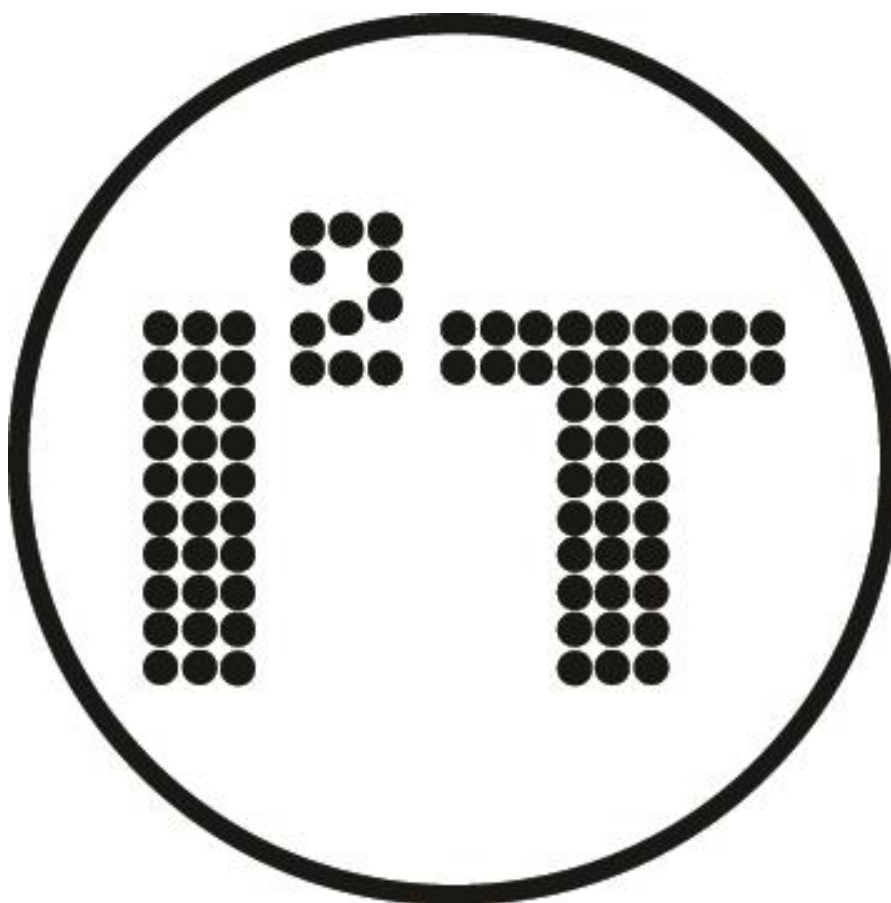


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The materials of The International Scientific – Practical Conference is presented below. The Conference reflects the modern state of innovation in education, science, industry and social-economic sphere, from the standpoint of introducing new information technologies.

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Consider the following classification of the causes of unreliable information at the output of the vision system:

- incorrect functioning of the system of technical vision because of a failure or degradation of the system elements; errors in design;
- natural causes of natural or technogenic character;
- a focused impact, aimed at the distortion of information at the output of the vision system.

The first group of reasons can be attributed to errors associated with the wrong choice of camera and/or lens, wrong position and/or orientation of the camera, bad software and algorithmic support of technical vision, impaired characteristics or orientation of the camera in operation.

The second group of causes involves the illumination of signs or camcorder, turn signs, shadows from stationary or moving objects, the overlap part of the marks trees or neighbouring vehicles, the discrepancy between the information on the sign with the information received from GPS or GLONASS, as well as other reasons.

The third group of reasons should include intentional exposure (blinding) of the camera, the appearance of conflicting or incorrectly showing characters, creating a mottled background of the picture on a road sign or its removal, and other causes of intentional nature.

Measures that can be proposed to neutralize these reasons, should also be divided into groups.

