APPLICATION OF AUGMENTED REALITY TECHNOLOGY FOR TEACHING INDUSTRIAL SPECIALTIES IN PRACTICE

N. Voit, S. Kirillov, S. Bochkov, A. Elancev

Ulyanovsk State Technical University (RUSSIAN FEDERATION)

Abstract

The problems of many Russian enterprises are the low level of training of new young personnel, as well as the constant reduction of specialists who are able to transfer their experience related to their age. The aim of the work is to formalize and transfer the experience of older generations, improving the quality and speed of education in the areas that are necessary for the enterprise.

Research laboratory of the Institute of distance and additional education of Ulyanovsk state Technical University (UlSTU) develops virtual jobs in various industrial specialties, and tries to use modern technology. Transparency Market Research company shows that augmented reality can surely be considered a real breakthrough in the educational sphere and the demand for technology will continue to grow. That's why our virtual training simulator of radio elements mounter was developed using AR technology.

After passing the theoretical course in the required direction, the young specialist is given the opportunity to start activity on a specially prepared real workplace. Moreover, the learner uses special AR glasses, which are not hinder him during task performance. In the beginning starts the stage of learning that describes each of the used tool, the workpiece and the document. The undoubted advantage is the ability to focus only on the information that is necessary to perform this work.

Also, the virtual simulator is equipped with an expert system that monitors the actions of the student in real time, gives additional recommendations and allows the repetition of certain types of operations, divided by competencies.

The obvious advantages over traditional methods are:

- Clarity. The trainee can study at a real workplace, and additional AR interfaces can be made as clear as possible.
- Visualization. Thanks to additional images and the use of visual memory improves the digestibility of the material.
- Interest. Most students want to feel "like in the movies" through the use of AR glasses.

Also, in comparison with the use of VR technology, the equipment for AR is less demanding on computing resources, and the efficiency of the latter is higher.

In conclusion, an experiment was conducted. Two groups of young professionals undergoing training were organized. The first group took courses with a teacher, the second was additionally trained with the application of augmented reality. The use of such a workplace and technology has improved discipline and motivation of students, increased by almost 60% the amount of acquired knowledge of technological processes and other features of the profession compared to traditional methods.

Keywords: augmented reality, AR technology in education, industrial specialties teaching.

1 INTRODUCTION

Most of the major industrial enterprises in Russia were launched in the last century and currently have a very long history. Despite the fact that the average age of employees is about 40 years, most of the managers of workshops and departments have an age closer to the elderly. The main part of the knowledge and manufacturing experience are accumulated by these managers. In this regard, there is a problem of transferring this information to younger employees. Information accumulation is usually carried out through the formalization of existing processes, documentation and internal standards of the enterprise, making them into the information systems of the enterprise, etc. But this is only part of the solution. Younger employees must learn this knowledge and skills. And it must be done for a minimum period. In the current situation, many IT companies are ready to offer the best conditions for good

professionals, so it is not known what level of specialist will be employed and how much time he will work at the enterprise. Also the future depends on the skills of current employees.

The aim of the work is to improve the quality and speed of training in the areas of education necessary for the enterprise, as well as the formalization and transfer of experience of older generations.

At the moment, various methodological materials have been developed in different areas with the involvement of specialists of the enterprise. However, there are not only standard types. The research laboratory of the Institute of distance and additional education of Ulyanovsk state Technical University (UlSTU) develops virtual workplaces in various industrial specialties, which are based on the experience and knowledge of key employees. This already shows its advantages. However, a study by Transparency Market Research shows that augmented reality can surely be considered a real breakthrough in the educational sphere and the demand for technology will continue to grow.[1] That's why our virtual training simulator of specialty named "wiring and radio mounting" was developed using augmented reality(AR) technology.

Thus, due to collaboration with specialists of the enterprise to gain experience and knowledge, and their integration into teaching materials and applications, as well as the use of modern AR technology for training, it is planned to achieve the goals.

