Implementing Robotics in Educational Events

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***Abstract*—Early exposure to robotics and programming can inspire curiosity and foster essential problem solving skills in young learners. This paper presents our experience in introducing robotics to primary and secondary school students through various events, including MINT Days, an Introductory Event, and Open House Days. We provided hands-on activities that allowed children to explore robotics, learn basic programming concepts, and understand the benefits of working with sensors and automation. Through structured presentations and interactive demonstrations, we aimed to spark an interest in technology and engineering while showcasing the opportunities available for students to continue learning. Our findings indicate that hands-on, engaging experiences are crucial in making robotics accessible and appealing to young minds.**

I. Introduction

Robotics and programming are becoming increasingly important in today's technology-driven world. However, many students do not get the opportunity to engage with these subjects at an early age. To bridge this gap, we introduced robotics to primary and secondary school students through a series of interactive events at our school. Our goal was to spark their curiosity, provide hands-on experience, and demonstrate the exciting possibilities that robotics offers.

During three key events

- MINT Days
- Introductory Event
- Open House Days (TDoT)

We guided students through various robotic activities, from basic programming to sensor-based automation. Through structured demonstrations and interactive challenges, we aimed to make complex concepts more accessible and engaging.

This paper outlines our experience working with young learners, the methods we used to teach robotics, and the impact of these events. Additionally, we explore the benefits of introducing robotics at an early age and highlight further opportunities for students to continue their learning journey in this field.

II. Already Existing Implementations

Vorarlberg has a history of courses in which you can explore robotics and programming. Some are privately organized, while others are public. In these programs, children get hands-on experience with sensors, wheels, and all the essential components a robot needs. In some secondary schools, there is an elective subject in which you can choose to work with robots. There, you will "program" robots by dragging and connecting small blocks using the Website Roberta, which can be seen in (fig.1) together. The focus is on what the robot can do and how it works. You start by assembling the robot, giving you a clear understanding of what it needs to function properly.

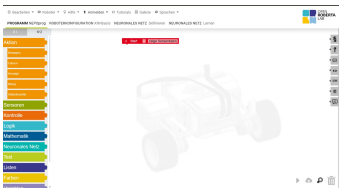

Fig. 1: Open Roberta Lab: The program most schools and the summer course use. [1]

A. Summer Robotics Programs in Vorarlberg

In Vorarlberg, there also used to be a summer program for children aged 6 to 12, where participants "programmed" robots by dragging and connecting small blocks. The program offered three levels: beginner, intermediate, and advanced courses. [2]

- In the beginner course, children learned the basics, such as how the robot turns, how to program the wheels, and how to make it stop.
- In the intermediate course, they learned to use sensors and the advantages they offer.
- In the advanced course, participants worked with larger and more complex robots.

III. Exploring Robotics: Benefits for Young Learners

Introducing children to robotics can offer many benefits. Actively promoting educational robotics across different grade levels helps spread information and excitement about the field while giving younger generations valuable insights and exposure. By introducing students to robotics in a structured and engaging way, schools can inspire interest and possibly influence future extracurricular or academic choices. Guided courses provide a tailored introduction, ensuring students aren't overwhelmed while giving them a kickstart in understanding key concepts. Creating their own simple programs can serve as a motivating factor, encouraging them to continue tinkering, exploring, and deepening their interest in robotics on their own.

IV. Our Preparation Experience

The preparations for the events held at our school were initially quite unstructured. However, with each event, our organization and planning improved significantly. There were many aspects that we needed to consider—-not only did we have to communicate within our team, but we also had to coordinate with the school and teachers. Along the way, we encountered complications that required our attention and problem solving.

For the first event, our focus was primarily on adjusting, repairing, and improving the hardware. We ensured that all the Wombats (Firmware by KIPR [3]) used in the event were standardized so that our demo code worked seamlessly across all devices, with only a few minor complications. We prepared demo programs (fig. 2) to showcase all the available functions of the Wombats without having to create them on the spot. Each member of our group prepared code to demonstrate and explain to the children. To share these programs, we set up a GitHub organization where we uploaded all the code into separate repositories, properly labeled and organized. As some programs did not work on every robot due to hardware differences, we had to adapt them for each specific device. This process was time-consuming, but once we resolved the issue, both the code and the robots ran smoothly.

The demo programs were then loaded onto each Wombat by creating a specific user account in the Harrogate IDE, preventing confusion between old and new code. The final preparation step involved setting up the test environments, which included arranging desks with one Wombat robot at each station.

While preparing for the subsequent two events, we followed a similar process. However, we were much more organized thanks to the experience we had gained. Additionally, our physical presentational environments were slightly different in each case, requiring us to set the robots up again.

V. Events

A. MINT Days

On October 25th, a group of 3rd graders from Musikmittelschule Götzis (a secondary school in Götzis) visited our school. We introduced them to our robots and demonstrated what they can do. Some of the children already had a little experience with robots and coding.

Fig. 2: Example demo code we prepared [4]

We started by giving the students a brief crash course in the C programming language and showed them some existing code:

- A program that demonstrated how the wheels and the arm work—our robot even performed a little dance.
- The code for a line-following robot. We placed a foil with a black line on the floor (fig. 3), which the robot was programmed to follow using its color sensor.