Errors associated with the wrong choice of camera and/or lens, wrong positioning and/or orientation of the camera, bad software and algorithmic support of technical vision needs to be identified and corrected in the debugging process of the system, its testing and finalize the test results. The violation characteristics and orientation of the camera in the process of operation should be identified by the self-diagnostic system, which must become an essential part of the system of technical vision.

The second group of causes involves the use of measures both technical and organizational nature:

- illumination of signs or camcorder can be eliminated by the use of filters, the transmittance of which depends on the intensity of radiation, re-reading and analysis of the road sign;
- turn signs, small overlap parts of characters the trees should be taken into account algorithmic and software provision;
- shadows from stationary or moving objects may require re-reading and recognition of the mark;
- significant overlap parts of characters the trees should be addressed through pruning or relocation of sign, but to detect this situation with a test trip on a given route by car with a driver;
- discrepancy of information on a sign with information received from GPS or GLONASS, may be caused by the delay information is updated in the GPS or GLONASS, and the unauthorized placement of a sign that, on the one hand, requires measures of an organizational nature on the other hand, for a prompt response, use of signals from other system sensors tactile sensing, such as radars, not to leave on a strip of oncoming traffic where cars are moving in the opposite direction.

Causes of the third group may require the application of additional elements of tactile sensing, which will be able, for example, to measure the signal strength of the illumination, and the use of more complex control algorithms, allowing the use in critical situations, the alarms of all system sensors tactile sensing, as well as fix any non-standard situation and, if necessary, to get in touch with the traffic management center until the transfer of the motion control of the vehicle.

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#### SOFTWARE DEVELOPMENT FOR PRE-SCHOOL EDUCATION USING AUGMENTED REALITY ALGORITHMS

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**Abstract** - The report provides an overview and analysis of the market of educational software, as well as the questions of Learning preschool children. This article analyzes the mobile application in the Russian market for the iOS platform, using augmented reality to enhance learning. On the basis of review, we proposed software development that implements the comprehensive approach to pre-school education, using the augmented reality algorithms.

Keywords - pre-school education, augmented reality, 3d modeling.

## INTRODUCTION

Modern technologies are not standing still: nowadays, the Augmented Reality is not a fiction. AR technologies are rapidly evolving, but unfortunately, they are used mainly in advertising and marketing. That is to say, the development of augmented reality technology is ahead of its implementation in the various spheres of life, despite the fact that it has great potential.

Augmented reality can change the picture of the modern world and make it more user-friendly and interactive. Applications of this technology are endless, it all depends on human imagination, it can be medicine, military affairs, education and the sphere of the state. services, etc.

The thing is that augmented reality, as opposed to virtual reality, complements the real world with virtual objects, and does not replace it. It means that AR requires direct user contact with reality through the additional content, which greatly simplifies certain tasks.

## THE RELATIONSHIP OF CHILDREN AND GADGETS

In this article, we shall discuss the application of augmented reality in education. Everyone knows that the human brain is more inclined to the processing of visual images than plain text. On this topic, there are a number of studies that have shown that augmented reality technology in education enriches the visual and contextual learning, improving the richness of information. When listening to lectures, the 25% of information is held in the short-term memory, in visual learning this number reaches 80%. The result of these studies have shown that the use of augmented reality in education will only benefit the people, especially children.

Using gadgets in children's education has always been a lot of controversy. [1] Many parents fear that children may go deep into the virtual world, as it has happened many times. However, it should be recalled that the augmented reality does not replace the real world, but only complements it. This eliminates the potential psychological dangers of this technology in education from the earliest age.

As for the interaction of children with gadgets, in France in 2013, the Academy of Sciences published a book "The Child and shields» (L'enfant et les écrans) [2], which opens the question about interaction of children and the gadgets with the help of the results of recent work in medicine, neurology and psychology. It describes that the child can be allowed to use the smartphone from the age of 1.5 years.

