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Functional Generator Controlled by Internet

Rumen Iv. Arnaudov and Ivo N. Dochev

Abstract: This paper presents a functional generator controlled by Internet. We describe a computer-system architecture, a block diagram of generator and working algorithms. The remote control is realized by computer networks and using the TCP/IP protocols. For that purpose is used "Customer-Server" architecture. The software algorithms is based on Linux operating system, Apache web server, MySql database, HTML and PHP languages.

Keywords: Functional generator, remote control, computer networks, internet, education.

1 Introduction

Some of methods for control and automatic diagnostic of electronic systems require different calibration signals [9], [10], [11], [16]. This problem is successfully solved by using the functional generators. These generators produce signals with calibration parameters. Some of them are: waveform, frequency, amplitude and phase.

The remote control and automatic diagnostic require communication area to be build. An opportunity is the existing computer networks to be used. This enables realizing remote control and automatic diagnostic without building new communication networks. Internet connects points from all over the world. We may use this property for carrying out our plan.

The functional generator, controlled by computer network, can be utilized for:

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The authors are with the Faculty of Communications and Communications Technologies, Technical University, Kliment Ohridski 8, 1000 Sofia, Bulgaria (e-mail ra@vmei.acad.bg)

- remote control in industry,
- remote control in scientific research, and
- distance learning education.

Some advantages of the functional generator controlled by computer network are:

- is not necessary the setup of the system to be changed when different objects are controlled, and
- low cost.

2 Computer system architecture

The computer-system architecture of functional generator controlled by computer network is represented on Fig. 1. The system includes users, Internet, local area network (LAN), server, database (DB), functional generator board (FG), data acquisition board (DAB), the analyzed object and interfaces (RS232).

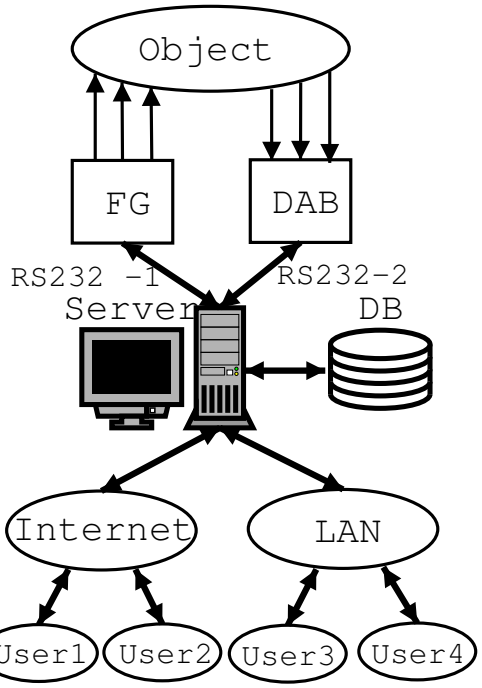

Fig. 1. Computer-system architecture of functional generator controlled by Internet.

Communications between "users and Internet", "users and local area network", "Internet and Server", "local area network" are based on TCP/IP protocols. Communications between "server and data acquisition board", "server and functional generator board" are based on standard serial protocol "RS232". The world wide web server is based on linux operating system and Apache web server [21], [24]. The software on the server includes: HTML, PHP, C and MySql [19], [22], [24], [25]. The HTML language utilizes building web pages. The PHP language utilizes online data processing. The C language utilizes data transmission from server to serial ports "RS232". The MySql database utilizes saving end reading control data. The users need Internet browser software. Some of them are: Netscape communicator, Internet explorer, Opera, Konqueror web browser and Mozilla. An example of the log-in web page is represented on Fig. 2. An example of log-in web monitoring of the generated signal with paremeters: sinusoidal waveform, phase=0^0, $U_{out} = 1V$ and $f_{out} = 0.5Hz$ is represented on Fig. 3.

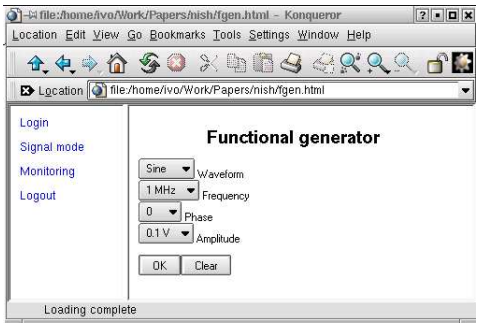

Fig. 2. An example of the log-in web page.

