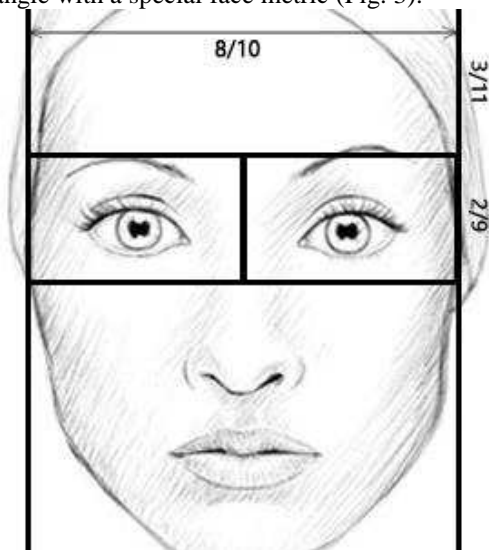


a face in the image and returns the coordinates of the corresponding rectangle.

Next, the eye area is highlighted in the resulting rectangle with a special face metric (Fig. 3).



Pic. 3. Proportions of the face to highlight the eyes area

To highlight the pupil searching for the dark section of an image starting from the center of the selection of each eye separately is used. The recognition quality strongly depends on the lighting, so for a more accurate determination, sharpening filter is applied for resulting image with the standard function library `EmguCV CvInvoke.cvFilter2D`. In addition, the user can set sensitivity to improve recognition accuracy.

## Conclusion

Thinking is the process based on associations. To recall a particular fragment the human brains simulate a rather long chain of associations. People, who have lost their memories, have the broken chain, to restore it sometimes only a few units are enough.

This project is aimed at being used in departments of psychiatry and neuropsychology of different hospitals and clinics. The program will be used by psychologists and psychiatrists to test patients. Joint efforts should lead to a qualitative result.

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## CREATING SIMULATOR FOR ELECTROCARDIOGRAMS DECRYPTION

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Nowadays there is a large-scale introduction of information technologies in the field of medicine. This process is connected with significant changes in medical theory and practice. These changes are associated with making adjustments for medical worker training. The main purpose of any medical information system (MIS) is a complex problem solving of information collection and analysis, as well as and control problems of therapeutic-and-preventive and financial activities of institutions [1].

There is a functional classification of information systems (IS); which include five functional IS classes:

1. Medical and technological IS.
2. Directory system.
3. Statistical IS.
4. Search IS.
5. Educational IS.

Educational ISs are designed for information support of training processes in medical institutions. According to pedagogical principles of assessing knowledge level these systems are divided into the following types:

1. Educational ISs based on the principle “question-answer” controlling students’ knowledge due to the answers to the systems’ questions, selected from possible options.
2. Educational ISs providing knowledge as e-learning courses and study guides. They control acquisition of knowledge on the principle “question-answer”.
3. Educational ISs based on knowledge bases and containing information about problem-solving methods, including expert and inference systems [1].

The article is focused on the problem of creating software for instructive MIS. Software includes math-

emational processing methods of biomedical information, algorithms and programs that implement system operation.

One of the most widespread and effective methods to study the heart's dynamic and mode of its functioning diagnosis is the analysis of electrocardiograms. Despite the fact that there are costly and complex cardiac tests, electrocardiography is the safest instrumental method to confirm a lot of diagnosis [2-3].

Electrocardiogram (ECG) is a graphic visualization (registration) of electric pulse passage through the cardiac conduction system. Electric pulse passage through the cardiac conduction system is recorded on the vertical axis as peaks up and curves down on plot. These peaks are called electrocardiogram's prongs and they are denoted in Latin letters P, Q, R, S, T and U. Moreover, time during the pulse passes through certain heart's parts is recorded on the horizontal axis of ECG plot [2].

