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DEVELOPMENT OF A MODULE FOR OBTAINING BIOMETRIC PARAMETERS FOR AUTHENTICATION IN MEDICAL SYSTEMS

Abstract. Automated identification using biometric authentication has a high level of protection of personal data, as it evaluates the physical parameters and characteristics of a particular person, which makes such access control more reliable. Due to the Covid-19 pandemic, the medical system is unprepared for such trials, where the incidence is increasing daily, causing a shortage of medical staff and facilities for diagnosis or emergency therapy. Therefore, today the urgent task is to develop automated medical systems that will expand the use of medical equipment and thus reduce the burden on medical staff. Automated systems must have a high degree of protection that will ensure the reliability of personal data during diagnostic procedures, excluding the influence of human factors of medical staff (fatigue, inattention that contributes to a number of errors that significantly affect the final plan of care). Existing medical devices and systems can be upgraded using the module for obtaining biometric parameters for authentication. An important step in the development of a module to automate the authentication process is the analysis, selection and integration of all necessary components for the assembly of the electrical system of the device.

Keywords: photoplethysmogram, dynamic signal, static signal, systole, diastole, heart rate monitor, authentication, identification, signal, fingerprint scanner, sensor, structural and functional diagram.

INTRODUTION

Currently, there are many ways to implement the module for biometric authentication. They all have their advantages and disadvantages. Some of the most effective are the retina scanner, face id and fingerprint scanner [1].

With the development of digital integration, there is a need for the introduction of biometric authentication in medical institutions to reduce the burden on medical staff and improve the quality of medical services. This is especially true of automated diagnostic systems and laboratory tests of biological material, where with the help of human biological characteristics is the confirmation of the patient's identity, which provides a high level of protection [2,3]. Since at each stage of the study there is a high possibility of human influence, which leads to incorrect diagnosis, or even falsification with subsequent illegal use, biometric identification uses information that can not be used by an outsider, as it is a characteristic of a person who is not may be falsified. The ideal method of establishing identity authentication is the use of biometric dynamic signals that provide control of the parameters inherent in a particular person and duplicate them for the purpose of substitution is impossible. But dynamic methods require complex algorithms for signal extraction and analysis.

When choosing the method of human authentication for the implementation of the module for obtaining biometric parameters for authentication, it was decided to combine static identification using a fingerprint scanner and simultaneous recording of dynamic indicators of the biological signal using a photoplethysmogram sensor (FPG). This decision was made because other methods have a number of shortcomings that are difficult to eliminate in today's pandemic. For example, face id cannot work in mask mode. Although the retina scanner has proven to be a fairly reliable method of authentication, it has some errors in the deformation of the eye due to time or certain injuries and is difficult to integrate into the module for obtaining biometric parameters for authentication [4].

In fact, it was thus decided to use a fingerprint scanner, and the combination with a pulse scanner will prevent falsification of the results of the biometric procedure.

The programming environment of the board microcontroller and the main components that will be built into the board are also selected. This module performs the function of recognizing the object that works with it by the presence of a pulse and subsequent authentication with a fingerprint.

CRITERIA AND STATEMENT OF THE PROBLEM

To solve this problem, a structural and functional scheme of the module for obtaining biometric parameters for authentication in medical systems was developed, which is presented in Fig.1