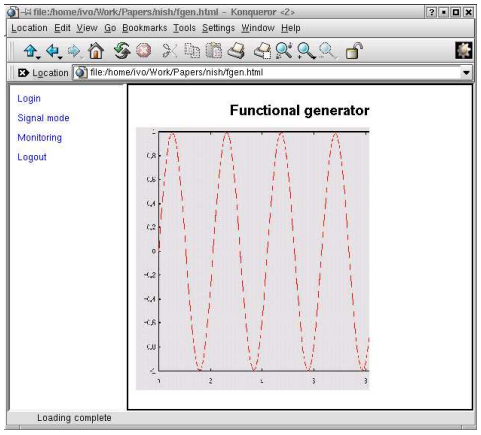

Fig. 3. An example of web monitoring of the generated signal. Paremeters: sinusoidal waveform, phase=0^0, $U_{out} = 1V$ and $f_{out} = 0.5Hz$

3 Computer system algorithm

The algorithm, which describes the processes in the computer system, is represented on Fig. 4. It includes registration and control process. The system starts with connection to the server. After legally registration the

operator chooses the signal type. The signal types are as follows: sinusoidal waveform, puls waveform, sawtooth waveform, triangle waveform, square waveform or direct digital synthesis. The next step is selection of the signals calibration parameters. Some of them are: waveform, frequency, amplitude, phase and duty-cycle. The software program makes data processing of the selected parameters and transmits them to the serial interfaces (RS232-1). The algorithm finishes with two options. The first option is the program returns to the main menu, so that, making a new choice of the signal type to be possible.

The second option is the program goes to the end.

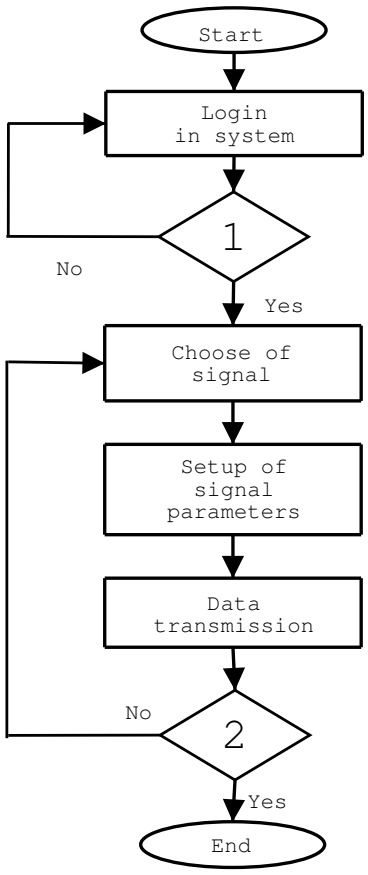

Fig. 4. Computer-system algorithm of functional generator controlled by Internet.

4 Functional generator board

4.1 One output functional generator

The functional generator board is represented on Fig. 5 a. The board consists of the following functional elements: microcontroller (μC), digital-to-analog converters (DAC), read only memory (ROM), voltage control oscillator (VCO), direct digital synthesizer (DDS), analog multiplexer (MUX), amplifier (A), and programmable attenuator (PA).