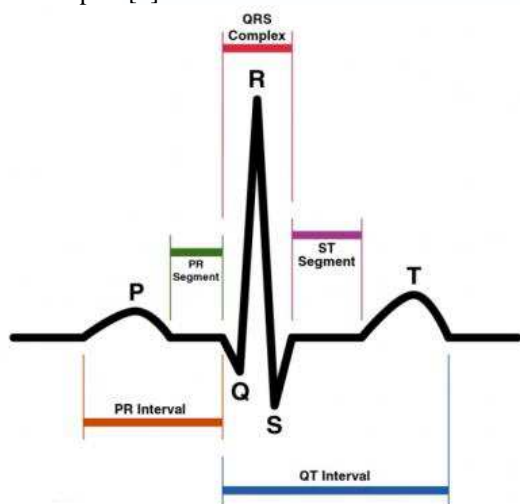


Fig. 1. ECG

Analyzing the ECG people should follow a strict sequence:

- heart rhythm and heart rate;
- intervals that reflect conduction;
- the electrical axis of the heart;
- description of QRS complex;
- description of ST segment and T prong.

Every doctor should know how to read electrocardiogram. That is why it is necessary to create a simulator that will allow to train to decrypt the electrocardiogram in a virtual environment. The simulator must help medical students, medical staff and cardiologists decrypt ECG competently. It will strengthen the existing knowledge, and therefore, it will reduce the risk of incorrect diagnosis.

An application designed for testing must adhere to a number of requirements:

1. To have intuitive, logical interface.
2. To get the result quickly.
3. To have an ability of saving results.
4. To have an ability of including the test in (high-level) structure with higher level.

The last requirement determines the necessity to perform the program as a separate module using object-oriented programming [4].

Listing 1. The structure interface  
struct Info

```
{
  AnsiString FIO; // User info
  AnsiString Group;
  int Percent; // Result
};
```

Listing 2. The class interface  
class Test

```
{
protected: // To transmit parameters
  Info List; // User list
  TStringList *RLst; // Right answers
public:
  Test(); // Constructor without parameters
  Test(AnsiString NameFileR);
  ~Test(); // Destructor
  int Percent; // Result
  void PutFIOGroup(AnsiString FIO, AnsiString Group); // Get the data
  AnsiString GetFIO(){return List.FIO;}
  AnsiString GetGroup(){return List.Group;}
  TStringList* GetRO(){return RLst;} //Answers
  void CalcResult(); // Calculate the result
  void PutResultInFile(char *); // Save the result
};
```

The application is to work in the following way: when it has already started, user can exit, get information about the program and go to the "Training" or "Testing" modes.

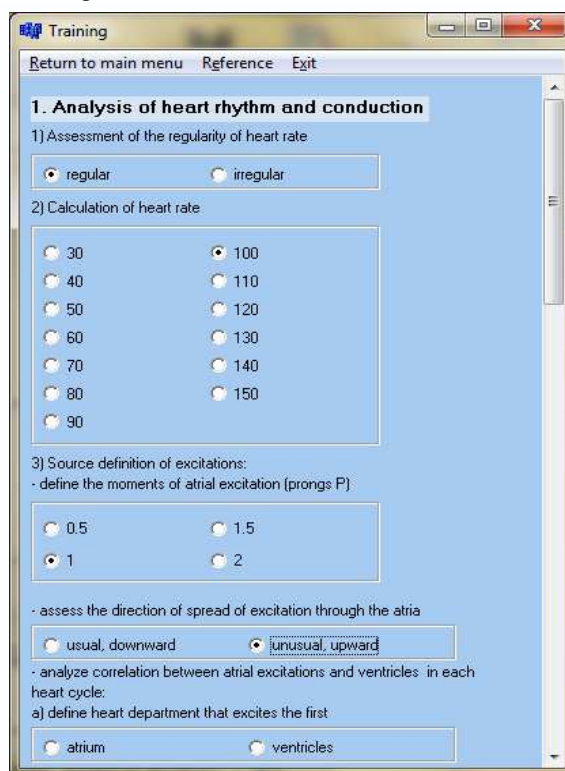


Fig. 2. Mode "Training"

