

Intelligent Video Surveillance Systems with the Purpose of Increasing the Economic Efficiency of Lending Financial Institution

A V Pisareva¹, S G Chekunkov², D O Vakhnin²

¹Department of Medical and Technical Management
Scientific-educational complex "Radioelectronics, laser, and medical equipment"
Federal State Budgetary Educational Institution of Higher Education "Bauman
Moscow State Technical University (National Research University)"

²Department of Biomedical Engineering Systems
Scientific-educational complex "Radioelectronics, laser, and medical equipment"
Federal State Budgetary Educational Institution of Higher Education "Bauman
Moscow State Technical University (National Research University)"

E-mail: pavpav.06@mail.ru, vd@3a-e.ru

Abstract. The essence of the project is the development of intelligent video surveillance systems and the implementation of sales of hardware and software security systems using face recognition technology. The payback period of the project is ten months. The total revenue for 2020 is planned to be 5, 75 million rubles. The project implementation period is from January 10, 2020, to December 31, 2020. The work calculated the material costs of the company LLC "Point of View" on the development of the project. A new algorithm for recognizing masked people is proposed. The main advantage of the proposed algorithm is that it uses a human mask, so it is applicable for video data with an arbitrary complex background. The results of testing the algorithm on its own sample of video sequences obtained from a stationary video surveillance camera are given.

1. Introduction

In Russia, invasive methods of recognition by fingerprints or by the iris of the eye are considered to be the most reliable methods of personal identification [16]. And the procedure of personal identification is one of the most developing areas, which is caused by the wide practical applicability of systems based on it [13]. Since, for the recognition of a person's biometric indicators, his consent is required and, for example, the application of a finger to a special device for further reading of fingerprints. As a result, it can be said that the development of an algorithm for a device that is able to recognize people only by photography/video to detect disguised faces is of particular interest [7], [12]. For identification of the person by the image of the face, many algorithms have been proposed [4], [11]. Due to the fact that all the proposed approaches often do not provide deep reliability of identifying additional features, many studies have been devoted to this research.

The main idea of our project is the creation of a biometric security system based on the detection of persons in masks "Point of View" [19]. This technology will be presented in the form of a complex consisting of high-speed video surveillance cameras [22], software for Microsoft Windows [5], [17].

Each person will be recognized by the camera and software, faces that are not masked by various objects (glasses, wig, mask) will be recorded as "not dangerous" [18]. Those people whose faces are hidden behind the masking items will be indicated on the security monitor as a person with a heightened threat. At this stage, there are two scenarios: the control over the security of the facility will be fully placed on the shoulders of the security service, and the program will pay attention of the security service to people with difficult-to-recognize persons, after which the guards make a decision on each person [20]; the software independently makes an assumption about each person with a difficult to recognize face, and with the help of a trigger camera, which will be installed at the place of a teller or employee of the hall, monitors the behavior of each employee [5], [14]. This system is able to replace the emergency call button, which will shorten the response time of the security services and increase the degree of security of the object [17].

2. Theory

2.1. Project goals

Creation of a complex of identification of masked people in order to preserve safety;

Using this technology to recognize the faces of visitors;

Using this technology to increase customer loyalty;

Product development collecting the emotional state of clients;

The use of the Vkontakte social network API to collect a target audience and set up advertising [2];

The development of the software for analytics purchasing power [21].

2.2. Project tasks

Development of a complex using modern technologies of "Artificial Intelligence" and "machine learning". To date, an emotion recognition system and face recognition technology have been developed with an accuracy of 99.8%.

- The necessity to write software using existing technologies.
- To choose cameras with optimal performance (resolution, number of frames per second, photosensitivity) and price.
 - To configure the connection between the camera and the PC, preferably without using Internet access to increase the security of the working node.
 - Conduct training on a sample of at least 500 people.

At this stage, the main obstacle to the goal will be training to work with the system [1]. Since individuals are personal data and when working with them, a special permit and a place where they would allow to install this complex are required.

3. Results

3.1. Market analysis

This business area is B2B [6]. Orientation is designed to use the product in order to optimize security systems and improve service quality. If necessary, the filling of the product can be changed depending on the tariff plan or goals pursued by the installation of this complex. At the moment, the uniqueness of the complex lies in its flexibility and scalability. From a simple tool to account for the quality of customer service, you can go to a complete system of analytics and security. The hardware-software complex also includes the possibility of the shop-window to interact with the customer, anticipating his behavior and desire, highlighting prices or goods. An important factor in the development is the transition to cloud technologies and management from any device with the right of access [15].

For the wages of security workers, statistics are generated quarterly, it includes expenses for payments to employees of private security firms, contractors for the installation of an alarm system, and so on, the salary of full-time bank security guards are not included in these accounts. According to "Medialogia", two of the three most resonant robberies are associated with "Sberbank", which has

17,500 branches, for the first 9 months of 2016, Russia's largest bank received only one place in the top three most notable attacks.

