WEROB 2012

Workshop on Educational Robotics

(an event co-located with the RoboCup Symposium 2012)
Mexico City, Mexico
http://www.robocup2012.org/
24th June, 2012
Message from the chairs

The use of robotics for educational purposes has been pursued for a long time and has become more and more popular. Several factors have contributed to such situation, such as the availability of adequate and inexpensive robotics kits in the market and individual components, as well as the proliferation of robotics competitions for the pre-university levels. As a consequence, robotics started to be incorporated into classroom lessons and has become a learning tool for teaching concepts in a broad range of areas, from electricity and mechanisms to programming, mathematics, physics, etc.

In this workshop, we are pleased to have Prof. Fernando Ribeiro from University of Minho in Portugal sharing his experience with robotics-related educational initiatives. He has been involved from the start in the strong development that this kind of initiatives had in Portugal in the last decade. This keynote is followed by a session dedicated to similar initiatives, namely in Costa Rica and Brazil. A following session includes 3 presentations focusing on teams experiences in different sub-leagues of Junior Rescue. After lunch, we will address open issues and challenges in RoboCupJunior with a presentation on a prospective junior version of the @Home major league, followed by a panel including members of RoboCupJunior Technical and Organization Committees. The workshop ends with a hands-on session on CoSpace for which participants are invited to come with their own laptops and learn how to use the CoSpace environment.

The program was also structured to allow the participants to attend the two enriching keynote speeches of the RoboCup Symposium, by Professors Martial Hebert and Edwin Olson.

Finally, we would like to express our gratitude to the speakers and participants, and we look forward to a fruitful workshop.

Luis Almeida
University of Porto, Portugal

Amy Eguchi
Bloomfield College, USA
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Children learning robotics easily

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Abstract. This paper presents a didactic robotics event where youngsters learn hands-on how to build a robot from scratch. Team of four people can participate, and they need to bring a laptop computer and a sleeping bag. During three days and two nights, they are taught by experienced people with short non boring lessons, the many subjects that they need to build a complete robot. Lessons of simple mechanics, electronics, and robot programming are the main ones, but followed by many others about motors, sensors, robotics events, etc.
This is all carried out in an entertaining way, where they can have a break to practice many sports, ludic activities, music, etc. On the last day, they can participate on opcional small competitions, in order to test the robot built, all this with large fair-play, and no competition stress at all. At the end, they take the robot home, which they can use to participate in other competitions like the Robotics National Open or RoboCup, and they can improve the robot performance at school or at home. All 6 editions of RoboParty had full house and booking in advance is required. This is the only robotics competition of this kind, and the main advantages consist of no stress from teachers and students, an optimal learning curve, and above all they get a robot for themselves to continue practicing.

Keywords: Robotics; Children; learning; RoboParty

Brief CV

Fernando Ribeiro was born in Guimarães, Portugal. He took his degree on Computer Science and Information Technology in 1988, lectured at University Portucalense for three years and moved to Cranfield (England) where he took in Master's Degree on Industrial Robotics in 1992 and his PhD on Advanced Manufacturing Technology in 1995. Returned to Portugal to University of Minho in 1995 where he holds a position of Associate Professor since 2003 at the Industrial Electronics Department.

He started in 1997 a Robotics Laboratory and he has since then many students working on Mobile Autonomous Robotics and participates actively on RoboCup with a football team of robots, amongst others. He developed the first Portuguese robotic football team that participated in a competition. He also organizes many robotics events (Local, National and International) like RoboParty, with different scientific challenges, and promotes science and technology. He also organized the first Festival Nacional de Robótica—ROBÓTICA’2001 in Guimarães. He is founding member of the Portuguese Robotics Society, which was created during Robotica’2006, also in Guimarães.

In 2006 he started a spin-off company called SAR - Soluções de Automação e Robótica, which creates and develops robotics and automation projects.

