DISTANCE MECHATRONIC LABORATORY FOR SMEs UNIVERSITIES and VOCATIONAL HIGH SCHOOLS IN TURKEY

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Abstract— **The term of mechatronic technology includes mechanical, electronic and software technology. Students need experience in order to learn mechatronic technology. Therefore, to increase experience of students and awareness of the mechatronic technology, distance (virtual) laboratory was set up at Tunceli University in Turkey. MECFUTURE project (Mechatronic consciousness for SME's and Vocational High Schools in Turkey), which is a Leonardo Da Vinci Transfer of Innovation project, is aimed to set up distance mechatronic laboratory. This project consists of 11 partners from 5 different countries. Preparing SWOT Analysis report for mechatronic education, controlling four mechatronic devices from distance laboratory by means of the Internet and preparing books for mechatronic education is done within the concept of the project.**

Keywords; remote control, distance laboratory, mechatronic education.

I. INTRODUCTION

Mechatronic term has been used since 1970 in the world, but in Turkey it was introduced around 2000's thanks to enterprises of some universities. Mechatronics term examines the close combination of electro-mechanical systems, electronics and information technology [1, 2]. Mechatronic systems consist of mechanical parts, actuators, sensors, controllers, hardware, and software technology [3, 4].

SMEs, vocational high schools are still not familiar to the mechatronics term in Turkey. Although development in the technology, enterprises still continue to use traditional production techniques especially in small cities like Tunceli in Turkey. Education of white-blue workers of these enterprises in mechatronics field shall result it an increase in the mechatronics consciousness. SMEs can follow the world standard in their fields. Moreover, vocational high schools and university students who study in small cities, have very little internship facilities because of having lack of SMEs. By increasing mechatronics applications in those places, students can have a chance to follow the development in the field of mechatronics. Hence, they can follow their predecessors in the world.

Practicing mechatronics education normally needs a huge laboratory and budget. Distance laboratory provides an opportunity to access the mechatronics laboratory kits for vocational high school and university students. The aim of the project is to prepare distance learning platforms, home kits, textbook and hands on lab exercises for home application.

This project was transferred from the Tallinn university of Technology (Estonia) to Tunceli University (Turkey). Original project was applied in different countries and results of these applications are positive. MECFUTURE project consist of 11 partners from different countries, Turkey, Finland, Estonia, Germany, and Lithuania, and also from different sectors, SMEs, universities, vocational high schools come together and to transfer the their experience to partners [5]. A huge network was established between companies, SMEs, universities and vocational high schools. In order to provide new opportunities for improving vocational competencies of students and employees at Tunceli.

The remainder of this paper is structured as follows "In Section 2 Swot analysis mechatronics education with distance laboratory in Turkey, in Section 3 application of distance laboratory at Tunceli University, in section 4 conclusion part of MECFUTURE project is presented.

II. SWOT ANALYSIS

SWOT analysis report, which includes mechatronics education with distance laboratory in Turkey, is prepared by Tunceli University. The survey and analyses are based on Turkish vocational schools, university of applied sciences and SMEs.

A. *Strong Sides of the Mechatronics Education by means of "Distance lab." in Turkey*

- "Distance lab." has a big potential to distribute knowledge via easy access from anywhere in Turkey.

- Students are able to follow the new technology.

- Students are able to make many projects independently.

- Students gain design experiences.

- "Distance lab" gives access opportunities to large number of people than conventional education materials and methods.

- "Distance lab" provides practicing opportunities for students.

- Turkey has young and cheap work power capacity. By using this capacity, Turkey has a potential to become economic power of EU and Middle East region in the near future. To achieve this aim, a successful mechatronics education will play a critical role.

- Weak sides of mechatronics education can be covered by "Distance laboratory".

B. Weak Sides of the Mechatronics Education in Turkey

- Main problem is that Academicians and administrative staff of Universities have no experience to set up a well-developed Mechatronics curricula and competency of academic staff.

