

# Control System design for System for Public Observation, Communication and Alert

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*Abstract*— The system for public observation, informing and alerting represent alarm station capable to control several electromechanical systems and collect and transfer data to supervisory system. Some of the basic functions of alarm stations are the following: used to broadcast warning signals and/or voice messages and informing and alerting the population in case of danger, as well as the termination of hazard. System can be activated remotely and/or locally with the same station, if necessary, it can serve for monitoring the area where it is located. System has the function of self-diagnostic work and has autonomous power supply safety equipment. This control system, as its name suggests, is used to manage the alarm station and supervision. It is based on a microcontroller control board BeagleBoneBlack. Options of the control system are: local activation of electronic horns and broadcasting selected warning signals, broadcast voice from a microphone, which is located within the cabinet alarm station, broadcasting recorded voice messages from MicroSD card, local diagnostics of work alarm station and displaying on the touch screen display of signage correctness of work. In case of possible failure in the alarm station, system can inform a master control center about the problem. System also can realize commands to activate alert cues or speech signal from the master control center. The control system also supports remote communication; it has an Ethernet port, USB port, SPI communication protocol, RS-485 and RS-232 communication standards.

*Keywords* - Control system, Public alert, BeagleBoneBlack

## I. INTRODUCTION

The main purpose of the system for public observation, informing and alerting is to supervise the potential natural, technical and social hazards that may threaten the population of the territory, and on the basis of information collected and according to the collected data of the occurrence and termination of the relevant risks, to alarm by sound signal. The system, if necessary, conducts the general, partial or selective

alerting the population in the endangered territory broadcasting different signs of alarm and/or pre-recorded voice messages or voice with the microphone. One such system can be used for alerting and alarming in settlements on river floods, dams, on objects of particular importance, industrial complexes, on military facilities, public prisons, etc. Also, this system can be used for audio reinforcement into the factories, recreation centers, sports facilities and stadiums, sports and production halls, fairs, shopping centers, etc. The system for public observation, informing and alerting are basically the alarm stations. Basically, alarm stations consisted of: box with electronics, horns with drivers, the pillar carrier, the mounted horns with drivers and control panel, which is used for remote control of electronic alarm sirens. Such systems are not so common in the world, and technical requirements are different depending of the country. In the text below it will be described in more details the control system for observation, alarm and monitoring stations.

## II. BASE SYSTEM CHARACTERISTICS

In the world there are similar realized systems, such as systems that are produced in the company Comtel [1] and systems produced into the company Sonnenburg [2]. The systems of these companies have their advantages and disadvantages, but the biggest drawback is their price and the impossibility of the configuration according to the needs and wishes of customers.

The new control system has to be implemented and to be compatible and integrated into the system which is already operated as an improvement. Implementation was carried out so that the new control system now has all the opportunities that had the old system, but at the same time adding new functions and new features [3, 4].