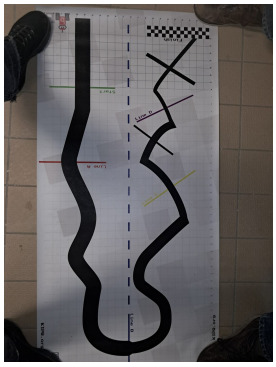

Fig. 3: A picture of the foil we taped to the ground

- An explanation of different sensors and their functions.
- A detailed demonstration of the pressure sensors, including a code example.
- A hands-on programming session in which we wrote a simple program together: the robot would drive for one second, grab an object while moving, and then throw it away (fig. 4).

  The children had a lot of fun, actively participated, and showed great interest, doing their best to engage with the tasks.

(a) Robot in its starting position

(b) Arm grabbing the foam roll

(c) Arm throwing the foam roll

Fig. 4: Three phases of a throw

B. Introductory Event

The Introductory Event took place from November 11th to November 15th. During this week, multiple 4th grade middle school students visited the school for an in-depth introduction to everything it has to offer. In addition to the primary subjects, our extracurricular robotics class was included in the presentations as well.

For each group of students, ranging from 2 to 5 members, we had around 10 minutes to explain key concepts and give them some insight into robotics. The first two minutes were spent introducing the extracurricular class and explaining what we do in it. We then quickly moved on to explaining the robot's hardware, piece by piece, using demo programs we had prepared in advance. The order of explanation was as follows:

- Basic hardware: We started by introducing the essential components of the robot, such as the wheels, arm, and claw. To demonstrate, we used the Dance Program, which we had retained from the MINT Days event.
- Sensors: Next, we explained the different sensors on the robot. We adapted two programs from the MINT Days event for this part—one demonstrating the pressure sensors, which detect when the robot bumps into an object, and another called the Line Follower. The Line Follower used a light sensor to initiate the program and a color-detecting sensor to differentiate between black and white, allowing the robot to follow a black line on a foil we had taped to the ground.
- Code explanation: While the robot followed the line, we briefly explained how the program worked, providing a basic introduction to the code without going into too much depth due to time constraints.
- Distance sensor (if time was left): If there was any remaining time, we also introduced the distance sensor, using a program that made the robot move faster the farther away it detected an object (via Braitenberg vehicle concept). If the object was directly in front of it, the robot would come to a complete stop.

After 10 minutes, the students moved on to the next station, and the process repeated.

1) Results of the Event: After each wave of students, the guides conducted a survey, which revealed that only a few students were genuinely interested in our station. Most of them were more focused on the primary subjects, which was a stark contrast to the previous event, where students showed much greater engagement and enthusiasm. This difference could likely be attributed to the short amount of time we had with each group.

C. Open House Days (TDoT)

From November 22nd to 23rd, the school hosted its annual Open House Days, which coincided with the introductory event. This event takes place around the same time each year, but this was the first time our elective subject, robotics, was officially presented. During these two days, anyone interested could visit the school and explore the different subjects and activities on display.

To prepare for the event, we made quick adjustments to our hardware, ensuring that any broken or malfunctioning components were fixed, and we resolved any remaining bugs in our code. We set up our station with multiple robots, allowing some to move continuously when not in use to showcase various programs and functions.

When visitors approached our station, we first introduced the extracurricular class before diving into more detailed explanations—following the same structure as during the introductory week. However, since there was no strict time limit, we had the opportunity to explore different topics in greater depth based on the visitor's interest. We explained the code line by line, provided a more detailed breakdown of how the hardware functioned, and even allowed motivated visitors to experiment with the code themselves.

Since our visitors ranged in age from as young as six years old to adults, we adjusted the level of explanation accordingly. We took care not to overcomplicate concepts, ensuring that everything was easy to understand for everyone.

Most primary and secondary school students who visited our station already had some exposure to robotics, either through school courses or personal projects. Interactive programs like the Dance Program and the Distance Sensor Program were particularly popular across all age groups, as being able to interact with the robots made the experience more engaging and exciting.

VI. Conclusion

Across all three events, we observed a mix of engagement levels among the students. While some showed great interest and actively participated in learning about robotics, others were less enthusiastic and did not engage as much with the activities. However, the majority of students were curious, eager to try things out for themselves, and excited to interact with the robots.

For many students, getting hands-on experience with the robots was the highlight of the events. They enjoyed experimenting with different functions, testing out the sensors, and even modifying small parts of the code. This interactive approach made it easier for them to grasp the basics of robotics and programming. On the other hand, some students preferred to observe rather than participate actively, either due to a lack of prior experience or simply because they were not particularly interested in the topic.

Despite these differences, the overall response was positive. Most students were engaged, asked questions, and showed enthusiasm for trying out the robots themselves. This indicates that events like these can be an effective way to introduce young learners to robotics, giving them an opportunity to explore technology in a fun and accessible way.

VII. Acknowledgment

We would like to express our gratitude to the teachers and staff at HTBLuVA Dornbirn for their support in organizing and facilitating these events. A special thanks to the students who participated with enthusiasm and curiosity, making our efforts truly worthwhile. We also appreciate the contributions of our team members, whose dedication and teamwork ensured the success of each event. Finally, we acknowledge the importance of extracurricular programs in fostering interest in STEM fields and hope to see continued efforts in promoting robotics education for future generations.

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