His main areas of research are Mobile and Autonomous Robotics, Automation, Rapid Prototyping. Computer Vision and Image Processing.
First National Robotics Competition in Public High Schools to Promote Innovation and Technological Education

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Abstract: The technological competitions trigger special interest in students who study diverse scientific disciplines. The reached goals by those who participate in individual system or in groups represent significant learning process and the improvement of cognitive skills particularly in problem solving approach. Moreover, the learned lessons of dealing with a national robotics competition are published to warranty success on technologic educative experience. As a matter of fact, this innovating educative experience marks the students’ life understanding that if they believe in what they are doing, they can overcome any obstacle.

Keywords: Education, technological competition, robotics

1 Introduction

In the last years, technological competitions have been positioned as an attractive educative alternative for those who study robotics and other scientific disciplines. It is through these types of experiences that we hope to stimulate and build up new initiatives that influence education in an effort to improve its quality.

The Omar Dengo Foundation (ODF) of Costa Rica, in conjunction with the Ministry of Public Education, has been implementing the National Program for Educational Informatics MEP-FOD (PRONIE) for the past 25 years, serving as pioneers in Latin America and the Caribbean in the area of educational programs supported by the use of digital technologies. As a result, we understand the importance of offering these types of experiences to students from less favored social sectors, in order to offer alternatives that strengthen new learning processes.

Thanks to ODF’s acquired experience in the accomplishment of this type of proposals in education and technology, the Ministry of Public Education financed the acquisition of robotics equipment to develop a national robotics competition in public high schools that implemented robotics programs and have been working on them for at least two years.

The main objective of this project was to enhance educative robotics with a challenging and creative approach that allows the students to acquire new knowledge and evaluate their abilities according to the improvement of technological skills and problem-solving. This initiative was significant for those who participated due to the challenges associated with preparing and participating in their first technological competition with other educational institutions from different geographic locations.
First National Robotics Competition in Public High Schools to Promote Innovation and Technological Education

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The accomplishments achieved during this contest left us remarkable lessons, which we have shared within this document in the hopes that it will be helpful to those who wish to design or to implement initiatives that enhance innovative and technology-based education.

2 The importance of robotics competitions

Technological competitions allow students to [1,2]:
- To analyze by means of research the best solutions to their challenges.
- To develop effective robot designs to solve the problems.
- To promote more abilities in areas like engineering, programming, mechanics, electronics, algorithms and design.
- To enhance tolerance to learning by error.
- To create a healthy collaborative environment between team members.
- To work hard as scientists in subjects related to robotics.

After considering these advantages and the positive impact they could have on the students’ lives, it was easy to make the decision to participate.

3 Development of a competition model

Before settling on a competition model that could be effectively developed in any educative center in the country, the ODF studied competitions of greater world-wide recognition in the junior category. In fact, we cautiously analyzed the regulations around each of the following aspects: the robotic equipment, professional training teacher profiles, geographic locations, national curriculum schedule and marketing.

Considering this previous study, it was decided that the First Lego League (FLL) fulfilled the conditions that were necessary for the model which we wished to develop in our country. Nevertheless, it was necessary to make some adjustments and adaptations in order to typify as significant approach into the Costa Rican educational context, with reliable problems for the students who would participate.

The fact that Costa Rica is well-known for its interest in preserving natural resources led us to the idea of linking technological competitions to challenges to protect our nature. This project, called Green Game [3], had an ecological theme. Contenders had to design and program autonomous robots to solve environmental missions: (Fig. 1)

1. To protect nature.
2. To collect solid waste
3. To plant and water trees.
4. To transport and deposit toxic waste.
5. To use clean energies.
6. To fix solar panels.
4 Organization of the competition

Each participating institution was offered a professional training process in which they were skilled to handle the robotic equipment destined to perform the competition. In this case, they learned to construct and program autonomous robots using NXT LEGO Mindstorms sets. Moreover, the competition regulations were explained to them in order to be aware of them during their students’ practices for the competition. In fact, during their practices they had to: respect rules, learn permissible strategies in order to solve the missions, identify behaviors to win or to lose points, be familiar with the robot’s characteristics such as weight and robots dimension, represent the working roles of each member of the team (Captain 1 and Captain 2), and finally evaluate the awarding contest methodology.