According to research conducted by Common Sense Media on the territory of the United States, even in 2011, 10% of children up to 2 years use mobile devices for viewing video and games [3], but their number increased to 38% in 2013. At the age of 8 72% of children are actively using devices [4].

In 2015, an expert Hi-Tech.Mail.Ru project conducted a survey in Russia among the more than 5,000 parents [5]. The survey found that children first begin to use the gadgets in age from 1 to 3 years, with 85% of parents give children "adult" smart devices. Also it was found that 66% of children use the gadgets for entertainment, and 20% - use smart devices for learning.

This explains the significant development of children's mobile industry. An increasing number of applications, aimed at the children's niche, with friendly characters, a simple and intuitive interface. However, most of the applications are cliché and not very interesting, because they are two-dimensional. The problem is that the program of this format can not ensure full development of the child. First, two-dimensional applications do not contribute to the development of fine motor skills of kids in full, as the uncontrolled use touch control leads to abnormal development of the baby hand muscles. Secondly, they inhibit the development of figurative thinking, which negatively affects the child's imagination and creativity.

Fortunately, nowadays modern technologies allow us to solve this problem with the help of augmented reality [6]. If we consider this technology with respect to the younger generation, it allows children to use gadgets to interact with the real world, animating tutorials or simple board games "live" 3d objects.

Since the topic of the Augmented Reality (AR) has been gaining more and more attention over the past five years, numerous attempts have been made to deepen the knowledge in this field and methods of AR usage in education. However, a wide range of research in the problem area have no practical examples. This part of article includes the review of theoretical sources which describe the main principles of the Augmented Reality and how the discrepancy between theory and practice may be reduced.

Holding that the Augmented Reality is a great technology which has a great future, Ronald Azuma [7] consolidates existing information from many sources and publishing an extensive bibliography of papers in this field. In addition, scrutinizing AR as a variation of virtual reality, the author claims that the Augmented Reality enhances a user's perception of and interaction with the real world. Furthermore, this paper presents six classes of potential AR applications, i.e. medical, repair of complex machinery, visualization, robot path planning, entertainment and military aircraft.

One must admit that the author makes a crucial contribution to the AR knowledge, his theory was reflected on works of his followers. However, the classification of Augmented Reality applications, which the author describes, to some extent is a partial. It is believed that there are two more variants at least.

Stressing that people prefer using two-dimensional media for teaching although the natural world has three-dimensional virtual environment, Mehmet Kesim and Yasin Ozarslan [8] present an Augmented Reality and state that this technology allows the user to enrich the real world by virtual objects with the real size in the real time. Furthermore, analyzing AR possibilities, they comment on key technologies and methods, i.e. head mounted displays, handheld displays and pinch gloves, and stress that interaction techniques of augmented reality enable manipulating virtual objects in the real world, as well as physical objects.

Undoubtedly, the authors make a significant contribution to the knowledge of the Augmented Reality as an instrument for education. However, it might be suggested that these techniques of AR applying in this field explicitly allow information disclosure to a certain degree. Put differently, the usage of the Augmented reality in the field of teaching is most likely the result of more complex and multidirectional interplay between the actions of users.

Otília Pasaréti et. al. [9] explain the nature of Augmented Reality, stressing that this type of reality is a step between real world and virtual reality. In addition, they describe some examples of AR usage in education and present an AR experiment which helps in popularizing some school subjects. Furthermore, one should not forget that this article shows an analysis of the experiment result. The authors make a crucial contribution to the Augmented reality research in the field of education. Moreover, the results of experiment, which described by the authors, prove that the AR technology have a positive impact on student learning. However, the authors present only a partial explanation for AR applying techniques.

Hirokazu Kato and Mark Billinghurst [10] consider Augmented Reality as an instrument for collaboration between people and predict that users of AR conferencing system can collaboratively view and interact with virtual objects using a shared virtual whiteboard. Besides, asserting that the use of spatial cues and three-dimensional object manipulation are common in face-to-face collaboration, the authors propose a method for optical see-through HMD based on the marker tracking.