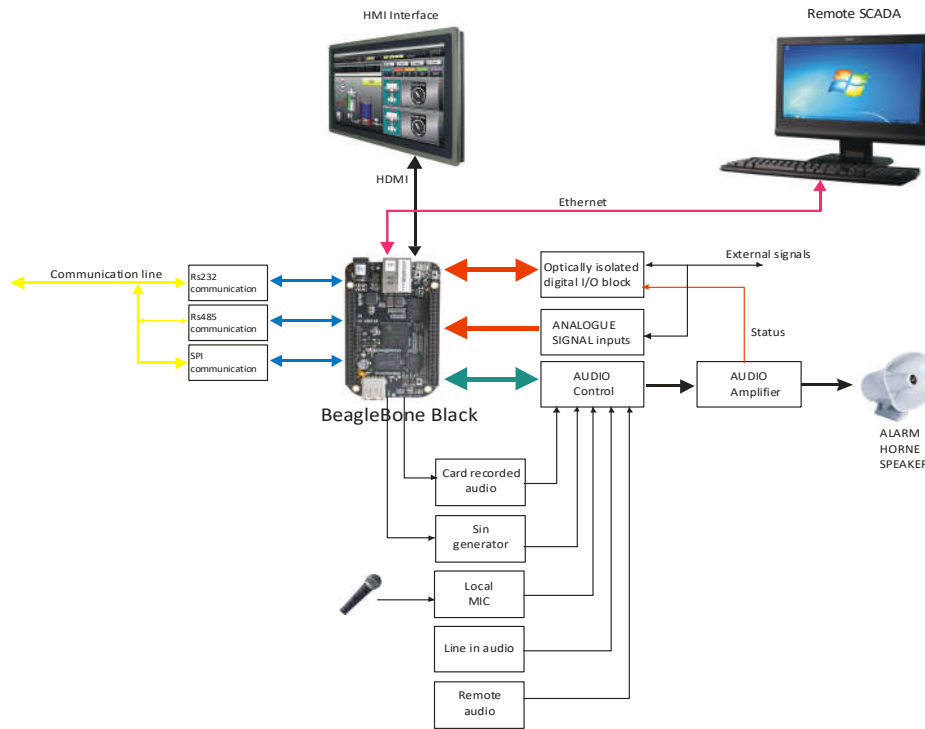


Figure 1. Block diagram of the realized control system.

In front of the new system are implemented many improved functions and technical requirements. The functions of the control system have the do following:

- Local activation of horn of sirens and broadcasting selected warning signals,
- Broadcast speech with a microphone located within the enclosure alarm station,
- Broadcasting pre-recorded voice messages to the *microSD* card,
- Local diagnostics alarm station and the display on the *touch screen* display signage about the correctness of work, or on the possible failure in the alarm station,
- Acceptance of external signals from the sensor close to the alarm station,
- Forwarding signals about the status and possible fault alarm station in the master control center and
- Acceptance of orders for the activation of the alert cues or speech signal from the master control center.
- Wide number (more than 30) of digital inputs and outputs
- Wide number of analogue inputs

Connectivity and communication between the master station and alarm center and/or sub-center is established using one of the following media: a standard telephone line (TT pair), VHF and/or UHF radio connections, Wi-Fi computer

network, GSM / GPRS modem (mobile telephony), optical cable and the like. Realized control system now supports:

- Ethernet connection,
- SPI communication protocol,
- RS232 communication standard and
- RS485 communication standard.

### III. DETAILED SYSTEM REALISATION

Basis module for supervisory and control system is a microcontroller board **BeagleBone Black** [5]. This microcontroller board is one powerful platform that supports a variety of interfaces. **BeagleBone Black**, besides the mentioned USB port, has implemented slot for *microSD* card which will be used for pre-recorded voice messages. It has also Ethernet port and HDMI output. HDMI output will be used together with the special module to broadcast sound messages that are prerecorded into the *microSD* card. The used microcontroller board is one of a much exploited industrial microcontroller and characterized by their reliability and low cost. Block diagram [6, 7] of the whole control system based onto the mentioned board is shown in Figure 1.

Sound alarm generator module and a communications module are integrated, and their functions are implemented by **BeagleBone Black**. There are 6 basic alert modes, such as:

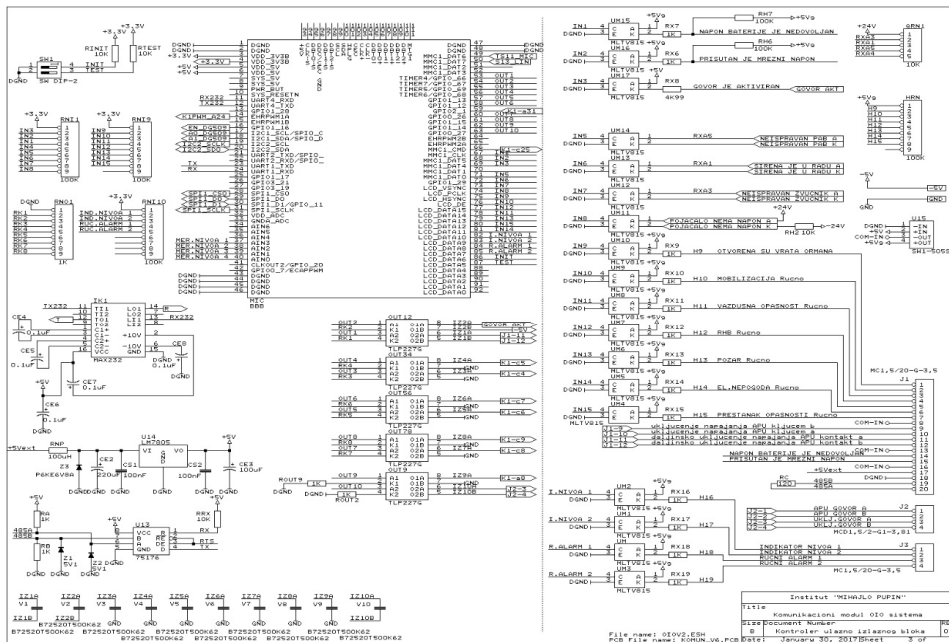


Figure 2. Electrical schematic of Control system.