2 OVERVIEW OF AR APPLICATIONS FOR TRAINING IN INDUSTRY

Questions of the effectiveness of the AR implementation are very detailed in the case study "Augmented Reality Efficiency in Manufacturing Industry", the authors of which are Juha Sääski, Tapio Salon and a number of other authors. [2]

A narrower study is "Evaluating the Benefits of Augmented Reality for Task Localization in Maintenance of an Armored Personnel Carrier Turret". Its authors are employees of Columbia University Steven J. Henderson and Steven Feiner. The study will be useful for familiarizing top managers of manufacturing and industrial enterprises to decide on the effectiveness of investment in new technology. [3]

Boeing is one of the largest aerospace companies on the planet that builds aircraft for 150 countries. The onboard systems of the aircraft contain many components connected by a system of wires. Laying and connection of cables is made according to a special template, after which they are fastened into bundles, and connectors are installed on the ends of the cables. The process of work takes a long time and requires special attention and responsibility. For the last 20 years, Boeing has been looking for a system that can reduce production time and eliminate errors. In early 2014, the company introduced an augmented reality solution on the Google Glass glasses platform. With the application, the operator gives a voice command: "OK, Skylight. Start creating the harness. Scan order 0447" and sees in the augmented reality glasses a visual road map for the Assembly of the harness № 0447.

According to data from the Boeing report on the project, "the use of Google Glass has reduced production time by one quarter and reduced the number of errors by half." [4]

Methods of using AR in education have been identified for a long time ago. They are reflected in the well-known MARE methodology (Mobile Augmented Reality Education) [5]. According to the diagram MARE, to the field of AR are primarily of educational resources, the combination of which creates educational environment.

3 AR APPLICATIONS AND SPECIALIZED WORKPLACE

After passing the theoretical course in the required direction, the young specialist is given the opportunity to start work on a specially prepared real workplace. In General, the workplace R for training can be presented in the form $R=\left(O,M,T,D\right)$ where:

- O – products and assembly objects (printed circuit boards, radio elements, bundles, etc.) represented by a set of parameters;
- M – consumables (flux, solder, etc.);
- T – tools;
- D – documents and regulations establishing requirements for the operation.

Information model of workplace presented in figure 1.

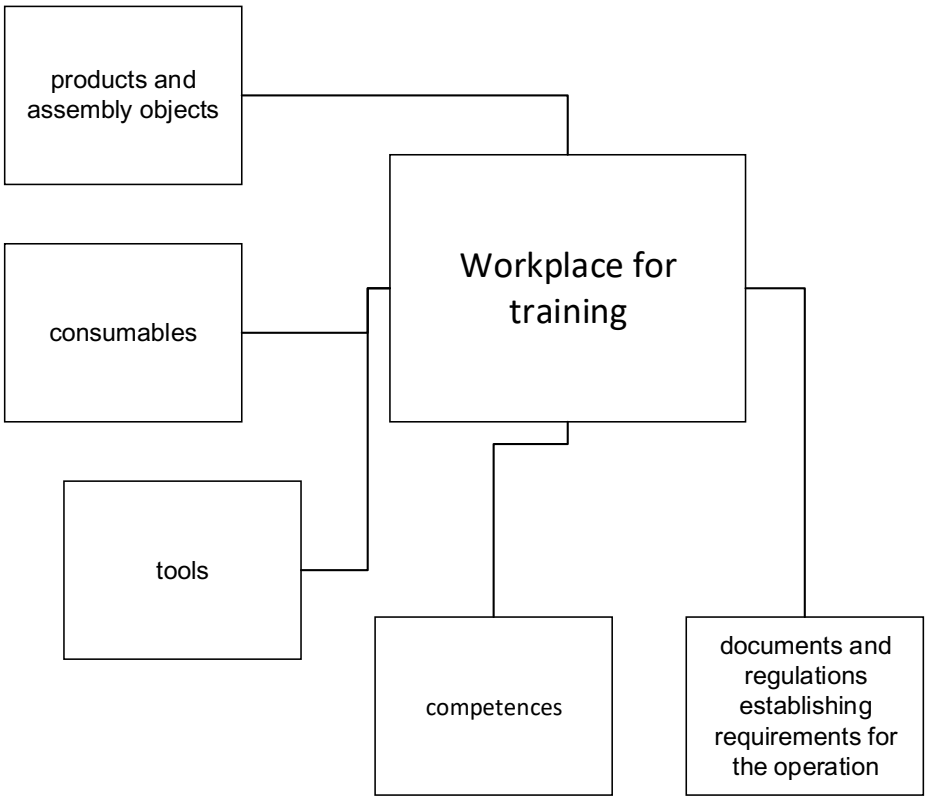

Figure 1 Information model of workplace

At the beginning, the training of working with tools and consumables is started. This is a simple step, which gives consistent tips and highlights the objects, and then can give test, the results of which the task can start again.

