SRobot Project

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SROBOT – The answer for STEM & Engineering education in Vietnamese High schools

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Acknowledgement

Abstract

The Vietnamese education system has been continuously improved for the last decades. However, due to the heavy theory-based, the students are losing their study interest and encountering career insecurity. Understanding the linkage between theoretical and practical training, in 2012, Saigon Institute of Technology (SaigonTech) introduced the first SRobot contest. The purpose is to create a programming playground for high school students and to nurture their interest in the field of Information Technology (IT). With the efforts to tackle the technical and organizational problems, SaigonTech's SRobot contest has achieved great success thanks to the governmental support from the Ho Chi Minh Youth Union and Ho Chi Minh City, Department of Education and Training (DOET) and from the student contestants. SaigonTech looks forward to building SRobot into a prestigious place for engineering education that is nationally and internationally acknowledged. We aim at improving students' interest in technology and career development security.

SROBOT – The answer for STEM & Engineering education in Vietnamese High schools

Literature Review

The term Information Technology (IT) first appeared in between 3000B.C. and 1450A.D. The tools and methods during that time were "simple picture drawings known as petroglyths which were usually carved in rock" ("History Of Information Technology", n.d.). However, the IT that actually affects mankind today has been developed since the age of electro-mechanics. Since then, the IT has been evaluating with the birth of World Wide Web by Tim-Berners Lee in 1989, Cloud computing, Big data and Internet of Things. Furthermore, IT is no longer a segregate field, but now often being incorporated into other fields such as agriculture, health, education, human resources and environmental management, or transport and business development (Mansell & Wehn, 1998). Therefore, to provide the enormous needs for human resources in this field, education is vital. However, Selingo (2017) showed that more and more students choose to study business majors over engineering majors these days, believing that business majors promise more post-graduation job opportunities. There are many reasons for this concept, which vary from countries to countries. This article, contemplating all of those issues, focuses on the engineering and technology education in Vietnam.

In Vietnam, Information Technology (IT) has been a trendy field for at least ten years. It is estimated that the compound annual growth rate in the 2011-2015 period was 16% (Massmann, 2015). For that reason, IT has received lot of encouragement from the government. Massmann (2015) also showed that in 2010, the Vietnamese Prime Minister mandated the Decision No. 1755/QD-TTg for the national strategy of "transforming Vietnam into an advanced Information and Communications Technology (ICT) country". As a result, the IT education and

training in Vietnam have received much attention from both governmental and private organizations. For example, in Decree No. 55/2008/CT-BGDĐT, the Ministry of Education and Training (MOET) emphasized the need for developing the education and human resources in IT field ("Chỉ thị về tăng cường giảng dạy", 2008). However, the lack of skilled and experienced IT engineers is our obstacle. According to Ministry of Information and Communication (MIC) and MOET, approximately 290 universities and colleges in Vietnam are offering IT training. However, a survey by the National Institute of Information and Communications (NIIC) showed that 70% of graduates in IT needed to be retrained, 72% lacked experience, and 42% showed poor teamwork (Massmann, 2015). These figures indicate the heavily theoretical Vietnamese education system. In contrast, there are not many contests or playgrounds for students to apply the theory to real life as well as developing the soft skills such as public speaking, team working, or communication skills, which engineers mostly need. Not until 2002 was there an international contest named Robocon to invigorate the interest in robot design for teenagers in Asia; nevertheless, this contest focused mainly on college and university students rather than on high school students. Fortunately, in 2012 the SRobot contest was introduced to this promising segment besides the original higher education students.

The SRobot Program

In 2003, The Saigon Institute of Technology (SaigonTech) in the Quang Trung Software Park (QTSC) in Ho Chi Minh City of Vietnam, entered a partnership agreement with Houston Community College (HCC) to jointly offer courses to HCC credits that will be implemented to the Associate in Applied Science (AAS) degrees in Computer Science Technology and Computer & Information Science Technology. Our mission is to combine education and training; research and development; and engineering services to effectively contribute to the continuing IT

and Bachelor's expansion in Vietnam. Besides providing the education for undergraduates, SaigonTech also realized the importance of guiding high school students in career development. In 2012, the first SRobot contest was established to create a computer-programming playground for high school students and nurture their interest in IT. SaigonTech decided to incorporate Lego Mindstorms into the contest where students do not have to worry much about the hardware, but focus on the programming aspect. The SRobot has three main purposes:

- To develop an effective collaborative environment for teaching/studying programming.

