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**LEARNING BASIC MECHATRONICS THROUGH HELICOPTER WORKSHOP**

**Adzly Anuar<sup>†</sup>**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Maryam Huda Ahmad Phesal**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Azrul Abidin Zakaria**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Goh Chin Hock**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Sivadass Thiruchelvam**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Dickson Neoh Tze How**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Muhammad Fahmi Abdul Ghani**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**Khairul Salleh Mohamed Sahari**

*Centre for Advanced Mechatronics and Robotics College of Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, Kajang, Selangor, Malaysia*

**ABSTRACT**

*In recent years, technologies related to mechatronics and robotics is available even to elementary level students. It is now common to see schools in Malaysia using Lego Mindstorm as a tool for active learning on mechatronics and robotics. A new yet interesting way of learning mechatronics and robotics is introduced by Dr. Dan Barry, a former astronaut and his son Andrew Barry during*

<sup>†</sup> Corresponding author

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*their visit to Malaysia. The kits used are based on a 4-channel RC helicopter, Arduino Uno microcontroller, IR transmitter and a PC or laptop. This paper discusses the techniques used and the feedback gathered from the participants of the workshop.*

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**Keywords:** RC helicopter, Microcontroller, Arduino, Mechatronics, Active learning, Critical thinking.

## 1. INTRODUCTION

On the 29th of October 2012, University Tenaga Nasional (UNITEN), with cooperation of Malaysian Industry-Government Group for High Technology (MIGHT), has organized an innovative workshop involving microcontrollers.

The aim of the workshop is to expose participants to the endless possibilities of microcontrollers in the world of rapid technology advancement. In fulfilling the purpose of the workshop, a simple microcontroller platform known as the Arduino microcontroller had been adopted by the organizers. Arduino microcontroller is an open source platform that enables participants to unleash their full potential of innovation and creativity in utilizing the controller. Apart from that, Arduino boards have been widely used by various end users ranging from professional designers, student to a total amateur in microcontrollers. The workshop was conducted by Dr. Dan Barry, a former NASA astronaut and his son Andrew Barry.

Hands-on workshop is always a good platform to learn about mechatronics and robotics. (Gurocak *et al.*, 2005), (Igel *et al.*, 2011), (Morris *et al.*, 2011), (Saygin *et al.*, 2012) and (Wang *et al.*, 2007) have all reported the success of using hands-on robotics workshop as a platform for active learning on mechatronics and robotics. It is expected that the helicopter workshop would be able to give similar impact to the participants.

## 2. HELICOPTER WORKSHOP

The workshop session begins with opening briefing by Dr. Dan Barry. Dr Barry introduced the purpose of the workshop and gave some insights on the usage of microcontrollers and how by manipulating the Arduino board via intelligent programming can the participants hack into electronic toys or gadget.

During the briefing session, he first demonstrated on how the microcontroller works and did some simple light emitting diode (LED) blinking programming as a start. Moving on from there, the workshop also covers on using additional electronics hardware to cater for various needs in different projects. For an instance, the same LED blinking program can be used to run a computer fan in the same manner provided a MOSFET is used in between as an amplifier.

The simple yet informative demonstration by Dr. Barry proved to work when the participants themselves get a chance to experience and observe first hand on the outcome.

The participants of the workshop ranged from primary school students, secondary school students to final year university undergraduates. In accommodating to all of different level of audience, they are all divided evenly into groups such that one group consists of participants from different knowledge background and age. As participants get along each other through cooperative learning

within a group, Dr. Barry had personally visited and supervised every group on the hands-on experiment that were designed to encourage out-of-the-box critical thinking. The ultimate hands-on experience that was brought along through the workshop was participants learn to hack into the communication protocols of a commercial helicopter product using the Arduino board. This also demonstrates and opens up the idea of what a clever manipulation of a microcontroller board is capable of doing. Participants were given a set of commercial helicopter product (S107G) by Syma Toys. The first session of the workshop involves each participant to fly the helicopter using the original remote control packaged together with the helicopters. Once everyone had grasped the concept of flying the copters, in the second session, participants were guided on how to construct the hardware to emulate the controller signal. Next, by programming the Arduino board, the constructed hardware is used to take over the original remote control. Now, instead of flying using the original remote, the copter can now be flown using an Arduino and a computer. Participants were excited by the fun of flying the copters through the hacking of the communication protocols. Dr. Barry noted that by acquiring knowledge the fun way, it is hoped that students can retain more of the substance that is learnt. Furthermore, by practicing out the theories learnt in classrooms, students can appreciate more of what that is learnt from the textbooks. The workshop ended with a prize giving ceremony and a photo shoot session with Dr. Barry. Figures 1 to 3 show some scenes during the workshop.

**Figure-1.** Scenes during the workshop briefing



**Figure-2.** Scenes during the hands-on session



**Figure-3.** Scenes during the competition and prize and certificate presentation



### 3. SURVEY

A survey was given to the participants at the end of the workshop. A total of 35 responses were collected. Ten questions were asked in the questionnaire (1=strongly disagree; 5=strongly agree). The overall response is as shown in Table 1. It can be seen that most of the participants gave a positive feedback for this workshop.

83% of the participants strongly agreed that the overall quality of the workshop was excellent. More than 91% would recommend this workshop to others. It can be seen that for all questions, most of the participants would agree or strongly agree with the questions asked.

**Table-1.** Overall response from participants

		1	2	3	4	5	Total
1	The overall quality of the workshop excellent	0	0	0	6	29	35
2	This workshop has given you new viewpoints and insights	0	0	1	7	27	35
3	The workshop activities simulated my learning	0	0	0	7	28	35
4	The difficulty of this workshop was appropriate	0	0	0	15	20	35
5	I accomplished the objectives of this workshop	0	0	1	12	22	35
6	I will be able to use what I learned in this workshop	0	0	2	8	25	35
7	The length of this workshop was appropriate	0	0	1	8	26	35
8	The workshop is very useful and effective	0	0	1	4	30	35
9	This workshop should be repeated	0	0	1	7	27	35
10	I would like to recommend this workshop to others	0	0	0	3	32	35

The relatively lower response was obtained for question four, which asked on the difficulty of the workshop. It could be due to the mixture of the participant, where some of them came from secondary school. They might not have prior exposure to electronics and programming and felt that the workshop is relatively difficult. Other than this, Table 2 shows some of the comments obtained regarding the workshop.

**Table-2.** Other comments from participants

<b>What did you like most about the workshop?</b>	
1	Programming the helicopter
2	The code that makes the helicopter move automatically
3	Control the helicopter with computer instead of using the remote control
4	Team work
5	It makes me more confident
6	Great stuffs are taught
7	Lots of new things that I could not get anywhere else
8	It is exciting to learn with Dr. Dan Barry and Andrew

#### **4. CONCLUSION**

The helicopter workshop was successfully organized. Dr. Dan Barry and Andrew Barry were excellent in conducting the workshop. The approach and pace of the workshop was good for beginners. The technical aspect was delivered in a simple and easy to understand manner where most of the participants are able to grasp the basic concept even though they have never built a circuit or program a microcontroller before. The overall feedback from participants was very positive. Most of them would recommend this workshop to other people.

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