- Current curricula have been adapted from USA and EU universities.

- Insufficient number of academic staff on Mechatronics makes development slow in this field.

- Infrastructure deficiency on Mechatronics education.

- Insufficient education material and education program on mechatronics.

- Currently working staff in industry requires an education on mechatronics.

C. Opportunity Sides of the Mechatronics Education with "Distance lab" in Turkey

- If a bridge can be established between Government, Industry and University, Mechatronics education will have a big chance to be successful in a short time.

- New working areas will be developed.

- New production areas will be developed in the mechatronics industry in Turkey.

- "Distance lab" provides new opportunities as a modern education model.

- Mechatronics based production in Turkey may provide new market areas on international level.

- "Distance lab" may help to change the structure which is based on theory and school in Turkey.

- As an educational model, "Distance lab" studies has a rapid distribution all education levels.

D. Threat Sides of the Mechatronics Education and "Distance lab" in Turkey

- Possibilities not to establish sufficient corporation between disciplines related to mechatronics topics.

- Possibilities not to establish sufficient bridge between Government, Industry and University in the Mechatronics education.

- If we do not proceed quickly, equipments in the "Distance lab" may become unfashionable in the near future. This is inevitable occasion, especially related to subjects on computer sciences.

III.   DISTANCE LAB

Distance laboratory consists of basic mechatronics kits, lifting mechanisms robot arms, and mobile robots. Establishing this laboratory aims to give chance to the students to have enough abilities for the main needs of the mechatronics education.

The website is adjusted with a web camera and server which communicates with the robots. Server has a master communication unit which can get in contact with any robot İn the network and reprogram it at any time when needed. The site server is connected to the portal server which passes and validates the communication between the robot and user input.

The distance laboratory offers a great opportunity for mechatronic stuff in Turkey. If anybody interested or aiming to develop themselves in mechatronic subjects can access to distance lab from anywhere in Turkey or around the world.

There are two steps for accessing the distance laboratory from away. First, users login to the MECFUTURE website and choose to appropriate date and time in order to use the modules from the website as shown in Fig 1. and Fig 2. This is called reservation system.
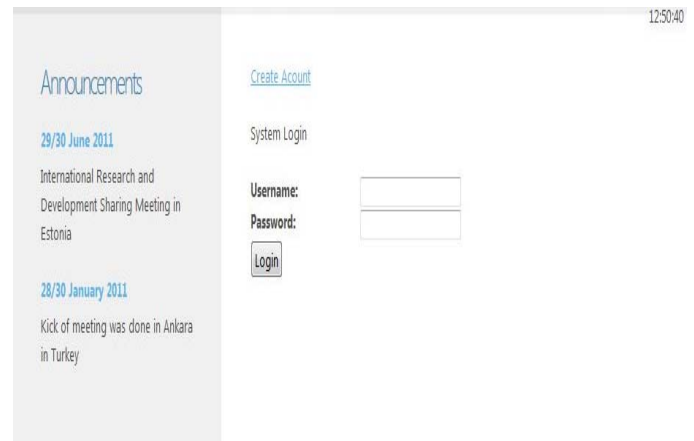

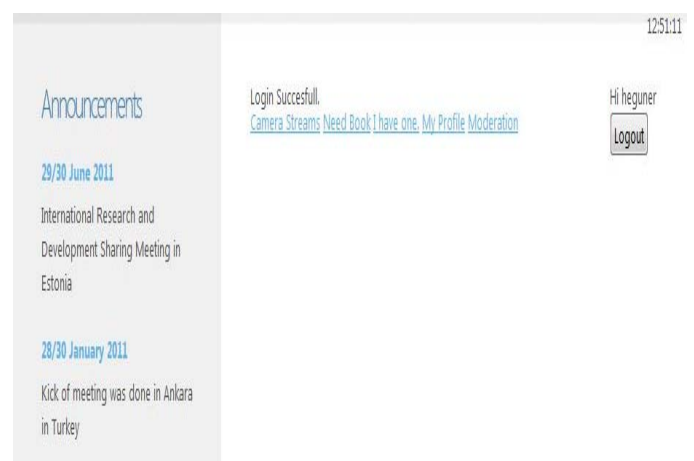Figure 1.   MECFUTURE login page.