- To encourage students' experimentation and exploration.

- To increase students' interest and engagement in programming courses.

The SRobot contest can be divided into two main periods: 2012-2015 and 2016-2018. The main changes are in the changing of technology to reduce the expenses for candidates, the cutting edge, and the availability of equipment.

No	Year	Application	API
1	2012	SRobot	- Pascal - Java
2	2013		
3	2014		
4	2015		
5	2016	SArduino	Pascal
6	2017		

Table 1: Integrated Development Environment (IDE)

and programming language development
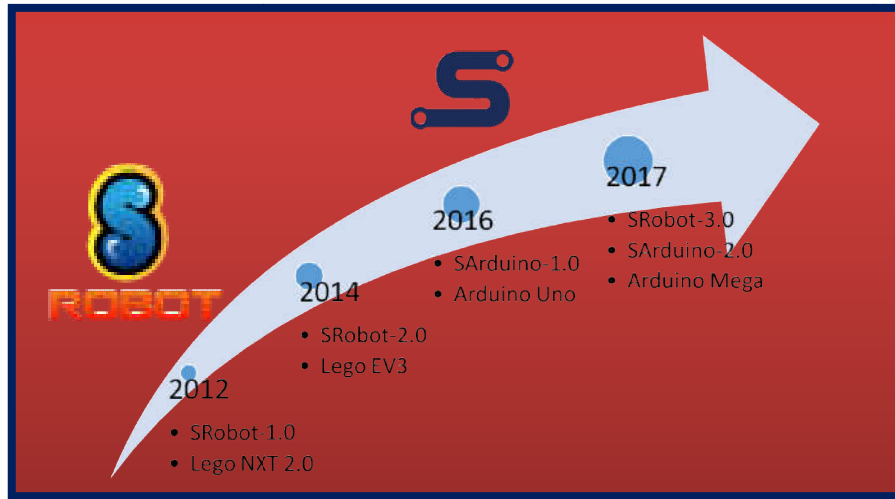
Figure 1: SRobot hardware and software development

Below are the difficulties in both hardware and software matters that we encountered:

Hardware. Before SRobot, there was no robot contest for high school students. In addition, Lego Mindstorms in Vietnam were not widely afforded at that time. SaigonTech realized there were two questions: "How to attract students to the contest?" and "How to provide them the tools and equipment to learn and practice for the contest?".

➢ For the first question, SaigonTech actively contacted the Ho Chi Minh Youth Union (HYU), whose "Youth IT contest" was quite a well-known and prestigious contest at that time. Believing that SRobot can compensate their lack of practicality, HYU agreed to embed the SRobot content in their contest. As a result, more and more students got used to SRobot library and the programming structure.

