Control Systems Immersion Program for High-School Students, Benghazi, Libya

IEEE Control System Society Outreach Fund

Final Report

1- Introduction

Libya has been going through so many unrests and tribulations in the last decades. This small North African country, population 6.5 million, is now looking to the future with fresh prospective. There is a strong realization that education, especially in the areas of Science, Technology, Engineering and Math (STEM), is key to the many problems the country is facing. This makes sense in view of the fact that more than %33 of the country's population is under the age of 24, according to UN data (2015). On the other hand, it is increasingly obvious that there is a huge appetite by the country's youth to get exposed to the latest trends and technical tools related to STEM subjects. Certainly, the prevalence of the internet and open information sources have helped in closing the gap of knowledge. However, there is still a strong need for real-life, project-based learning opportunities and face-to-face interactions with experts in various fields. This outreach proposal aims to help in filling this gap.

Control systems engineering has been a core subject of study in most of the Libyan universities. Recently, many of the country's leading universities, such as the University of Benghazi and the University of Tripoli, have adopted control systems as one of the main areas of specialties in a number of their engineering departments. The growing interest in control can also be seen in the increasing number of graduate projects and degrees related to this field. This has led to an increasing number of relevant research publications. This growing interest, although admirable, is still not on par with what one can see in the neighboring countries such as Egypt, Tunisia and Morocco. And this is definitely not reflective of the potential of the country's research community in this field. This observation is one of the motivating factors of this outreach proposal. The objective is to raise the interest in control systems among high-school and university-level students.

Thanks to the generous grant provided by the IEEE Control Systems Outreach Fund, a team of Libyan educators and engineers organized a control systems immersion program that is targeted to high-school students in the city of Benghazi, the second-largest city in Libya. The program is a result of collaboration between the Electrical and Electronic Engineering Department, University of Benghazi, Libya, and the Division of Engineering, Marshall University, USA

2- Project Description

The immersion program was centered on the utilization of an education kit provided by the LEGO company, called LEGO MINDSTORMS® Education EV3 robotics, shown in Fig. 1. This tool was used to demonstrate the basic concepts of control systems. More specifically, a number of these kits were used to demonstrate how to design and implement different control systems to achieve different tasks. Students learned how to design a controller so that it can receive a signal from a sensor and, accordingly, generate a signal to an actuator to make a robotic toy accomplish a task.

Fig. 1 LEGO MINDSTORMS® Education EV3 Core Set.

The program was held in the period of 07/15/2019-07/23/2019. It was divided into two parts. The first part included a workshop focused on university-level students and the second part was geared towards high-school students. A detailed description of the project activities is listed below:

2.1 A Control Systems Workshop at the Electrical and Electronic Engineering Department, University of Benghazi, Libya, 15, 17 July, 2019

An outreach activity at the Electrical and Electronic Engineering Department, University of Benghazi, Benghazi, Libya, was organized prior to the proposed high-school immersion program. The targeted audience is undergraduate and graduate engineering students and faculty at the University of Benghazi. In this activity, there were a number of presentations about control systems engineering and an advertisement about the immersion program. In addition, a hands-on workshop was organized for a selected group of undergraduate students. This activity served as a final preparation for the immersion program, and provided a chance to recruit a number of students to help organize the program. In total, there were 2 undergraduate students and 8 graduate students in attendance for this activity.

2.2 A Control Systems Immersion Program for High-School Students, 22-23 July, 2019

After reaching out to local high schools, 12 students were selected from 5 different schools. The selection criteria were based on merit. The organizers of the program were forced to limit the number of participants because of limited space and the limited number of kits. Nonetheless, this

event is, hopefully, going to be a first of many similar workshops that will be organized in the future, giving the chance for wider participation.

The description of the two-day program is as follows:

Day 1

A full day was organized that included presentations about:

1. An overview of the workshop.
2. An introductory presentation on the field of control systems that includes a background history and explanation of open and closed-loop feedback.
3. Applications of Control systems.
4. Control Systems Careers.

Day 2

In the second day, students were engaged in a cross-curricular, hands-on learning environment using LEGO MINDSTORMS® Education EV3 robotics. Through a couple of projects students designed, built, programed, and tested robots to do a variety of tasks. The experiments were chosen to be:

Experiment No.1: Introduction to programming using Lego® Mindstorm® Education EV3
Objective: Learning the Basics

Experiment No.2: Creating & Controlling Your Robot
Objectives:

1- Building an Ultrasonic Driving Base Robot.
2- Object Detection and Avoidance.

Students learned to control motors and collect data using a variety of sensors and log the results of experiments. The instruction of the educational set included open-ended problem-solving activities designed to make learning control systems through real-life robotics engaging and fun. The main focus of these exercises was to get the students exposed to the concepts of open- and closed-loop systems. In addition, students were introduced to the different components of a control system, namely, the plant, the actuator and the sensor and the controller and how they can work in tandem to make the system accomplish a desired task.

Various pictures of the program activites are included in Appendix A.