Expenses for physical security decreased slightly, but at the same time, the cost of technical security equipment increased, as reported in the press service of Sberbank. Effective interaction with the police and private security structures allows arriving at the scene in the shortest possible time to localize emerging non-standard situations. Thus, we can conclude about the relevance of this development in the banking sector. Additional functions of the complex presented by us, such as analytics, audience gathering, emotional state assessment, will help companies to segment target audience in a more detailed way, optimize advertising budgets, make the most profitable unique selling proposition [2]. Competitors currently are companies: VisionLab, MDGs. Our potential buyers are mainly retail outlets, communication shops, jewelry stores, pharmacies, bank offices, those places where it is necessary as a high-quality security rapid response system, but also a unique approach to each client.

3.2. Product characteristic

The system is called "Point of View." Multifunctional complex for defining masked people. Characteristics of installed CCTV cameras:

- Video Signal Standard: Color (PAL)
- Matrix CCD size, inch: 1/3" ICX673
- Horizontal resolution, TVL: 700
- Minimum illumination on the object, Lx: 0.1 / 0.01
- Signal to noise ratio s / n , dB: > 50
- Focal length of the built-in lens, mm: 2.8 ~ 10
- The possibility of additional use of the complex to work with clients. Management of a complex with a PC, in perspective with tablets and phablets.

4. Marketing plan

At the initial stage, it is planned to install the "Point of View" system in one of the customer service offices and conduct test launches in the office working mode. Also to agree on a pilot project with one of the leading banks in Russia. This pilot project will allow detecting current shortcomings and training the system to recognize faces with a certain accuracy on the statistics. After the test launches, you need to get feedback from the management and employees of the bank to take into account all the shortcomings and suggestions. Carrying out a pilot project in a bank will increase the level of trust in the brand and technology, which will make it possible to occupy a certain place in the market. From the fourth month, it is planned to introduce contextual advertising and search promotion, and allocate 15 thousand rubles a month from the budget.

To work with small stores and retail chains, a necessary step will be to create a landing page to attract new customers and demonstrate the ability of the system. Later, through the site, it will be possible to get access to their complexes, collect analytics, audience and create advertising campaigns for the social network Vkontakte. To attract customers to a website platform "Yandex. Direct" will be used, our target audience will be companies with search requests to install security systems in the store, video surveillance systems and on similar topics. Getting to the site, the client will see a unique selling proposition and discount offers with a free trial period. To work with large companies, it is necessary to personally meet with their management, making cold calls, in this case, is not the best way to attract. The result of the meeting should be to obtain permission to participate in tenders.

5. Production plan

In the beginning, there is the possibility of minimizing the cost of launching a pilot project. One will use the following features:

1. Software development is possible to implement using freelance services. It is necessary to decompose the global development task into small tasks with the definition of the estimated time for

execution. To create a finished product you need at least 3 programmers who will work full time. Now, the average salary of a specialist is 100 thousand rubles, for three highly qualified programmers, it will take about 300 thousand rubles for an 8-hour working day. It is worth noting that 20% of work and time bring 80% of the result, so at the initial stages it makes no sense to recruit staff. Working with freelancers using the “SCRUM” methodology we can save up to 40% of resources (120 thousand rubles) [16]. We lay 180 thousand rubles a month for the work of programmers.

2. To work before the release of the first finished version of the pilot product, we will use the place in the coworking center. The average rental price is 8 thousand rubles per person. Initially, two people will work: the head of the development department and the head of the promotion department (16 thousand rubles).

3. For testing, one will need a sample surveillance camera, for the initial stages - a laptop webcam camera, a laptop - 2 positions (140 thousand rubles).

4. The cost of the camera, for installation, satisfying the characteristics in Section 7 is equal to 30 thousand rubles.

As a result, the action plan consists of the following steps:

- Drawing up the project framework
- Drafting technical tasks for programmers
- Product development and testing
- Testing using surveillance cameras
- Launch a pilot project

6. Organizational plan

The legal form of organization - LLC (USN) [9]. Management personnel: project manager (general director acting on the basis of the charter), head of the promotion department, head of the development department [21]. Founders: one founder and he is the project manager.

7. Financial plan

The prime cost of production is 150 000 rubles, taking into account the work of programmers and the cost of hardware [8].

Table 1. The composition of the cost.

Production prime cost	
Equipment	30 thousand rubles
Unit Cost of Programmers Work	100 thousand rubles
Other expenses	20 thousand rubles

The sales volume for the next 5 years is planned to be increased in stages, starting with 2 complexes per month (paragraph 11.3), by 20% each quarter, leaving the first quarter for product development and assume that sales will not be made, thus by the year 2024 the planned sales volume should be about 53 complexes per month, and for 2020 it is planned to sell a total of 22 complexes. The figure shows the planned sales growth for each month, Table 3 shows the “Profit and Loss Plan” for 2020. [21].