Each Institution received six complete NXT sets (LEGO Mindstorms 9797, 9695, 9794), one contest field where they had to practice (Game field based on FLL area 2010). Furthermore, each institution was responsible for working on a strategy that better accomplished the missions. Some students preferred to solve each mission separately; others grouped two or three missions together so that robots accomplished them through a single execution.

A group of four high schools made it to the final, where there were a total of 48 students. Two high schools came from to the southern region of the country and the other two belonged to the central region. Each high school could decide if they registered their teams as a single team (twelve participants) or as three separate teams (four students each).

As part of the methodological support that ODF gave to these participating high schools, there were pedagogical visits to evaluate the level of mission progress that they had obtained. In addition, the use of blogs, email, videconferencing and calls were offered as a way to respond to students’ doubts and inquiries.

We found important circumstances related to the team members’ attitude that made this experience more successful than other ones. For example, some teams received more support from the mentor because of their high level of commitment throughout the project. This meant access to extra robotics lessons, more study time
in order to achieve better solutions with robots, repeating the design in order to improve the competition missions, studying the sections of the programs to debug them, as well as other actions that required much effort, interest and perseverance.

Finally, the essential strategy for all teams was focused on constructing the most efficient autonomous robot, able to solve the missions in less than five minutes. This assignment became the main focus of the work done by the competition teams.

5 Development of the competition

The competition was defined in two rounds: one would take place in the morning and the other one in the afternoon. Each team would have five minutes to solve the missions, and they had two extra minutes that could be used if needed. After the team’s registration and lodging were complete, there was a conference between the captains of each team, in order to reach agreements and to clarify doubts. This reunion offered a space to relax and share doubts between themselves. It was the moment in which they began to cross over into the competition experience. At that time, a public lottery was prepared to determine the order of the competition, in which each captain would take a number to know the position. Once it was established, teams were given time to organize themselves before initiating the competition’s rounds. After that, teams could no longer modify the robots or programs, which would guarantee a fair participation for all.

In the first round, teams were nervous about facing an audience in a contest field. Their inability to manage their feelings and focus solely on solving missions was unfortunate and resulted in the teams’ failure to solve more than three missions. Nevertheless, for afternoon rounds the teams’ performance increased positively and many teams succeed in completing more than six missions. Finally, the winning team was associated to the one that planned the best strategy in saving time and collecting easy points, during the two previous rounds.

6 Findings

6.1 Pedagogical

A strong preference for design and construction over programming is evident, since the latter requires more patience and sometimes they miss details and lack concentration. In contrast, students interviewed agreed that they prefer to construct because it requires less attention and more creativity.

A majority of students agreed that their participation performance improved once they could organize to work as one team, although at the beginning there was difficulty establishing a team identity and they had difficulties accepting productive suggestions or observations, but as they got used to each other they began to share experiences and create true friendships. In a few cases, the mentors had to reassign groups because of students’ incompatibility.

The fact that they had to get ready for a competition encouraged them to face their own limits and help them realize that they were able to reach enormous goals. The anxiety caused to them to make mistakes on many occasions, forgetting where to place the robot in the appropriate position or how to run the right program for the corresponding mission. The most significant sensor for this contest was the one involving rotation, used to guarantee the precise distances and turns in each mission. The effort of using a diversity of sensors was demonstrated; however, they did not work successfully. The students explained that their feelings had a definite influence on their performance. As they stood in front of the audience, they became increasingly aware of external factors such as the audience’s noise, supporting mentors, and other the robots’ design, increasing
their level of pressure. But the most stressful moment came when their strategy began to work against them with regards to time.