Certainly, the authors make an outstanding contribution to Augmented Reality, many scientists believe that this paper unjustly neglected. Nevertheless, the new method proposed by the authors is most likely disclose possibilities of AR to a certain degree.

Numerous studies have been conducted to examine AR possibilities and its usage methods. However, most of them could not be applied in AR for the education. Many papers focus on the application of augmented reality in different areas, losing the importance of education each time. As we have seen a small number of studies have been directed to deepen the knowledge in this field and development applications for education. Therefore, there is a wide gap in this field of research, which should be decreased.

#### AUGMENTED REALITY MARKERS

It seems that the very first camera recently appeared on mobile phones, but now these cameras can compare with the professional ones. Moreover, the good cameras in mobile phones allow us to deal with computer vision. The concept of computer vision is considered to be fundamental for the development of augmented reality technology. Its algorithms are engaged in research and image processing and provide an opportunity to highlight key features of the image.

In the field of augmented reality computer vision techniques are used to search for a camera with special markers. After the recognition of markers, it becomes possible to construct a matrix of projection and positioning of virtual models.

What are the markers and why we use them? First of all, it should be noted that there are two main principles in the construction of augmented reality:

- On the basis of the marker;
- On the basis of the user's location coordinates.

The main difference between these two technologies is that the usage of a marker is tightly connected with computer vision (recognition by the camera), while a markerless technology relies on specialized sensors such as gyro, GPS-receiver, an accelerometer and a magnetometer. The first technology is actively used as well as on PCs and on mobile devices, while the second is not suitable for use on a computer, and is most often used in mobile gadgets.

The marker refers to the items found in the surrounding area, which are located and analyzed by the software in order to position virtual objects. The camera detects the marker, after which the program analyzes its condition and location in the space, in order to accurately project the virtual object on the marker. With this technology an effect of the physical presence of an object in the environment. There are many graphic filters and programs for creating high-quality 3D models, which enables virtual objects to be sufficiently realistic and natural, making it difficult to distinguish from real objects.

Most often serve as markers dimensional images printed on paper sheets. Types of markers on the image quite fluctuate and depend on the image recognition algorithms. As a two-dimensional markers can be as simple geometric shapes and complex images with a unique pattern, and even the human body marker technology does not shy away from.

## ANALYSIS OF EXISTING APPLICATIONS

The analysis considers the applications available on the Russian market for mobile phones on the iOS platform, in which augmented reality is used for the education of children. Additional equipment is not required for these programs, such as goggles. To implement the described applications you only need a smartphone with an integrated camera. It is important to note that for each program considered necessary printed material from which the device camera will read the marker and then display their content. In this case, some applications require the purchase of the printed edition, while, for others enough to print materials at home.

Due to the fact that the idea was to create a comprehensive application that combines several academic disciplines, we were considered different areas of the market of educational mobile applications. The analysis revealed that this unique complex of applications do not exist, however, some separate discipline for preschoolers are in the form of mobile applications with augmented reality. As a result, the program was considered to render the digital content when viewing the alphabet, as well as programs that use augmented reality for learning mathematics.

The first application, which should be considered - Maths Teach-AR. It gives users the opportunity to study mathematics and geometry. The program is useful for those who find it difficult to imagine three-dimensional figures in two-dimensional format. In the pre-printed forms application starts the animation and visual effects with the calculations. There is an English interface and the application is paid.

Next mobile application that must be taken into account - FETCH! Lunch Rush. This program allows children to learn simple mathematical account. The display shows the arithmetic operation and the child has to point the camera at one of the pre-printed image to the desired result. At the beginning of work with the application the user is prompted to print the necessary additional material on the developer's website.

