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ORGANIZATION OF INTERACTION OF PHYSICIANS AND PATIENTS IN THE TELEMEDICINE INFORMATION TECHNOLOGY FOR ESTIMATION OF FUNCTIONAL HEART CONDITION

The problem of cardiovascular diseases in Ukraine is one of the most priority in clinical diagnostics and telemedicine nowadays. In this context the early identification of heart's pathologies has more and more importance.

ECG signal, as one of the most popular method in functional diagnostic of cardiovascular system, can be registered by any of portable devices, that are very popular nowadays. Modern smartphones and tablets are able to receive and save ECG record, but effective analysis of signal requires more computing abilities.

Rapid evolution of telemedicine, especially in ECG-telemetry, allows us to overcome the difficulties with massive computations by using the client-server architecture [1].

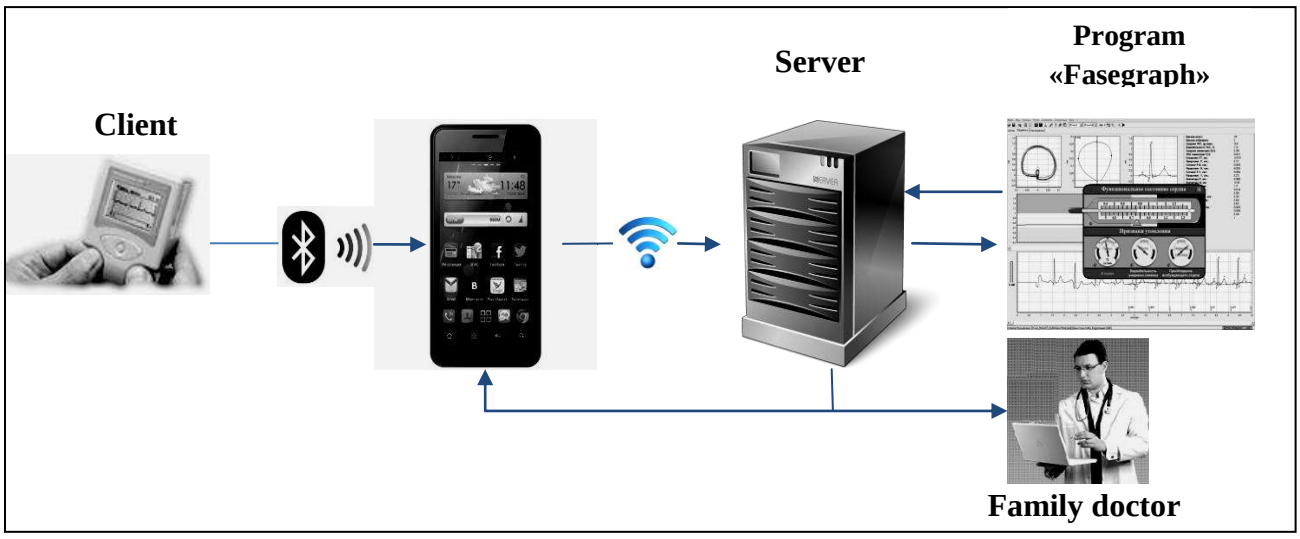

Рис. 1. Client-server architecture for implementation of IT processing of ECG

In system, proposed by us (рис. 1), ECG-signal is registered by sensor with finger electrodes and then shared to Android smartphone via Bluetooth. Received data is saving to file in required format, that is delivered to server by Internet for post-treatment.

When file is received, server decodes it and sent to program Fasegraph® for analysis. Fasegraph® implements original algoritms of ECG's processing in the phase

space [2]. The results of processing is delivired to client and family doctor. Thus, the communication between physians and patient doesn't require direct contact.

The main issue in communication between client and server is amount of information to be transmitted. The algorithms of prudent encryption and decryption, proposed in [2], was used for reducing delivered data.

Each of informative fragment of ECG (waves P,Q,R,S,T and segment ST), that are represented by the sequence of values $z_k(t_m)$, $k \in \{P,Q,R,S,ST,T\}$ in discrete time t_m, $m = 1,..., M_k$, is aproximated by asymmetrical Gaussian function

$$\varphi_k(t) = E_k \exp[-\frac{(t-\mu_k)^2}{2[b_k(t)]^2}], \quad k \in \{P,Q,R,S,ST,T\},$$

where parameters E_k and μ_k determines the values of amplitude and moments of time, when fragment has a maximum value when $E_k > 0$ or minimum value when $E_k < 0$, parameter $b_k(t)$ allows to set assymetric of Gaussian function:

$$b_k(t) = \begin{cases} b_k^{(1)} & \forall \ t \le \mu_k, \\ b_k^{(2)} & \forall \ t > \mu_k \end{cases}.$$

For each fragment $k \in \{P,Q,R,S,ST,T\}$ the optimal parameters E_k, μ_k, $b_k^{(1)}$, $b_k^{(2)}$ are defined by criterion of minimum sums of squared deviations

$$Cr_k = \sum_{m=1}^{M_k} [E_k \exp[-\frac{(t_m-\mu_k)^2}{2[b_k(t_m)]^2} - z_k(t_m)]^2 .$$

As result, instead of 500 discrete values, that are needed for acceptable encoding of real ECG cycle, there are only 25, delivered to server. The reconstruction of this cycle is provided by this parameters with necessary accuracy for ECG interpretation. Therefore, the amount of data, that is send to server, is decreased by

$$\delta = \frac{500-25}{500},$$

i.e. the quantity of data in traffic is decreased by 95 %.

Resources

1. E. Zemcovskiy, I. Reznikova, A. Konobasov. New prospects for electrocardiography in ambulatory and preventive cardiology // Practical Medicine – 2011. – Issue 4. – P. 45-53. (In Ukrainian).

2. Fainzilberg L.S. Generalized Method of Processing Cyclic Signals of Complex Form in Multidimensional Space of Parameters // Journal of Automation and Information Sciences. – 2015. – Vol. 47. – Issue 3. – P. 24-39.