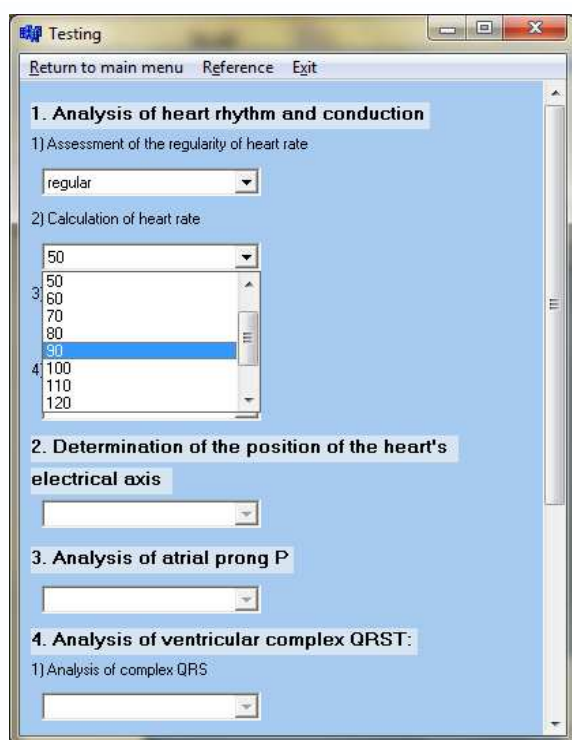


Fig. 3. Mode "Testing"

Training mode is designed to form an exact algorithm of actions in electrocardiograms decrypting, and test mode is designed to consolidate and strengthen knowledge of the algorithm.

When user has selected "Training" or "Testing", the registration window opens and user registers. Next the window with the appropriate test mode and the window with ECG picture open. The window with ECG picture must be decrypted by user's answers in system's questions.

When testing completed, the result is displayed on the screen and stored in the file.

Despite the seeming simplicity of the algorithm, the process of ECG analysis is rather time-consuming. It is necessary to analyze the types of prongs and segments changes to identify pathologies, if there are any, and after that to choose a diagnosis from a large number of variants.

The system is planned to be implemented in test operation in the city hospital number 3 in Tomsk.

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## ВИЗУАЛИЗАЦИЯ МНОГОМЕРНЫХ МЕДИЦИНСКИХ ДАННЫХ С ПОМОЩЬЮ ПИКТОГРАФИКОВ «ЛИЦА ЧЕРНОВА»

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### Введение

Многомерные пиктографики – не очень простой, но мощный исследовательский инструмент разведочного анализа данных. Главная идея такого метода анализа основана на человеческой способности "автоматически" фиксировать сложные связи между многими переменными, если они проявляются в последовательности элементов. С помощью пиктографиков можно представить элементарные наблюдения как отдельные графические объекты, где значения переменных соответствуют определенным чертам или размерам объекта (обычно одно наблюдение = одному объекту).

Лица Чернова – это один из наиболее интересных типов пиктографиков. Негман Chernoff придумал использовать для поиска зависимостей одних статистических показателей от других (корреляций) ресурсы мозга, отвечающие за распознавание лиц.

Итак, лица Чернова (Chernoff Faces) – это схема визуального представления многофакторных данных в виде человеческого лица. Для каждого

наблюдения рисуется отдельное "лицо", где относительные значения выбранных переменных представлены как формы и размеры отдельных черт лица (например, длина носа, угол между бровями, ширина лица).

Сложность данного метода, заключается в правильном сопоставлении исследуемых переменных с частями лица. При ошибке важные закономерности могут остаться незамеченными.

### Представление многомерных данных в виде пиктографиков «Лица Чернова»

Информация из окружающей среды, которую воспринимает человек, вызывает у него определенные эмоции. Эмоциями называют более или менее устойчивые психические состояния, выражающие отношение человека к другим людям, к самому себе, к окружающей жизни. У человека выявлено шесть таких универсальных состояний эмоций: грусть, гнев, радость, страх, отвращение и удивление. Каждая эмоция отображается на лице, поэтому выражения лица являются надежным ин-