UDK 621

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SIGNALIZATION SYSTEM WITH REMOTE NOTIFICATION AND CONTROL

This article presents alarm system, which sends voice messages to appropriate responder via telephone line, when some problems occur on the controlled area. Only one PSoC is used to rich functionality implementation.

Key words: alarm system, telephone line, PSoC.

Наведено систему сигналізації тривожних подій, яка передає голосові повідомлення відповідному отримувачу через провідну телефонну мережу загального призначення, у разі виникнення проблем на контрольованій території. У цій системі використано тільки один програмований мікроконтролер для реалізації широкої функціональності.

Ключові слова: сигналізації тривожних подій, телефонна мережа, програмований мікроконтролер .

Abstract

Modern signalization systems propose rich functionality for user, which include voice message transmitting via telephone line, device remote control and tuning via telephone line, device local tuning with PC using or other special devices and other features. So, designer must solve different tasks in one device. It requires using different specialized chips in one design (like specialized communication controller, DTMF detector for remote control, cap-sense keyboard controller for local control, etc.), what increases the device cost.

Modern programmable microcontrollers already have required set of communication and other controllers or provide ability to build different functional blocks on the general purpose configurable hardware blocks. It allows to implement wide functionality on modern programmable microcontrollers without using specialized chips. It simplifies device end-device, the design cost and power consumption decreases (what is critical for autonomous systems), but microcontroller firmware complexity increases.

For implementation of proposed signalization system, the programmable Cypress microcontroller CY8C24794 was chosen. It contains all required communication blocks and hardware for building capacitive keyboard controller and analog blocks for obtaining and processing sensors data.

Problem formulation

For reliable notification of problem occurrences, system should provide possibility to transmit several voice messages (depending on type of the alarm event) to several recipients (depending on the event type and in the case when appropriate recipient doesn't respond). For required functionality providing, system should correspond to the following parameters:

Power supply	9-12V
Current consumption (max)	80mA
PC communication interface	USB
Voice message duration (max)	16 sec.
Message recipients count (max)	3
Voice messages count (max)	3
Phone numbers length (max)	40

Signalization system functioning

Signalization system functional scheme is shown in the Fig. 1. It consists of the following components:

1. Programmable microcontroller (PSoC);
2. Flash memory, which is used for voice messages, phone numbers and sensors parameters storing. Sensors parameters are used for alarm events generation;
3. Sensors set, which is used for controlled area and device state monitoring (Temperature/Power/Battery Sensors);
4. Capacitive keyboard for device local control (CapSense Keyboard);
5. Phone line interface (DAA).

Microcontroller is used for the following tasks:

1. Sensors scanning and obtained data processing (Sensors controller);
2. Call to the appropriate recipient and play voice message if obtained from the sensors data exceed specified range (Dialer);
3. Analyze phone line signals for DTMF symbols presence during and after voice messages playback for system remote control providing via phone line by message recipient (DTMF detector);
4. Scan capacitive keyboard for system local control (CapSense Controller);
5. Process and fulfill commands from PC, when it is connected to signalization system for extended local control providing.

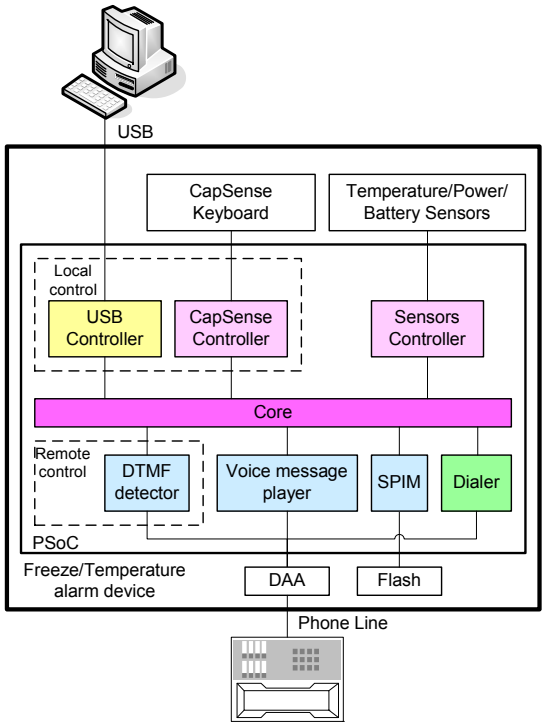

Fig. 1. Signalization system functional schematic

Signalization system operates in two modes:

1. PC communication mode via USB;
2. Operational mode.

System switches to the PC communication mode when USB cable is connected to the PC. System does not scan sensors and capacitive keyboard in this mode. PC commands are obtained and processed in this mode. Voice messages, phone numbers and sensors appropriate range can be downloaded to the system in this mode only. Special PC application was created for signalization system controlling in this mode.

