The several errors were found during the compilation. They were mostly of syntactic and algorithmic nature. The errors were removed until the successful compilation of the program.

Checking the size of the application and the required enough memory, which is available to the Arduino - board where you boarded- are an important aspect. The Arduino board which was chosen has a 256 Kbyte memory. The application has a size about 12 Kbyte, so that the available memory is sufficient for our application.

It is necessary to implement the process of upload or upload the application of the Arduino development board upon successful compilation. Re-checking the source code for errors is being done during the upload.

V. Environment for Implementation of the Mobile Applications - J2ME

When developing a mobile application- a java 2 micro edition (j2me) is being used. It combines the limited resources jvm JavaScript virtual machine and a set of APIs (apis) application development for mobile devices. APIs cannot be run on traditional JavaScript virtual machine. They are compatible only with jvm, provided by j2me environment. This is due to the fact that mobile devices have limited resources of memory. The environment j2me is installed by the manufacturer of the mobile device and the applications' developers have no relation to this process.

There are seven steps of creating MIDlet. These steps are: design, coding, compilation, verification of the compliance, created packages, test and an upload device. Some of these steps may be omitted, but the design, writing the code and the compiling process are required.

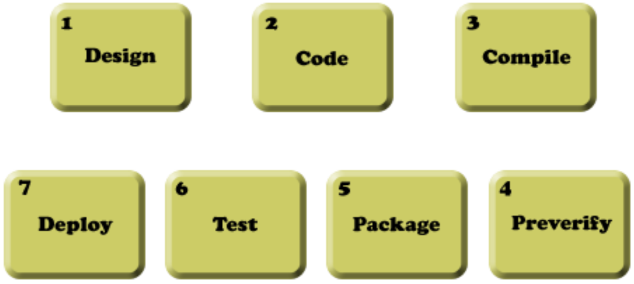

Fig. 2. The Steps at creating a MIDlet

The next stage is when the application is ready to be used in a real environment. It must be installed at a real device. There are two ways to accomplish this. The first is via a USB cable or a Bluetooth wireless communication. Most devices supporting JAVA, allow installing the application. The second way is more interesting-It opens the application to the outside world via Internet. The device must be connected to the Internet via its built-in browser. Before that we should upload mobile application at a WEB server. We should bear in mind what the size of the contents of the host will be, because it will be accessed from the mobile browser, which has limited resources. The application can be downloaded and installed on the mobile device when the host is available.

VI. Testing the Application in a Real Environment

The application testing is the final step. We need a certain period of operation of the system in a real environment because a few things must be established:

- If the application is stable at work, i.e. If there are periods in which it works and others in which it does not work;
- If the application affects the temperature of the system. It is possible for the system to be overloaded due to programming errors and this can affect the temperature of the microprocessor and other components;
- If the application responds to our expectations, i.e. If It performs all the functions which are set in in the source code;

The findings from the testing of the application are as follows:

- Whether the application works stable. There are no periods when the application does not serve its purpose;
- The work of the application does not influence the temperature of the system during continuous operation;
- The application meets our expectations, all the functions, described in the source code, are operating normally.

VII. Conclusion

The advantage of our application is that it is not necessarily a specific text message to be remembered. It is easy for usage and is protected from an unauthorized access.by password

The product is able to compete with similar commercial products at the market. The functionality has still unused additional opportunities, thanks to the Arduino platform. Its cost is similar to the cost of its competitors, but when it is implemented at mass production, the price will decline.

Acknowledgement

The authors would like to acknowledge the support of the "Research & Development" division of Plovdiv University in the project: НИ15-КС-016/24.04.2015.

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