Finally, by the end of the program, students were given certificates of attendance. Overall, students were motivated to learn more about control systems engineering. They were also encouraged to get involved with IEEE in general and the Control Systems Society in particular. Student testimonies are included in Appendix B.

All the organizers of this program worked on a volunteering basis. The total cost of the project was $11,637, which was used to pay for the Lego kits and shipping to Libya.

3- The Team

Project Lead

Almuatazbellah M. Boker, Ph.D.
Assistant Professor
Bradley Department of Eletrical and Computer Engineering
Virginia Tech

University of Benghazi Team

Abdelhamid Alhassi, Ph.D
Dean, College of Engineering

Zakreia Rajab
Chair, Department of Electrical and Electronic Engineering

Ibrahim Ighneiwa, Ph.D.
Professor, Graduate Studies Coordinator
Department of Electrical and Electronic Engineering

Asma Mohamed Najem Alfergani
Assistant Lecturer, Department of Electrical and Electronic Engineering

Mawia Mohamed Elgazzar
Graduate Student, Department of Electrical and Electronic Engineering

Names of Participants

Undergraduate Students

1- Osama Gseibat
2- Rima Mosbah Mukhtar

Graduate Students

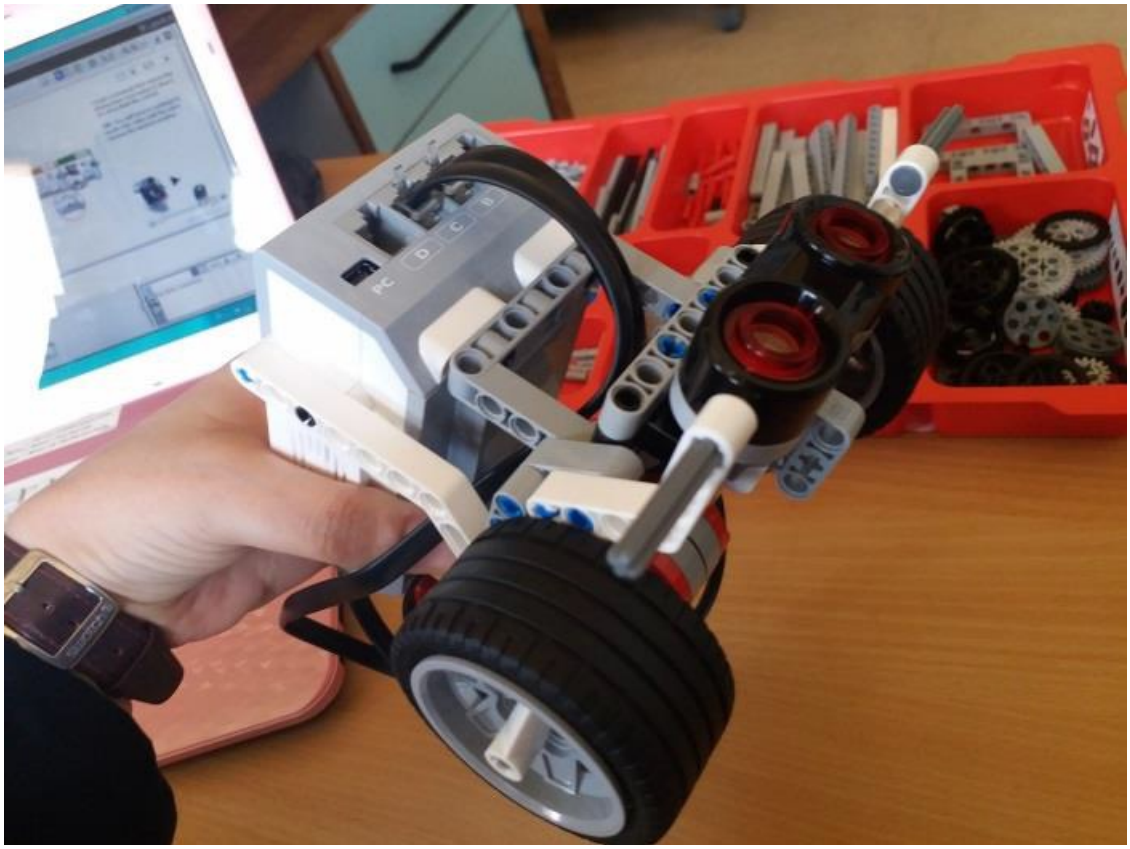
1- Seham. A. Abdella El-fakhri
2- Israa Masoud Mohamed Elhaddad
3- Shoroug.A.Mohamed Al.Weheshi
4- Aya Abdelgader Abdeljleel
5- Mohammed Yousuf Alkizzah
6- Bana Shamsaldin Abdallah
7- Akram Salem Ali Ihwedi
8- Munay mohammed mousay Aljeagdaf

High-School Students

1- Dalal Suliman Alwerflli
2- Assel Abudalnasir Albadre
3- Sofian Ayman Ezzat
4- Ali Omran Alagouri