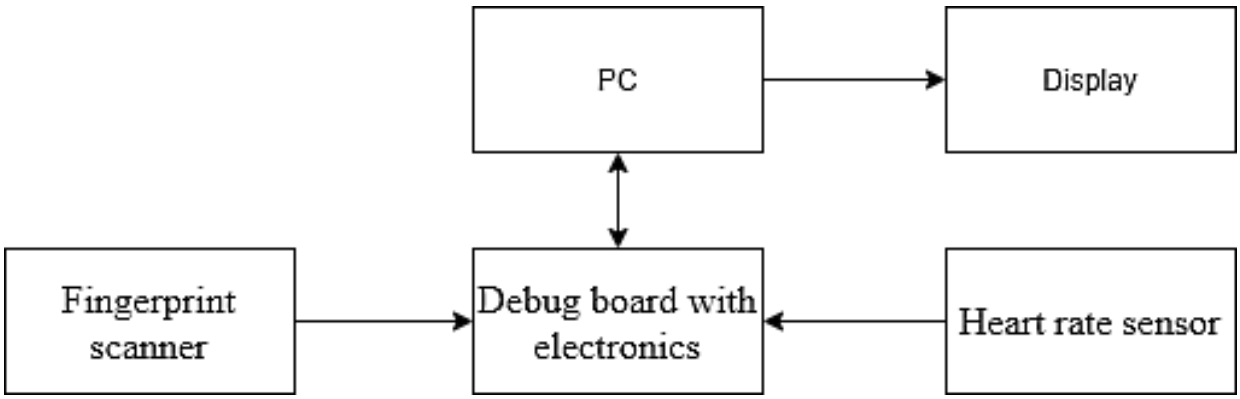

Fig.1 Structural and functional diagram of the device

The main criteria for designing the module were: mobility, small size, reliability, ease of setup and structure of the device. Also, an important factor is the wide and easy availability of electronics components used in this module, because if you need to replace or repair equipment, it will be easy to find all the necessary and compatible elements in the electronics market [1].

In order for the module to be mobile, small and versatile, it was decided to use an Arduino Uno Rev3 debug board. The FPM10A model was chosen as the fingerprint scanner, as this model is quite small, budget and can be customized using Arduino sketches, which is advisable using the selected board. The Arduino Pulse Sensor model was chosen as the heart rate sensor. This sensor is also convenient for the selected subject of the device, as it is also programmable and is compatible with Arduino.

The principle of operation is quite simple, but effective: the signal received from the heart rate sensor gives permission to scan the fingerprint, which in turn is transmitted to the PC via the board and displays the result of an attempt to authorize the person interacting with the device.

SELECTION OF COMPONENTS FOR IMPLEMENTATION

The development of the module should begin with the selection of the board on which it will be placed and to which the main operating sensors of the recognition system will be connected.

The Arduino Uno Rev3 debug board is a compact and multifunctional board based on the ATmega328P microcontroller. Its small size allows the board to be used in many robotic devices, Smart House systems and security systems.

Table 1. Technical characteristics of the Arduino Uno Rev3 board

Characteristics	***Parameters***
The amount of RAM	2 KB
Type of microcontroller	ATmega328P
Supply voltage	5 V
Analog inputs:	6 pcs.
Digital inputs-outputs	14
Recommended voltage	7-12 V
Permissible current of digital outputs	20Ma
Program memory	32Kb
Frequency	16MHz
The amount of non-volatile memory	1Kb
Size	68x53x15 mm

The FPM10A fingerprint scanner is a budget optical fingerprint scanner based on the ARM Cortex M 32-bit processor - Synochip AS608 (FPM10A). This model allows you to encrypt data. One of the features is that this model has an internal memory and automatically creates a database of fingerprints and performs comparisons with patterns of previously recorded fingerprints.

This scanner is compatible with many microcontrollers on the digital electronics market, and the settings are made using a utility from the manufacturer or sketches for the Arduino, which is convenient in this case. This scanner model has low power consumption and less than 1 second of image processing time.

Table 2. FPM10A fingerprint scanner specifications

Characteristics	***Parameters***
Supply voltage	3.6-6.0 V
Current	120 mA (140 mA max)
Imprint image processing time	<1.0 seconds
Sensor	Optical
The size of the sensor	14 mm x 18 mm
Signature size	256 bytes
Template size	512 bytes
Capacity	300 cells
Security levels	1-5
Interface	UART TTL
Data transfer rate	9600, 19200, 28800, 38400, 57600 (default is 57600)
Operating temperature	-20 C - +50 C
Permissible humidity level	40% - 85% RH
Overall dimensions	45 x 26 x 19 mm
Weight	15 gr

Arduino Pulse Sensor - is designed to measure heart rate and is based on the principle of optical measurement of reflected light flux from blood vessels.

Measurements are best done on the fingers or in the earlobes. The board has circuits that allow you to get the cleanest, noiseless output signal.

Table 3. Technical characteristics of the Arduino Pulse Sensor

Characteristics	***Parameters***
Supply voltage	3-5 V
Current	4-5 mA
Diameter	16 mm
Thickness	3 mm
Wavelength	565 nm

All these components are important components of the future module and will provide the highest quality identity authentication.

CONCLUSIONS

This paper analyses systems for fingerprint authentication and FPG signal. The main parameters for designing the electrical structure of the module for obtaining biometric parameters for authentication were identified. The programming environment of the board microcontroller and the main components that will be built into the board are also selected. These components include the Arduino Uno Rev3 debug board, the FPM10A fingerprint scanner, and the Arduino Pulse Sensor. The main technical characteristics of all components are described and the scheme of connection of modules to a board is offered.

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