The payback period of the project is 10 months, and the starting capital of the project is 1 058 thousand rubles (table 2).

Table 2. Profit and Loss Plan.

№	Indicators Names	Total for the period	2020 Monthly											
			1	2	3	4	5	6	7	8	9	10	11	12
1.	Sales revenue, thousand rubles	5750	0	0	0	500	500	500	500	750	750	750	750	750
2.	Direct material costs, thousand rubles	860	140	0	30	60	60	60	60	90	90	90	90	90
3.	Production staff salary	2160	180	180	180	180	180	180	180	180	180	180	180	180
4.	Gross profit, thousand rubles	2730	-320	-180	-210	260	260	260	260	480	480	480	480	480
5.	Constant (general and other) expenses, thousand rubles	327	16	16	16	31	31	31	31	31	31	31	31	31
6.	Fixed salary costs for administrative and management personnel (incl. Insurance premiums), thousand rubles	1380	60	120	120	120	120	120	120	120	120	120	120	120
7.	Operating profit/loss	1023	-396	-316	-346	109	109	109	109	329	329	329	329	329
8.	Property tax	0	0	0	0	0	0	0	0	0	0	0	0	0
9.	Profit before tax, thousand rubles	1023	-396	-316	-346	109	109	109	109	329	329	329	329	329
10.	Tax on profits, thousand rubles	499,4	0	0	0	26,1	26,1	26,1	26,1	79	79	79	79	79
11.	Net profit, thousand rubles	523,6	-396	-316	-346	82,9	82,9	82,9	82,9	250	250	250	250	250
12.	Profitability ratio	17 %				21 %	21 %	21 %	21 %	43 %	43 %	43 %	43 %	43 %
13.	Project profitability	9 %				16 %	16 %	16 %	16 %	33 %	33 %	33 %	33 %	33 %

It can be concluded that the biggest investment at the start of the project is the remuneration of programmers; this cost item should be optimized starting from 2020 when all major products will be developed [22]. Gross profit (GP) for 2020 is equal to 2 730 thousand rubles. Financial profit is not yet taken into account [3].

Break-even point:

$$\text{BEP} = \text{FC} / (\text{P} - \text{AVC}), \quad (1)$$

where FC is fixed costs (rent, managerial staff salaries, programmers pay 316,000 rubles per month), P-cost of goods (estimated cost of security complex is 250,000 rubles), AVC are variable costs (components, cameras — for one project approximately 40 000 rubles).

Thus, the break-even point (BEP) = 2 complexes per month at the beginning of the stage. Taking into account the plan for increasing sales, a table of cash flow was compiled (table 3).

Table 3. Cash flow plan.

Indicator	2020 year	2021 year	2022 year	2023 year	2024 year
CASH INCOME					
Sales income, thousand rubles	5 750	11 500	20 000	40 000	60 000
Service income, thousand rubles	0	1 000	2 000	5 000	10 000
Total income, thousand rubles	5 750	12 500	22 000	45 000	70 000
CASH OUTFLOW					
Operating costs, thousand rubles	327	600	1 000	1 000	1 000
Wage Payment, thousand rubles	3 540	6 000	6 000	6 000	4 000
Equipment, thousand rubles	1 000	2 000	4 000	8 000	10 000
Capital expenditures, thousand rubles	0	0	0	0	0
Total costs, thousand rubles	4 867	8 600	11 000	15 000	15 000

8. Analysis of possible risks

The list of potential problems is fashionable to consider the following. The imperfect legal framework in the field of personal data protection. High market competition among companies that provide face recognition systems. The ban on access to the database of persons for training neural networks. First of all, the problem associated with an unprepared regulatory framework can be solved by writing the relevant draft laws and submitting them for consideration. High competition can be both positive and negative. Proper marketing strategy in conjunction with a competitive pricing system, will allow taking a strong position in the market among other solutions [10]. Today, various types of video surveillance systems are also being actively introduced, and in this area, all doors are open for experiments, as security is today one of the main prerogatives of the state in the struggle for the preservation of law and order and resistance to terrorism [3].

9. Conclusion

During the work on the project, it can be said that the hardware and software complex will be ready for commissioning in the second quarter of 2020. From the second quarter of 2020, it is planned to begin sales from two complexes per month and quarterly increase sales by 20% per month. The required amount of investment is 1,058 thousand rubles and will be financed with its own funds. For

2020, it is planned to sell 22 complexes to the banking sector, under these conditions, the net profit for the year will be 523.6 thousand rubles. The payback period of the project is ten months. Total revenue for 2020 is equal to 5,750 thousand rubles. The project implementation period is from January 10, 2020, to December 31, 2020. It is planned to implement the software using modern information technology, selected cameras with optimal performance in a particular price segment. The software will be trained on a sample of 500 people, training will be continued during the initial stages of commissioning.

