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Specialized software tool for pattern recognition of biological objects. *Sergey D. Kulik^{1,2}, Evgeny O. Levin²*.

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SUMMARY

This paper provides the results of developing face recognition mobile application for iOS operation system that can work with any machine learning model saved in a specific format according to the simple rules.

INTRODUCTION

The application is built purely in Swift programming language. We used such libraries as UIKit, Core Data, Core ML and ARKit.

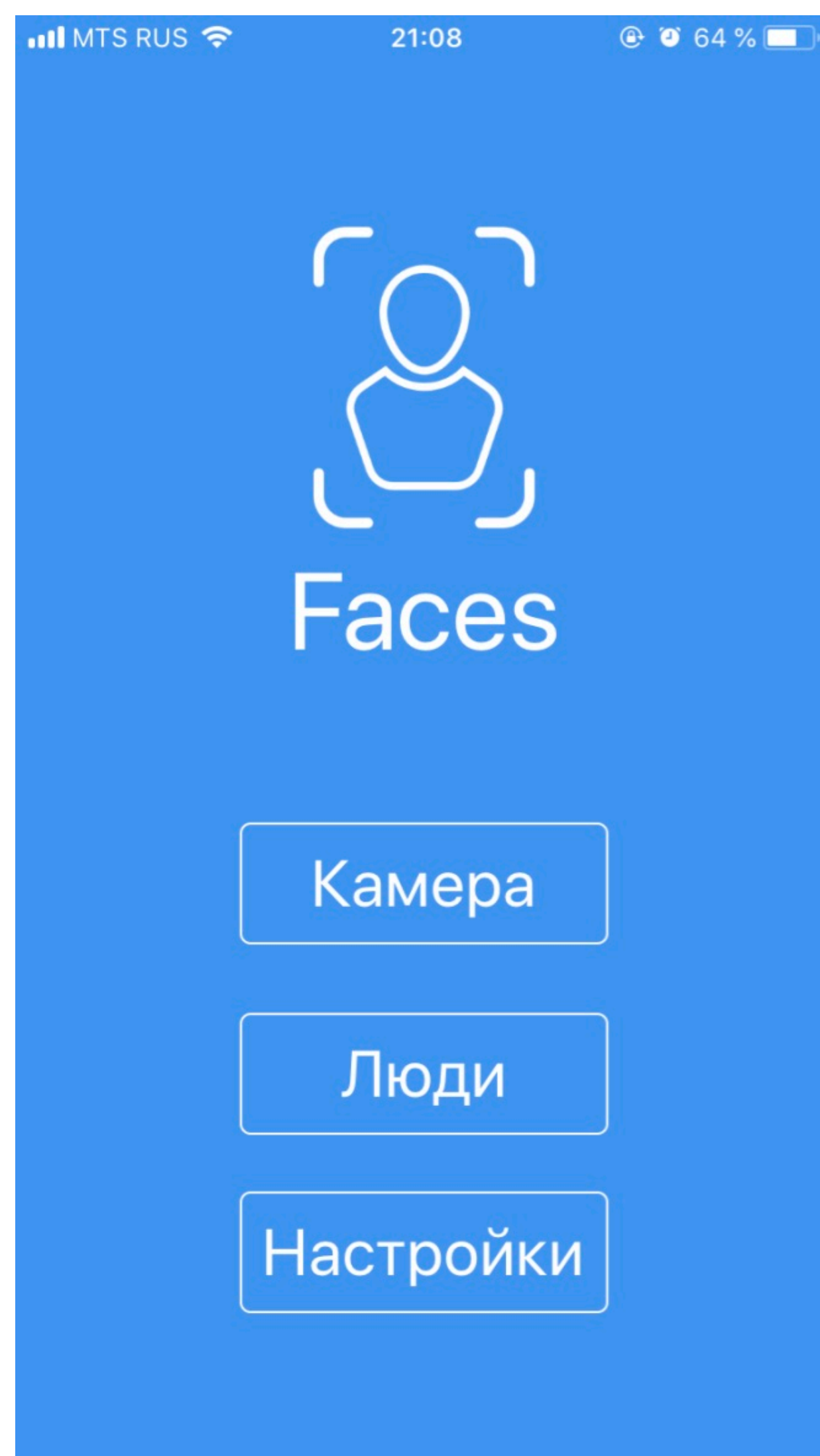


Fig. 1. Application home screen.