➢ Secondly, in order to solve the last piece of the puzzle, SaigonTech introduced a tool – simulation environment. In this environment, users can design terrains and robots; simulate and control robots (using Lego Mindstorms NXT, EV3).The robots' components include: motors, Laser Gun, IR Ball, and Sensors such as Touch, Ultrasonic, Color, Light, Sound, Compass, IR Seeker, Gyro.
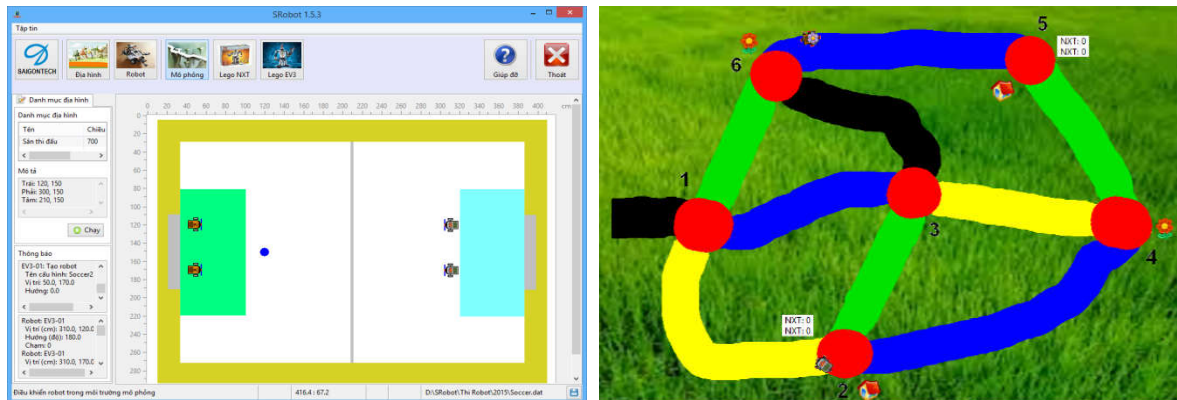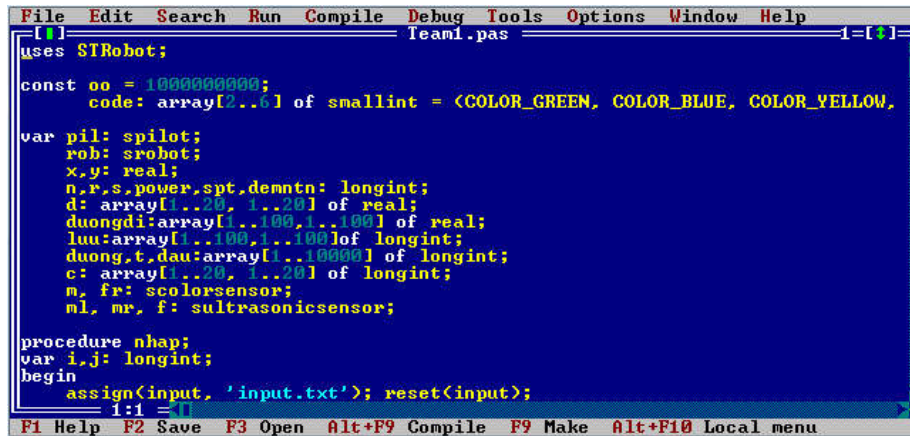
Figure 2: The SRobot simulation environment

Software. As mentioned earlier, thanks to the governmental encouragement reflected through the strategies, programming has become the official unit in education for high schools across the country. During the first days, the government chose Pascal as a good language for high school students to enter the world of programming due to its simplicity and economic efficiency to apply in a massive scale. However, choosing Lego Mindstorms, SaigonTech was aware that there was no support for Pascal language. As a result, SaigonTech has developed an SRobot library for Pascal and an environment named SRobot-1.0 as described above, which allows the programming in Pascal programming structure.

Specifically, the students will use the Free Pascal Compiler (FPC), declare SRobot library, and then use the SRobot-1.0 environment to run the simulation or stream the code to the robots through Bluetooth or Wi-Fi. The advantage of this method is that the code is not saved directly on the robot's internal memory. However, we realized the delay in the operation of the robots due to the streaming method. Therefore, in the update version SRobot-2.0, we decided to save the code directly on the robots, and this method was applied until the last contest using Lego Mindstorms in 2015. The great feature of the simulation environment that is worth

mentioning is that on one terrain, the robots will operate independently according to different codes at the same time. The link to our free software is provided in the appendix.