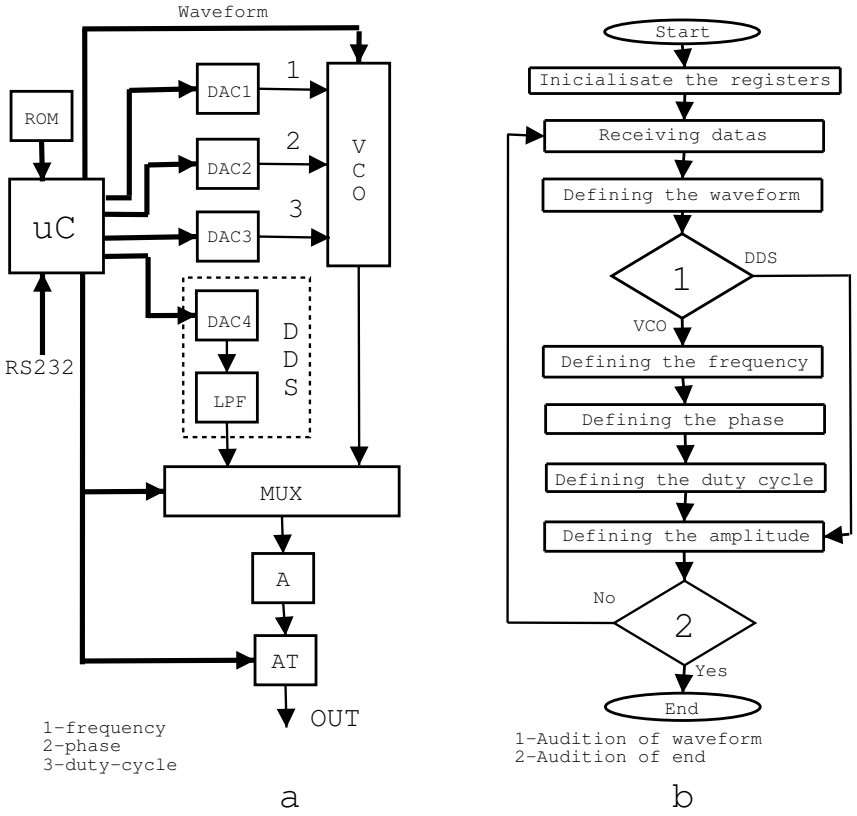

Fig. 5. One output functional generator. a) Block diagram of the functional generator board. b) Algorithm of the one output functional generator board

The microcontroller receives the data from serial interface (RS232-1) and performs codes to the digital-to-analog converters, voltage control oscillator, analog multiplexer and programmable attenuator. These codes define the work mode of the functional generator. The digital-to-analog converters transform the digital codes to analog signals. The analog signals from DAC1

to DAC3 are supplied to the voltage controlled oscillator and to the low-pass filter.

The voltage controlled oscillator is a high-frequency, precision function generator producing accurate, high-frequency sinusoidal, pulse, sawtooth, triangle and square waveforms. The waveforms may be chosen, using digital code, produced from the microcontroller. The frequency, phase and duty-cycle are controlled by means of analog signals.

The direct digital synthesizer (DDS) includes microcontroller, digital-to-analog converter (DAC4) and a low-pass filter (LPF) (Fig. 5 a). It can be utilized for generating a low-frequency, super low-frequency and DC signals. The waveform, frequency and phase of the output signal are defined by means of the input code sequence.

The analog multiplexer selects one of two input signals. The selected signal is amplified by means of the amplifier. The amplified signal is attenuated by means of the programmable attenuator. The amplitude of the output signal is defined by the attenuation constant.

The algorithm, which describes the processes in the functional generator board is represented on Fig. 5 b. The system starts with initialization of the registers and with the determination of the constant values. After the initial setting the microcontroller receives the data from serial interface (RS232-1) and produces codes for the work mode. The modes are as follows:

- generating a signal from the voltage control oscillator, and
- generating a signal from direct digital synthesizer.

The parameters: waveform, frequency, phase, duty cycle, amplitude of the signals, generated by means of the voltage controlled oscillator, may be controlled. The waveform is defined by binary digital code. The frequency, phase and duty cycle are defined by means of analog signals, transformed in digital codes.

The parameters: waveform, frequency, phase, amplitude of the signals, generated by means of the direct digital synthesizer, may be controlled. All of them are defined by means of code sequence, produced from the microcontroller.

The amplitude of the output signal is defined by the attenuation constant. The attenuation constant is defined by means of a binary digital code, produced from the microcontroller.

The algorithm finishes with two options. The first option is the program waits the receiving of new data. The second option is end of the program.

4.2 Multioutput functional generator

The functional generator board is represented on Fig. 6 b. The board consists of the following functional elements: microcontroller (μC), digital-to-analog converters (DAC), read only memory (ROM), voltage control oscillator (VCO), direct digital synthesizer (DDS), analog multiplexer (MUX), analog demultiplexer (DMUX), amplifier (A), and programmable attenuator (PA).

