Oportunities of using Avisenna methods in sphygmographic diagnostics by mean of automated digital processing of cardiac pulse signals.

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Abstract.

This article discusses the concept of developing an automated device for processing pulse signals obtained from several nearby wrist points using the methods of Avicenna and modern alternative medicine. Such devices can be used in home and field conditions and are useful in the early warning of various diseases and giving recommendations for the examination of doctors with relevant specializations.

Keywords: cardiac signal, heart rate signal, sphygmography, pulse diagnostics, automated processing of cardiac signals.

Currently, more than 100 diseases of the human cardiovascular system are known to medicine. Some of them are deadly dangerous. According to statistics, heart diseases are leading among all other diseases as the cause of deaths. About 15 million people die every year in the world due to cardiovascular diseases.
That is why heart diseases are in the area of special attention. According to the World Health Society facts, mortality from cardiovascular diseases is atop (30% of all diseases), according to World Health Statistics – about 10% of vascular diseases, about 12% of heart diseases [1].

Among the total mortality in Russia, cardiovascular diseases account for 57%. 1 million 300 thousand people die because of cardiovascular diseases in Russia per year (source - https://medtravel.ru/cardiosurgery/cardiac-disease/).

About 80 thousand people die in Uzbekistan annually due to ardiovascular disease, which is almost 57% of the total mortality （sourse - https://stat.uz/）.

The main reason for the high mortality rate is too late visiting doctors to consult, usually in critical situations or after the appearance of obvious symptoms. Most people without a medical education cannot determine the initial signs of cardiovascular disease on their own. Sometimes they do not pay attention to short phenomena, such as impulsive chest pain, which can be a sign of stenocardia. As Julius Caesar said, "People willingly believe what they want to believe". People do not want to be sick, they want to be healthy, and they believe that. In order to go to the doctor you need a reason, or at least someone's hint.

In this paper, we consider the problem of creating an automated warning system for possible cardiovascular diseases by digital processing of human pulse signals [2].

Due to the extreme importance of timely and correct diagnosis of cardiovascular diseases, there are invented many techniques, technologies, methods and experience of their medical examination, such as ECG, FCG, ICG, ultrasound, etc. Today they can be found in all corners of the world and are affordable for almost everyone. However, there are some problems with the medical examination.

Firstly, as mentioned above, all these achievements of science and technology are useful only after people turn to them. True, at present this sphere is developing very intensively, using modern means of communication, but so far it is not accessible to all people.

Secondly, for a full medical examination requires special expensive equipment and conditions.

Thirdly, to analyze the information received from technical systems, doctors with high qualifications of narrow specialization and reach medical experience are required.

Fourth, there is a human factor in the study of the dynamics of the status of patients. A person needs a lot of time and effort to compare archival data from previous measurements. We need an automated system for storing, processing and comparing data.

These problems oblige scientists and physicians to develop low-cost, accessible for all automated systems for the diagnosis and prevention of cardiovascular diseases using the latest scientific and technological achievements.

Automation of the receipt and processing of information is carried out in the following sequence.

1. Measuring signals;
2. Filtering them from extraneous noise (intrinsic noise may be useful in analysis).
3. Digitization of discrete signals with maximum preservation of their properties.
4. Structurally (invent the original structure) to save digital data.
5. Create an application package for data processing and automated decision-making of a recommendatory nature.
6. Identify abnormalities that are invisible to the human senses.

Obviously, not every person can draw the right conclusions (make the correct diagnosis) for different symptoms (signs) of a particular disease. This requires a highly qualified doctor with vast experience in medical practice. The probability of having such doctor nearby at the right time is almost zero. Therefore, any system that can prompt a possible disease on the spot according to pocket sensors, as well as suggest the necessary actions before the arrival of medical care, is extremely important for saving a person's life. A portable (pocket) system for prompting possible diseases using pulse diagnostics can be one of such sistems.

By sensoring data at four points (according to the Avicenna method) in the area of the wrist next to each other (the distance between them is the width of a finger), some preliminary conclusions can be drawn. Somehow, Avicenna distinguished between the pulses [3]:
  – in magnitude of expansion;
  – by the quality of the impact (compression);
  – by movement time;
  – by state of artery walls;
  – according to the degree of emptiness and filling (artery);
  – by warmth and coldness (of the palpable place);
  – by rest time;
  – by equality and nonequality;
  – by the presence of order (or disorder) in irregularities ("size" of the pulse).

According to the data, he was able to make a diagnosis of diseases with some accuracy. But, unfortunately, this gift of nature is not transmitted to other people through training.

Modern medicine refutes the methods of pulse diagnostics. And she is right that once medicine was underdeveloped and people were forced to be treated on the basis of pulse diagnostics. Information only about the pulse of a person, of course, is not sufficient for a full diagnosis of diseases, especially those related to the heart.

Currently, the world has highly developed medical techniques, technologies and methods for analyzing the functioning of human organs and making the most accurate diagnosis. And the means and methods of treatment are clinically proven almost 100%.

But, nevertheless, some representatives of the pulse diagnosis are able to determine, albeit approximately, the disease of a person by applying four fingers to the arterial vessel of the wrist. Historical facts prove that the coincidence of their diagnoses with reality is not accidental, but has some regularities.

Of course, the diagnosis made using only the pulses should be of a recommendatory nature only and should not be the basis for treatment, but a call to a specialist doctor.

Currently, there is a trend towards a smooth transition from free medical care to commercial medicine. This can lead to the fact that any doctor whom we contact first, regardless of his specialization, "finds" with us "his" disease, since each patient is a potential sponsor for a commercial medical institution. Subsequently, the true disease may go unnoticed until the patient does not feel deterioration go to another doctor to consult. And there is no guarantee that the other will not be the same merchant. In this way, a true disease can be neglected.

Therefore, any information about a possible illness and advice to contact the appropriate doctor can be invaluable. The loss will not be great if a person goes to the doctor, for example, on the recommendation of his "smart" watch, based on the processing of data received by tiny pulse sensors mounted on the lid or inside the belt. After all, a saved human life, all the more own one, justifies any expenses. It is said that if one of the thousands of predictions about the time and place of the earthquake is correct, then all the expenses spent for the forecast are justified. The same can be said about ilness predictions.

Having modern equipment and devices, even a person who does not have special medical training can determine the following data using the Avicenna method:

- heart rate:
- pulse amplitude;
- blood pressure;

- blood movement speed and blood viscosity by means of differences in time of neighboring sensors;
- heart cystolic duration by means of pulse duration;
- determine the density of blood by the difference between the acoustics of shutting the heart valve and the pulse in the wrists (by the speed of sound propagation in media of different densities);
- determine the amount of hemoglobins by the acoustics of the blood flow in the vessels (perhaps they create a kind of noise) or using sensitive iron detectors (in this case, you can use a wide metal bracelet as a shield against external magnetic noise);

In conclusion, we note that in the future, using the capabilities of high-precision remote electromagnetic sensors (now they are too expensive) and the abilities to transfer data via the Internet or other means of communication (a database in the form of a structured file), you can create handheld remote collectors of a personal growing database and portable voice advisors (for example, in the form of a watch). Currently, we are conducting active research in this area.

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