Figure 2.   MECFUTURE access page.

In this step, users can easily write and install their programs or install example codes to the system remotely as shown in Fig. 3. Thus, users' activity can be increased.
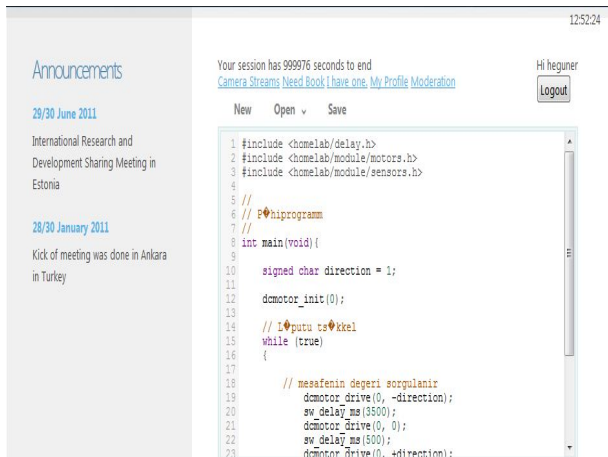

Figure 3.   Program codes.

A. Lifting Mechanism:

Lifting Mechanism consists of a dc motor, read relay, proximity sensor and AtMega 2561 microprocessor as shown in Fig. 4 [6]. Students can control lifting mechanism remotely. Using this module, they can practice lots of mechatronic examples. For instance, they can control the speed of dc motor by using PWM (Pulse Width Modulation) and thus speed of the lifting mechanism can be adjusted. Moreover, they can read and control proximity sensors. Therefore, lifting mechanism is stopped at the desired flat.
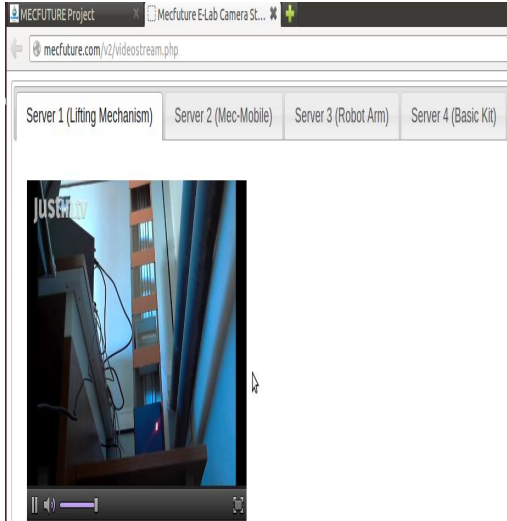

Figure 4.   Lifting mechanism.

B. Robotic Arm

This mechatronic mechanism consists of 4 servo motors as shown in Fig.5. Users can gain enough experience on the control of servomotors by using microcontrollers. Servo motors can be controlled using the PWM signals. They can observe and control this mechanism as well. The robotic arms can be used to take and transfer the objects from a place to another place.
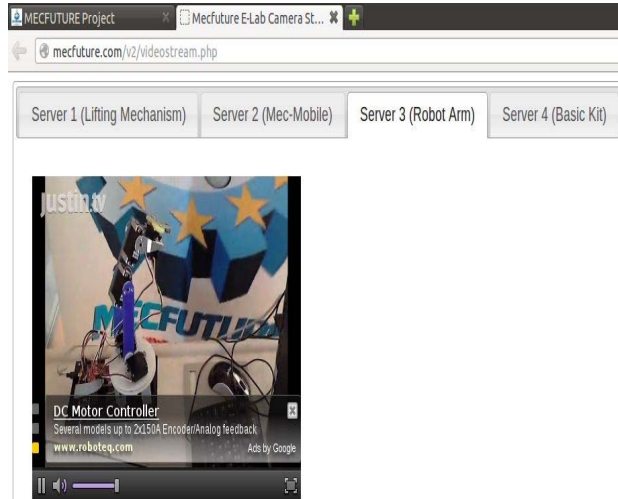

Figure 5.   Robotic Arm.