Figure 3: Free Pascal Compiler (FPC) that uses SRobot library

However, working with robots is more appealing than with the simulation. But again, the cost of a set of Lego Mindstorms is not widely affordable in Vietnam. In 2015, SaigonTech adverted to the Arduino. After one year of developing the idea, in 2016, SaigonTech introduced the new content, which shifted to using all technologies of Arduino with equipment availability and economic benefits. Similar to Lego Mindstorms, the Arduino community does not support Pascal language, therefore, the SArduino was also introduced for Pascal programming. For free download, please refer to Appendix.
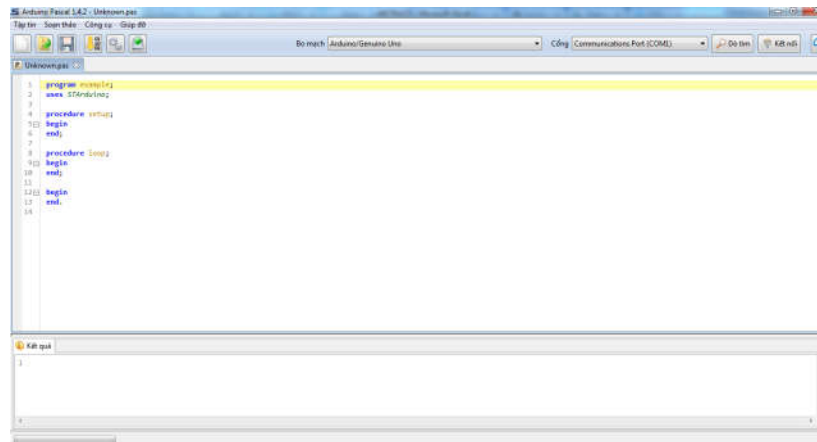
Figure 4: SArduino IDE for Pascal programming

As a result, each team is now able to get one set of physical robot for training before the contest. In addition, SaigonTech also recorded the significant increase in the number of contestant teams. For details:

2015-2016 Lego Mindstorms	2016-2017 Arduino
70 teams	174 teams

Table 2: The significant increase in participation

The Training

Besides providing the tools and working environment, SaigonTech also holds annual training sessions a few months prior to the contest, most of which are during weekends so that the training will not affect the high school curricula. Over this training, the teachers and students from all the competing high schools will gather at SaigonTech. They will be provided with all the necessary facilities such as computers, robots, electronic tools such as Volt-Amp meters or

oscilloscopes, and attend group work for SRobot. In each session, one instructor from SaigonTech will

- Introduce the updated information as new rules, contents, robot parts, supported programming libraries, or IDE version.

- Train the contestants in scratching as how to control LED or motors. SaigonTech instructors will then guide the students in expanding their products outside of the contest as well. For example, they will be able to apply controlling LED to controlling household lights.

- Apply STEM (Science Technology Engineering and Math) into the session by explicating how to apply theory to controlling robots.
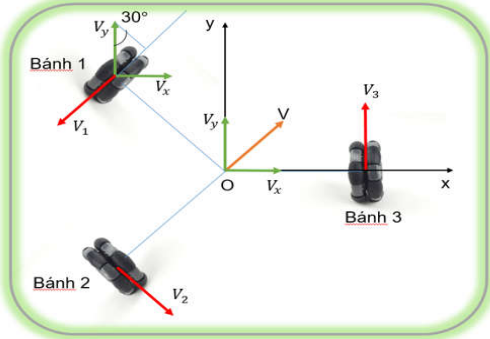

Figure 5: A training session for students (left image) and teachers (right image)

Figure 6 below is one part of the training material that shows how to apply Math and Physics to controlling three-wheel Omni robots.

Figure 6: A presentation slide about applying Maths and Physics to finding Dynamic equations for controlling robots

The Competition

SaigonTech understands that there is no "one size fits all" when it comes to personal preferences. Throughout the past competitions, SaigonTech categorizes the candidates into three groups: Group 1 – students seeking for challenges and glories; Group 2 – students looking for leisure and a chance to get more knowledge; Group 3 – students wanting to support their friends who are the contestants.

Following the primary purposes of SRobot, which were stated above in section B section, we desire to keep all students in three groups participating in the competition. Therefore, there are three different contests within the SRobot as follows:

- The SRobot Inter-school contest: This contest requires the students to do the programming on the spot where they have no support from friends or teachers. The students who win this competition earn the highest respect from other candidates for their skills and knowledge. This suits Group 1.

- The SRobot Open contest: The content will be open to the students normally a month before the contest date. Students will have time to develop the code with their friends and teachers. The purpose of this competition is to improve team-working skills and to offer students the chance to explore new knowledge from learning resources. This is for students of Group 2.