During the competition, two strategies were observed: robots that solved individual missions in which students reinitiated the interface in order to find the program for each mission, and robots that used just a single program to accomplish several missions simultaneously. The second strategy was more successful; nevertheless, this strategy requires more programming time and precision conducts.

Students who encountered major problems to get through specific missions explained several factors that did not allow them to obtain better results. In the particular case of the team that placed last, students claimed that that they could not stick to the time frame established for the year due to a number of factors, such as the teachers’ lack of time, extracurricular activities and the lack of authorization from the principal to work extra days.

Another team affirmed that they did not save the last version of the programs developed to solve the missions. They claimed that they did not assign someone in specific to create backups of the programming challenges. They explained that at the beginning it was hard to work all together as a team, because most of the time they preferred doing things independently, but at the end they understood that teamwork might be better than working alone and without help.

One of the main lessons learned by the participants in this contest was the need for teamwork. For future competitions, we hope to look for technological contests with unexpected missions that encourage them to shine in their performance, strengthen their collaborative skills, and develop better programming and design skills in a mission that has not been solved before.

6.2 Mentoring and Support

One of the factors that contributed to good coordination between all the supporting mentors and coordinators that participated in the logistic development of the championship was the simulation of the functions they would be performing, especially from those in charge of judging and deciding the winning team.

The logistic coordinators anticipated the need to have a communication channel easily that was easily accessible. The blog and videoconferencing were valuable resources for the professors. Nevertheless, for those who were not “digital natives”, there was the opportunity to communicate via text messages via their personal phone.

The constant communication between parents and mentors about the contest’s progress allowed the community to follow the students’ performance during the entire competition.
7 Conclusions

The successful participation in a technological competition is no simple task. The investment of both funds and human resources is considerable. Nevertheless, it marks the difference between an innovative educational initiative and that of a traditional conformist educational method.

We were glad to lead the way through this experience in our search to pioneer high-quality education supported by the use of digital technologies. This experience allowed students to test their abilities at the ultimate level and gave participants the skills to better deal with the problems they may face both personally and academically in the future.

Among the lessons learned were: learning to handle pressure, teamwork, mutual respect, leadership abilities, defining a strategy or action plan, and most importantly that there are no limits to what we can if we are persistent, methodical and patient.

8 Bibliography


NERA – A Center for Research on Educational Robotics and Automation

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Abstract. This work presents the results of projects on educational robotics so far developed by the teachers working at NERA, the Center for Research on Robotics and Automation of the Federal Institute of Education, Science and Technology of Espirito Santo, Brazil. NERA was founded in 2011 with the main objective of providing the resources for the students on technical and engineering courses to work with practical projects on robotics and automation. It also had the objective of integrating isolated projects that were being carried out by some teachers. Despite the fact that NERA exists for less than one year and a half, several projects are being executed and a group of about 30 students had the opportunity to work with practical projects on robotics so far. For example, one of the projects is the design, construction and programming of small mobile robots. This project is mainly directed to students of the technical course in informatics, so that they can learn about electronics and sensors (topics that are not part of the regular curriculum of their course). Another project is the organization of groups of students to participate in robotics competitions, which can be a very strong motivator for autonomous study. There are two teams, so far. One is composed by high-school level students and has participated in several robotics competitions, including RoboCup Junior. The other was recently formed by undergraduate students to compete at the Latin American Robotics Competition. Two undergraduate research projects related to robotics are also being developed. One is to develop a platform to enhance the capabilities of the Lego NXT, and the other is to develop a measuring system to be integrated on a Ph.D. research project on autonomous vehicles. Some of the results of the above mentioned projects are going to be presented. It is clear to us that students get highly motivated and learn much more when they are dealing with practical projects and/or competitions. We have noticed that robotics is a powerful tool to improve creativity and analytical reasoning, two important characteristics of workers on technical fields.