C. Basic mechatronic Kit

This is an elementary kit, which is used for introducing the concept of mechatronics to the students. This kit consists of 7 segment, graphic LCD, buttons and buzzer as shown in Fig 6.
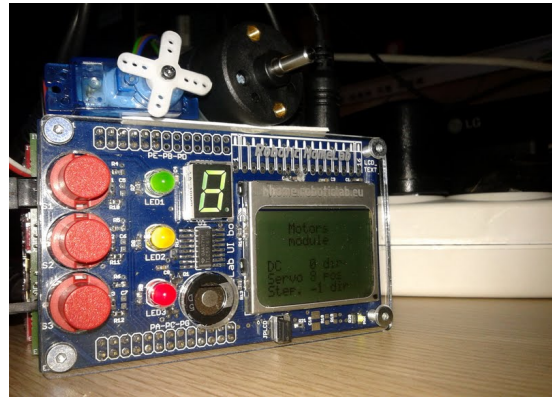

Figure 6.   Basic mechatronics kits.

The Internet communication panel is shown in Fig. 7. Students make an experiment using distance laboratory. They can make practice with Mecfuture home laboratory book.
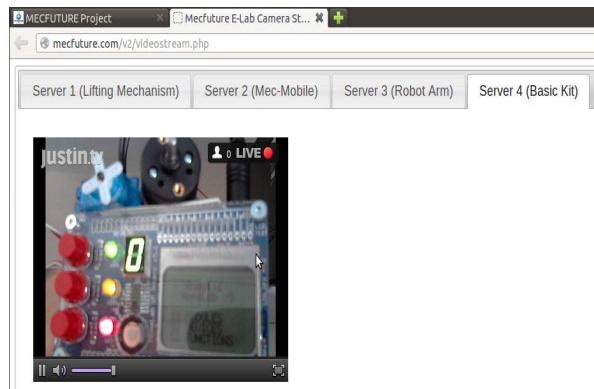

Figure 7.   Basic mechatronics kits control using distance lab.

D. Books And Laboratory Manuals

"MECFUTURE" book that covers 10 modules is prepared by the project partners as shown in Fig. 8. MECFUTURE book consist of the reports for the modules of mechatronics education and home laboratory examples.

Figure 8.   MECFUTURE book

E. Pilot education system

A six week pilot application course was arranged in Tunceli University. This course consists of basic principles of the mechatronics education and design. Students learn how to use basic electronic equipment (such as multimeter, oscilloscope, signal generator) and make laboratory experimentation using Mecfuture laboratory book. Students can learn how to program microprocessor and control of the mobile robots, robotic arm and two legged robotic mechanism in the laboratory. Moreover, teachers gave home assignments for each student. Students can access Mecfuture website and choose an appropriate time and date for making their homework. Teachers can evaluate the homework results using the instructor page of the Mecfuture web system. This system gives the login time and program codes of the each students.

Students who finished the course successfully get a certificate from Tunceli University. Then, questionnaires were prepared in the end of the course. According to the feedbacks of the student and instructors, students learning time is decreased and lectures passes effectively.

The distance laboratory applications and Mecfuture books will be used introduction to programming of microcontrollers course in Tunceli University. This lecture will be done 2015 spring semester.

CONCLUSION

Distance Laboratory is set up with in the scope of the MECFUTURE project at Tunceli University funded by EU Leonardo Da Vinci Life Long Learning Program. This project creates new opportunities to follow new technologies for SMEs, vocational high schools and universities. Finally, Mechatronic consciousness shall be increased by the help of this project.

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