- The Creative Clip contest: Students need to make a short video clip about the robot used for the competition. This contest focuses on the students who got no or little knowledge in programming. This is also a chance for them to access and consider the field as a major in university level. A lot of clips are sent to SaigonTech every year, showing students' great interest in SRobot.

The Result

As demonstrated in Table 1, from 2012 to 2015 SRobot was using the Lego Mindstorms with Pascal IDE and simulation environment to support the training. Generally, the data are quite similar in those years, so in order to analyze them, we choose the data of three most recent years: 2016, 2017 and 2018 when SaigonTech noticed significant changes. The data are as follows:

	2015-2016	2016-2017	2017-2018
Platform	Lego Mindstorms EV3	Arduino Uno	Arduino Mega
Content	Robots shooting: the robots are equipped with the special gun to shoot at each other for points.	2-wheeled robots tracking line. There are obstacles and missions on the contest field to solve as well.	3-wheeled Omni-directional robot solving maze. The contest field is the perfect maze type (with only 1 way in and 1 way out, all the line are connected within the maze)
Number of high-schools/ teams	23 schools/ 70 teams	54 schools/ 174 teams	52 schools/ 170 teams
*Number of secondary-	N/A	N/A	48 schools/ 97 teams

schools			
Budget	Data loss (SaigonTech lost the budget data for this year. However, approximately US$ 50,000.00)	US$ 27,356.29*	US$ 26,841.27
**Website access count	Total from 13/10/2016 to 17/01/2018: 32,839		
**Facebook like count	Total from 09/11/2016 to 17/01/2018: 2,181		

Table 3: The SRobot data in 2015-2018

Originally SRbot candidates are high-school students. However, the Department Education and Training of Ho Chi Minh (DOET) requested SaigonTech to host the contest for secondary students this year (2018).

**SaigonTech did not focus on recording this date earlier, so the number might not be correct for analyses. By starting to keep track of this data since 2015, SaigonTech hopes to understand the concern of the public to SRobot through the Social Network and improve the website.

Analysis

There are two big concerns:

1. The content: Is the content of each year interesting enough to attract students? Will the students learn new knowledge each year?

2. The budget: Will the cost of hosting the competition be reduced, but still interesting? Will the students have to pay less for the robots? Will the robots be re-usable from previous competitions?

In order to analyze the concerns, SaigonTech used the number of partnership and students' participation as the indicator. For the first concern, we are convinced that our strategy in introducing new content each year is effective. Firstly, we are getting more attention from the government. At first the Ho Chi Minh City Youth Union has shown their interest in the program, and then the Department Education and Training of Ho Chi Minh (DOET). Specially, their latest request for us to hold the contest for secondary students strongly proves that SRobot is the program they are long seeking for to support the STEM education. Secondly, the increase in the teams shows that more and more students have found excitement in SRobot. Einon (2014), an expert in early year play and child development, showed that if kids think they know everything, or if they think the toys are too advanced to play with, they will ignore it. Therefore, SRobot difficulty is increased gradually each year with the new content so as not to bore the students. On the other hand, we also train the fundamental knowledge every year so that the new candidates do not find it overwhelming. Furthermore, we found that some high schools are incorporating the SRobot program in their career class (a kind of class that all the high school students must take

before graduation to guide their career choice). In general, SRobot has brought the following benefits to:

- ✓ the current education system by fulfilling the lack of practical education.
- ✓ teachers as a tool for STEM education and for developing teach-student bond.
- ✓ students as an educational playground that not only nurture their interests in engineering, but also soft skills.

An effective program is the program where the budget is in par with the benefits. In the past years, SRobot was using Lego Mindstorms when the budget was greater than the recent contests. The reason is mostly because we had to invest many sets of robot for the contestants. In Vietnam during the 2012-2015 period, sponsorship for a robot contest was quite rare. For that reason, in order to encourage students, we decided to be the pioneer and provided the robots. We also tried our best to reduce the cost by creating the simulation environment where students can practice without owning a robot. However, we realized it was still not engrossing. In the 2016-2017 contest, we first applied the Arduino contest that made a robot more affordable; then, a significant increase in the participation was recorded (see Table 2). This shows us that SRobot needs to take financial matter into consideration when introducing a new content every year.