5- Ahmed Saleh Behah
6- Abdelaziz Mangosh
7- Salem Alamami
8- Sufyan Ramadan
9- Laila Mohammed
10- Ola Wesam Mustafa
11- Taqwa Mailud Alfurjanee
12- Haneen Mohammed Aloriby

Appendix A: Pictures




EV3

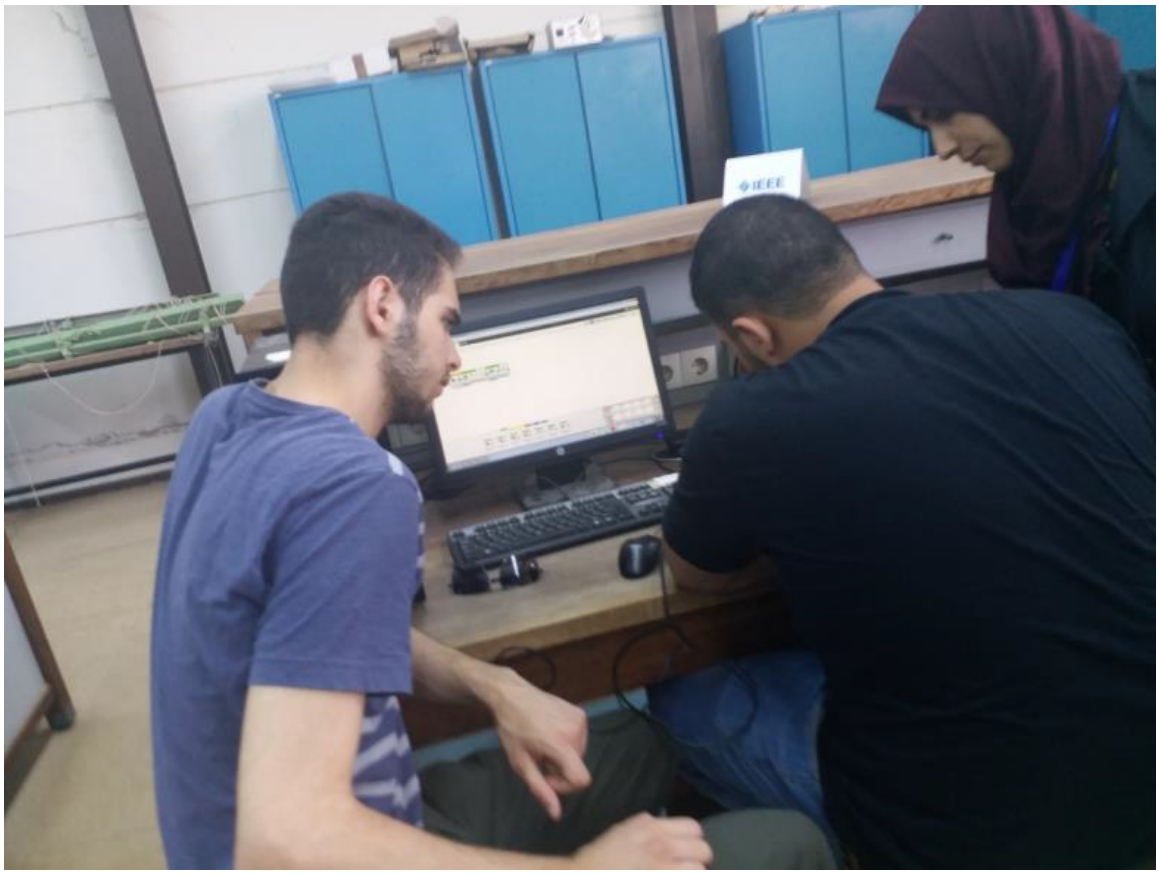

IEEE


IEEE


IEEE
INDUSTRY TRENDS
IEEE


IEEE
IEEE
Control Systems Immersion Program for High-School Students 2019
IEEE Control Systems Society
Ms. Asma Alfergani
University of Benghazi
Trainer
Trainer
Trainer


IEEEDAY


IEEE

Link to some video clips
https://mega.nz/#F!1AcjgIpR!fXEUFtM0NZmdTzojXmrW9A

Appendix B: Student Testimonies

Sofian Ayman Ezzat (high-school student)

This is was a fun and exciting experience for me. This is because it was both theoretical and hands-on. The organizers were so helpful. I would like to thank IEEE Control Systems Society for this opportunity. I appreciate this experience because it is not typical in our country. It gives me hope of what is to come.

The program was for two days, with 6 hours per day. It was well organized. I thank IEEE once again for paying attention to our age group.

Osama Gseibat (undergraduate student)

It was a nice experience and fun, and I hope to repeat it again. I thank IEEE for their good cooperation with Benghazi University and I hope this cooperation will continue.

Rima mosbah mukhtar (undergraduate student)

It was a nice experience. I learned how to build and program the controller. I would like to thank IEEE for supporting our country and I look forward to learning more about control systems engineering.

Seham A. Abdella El-fakhri (graduate student)

It was a fun and beneficial experience. I wish there is more like this activity in the future.