Along with the above application for teaching elementary mathematics, there is a program - AR Flashcards by Developer Mitchlehan Media LLC. It also allows children to learn the account, but there are some differences. If the interface of the Fetch application is rather complicated to work independently for children up to 5 years, so the parents should print a printing material. Working language - English, the application is free.

Let us consider another application by the same developer, called AR Flashcards - Animal Alphabet. By the name you will notice that the program is also in English, nevertheless it is still to be considered, since it is an excellent example of the use of augmented reality to teach children the alphabet. The app is free and to get started you only need to print the printed materials. The user moves the camera of his mobile device on different cards, depending on the images appear on the screen 3d animal model.

Another children's mobile application for learning the alphabet - Live 3D alphabet from producer Constantin Gavriliev. Here the principle is the same as in the previous application, but it is needed to buy a book corresponding to the program. The application interface is in Russian.

Attention should be given a single application, which does not quite fit into the category of "education" and refers to the category of entertainment applications. He is needed to pay attention, because one of the parts of the program is an assistant for learning the alphabet. The application is called Devar kids. The sub-applications are presented on the homepage of the application for which it is necessary to buy a special book. Basically, all the sections that are presented in this application are intended for coloring. The point that the user paints the figure, then it leads to a mobile device camera, after which the model appears this 3d-figure, in those colors in which it painted user. However, one section is designed to work with the alphabet. In this section, point the camera at the ABC letters appear 3d animal model. This program is not independent, it is considered to be a mandatory addition to the purchased prints. The application is free, however, to complete the work necessary to buy books. If the user has on hand the necessary baby coloring or ABC, it must enter into a personal code of the application, which can be found in the book, to activate the corresponding section of the program.

Thus, for children, there are not many training applications with augmented reality, despite the fact that the demand for them grows. At the same time, educational programs are divided mainly into two categories: the learning of ABC and mathematical account. With regard to the application with the alphabet, there are at least 3 of the program, but they require the purchase of additional content. It should also be noted that among the programs found Russian-language content have only - Devar kids and alphabet 3d Live. Below is a table which displays the results of a comparative analysis of applications for teaching ABC the children (Tab. 1). Application parameters are described in the last column, the presence of which will give the market diversity and be a good competition.

TABLE I. COMPARATIVE ANALYSIS OF THE AUGMENTED REALITY APPLICATIONS FOR ABC

	AR Flashcards – Animal Alphabet	Devar kids	Live ABC 3D	New project
The cost of the full version	free	free	free	free
Additional purchase	-	+	-	+

An additional printed material	-	+	+	-
The target audience (years)	< 5	4+	< 5	< 5
Sound assistant	-	-	+	+
Russian language	-	+	+	+

A program for the study of mathematics that uses augmented reality technology does not pose much diversity, there is even no programs in Russian. AR Flashcards is the only program to teach children at the age up to 5 years. That is why the creation of applications for children in Russian where augmented reality is used to study mathematics is relevant. The comparative analysis (Table 2) shows that the new application will be unique and have the advantage among Russian-speaking users.

TABLE II. COMPARATIVE ANALYSIS OF THE AUGMENTED REALITY APPLICATIONS FOR MATHEMATICS LEARNING

	Maths Teach-AR	FETCH! Lunch Rush	AR Flashcards	New project
The cost of the full version	7,5\$	free	6\$	free
Additional purchase	-	-	-	+
An additional printed material	-	-	-	-
The target audience (years)	12+	6-8	< 5	< 5
Sound assistant	-	+	-	+
Russian language	-	-	-	+

Creating a stand-alone application of the above, of course, will provide competition in the market. However, it should be noted that the indisputable superiority over competitors would have such an educational application that will combine more than one function. Proceeding from the above comparative analysis, it can be stated that there is a necessity of application development, which will combine different areas of education. The application can be downloaded free, and with an in-app purchase feature you can discover new areas of study.