Restrictions

Currently, SaigonTech is analyzing SRobot's effectiveness mostly on the participation of the partners and the students. However, more different types of input will be developed such as questionnaires or feedback forms for more sophisticated analyses and evaluation.

The Future

We strongly believe that this is the program that the Vietnamese education system is looking for. SRobot's scale is in Ho Chi Minh City and some nearby provinces; however, SaigonTech is looking forward to expanding the competition to other remote provinces to meet the needs of students with interest in the field. Our hope is to show MOET the importance of embedding practical knowledge in the curricula. We hope that SRobot will be renowned all over the country, officially taught in all high schools, and become a prestigious playground for students to learn, share knowledge and seek a chance to develop their future career both academically and financially.

Internationally, SRobot would like to expand its connection to other competitions all around the world so that the winners in this contest will be sent to other international contests for greater opportunities. In the 2018 contest that will take place in the first quarter, SRobot will use the Omni-wheeled robots in training the students in control so that in the next contest, SRobot will apply a soccer game for these robots. The winners may be able to participate in the annual RoboCupSoccer – Small Size League.
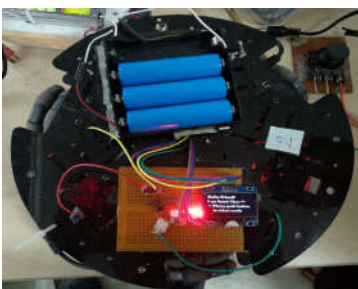
Figure 7:SRobot 2018   **Figure 8:**RoboCupSoccerSmallsize League

Retrieved from:

http://www.robocup.org/photos/search

References

(n.d.). *History of information technology.* Retrieved from

    http://openbookproject.net/courses/intro2ict/history/history.html

(2008). *Chỉ thị về tăng cường giảng dạy, đào tạo và ứng dụng công nghệ thông tin trong ngành*

    giáo dục giai đoạn 2008-2012. Retrieved from https://thuvienphapluat.vn/van-ban/Cong-

    nghe-thong-tin/Chi-thi-55-2008-CT-BGDDT-tang-cuong-giang-day-dao-tao-ung-dung-

    cong-nghe-thong-tin-nganh-giao-duc-giai-doan-2008-2012-71018.aspx

Einon, D. (2014). *Why does my baby seem restless and bored with her toys?*. Retrieved from:

    https://www.babycentre.co.uk/x556950/why-does-my-baby-seem-restless-and-bored-

    with-her-toys

Hays, J. (2008). *Education in Vietnam*. Retrieved from http://factsanddetails.com/southeast-

    asia/Vietnam/sub5_9f/entry-3457.html

Mansell, R. & Wehn, U. (1998). *Knowledge societies: Information Technology for sustainable*

    development. Oxford University Press.

Massmann, O. (2015). *Vietnam - Information Technology - 2015*. Retrieved from

    https://www.slideshare.net/olmas66/vietnam-information-technology-2015

Selingo, J. J. (2017). *Business is the most popular college major, but that doesn't mean it's a*

    good choice. Retrieved from https://www.washingtonpost.com/news/grade-

    point/wp/2017/01/28/business-is-the-most-popular-college-major-but-that-doesnt-mean-

    its-a-good-choice/?utm_term=.1ce119c20756

Thanh, M. (2015). *Theory-heavy university curricula cannot produce highly qualified workers*.

Retrieved from http://english.vietnamnet.vn/fms/education/121211/theory-heavy-

university-curricula-cannot-produce-highly-qualified-workers.html

Appendix

Link to SRobot website: http://SRobot.saigontech.edu.vn/en/

Link to SRobot environment: http://SRobot.saigontech.edu.vn/en/SRobot-software/

Link to SArduino IDE: http://SRobot.saigontech.edu.vn/en/sarduino-software/

Link to robotcup competition: http://www.robocup.org/leagues/7