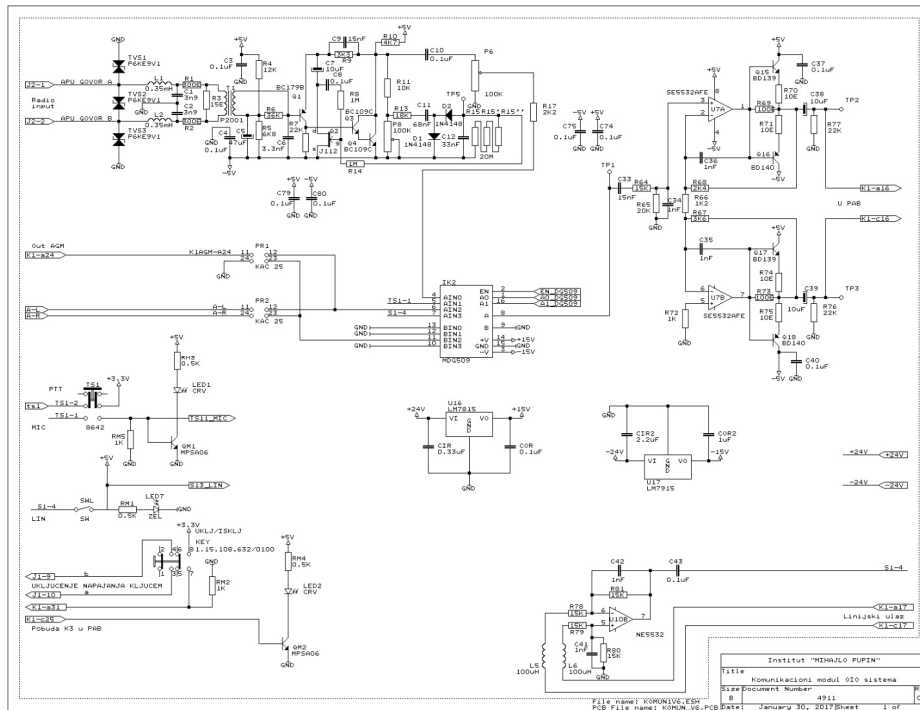


Figure 3. Part of electrical schematic of audio control.

- general public mobilization alert,
- air raid alert
- radiological - chemical - biological alert
- fire risk alert
- the risk of natural disasters alert,
- Termination of all alerts.

Each of the 6 signals has a corresponding shape and duration defined by the law. The generation of these signals is carried out as follows. The microcontroller itself has integrated more PWM outputs. One of these outputs is used to generate a corresponding rectangular signal, which has the minimum value of 0V, and the maximum value of 3.3V. This rectangular PWM signal is then used as the input of an electronic circuit, and its output signal is obtained corresponding sinusoidal shape. By duration of PWM

rectangular signal it is realized corresponding duty cycle of the sinusoidal signal. Amplitude of the signal can be adjusted by corresponding amplifier. The basic frequency of both PWM rectangular signal and corresponding sinusoidal signal is 600Hz, Test signal was carried out from 580Hz up to 620Hz. realized about 600 Hz frequency. By PWM signal generated by BeagleBone Black it is possible to change frequency and duty cycle. As it is already mentioned amplitude can be adjusted manually by potentiometer. Another possibility is to record all necessary signals onto SD micro card inserted into the controller board and to reproduce this recorded signal directly to the amplifier.

The new supervisory and control system (Figure 1) has also inherited the functions and capabilities of a communication module, which has already been said above. Among other things, one of the basic functions is communication between the sub-center and/or alarm center and other local stations.

Presented system use all benefits of implemented BeagleBone Black microcontroller board, some communication standard which are already implemented, HDMI port, *microSD* card slot and so on. Some detailed electric scheme of management and control can be seen in the Figures 1 and 2. It should be noted that the control system is separated from a power amplifier module, but also can handle any type of the amplification module. In Figure 7 it can be seen one fully operated system for public observation with all implemented features.