#### ABOUT THE PROJECT

The aim of project is to increase the level of learning for pre-school education through the development of software for the interactive visualization of the educational material with the use of algorithms for augmented reality. To solve this problem, the following tasks were set:

- Reviewing and analysing of the market for the education of children under the age of 14
- Development of augmented reality marker recognition algorithms and interactive visualization of educational content
- Software development
- Testing and debugging the developed software

As for the scientific component of the project, we use a comprehensive approach to early childhood education with the use of augmented reality. Today, actively developed dynamic visualization algorithms of arithmetic operations as operations with virtual objects. Moreover, we also consider the creation of the image recognition algorithms for the implementation of user interaction with the virtual objects.

#### CONCLUSION

Pre-school educational applications occupy a small part of the market, but now are very popular among users. Most existing mobile applications for children based on augmented reality are entertaining, while the number of educational apps on the market is very small. Due to this, the actual creation of a mobile application for teaching children different sciences, where the main principle is - the use of augmented reality. Thus, the development of software for mobile devices with an integrated approach to pre-school education using augmented reality, will undoubtedly have a major advantage over competitors.

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## ALGORITHM FOR CREATING AND FILLING DATABASES FOR RELIABILITY PREDICTION SYSTEMS

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MIEM HSE

**Abstract** – This article discusses the problem of creating a system for automatic reliability calculation, in particular, the problem of time and resource-consuming process of data transfer from the reference books of reliability of electronic products to databases used to store and organize information. Article describes developed software product which allows to reduce the data transfer time.

**Keywords** – reliability prediction, database.

## INTRODUCTION

The use of various software tools to automate the calculation of equipment reliability can significantly reduce the calculation time [1]. But when developing such programs, it is necessary to fill in their databases with information of a different nature that will be used directly in calculating reliability indicators [2]. The "manual" input of this information is time-consuming and resource-intensive, therefore, to simplify and accelerate the filling of the АСОНИКА-К-СЧ database [3], a program has been developed that allows transferring data from such directories as "Надежность ЭРИ 2006" [4], "Надежность ЭРИ ИП" [5] and "MIL HDBK 217F" [6] into the electronic form and use the processed data for automatic calculation of reliability indicators.

Handbooks [4-6] contain mathematical models and (the intensity of failures, etc.), the values of the coefficients used for calculation by mathematical models, and tables containing information on the reliability of various types of ERI. Therefore, the program of "digitizing" directories should include these three types of data. In addition, mathematical models use different parameters that do not have a fixed value and vary depending on the input data, such as ambient temperature, acceptance, equipment group, etc. These parameters must also be taken into account by the program and requested from the user immediately before calculating reliability indicators.

## PROBLEM STATEMENT

The mathematical models of the operational failure rate of most ERI groups have the following general form:

$$\lambda_g = \lambda_0 \times \prod_{i=1}^n K_i, \quad (1)$$

where  $\lambda_0$  is the base failure rate of the ERI type (group),  $K_i$  is the coefficients that take into account changes in the operating failure rate depending on various factors;  $n$  is the number of factors considered.

One of the coefficients necessary to calculate the operational failure rate of individual groups (types) of resistors is the mode factor ( $K_p$ ). Consider on his example the process of filling the database with the information necessary to calculate this coefficient.

In the reference book "Надежность ЭРИ ИП" [5] the following mathematical model of this coefficient is given:

$$K_p = A \cdot e^{B \cdot \left( \frac{t+273}{N_t} \right)^G} \cdot e^{-\left[ \frac{P/P_n}{N_s} \left( \frac{t+273}{273} \right)^J \right]^H}, \quad (2)$$

where:  $A$ ,  $B$ ,  $N_t$ ,  $G$ ,  $N_s$ ,  $J$ ,  $H$  are constant coefficients of the model;  $T$  - ambient temperature, °C;  $P$  - working power dissipation of resistors, W;  $P_n$  is the nominal dissipation power of the resistors, W.