APPROACH

The key feature of the developed software tool is that the model of machine learning is not represented in the source code of the application, i.e. the user can set up his model and use it. For this purpose, it is enough to assemble the model according to certain rules, upload it to a cloud service and provide a link to this model in the application. The application will download, configure and compile it itself; after that, in case of successful completion of the process, the face recognition mode will be ready to work.

Application provides information about recognized person on the special screen. From this screen, the user can call or send a text message to a selected person with one touch, send an e-mail, and save all available information about the person to the user's contact list in the Apple ID account.

METHODS

We chose Microsoft Custom Vision service to train the machine learning model.

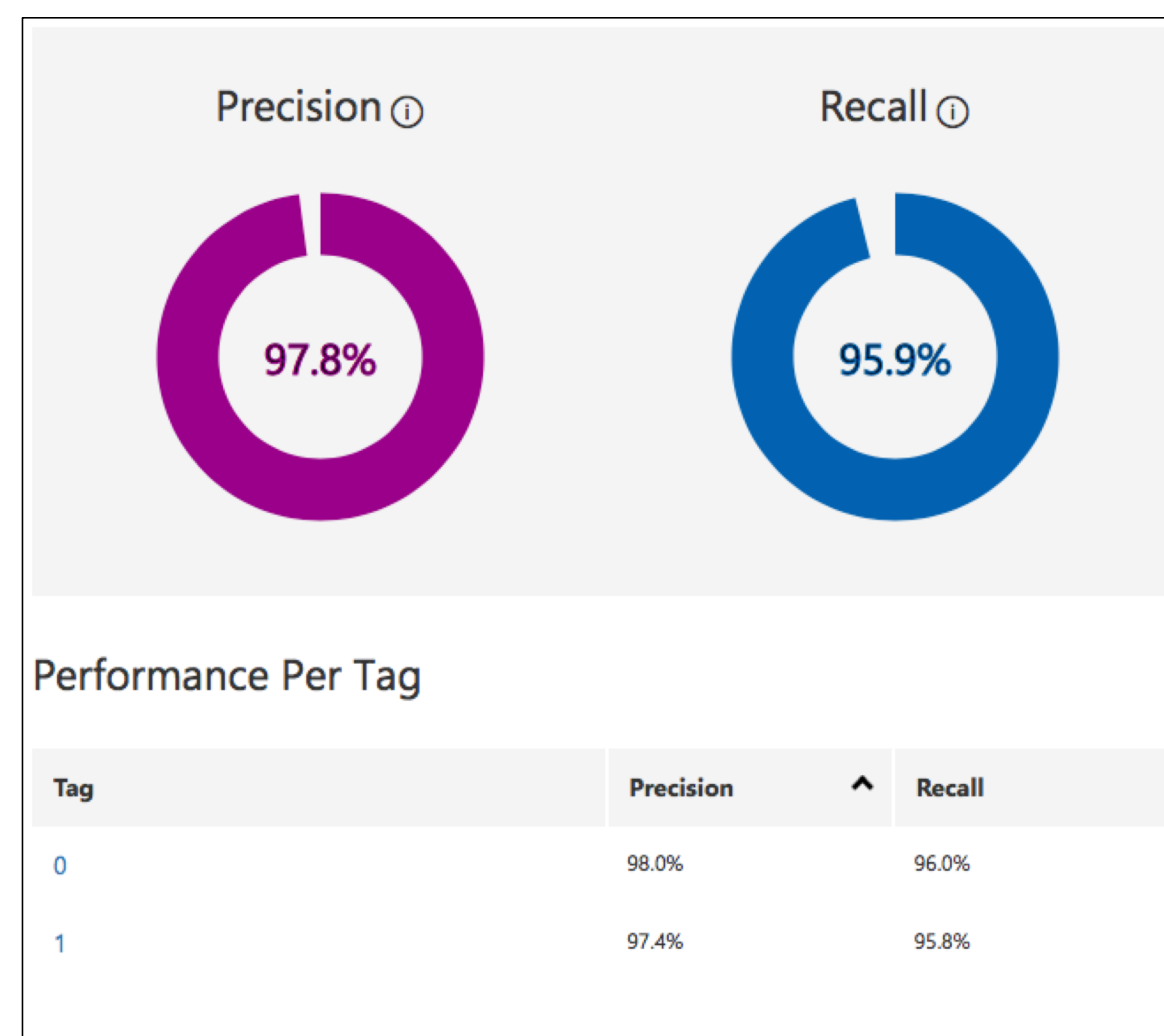


Fig. 2. Results of training the classification model.

RESULTS

Application provides information about recognized person on the special screen. From this screen, the user can call or send a text message to a selected person with one touch, send an e-mail, and save all available information about the person to the user's contact list in the Apple ID account.



Fig. 3. Face recognition mode

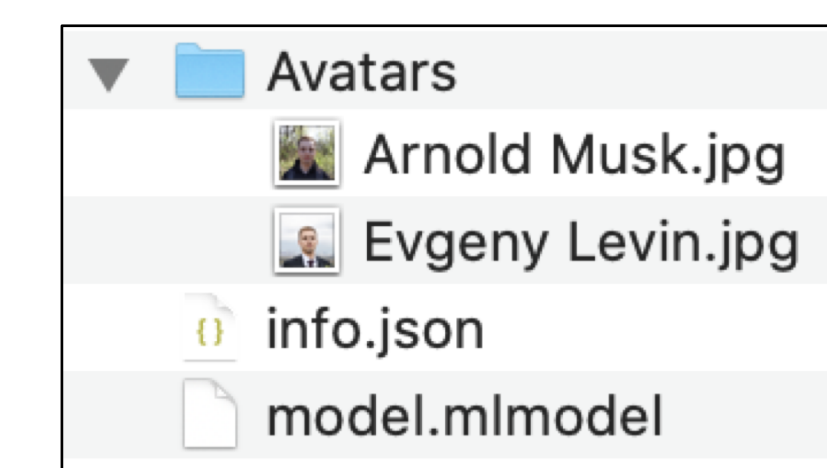


Fig. 4. Example content of the zip archive with the trained model.