Next comes the training of basic operations, which are specified in the accompanying documentation. For example, this may be options for cutting wires. Trainee takes the operation of the first embodiment, with animated hints before my eyes. Most of the results can be checked for correctness using the capabilities of machine learning and artificial intelligence. But there are problems associated with the technical capabilities of augmented reality equipment and small objects. In such cases, you can use special training blanks with additional sensors.

Depending on the resulting competencies, and whether the user can work with defined objects in the assembly. Product technical process becomes available. Application has all features of process thanks to collaboration with experienced professionals.

In order to prepare the workplace to work with AR glasses, it is necessary to provide all objects with labels, with which recognition will be conducted. The example is of figure 2.

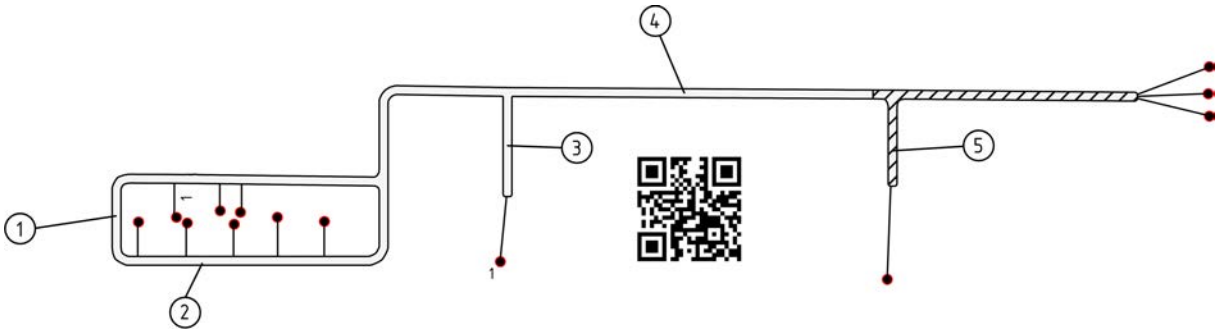

Figure 2 An example of a simple workpiece of a future template for wiring

Guided by the labels it is possible to route the wires, make the necessary tips and check certain actions.

Special AR glasses use would not hinder the learner during task performance. Despite their large selection, their technological capabilities are often lacking, and it is necessary to limit the functionality and interfaces of the application.

The undoubted advantage of using glasses is the ability to focus only on the information that is necessary to perform this work, as well as to minimize various time losses.

4 LEARNING EXPERIMENT

As a result of the application development, an experiment was conducted to assess the effectiveness of the use of technology.

Two groups of young professionals undergoing training were organized. The first group took e-courses with a teacher, the second was additionally trained with the application of augmented reality.

Practical tasks were prepared for both groups at the future workplace, covering the maximum number of necessary competencies. Everyone was given the opportunity to perform all tasks. The main evaluation criteria were the time of the task and the number of mistakes.

As a result of calculations of the data obtained, it was found that the use of such a workplace and technology allowed to increase the discipline and motivation of students of the second group, to increase by almost 60% the amount of knowledge of technological processes and other features of the profession in comparison with the first group. This is a good result that allows you to achieve your goals.

5 CONCLUSIONS

Developed a special application for one of the enterprise training areas using augmented reality technology, which increases the productivity and quality of training. This is confirmed by the results of one of the groups as a result of the experiment. And with certain changes, it is possible to increase the efficiency already in the application of technology in the workplace.

In the future, it is planned to conduct a more extensive experiment and try to cover several specialties.

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