Keywords. Educational Robotics, Robotics Competition.
Design and Implementation of an Android-Based Omnidirectional Robot for the RoboCup Junior Rescue B Competition

André S. Oliveira, Gabriel Lima Guimarães, Ivan Seidel Gomes, and Matheus P. Canejo da Cunha – team students
Felipe N. Martins, and Hudson Cassio G. Oliveira – team mentors

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Abstract. This work presents the design, programming and prototype construction of an omnidirectional robot to be used on the RoboCup Junior Rescue B competition. The main robot controller was written in Java and runs in an Android-based mobile phone. The phone is connected to an IOIO board that was programmed to serve as an interface between the main controller and the robot’s motors and sensors (see Figure 1). The IOIO board connects to an Arduino that is responsible for the distance and temperature sensors readings, and to an Mbed board that controls the motor drivers. There are four infra-red distance sensors mounted on a rotary base on the top of the robot. The base angle is constantly changed by a servomotor, which allows a 360º distance measuring. The robot mechanical structure was designed using a 3D modeling software (Figure 2). It has four omnidirectional wheels that allow the robot to move in any direction without the need of turning itself. The structure was built using acrylic (Figure 3). So far, some tests were executed (Figure 4) and the results indicate that the system works as designed. The robot was entirely designed, built and programmed by the team students.

Keywords. Robotics Competition, RoboCup Junior, Rescue B, Robot Design
Figure 1. System overview.

Figure 2. Mechanical design.
Figure 3. Robot mechanical prototype.

Figure 4. First electronics test.
Software and Hardware Achievements of RoboTec1 in Junior Rescue A Secondary

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Abstract. Manta Ray is a robot created by a group of students from ITESM Campus Puebla. It is designed to participate in the Junior Rescue A Secondary Category, in RoboCup 2012. In this category the robot must autonomously complete a circuit that involves different tasks, such as following a line, avoiding obstacles, going up a ramp, and finding and moving a can. The robot has hardware developments that permit it to be stable and efficient by having a robust design, grab and lift a can with a claw, and receive input form the environment with different sensors. Its software is designed for an intelligent behavior of the robot by acting based on sensor input, to be able to adapt to different environments.

Keywords: Rescue Junior, Lego NXT, PID control.

1 Introduction

RoboTec 1 is formed by a group of students from ITESM Puebla. Edgar Sucar, the team captain, had previous experience by winning the Mexican Robotics Tournament of 2011 and participating in RoboCup 2011 in Istanbul, Turkey. Together, based on the experience acquired in RoboCup 2011, the team worked to build and program an intelligent, robust, and fast robot, Manta Ray, to participate in the Junior Rescue A Secondary Category.

The Rescue A Secondary Category [1] consists on a circuit in which an autonomous robot must complete different tasks. This category simulates a disaster scenario in which a victim must be rescued. The circuit is divided in modules: The Orange Zone, The Ramp, and the Red Zone. The Orange zone consists of two rooms connected by a hallway. On The Orange Zone the robot must follow a black line on the floor, with obstacles such as bumps, gaps, and debris. The robot must then detect and go up through The Ramp which connects to the Red Zone. On the Red Zone there is a randomly placed can which represents the victim, the robot must find the victim and take it to the Safe Zone, which is a black corner with certain height.

⋆ We would like to thank our school, ITESM Campus Puebla, for their financial support; and Enrique Sucar, for his advice for programming our robot, and support to attend the Mexican Robotics Tournament 2012.
In this article we describe the main hardware and software developments of the robot, as well as the main challenges faced throughout the project and the results obtained.

2 Hardware

Our robot was built using the Mindstorms NXT Kit, and sensors from HiTechnic and Mindensors.