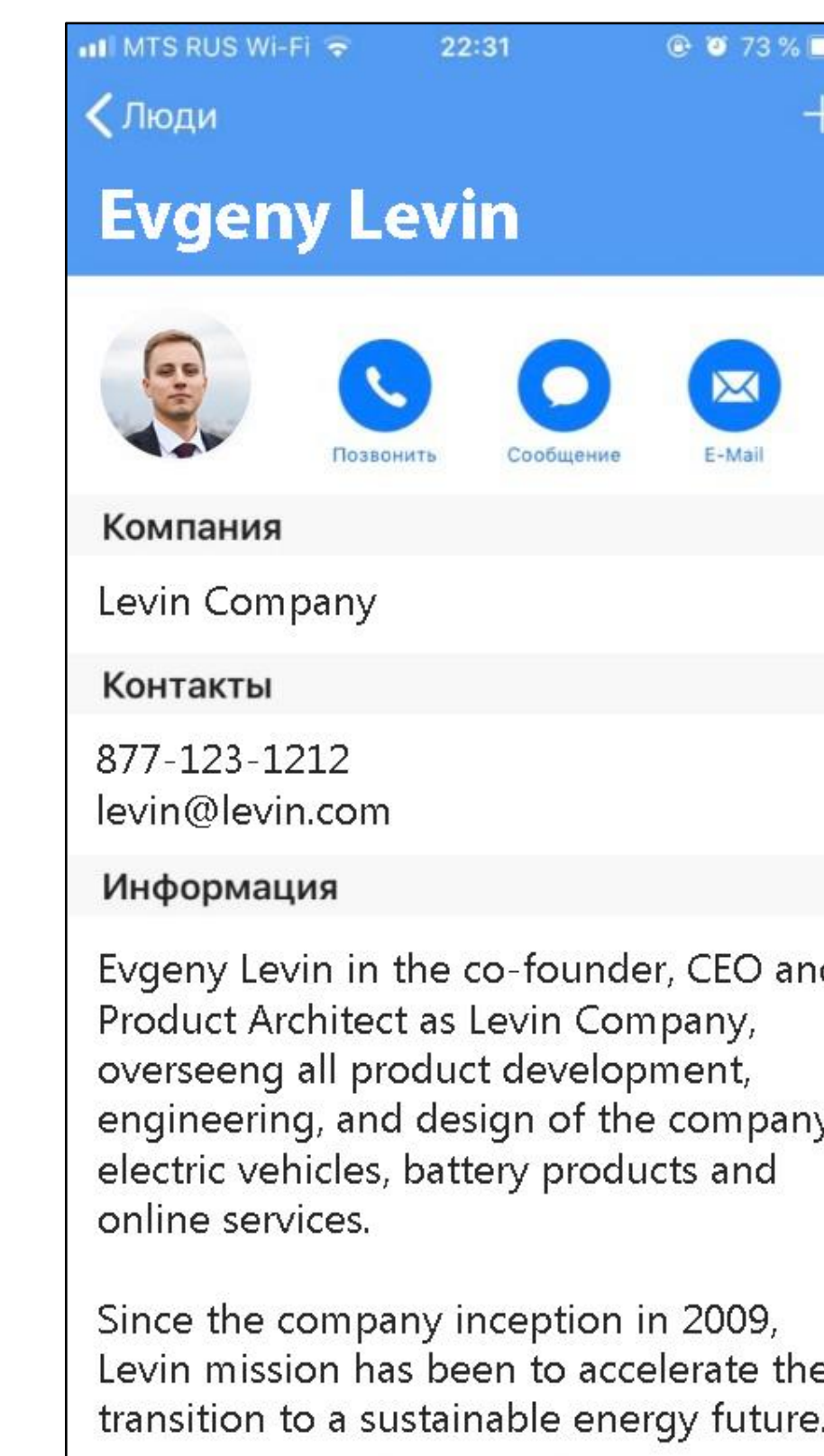


Fig. 5. User information page.

ANALYSIS

The k-fold cross-validation method is used to evaluate the learning results of the model. The initial sample is randomly divided into k subsets of the same size. From k subsets one is saved as test data for model testing, and the remaining k - 1 are used as training data.

The cross-check process is then repeated k times, and each of the k subsets is used exactly once as the test data for model testing. The results can then be averaged to produce a single score.

Iteration 1	Test	Train	Train	Train
Iteration 2	Train	Test	Train	Train
Iteration 3	Train	Train	Test	Train
Iteration 4	Train	Train	Train	Test

Fig. 6. K-fold cross-validation method

DISCUSSION

As mentioned earlier, the developed mobile application is that it can work with any machine learning model saved in a specific format according to the simple rules. This means that we only need to compile the app once and upload it to the App Store.

Of course, there are several disadvantages too:

1. To prepare the model, you must manually fill in the information in JSON format. The solution to this problem is to create a simple web service with a clear interface that can generate information in the desired format on its own, and the user will use a convenient graphical interface.
2. Another problem is the issue of personal data security. The app loads data from a link, meaning the trained model must be publicly available. The solution is to allow you to load the model from the local iOS storage.

CONCLUSIONS

1. We developed a facial recognition algorithm using standard libraries from Apple.
2. The application is designed with a focus on loading external machine learning models over the Internet, which allows you to change the model without making any modifications to the application.
3. As an example, we have trained a classification model and received the following scores of recognition quality indicators precision: **97.8%** and recall: **95.8%**. In our future work we consider adding the functionality of emotion recognition based on the special pattern recognition algorithm.

ACKNOWLEDGMENTS

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