Semi-virtual Laboratory Exercise in SMT

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Abstract – **This paper examines the methodology and results of laboratory exercise in Surface Mounting Technique using different techniques to conduct it. The exercise is conducted in the presence of students, but with application of distant and multimedia resources. Combining these tools allows detailed examination of the elements of both products and processes by several students. The methodology does not limit the direct participation of students in various tasks. The results from the application of the e-management environment are presented.**

Keywords – **multimedia, SMD, education**

I. INTRODUCTION

Surface mounting is dominant in modern electronic production. The main part of the electronic components are mounted using this technology. The mounting as a technology is described in numerous publications and monographs [1] [2] [3]. Due to the massive expansion at production, they need to adequately represent it in training and electronic fields. At the Technical University of Sofia, it is covered by a discipline named Surface Mounting Technique [4].

The use of increasingly smaller elements [5], and high density mounting is typical of today's level of development of surface mounting. This makes requirements for the systems for monitoring and control, and the operators themselves. The latter is strongly linked to the operators training approaches in dealing with different elements. They must be able to identify and classify the various defects in the assembly of the elements and the type of individual elements mounted. Miniature sizes make prerequisites for the learning approach.

II. THE PLAN OF THE EXERCISE

In SMT, there are three main groups of processes. The first is the application of a soldering paste, the second is the placement of the elements and the third is the soldering itself. However, students should know the auxiliary activities related to the choice of material, components, substrate, optimal topological design, programming of the machines, etc. In this respect the study of SMT should cover several topics including relevant laboratory exercises.

Laboratory exercises in the classical case are associated with measuring parameters, running calculations and in some cases carrying out experimental processes. The latter are combined with the provision of adequate work places and resources. The resource is the availability of the technological environment, equipment and supplies (parts, materials, energy).

In connection with the above a planning of the exercise is carried out. It should cover topics and tasks for implementation, preparation of relevant work places, number of students working on a task. The situation gets complicated when the topic of an exercise is associated with a specific lecture and the aim is to have the same exercise topic for everyone.

One possible approach to solve the problem of work places for all students on the same topic is the creation of virtual workbenches by means of multimedia. But in that case one loses the connection between the real object and the student.

Given the above the following structure for conducting the exercise as combining work with real objects and processes and use of virtual environments and multimedia resources was proposed. The exercise covers:

- Understanding the basic elements of the topic by means of animation and multimedia. Such a solution allows to demonstrate objects with tiny (micron) sizes, which cannot be observed directly;
- Individual examination of the objects through animation;
- Observation of a specific object by using electronic means, and multiplexing of the image. The work is carried out in real time with real objects;
- Processing the results of object's observation;
- Doing a research on the topic using the Internet. Archiving the results of the general research.
- Submission of an electronic report in the e-management environment.

• III. A SAMPLE PERFORMANCE

A stage of the first phase of the exercise, namely the use of multimedia and animation is shown in Fig.1. In this example the presentation of surface mount resistors is shown.

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Fig. 1. Animation module for the demonstration of surface mount components: Part I - resistors.

Upon completion of this stage, each student gets access to the animation related to the topic of the exercise and opportunity for individual observation. The work places for animation observation - in this case the animation is related to soldering defects - are shown in Fig. 2.

Fig. 2. Getting acquainted with the exercise.

The third part of the laboratory exercise is related to the usage of a digital camera for monitoring a process or an object. The images are multiplied on each monitor. For example an image may be from a camera mounted on the machine for placement of elements, or the process control camera.

Fig. 3 presents the results of implementing the next phase - image processing. This stage may involve different tasks depending on the specifics of the topic. In this case, determining the sizes of objects, their repeatability and matching with catalogue data.

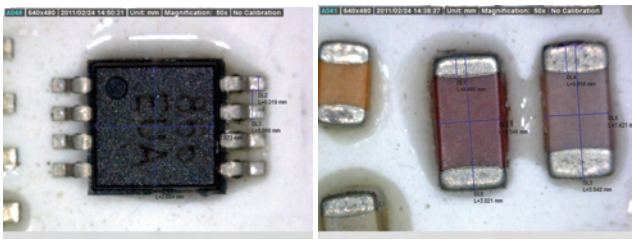

Fig. 3. Measuring the parameters of SM devices.

Then students perform research on the topic using the Internet and record the data in the e-management environment. There they prepared their electronic reports. A screenshot of such electronic report is shown in Fig. 4.

Fig. 4. Review of an electronic report in the e-management environment.

IV. Conclusion

The plan and results of conducting a laboratory exercise in Surface Mounting Technique at the Faculty of Electronic Technologies, the Technical University of Sofia had been reviewed in this paper. Multimedia and animation were implemented during the carrying out of the laboratory exercises, but it would not be correct to classify it virtual because it includes elements of real processes and objects. Typical electronic means, which are used in industrial process control are applied. The specific part is that the images are being multiplied on several work places, allowing normal operation of more students. In this sense, the term semi-virtual exercise is introduced, which means it is not purely virtual because students attend it and at the same time they make a review of real objects by virtual means.

Students' opinion regarding the introduction of this type of exercise is very positive. The submitted electronic reports showed better understanding and presentation of the results.

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