2.1 General Design

Manta Ray has a compact and robust design. By avoiding the use of unnecessary pieces and spaces between them, the robot was made as small as possible, which helps it to be stable and to navigate through the arena with ease. The solid design keeps the robot functioning well at all times throughout the circuit. The NXT (the robot’s computer) is the heaviest element of the robot, so it is placed next to the wheels in order to have a low center of gravity and avoid the robot from flipping in the ramp. The NXT was not enough to keep the robot from flipping in the presence of bumps on the ramp, so additional weights were added to the bottom-front part of the robot.

The most significant elements of the robot are: (i) Caterpillar tracks, (ii) Claw, (iii) Three servomotors (Lego NXT), (iv) Four light sensors (Lego RCX), (v) Two touch sensors (Lego RCX), (vi) Compass sensors (HiTechnic), (vii) Infrared distance sensor (Mindensors), (viii) Acceleration sensor (Mindensors), and (ix) Three multiplexers (Mindensors). Fig. 1 shows the robot with the previously listed parts.

Fig. 1. Side view of Manta Ray.
2.2 The Claw

The claw allows the robot to grab and lift the can, which is necessary to take it to the Safe Zone. The claw has two degrees of freedom with only one motor in order to avoid the use of extra motors. The NXT only has three motor ports, so an extra motor would require another NXT, which would make the robot heavier and slower, this would also cause problems in going up the ramp. A system of gears allows the claw to have two degrees of freedom with one motor (as seen on Fig. 2). When the claw is closed and in the upward position, the motor is able to lower the claw, once the the claw is lowered certain gears get stuck so the same motor now opens the claw. The same happens when the claw grabs the can, once the claw closes and grabs the can, the gearing changes the degree of freedom, so the motor proceeds to lift it. The claw drops the can in the Safe Zone with the same procedure in which it is lowered before grabbing and lifting the can.

Because the Safe Zone has a height of 6cm, the claw was built with certain length in order to reduce the degrees it needs to rise to drop the can in the Safe Zone, so it is placed almost straight and the weight of the can makes it land upward. If the degrees necessary to place the can in the Safe Zone were larger the can would flip and land sideways, which is not permitted by the rules.

The claw needs a sturdy design so that it does not brake when lifting the can that has a weight of 150g. The claw must also have the necessary strength to be able to lift it. To make the claw stronger the gears which connect the motor to the claw increase the torque.

![Fig. 2. Back view of Manta Ray, which shows the gearing of the claw.](image)

2.3 Light Sensors

Our robot has three light sensors. Two are used to follow the line, while the third one has the purpose of detecting when the robot loses the line. The three
light sensors are touching the ground with weights attached to them; this has two purposes: it avoids the effect of environmental light when detecting the line and they work as sweepers to prevent sticks from getting stuck in the wheels of the robot. The light sensors are mounted on an axis, this allows the light sensors to swivel, as seen on Figure 3, so that the sensors do not get stuck on bumps or the ramp.

![Fig. 3. Left: flat positioned light sensors. Right: lifted positioned light sensors.](image)

2.4 Touch Sensors

The robot has two touch sensors to detect walls and obstacles. The touch sensors have a front bar which presses both of the touch sensors to detect walls and obstacles in front of the robot. Each touch sensor also has a side bar that presses the sensor, this is used to follow walls, and obstacles when surrounding them. The touch sensors have a rubber band to keep the bars tight, and avoid the bars form staying pressed. Figure 4 shows a top view of the touch sensors, the front and side bars and the rubber band can be seen.

![Fig. 4. Top view of Manta Ray displaying the touch sensors.](image)
3 Software

We programmed our robot in the RobotC IDE [3]. The program is divided in functions according to the different tasks the robot must complete along the circuit. The behavior of the robot is intelligent, it acts accordingly to sensor input. Certain constants that modify the behavior of the robot are at the beginning of the program for easy access and modification.