System switches to operational mode after USB cable disconnection from PC. Sensors and capacitive keyboard are scanned in this mode. System calls to the appropriate recipient if alarm event occurs.

Signalization system firmware

Signalization system firmware consists of such components:

1. Main program. This part controls USB connection and operates in appropriate mode. The diagram of main program is shown in Fig. 2;
2. SPI communication block (SPIM) interrupt handler. This part provides signalization system communication with Flash memory on physical level;
3. Flash memory control library. Provides functions for flash memory controlling on logical level. These functions provide required communication protocol with flash memory;
4. CSDADC interrupt handler (used for sensors and capacitive keyboard scanning). Standard CSDADC interrupt handler was changed for providing DTMF symbols detection and voice messages playing when it is required;
5. DTMF symbols detection subroutine. Implements phone line analysis, collects data and provide high-level decision logic for reliable DTMF symbols detection;
6. User commands processing subroutine. Implements PC and capacitive keyboard commands processing.

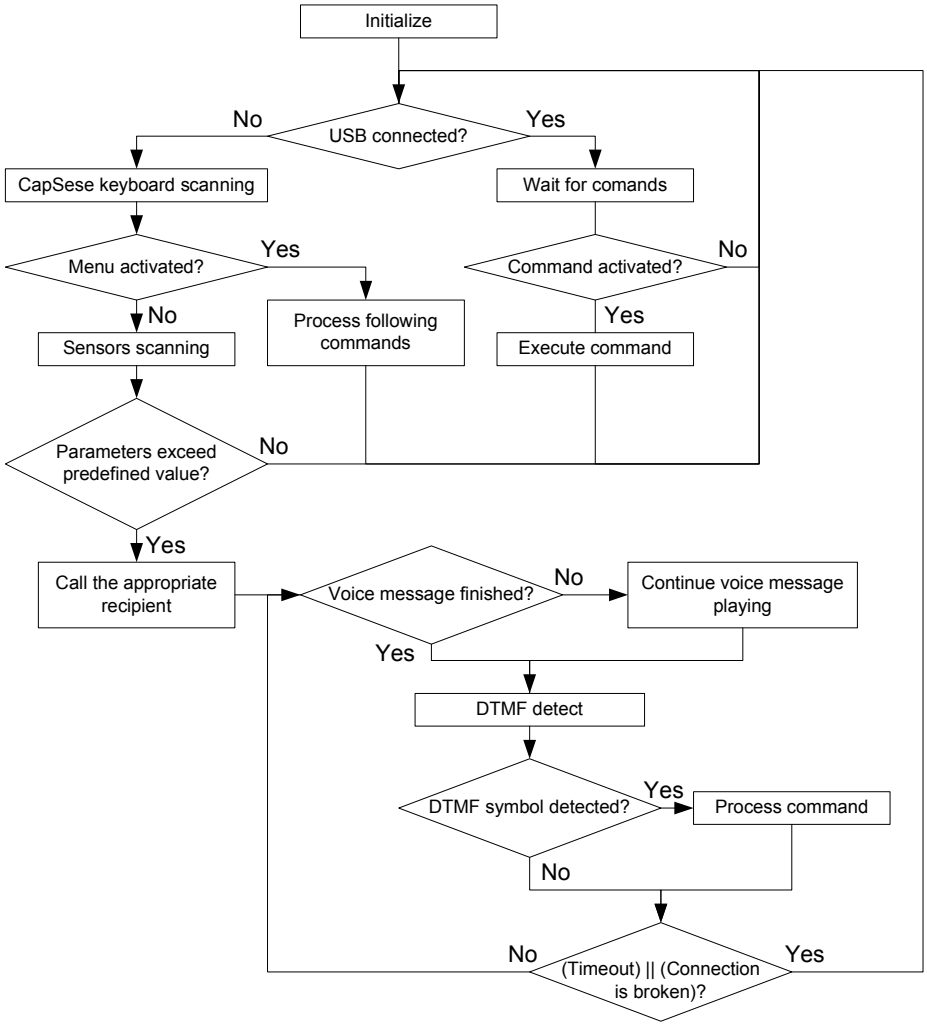

Fig. 2. Signalization system main program functional diagram

PC application

PC application view is shown in ***Fig. 3***. This application allows set alarm recipients phone number, voice messages downloading into signalization system and set sensors appropriate ranges. PC application window contains three tabs:

1. “Phone Numbers” tab. Up to three recipients phone number could be set in this tab and downloaded to the signalization system by selecting appropriate numbers in the “Sel.: field and pressing download button;

2. “Sound selector” tab. This tab is used for voice messages selection. Voice message should be in “.wav” file, which contains 1 voice channel with 8KHz sample rate. If file size exceeds voice message duration, file will be truncated. Test call with voice message playing can be made by “Call” button pressing (phone number and voice message should be downloaded into signalization system before it);

3. “Temperature settings” tab. This tab is used for setting valid ranges for sensors. In designed signalization system the temperature settings are used alarm invoking.

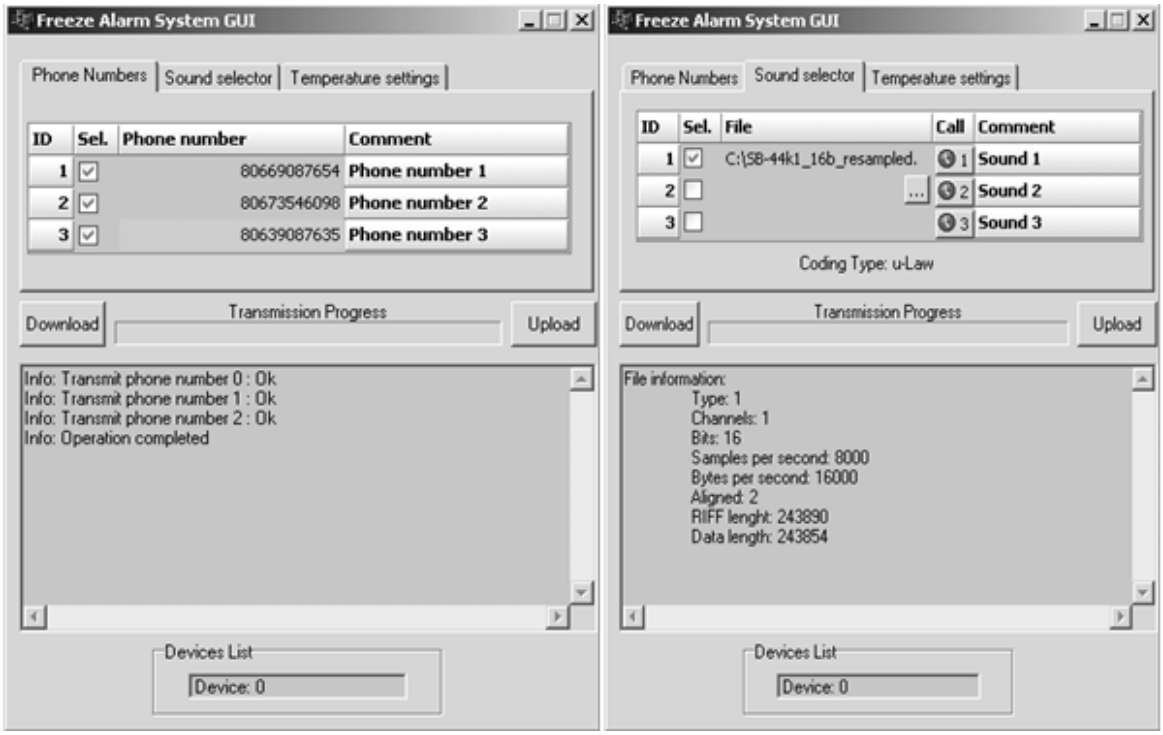

Fig. 3. PC application view

Conclusion

Signalization system built on one programmable microcontroller is presented in this article. This system provides several parameters monitoring and makes alarm call via phone line and plays voice message to call recipient when controlled parameters exceed valid ranges. Presented system has the following advantages:

1. Rich functionality is implemented in one PSoC;
2. Remote control via phone line;
3. DTMF symbols detection during voice messages playing;
4. System local controlling from PC via USB;
5. System local controlling with capacitive keyboard;
6. Different voice messages (up to 3) and different recipients (up to 3) for different problems in controlled area.

There are following drawbacks of the designed system:

1. No visual control when device is turned off from the capacitive keyboard;
2. Phone line state is not analyzed when device make a call to the recipient;
3. DTMF detector is not ITU compliant;
4. Firmware utilizes 99.9% of microcontroller program memory what complicates system improvement and adding new features.

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