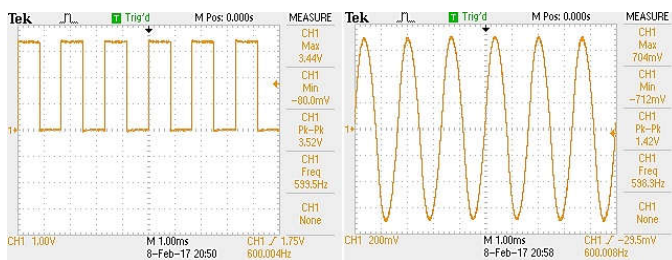


Figure 4: Verified PWM to SIN signal realization at 600Hz.

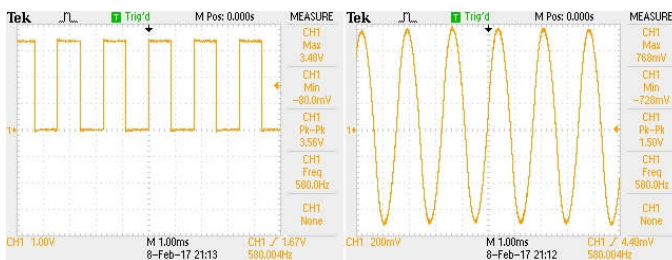


Figure 5: Verified PWM to SIN signal realization at 580Hz.

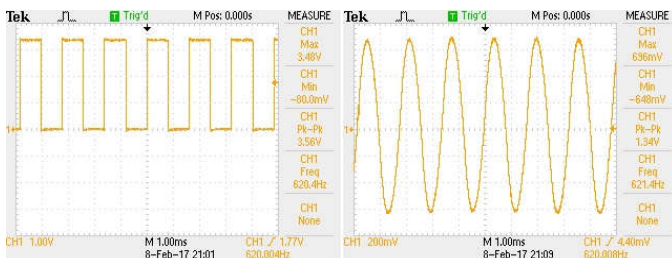


Figure 6: Verified PWM to SIN signal realization at 620Hz.

Corresponding electric schemes are presented onto the Figure 2 and 3.

Figures 5, 6, and 7 presents realized sinusoidal wave output signal by corresponding PWM input. Sinusoidal generator is

#### IV. CONCLUSION AND FURTHER DEVELOPMENT

In the paper is presented new control design for public observation, informing and alerting represent alarm station. This control system, as its name suggests, is used to manage the alarm station and supervision. System is designed, tested and implemented based on BeagleBone Black control board. Options of the control system are: local activation of electronic horns and broadcasting selected warning signals, broadcast voice from a microphone, which is located within the cabinet alarm station, broadcasting recorded voice messages from MicroSD card, local diagnostics of work alarm station and displaying on the touch screen display of signage correctness of work, or on the possible failure in the alarm station, accepting external signals, forwarding signals about the status and possible fault alarm station in a master control center and the accepting of orders to activate alert cues or speech signal from the master control center. The control system also supports remote communication; it has an Ethernet port, SPI, USB, RS485 and RS232 communication standards. The fulfillment of the set technical requirements, modernization and improvement obtained by the control system for the control system for public observing, informing and alerting that is smaller in size, which is increasingly more difficult, and therefore occupies less area, which has a lower power, which is cheaper and more that is consistent with today's modern technologies. One of the main problems of today is certainly the protection of the population and the environment from a variety of potential hazards that could result from ordinary activities in the production process, or random accidents, or intentional acts of terrorism. Thus, modern system for observing, informing and alarming, has a special significance and importance.

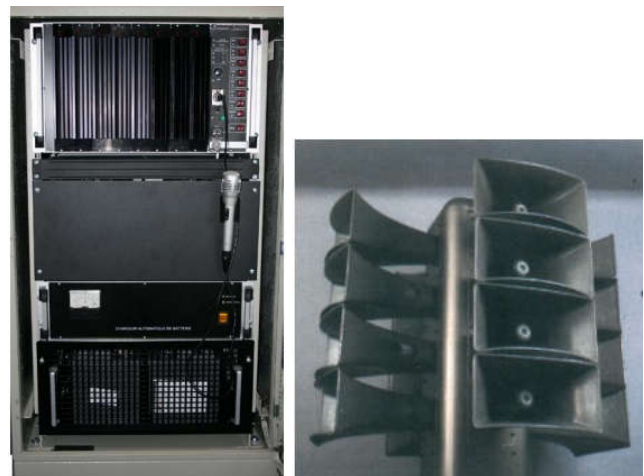


Figure 7: Picture of some realized system for system for public observation, communication and alert.

#### ACKNOWLEDGMENT

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