3.1 PID Line Following

The robot uses a Proportional Integral Derivative (PID) [4] control algorithm to follow the line. The algorithm functions according to the input from the two light sensors, which must stay at each side of the line. The error is established by calculating the difference of the readings from both light sensors. The error is related proportionally to the power of the two motors of the robot, thus permitting the robot to follow the line smoothly. The integral of the algorithm calculates the accumulated error and acts upon it, to avoid the robot from staying on a side of the line and to eliminate small errors. The derivative calculates the rate of change of the error, this is useful to predict future error, for example in tight turns.

3.2 Obstacle Avoidance

When the robot detects that both touch sensors are pressed while following the line, it calls the function for obstacle avoidance. In this function the robot surrounds the object with the input from one of the touch sensors until it returns to the line.

3.3 Line Recovery

The robot detects that it has lost the line when the three light sensors detect a white surface so it calls the line recovery function. First, the robot advances during a certain time, if it does not detect the black line, it turns 90 degrees to both sides along its own axis to recover the line in case it was lost in a tight turn. If the line is not found with this procedure it means that the robot has found a gap, so it advances by describing a Y figure in a loop, until it finds the line again.

3.4 Ramp

If the robot detects a change in inclination during a certain time while it does the first step of the line recovery function, it calls the ramp function. In this function the robot goes up the ramp, following the left wall with a touch sensor. It then aligns with the Red Zone’s entrance once the robot reaches the top of the ramp module, which is detected when both sensors are pressed.
3.5 Can Localization and Deployment

There are three steps in order to find the can. First the robot advances until the distance sensor measures a distance that is shorter than the one between the robot and the wall. Then the robot turns 90 degrees to the right along its own axis and proceeds to advance by describing a Y figure in a loop until one of the touch sensors is pressed. Finally the robot aligns more precisely with the can by using a light sensor and takes it with the claw.

After finding the can, the robot centers in the Red Zone with two walls previously calibrated with the compass sensor. Then it turns along its own axis until it finds the Safe Zone, its position was also calibrated with the compass sensor. Finally the robot advances until both touch sensors are pressed, and turns 180 degrees and deploys the can.

4 Challenges and Results

During our participation in the Mexican Open we had the chance of testing our work on the robot. The robot was able to follow the line successfully thanks to the line recovery which prevented the robot from getting lost. Negotiating obstacles was easily achieved by the robot, as it never failed to do so. The robot was able to lift the can and place it in the safe zone, completing the course and achieving its main objective.

Nevertheless, the robot presented some imperfections that we have fixed in order to participate in Robocup 2012, such as the alignment of the robot at the entrance of the Red Zone. This is important because it was sometimes difficult or impossible for the robot to pass through the door. We put a bar on the of the back of the robot so that it can align with the wall and pass straight through the door. Another problem was that the robot slows down when it is close to reaching the end of a turn. Better turns are achieved by combining this system with a better control movement algorithm, which works by recognizing the speed of the motors, and adjusting their power accordingly.

We also changed the behavior of the robot in the Red Zone. Instead of having an straight displacement, the robot advances diagonally, making a zigzag pattern, this is because we observed that the reflections on the walls of the room could cause the infrared distance sensor to obtain inaccurate measurements.

References

Rescue A, B to CoSpace: Our RoboCupJunior Rescue Experience

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Abstract.
This presentation introduces the learning experience of M&Y, a Japanese rescue team, that accomplished their participation in all of the Junior Rescue league games including Rescue CoSpace in past years both at the national and international levels. The team members emphasize that the learning experience from any Rescue league games will benefit a team that takes a new Rescue challenge by moving onto another sub-league (i.e. from Rescue A to B). The team members believe that programming is the core of autonomous/intelligent robotics.

Keywords: RoboCupJunior, Rescue, Learning Experience

1. Introduction
M&Y started its rescue challenge in 2007. In 2007, we participated in RCJ International, Atlanta, USA, for the first time and won the 2nd place with Rescue SuperTeam. In 2008, we participated in RCJ International, Suzho, China and won the individual 2nd place. In 2010, we challenged Rescue B and participated in RCJ International, Singapore, and placed in the individual 1st place. We kept challenging ourselves and tried out CoSpace Rescue in 2011 at RCJ International, Istanbul and won the SuperTeam 2nd place.