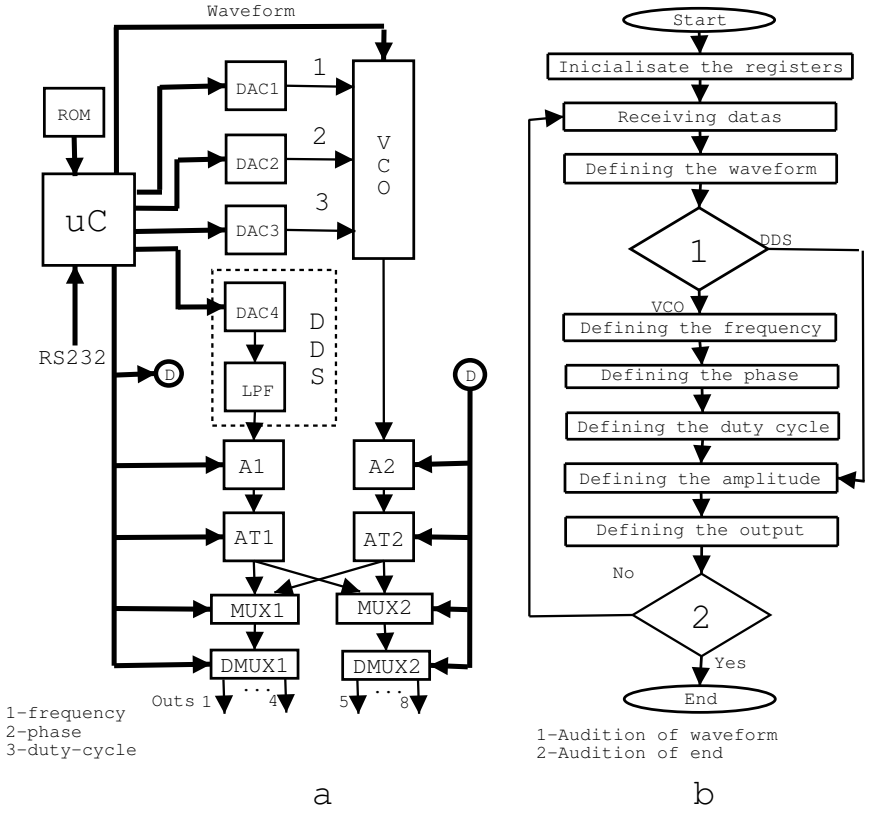

Fig. 6. Multioutput functional generator. a) Block diagram of the functional generator board. b) Algorithm of the multioutput functional generator board.

The microcontroller receives the data from serial interface (RS232-1) and performs codes to the digital-to-analog converters, voltage control oscillator, analog multiplexer, analog demultiplexer and programmable attenuator. These codes define the work mode of the functional generator. The digital-to-analog converters transform the digital codes to analog signals. The analog signals from DAC1 to DAC3 are supplied to the voltage con-

trolled oscillator and to the low-pass filter.

The voltage controlled oscillator is a high-frequency, precision function generator producing accurate, high-frequency sinusoidal, pulse, sawtooth, triangle and square waveforms. The waveforms may be chosen, using digital code, produced from the microcontroller. The frequency, phase and duty-cycle are controlled by means of analog signals.

The direct digital synthesizer (DDS) includes microcontroller, digital-to-analog converter (DAC4) and a low-pass filter (LPF) (Fig. 6 a). It can be utilized for generating a low-frequency, super low-frequency and DC signals. The waveform, frequency and phase of the output signal are defined by means of the input code sequence.

The generator output signals are amplified by means of the amplifier. The amplified signals are attenuated by means of the programmable attenuator. The amplitude of the output signal is defined by the attenuation constant. The analog multiplexer selects one of two input signals. The analog demultiplexer define the active output.

The algorithm, which describes the processes in the multioutput functional generator board is represented on Fig. 6 b. The system starts with initialization of the registers and with the determination of the constant values. After the initial setting the microcontroller receives the data from serial interface (RS232-1) and produces codes for the work mode. The modes are as follows:

- generating a signal from the voltage control oscillator, and
- generating a signal from direct digital synthesizer.

The both work modes are available at the same time in different outputs.

The parameters: waveform, frequency, phase, duty cycle, amplitude of the signals, generated by means of the voltage controlled oscillator, may be controlled. The waveform is defined by binary digital code. The frequency, phase and duty cycle are defined by means of analog signals, transformed in digital codes.

The parameters: waveform, frequency, phase, amplitude of the signals, generated by means of the direct digital synthesizer, may be controlled. All of them are defined by means of code sequence, produced from the microcontroller.

The amplitude of the output signal is defined by the attenuation constant. The attenuation constant is defined by means of a binary digital code, produced from the microcontroller.

The algorithm finishes with two options. The first option is the program waits the receiving of new data. The second option is end of the program.

This block architecture is more flexible than this shown on 5 a, because here is not necessary the outputs to be switched over to different points.

5 Conclusions

In this paper, we have presented a functional generator, controlled by Internet. We described a computer-system architecture, a block diagram of generator and algorithms. The remote control is realized by means of computer networks. The software algorithms are based on Linux operating system, Apache web server, MySql database, HTML and PHP languages, which are free of charge.

The proposed functional generator controlled by computer network may be used for:

- remote control in industry,
- remote control in scientific research,
- remote automatic diagnostics of electronic systems, and
- distance learning education.

The advantages of the functional generator, controlled by computer network, are:

- it is not necessary the setup of the system to be changed, when different objects are controlled,
- work flexibility,
- low cost,
- online data processing, and
- the browsing technologies enable asynchronous distance learning education with real active systems and devices.

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