References

- [1] Akberdina V, Kalinina A, Vlasov A 2018 Transformation stages of the Russian industrial complex in the context of economy digitization *Problems and Perspectives in Management* **16(4)** 201-211
- [2] Asmaryan A, Levanov A, Borovik I 2018 Smart advertising (Book Chapter) *Brand Culture and Identity: Concepts, Methodologies, Tools, and Applications* vol 2 529-534
- [3] Berduygina O N, Vlasov A I, Kuzmin E A 2017 Investment capacity of the economy during the implementation of projects of public-private partnership *Investment Management and Financial Innovations* vol 14 3 189-198
- [4] Boyko A A, Pilipenko M N, Spiridonov I N 2016 Determination of motor units on the video image of the process of psychological testing by the method of R. B Kettel *Physics and Radioelectronics in medicine and ecology – FRAME'2016 Reports of the XII International scientific conference with the scientific youth session* 42-46
- [5] Devyatkov V V, Alfimtsev A N, Taranyan A R 2018 Multicamera Human Re-Identification based on Covariance Descriptor *Pattern Recognition and Image Analysis* **28(2)** 232-242
- [6] Falco S G 2018 Business models of new enterprises in the transition to the digital economy *Innovations in management* **3(17)** 2–3
- [7] Konushin V S 2010 Algorithm for recognition of people in the video sequence of clothes *Computer science and its applications* vol 4 174-78
- [8] Kostyrin E V 2018 Calculation of cost and efficiency of investments in the design and production of magnetic resonance blood flow sensor *Economics and management: problems, solutions* vol 3 **2** 118 – 136
- [9] Larionov V G Melnikov O N, Gankin N A 2016 Development of controlling from the standpoint of production organization *Controlling* **4(62)** 3–9
- [10] Pisareva A V 2011 Bases of marketing at the enterprises of medical and technical profile: guidelines for homework on the subject "Fundamentals of marketing in enterprises of medical and technical profile" MGTU im. N E Bauman M.: MGTU im. N E Bauman 1 CD-ROM FSUE "Informregister" №0321102266
- [11] Samorodov A V 2013 Building Intelligent Systems For The Analysis Of Microscopic Images In Medicine And Biology *Pattern Recognition and Image Analysis (Advances in Mathematical Theory and Applications)*. vol 23 **4** 508-511
- [12] Semenov D 2015 Video surveillance in banking update rooms *Security algorithm* **3** 50
- [13] Solodova E N, Nabilskaya N V, Sedykh M A 2015 Profitability of acquisition of video surveillance system (for example, smartstation video surveillance system for the banking organization) In the world of science and innovation *Collection of articles of the International scientific-practical conference* Responsible editor: Sukiasyan Asatur Albertovich 61-65
- [14] Taranyan A R, Devyatkov V V, Alfimtsev A N 2018 Selective covariance-based human localization, classification and tracking in video streams from multiple cameras *BIOINFORMATICS 2018 - 9th International Conference on Bioinformatics Models, Methods and Algorithms, Proceedings Part of 11th International Joint Conference on Biomedical Engineering Systems and Technologies* *BIOSTEC* **3** 81-88
- [15] Vlasov A I, Grigoriev P V, Krivoshein A I, Shakhnov V A, Filin S S, Migalin V S 2018 Smart management of technologies: Predictive maintenance of industrial equipment using wireless

- sensor networks *Entrepreneurship and Sustainability Issues* **6(2)** 489-502
- [16] Volochienko V A 2018 Methods of preparation and decision-making in production systems *Production organizer* vol 26 **3** 19–33
- [17] Devyatkov V V 2016 Selective-covariance method of localization, classification and tracking of people in video streams from a variety of video cameras *Bauman Moscow State Technical University Bulletin. Series: Instrument making* **6(111)** 54-70
- [18] Ilyin N N 2017 Using videotapes to prevent crimes of persons serving a sentence at the facilities of the penitentiary system *Bulletin of the Kuzbass Institute* **1(30)** 124-131
- [19] Kolpakov A V 2016 Application of technologies of biometric verification at checkpoints across the state border Physics and radio electronics in medicine and ecology - FREM'2016 Reports of the XII International Scientific Conference with a scientific youth session 57-59
- [20] Markachev A V 2017 Biometrics in the face Criteria for choosing a software product *Security Algorithm* **1** 22-24
- [21] Pisareva A V 2017 Business Planning *M.: BMSTU publishing house* **56**
<http://ebooks.bmstu.ru/catalog/253/book1403.html> ISBN 978-5-7038-4360-4
- [22] Plastinina N 2012 Video surveillance is the “business intelligence” of its employees *Secretarial work* **2** 10-18