Many Rescue A teams that we have met in various competitions comment that it would be difficult to move to Rescue B and/or CoSpace Rescue. However what is required to compete in either of the games is different, what we learned through Rescue A could help us with our challenges with Rescue B and CoSpace Rescue. We could apply some of what we learned with Rescue A effectively with Rescue B and CoSpace Rescue.

2. Rescue A
M&Y started out with Rescue A. Although the victim with Rescue A is only one and the most difficult part of the game might be more of the engineering challenge of how to make the grabbing mechanism successfully to move the victim to the evacuation zone, it was not the case when M&Y started in 2007. In the red zone, which is the last room on the second floor of the arena, has no line to use as a guide. We struggled to find better solutions to tackle the problem.

3. Rescue B
M&Y moved to Rescue B in 2010. Rescue B arena has no line, as Rescue A arena has. A robot has to look for victims emitting human temperature heat. When the robot found a victim, it has to flash a ramp to indicate the “rescue.” People might ask if we need to create a program from scratch or make a major revision on the previous program used for Rescue A. Our answer is “no.” When we worked on the maze program for Rescue B, we used the strategy that we learned with Rescue A red-zone programming. We have already mastered the code to make a robot make 90-degree turns and move forward for specific distance defined through our experience with Rescue A. Those are the strategies that helped us with Rescue B programming.

### 4. CoSpace Rescue

Challenging CoSpace Rescue was not different at all. With CoSpace Rescue, the programming strategies that we learned with Rescue A helped. For example, with CoSpace Rescue, there are lines that lead to “special zone” where the points gained doubled. The line following program that we mastered with Rescue A became very handy. Also, the objects that a robot has to find are all laid on the floor, similar to the old Rescue A game of searching victims. We could use the same strategy that we used to find the Rescue A victims.

On the other hand, what we learned with CoSpace Rescue helped us with Rescue B. Since CoSpace robot uses ultrasonic sensor to detect obstacles, we learned how to use ultrasonic sensors, which became very helpful with Rescue B.

### 5. Conclusion

Looking back, for us, moving from Rescue A to B and CoSpace rescue was not hard challenges because we could make connections from what we had learned with a previous challenge to the new challenge. We think our concepts of robotics helped us as well. Our concepts of robotics are 1) small, 2) simple, and 3) software. When we work on a new robot, we try to create a robot as small and simple as possible, and create solutions through programming, not by engineering of the robot itself. This might be because of both the team members are programmers. But also, we try to spend less money on developing robot without expensive and sophisticated parts. Rather, we want to show that robotics can be done by anyone without those expensive and sophisticated parts. Although, at Japan Open, a team that created a robot from scratch was given a special award that may equals to a third place, those special awards are usually given in Dance league. It is important to have a robot that is steady and functional; however, we believe a robot becomes effective because of its advanced program. We should remember that autonomous/intelligent robots move and do tasks that we want because of the programs that we create.
Dive into CoSpace Educational Robotics

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Abstract. With this hands-on session, you will learn how to use the CsBot platform which is used with Junior CoSpace Rescue and Theatre demonstrations. This session is a BYOD session (Windows OS ONLY). It will cover from the installation necessary to run the CsBot successfully on your PC to the different features of programming interface that users need to know, as well as how the program that are created with CsBot can be edited with C++ or visa versa. At the end of the session, you will see your CoSpace robot in action. We will also discuss some of educational approaches that CoSpace educational robotics can benefit from to enhance student learning in STEM fields and of the 21st century skills/competencies.

This BYOD (Bring Your Own Device) session needs participants to bring PC computer for the hands-on activity.