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Special edition

Robotics as an interdisciplinary tool in physics

Robótica como ferramenta interdisciplinar na física

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ABSTRACT

Educational robotics as a pedagogical resource is still a high-cost tool, and for this reason, restricted to a few students. Studies show that robotics as an educational tool allows students to relate knowledge from different areas, enabling dynamic learning. As a low-cost solution, this project proposes to develop a small robot prototype. The proposed prototype moves freely with two engines and when it collides with an obstacle, it changes its direction immediately. The construction of this prototype is carried out using two mini DC 1.5V motors, two micro switch keys, a battery holder, a piece of galvanized sheet metal, a small switch, and paper clips. The principle of movement of the robot is based on the on/off switches, which turn off/on the motors. In collisions with objects, the on/off mechanism guarantees changes in direction and direction. Vectors, circuits, electric current are some of the possible studies through this project. Teaching the circuit involved in the prototype, and its assembly, can transform physics and science classes in general into something more attractive to the student and promote meaningful learning of content in exact areas.

Keywords: Educational robotics; Teaching; Physics

RESUMO

A robótica educacional como recurso pedagógico ainda é uma ferramenta de alto custo, por isso restrito a poucos estudantes. Estudos mostram que a robótica como ferramenta educacional proporciona aos estudantes relacionar conhecimentos de diferentes áreas, possibilitando o aprendizado de forma dinâmica. Assim, como uma solução de baixo custo, propõe-se desenvolver um pequeno protótipo de robô. O protótipo movimenta-se livremente com dois motores e, ao chocar-se com algum obstáculo, ele altera sua direção imediatamente. Sua construção é realizada com o uso de dois minimotores

CC 1,5V, duas chaves microinterruptor, um suporte de pilhas, um pedaço de chapa galvanizada, um pequeno interruptor e clips de papel. O princípio de movimento do robô baseia-se no liga/desliga dos interruptores, os quais controlam os motores. Nas colisões com objetos, esse é o mecanismo que lhe garante as mudanças de direção e sentido. Vetores, circuitos e corrente elétrica são alguns dos possíveis estudos através deste projeto. O ensino do circuito envolvido no protótipo e a sua montagem podem transformar as aulas de física, e de ciências de modo geral, em algo mais atrativo ao estudante e promover a aprendizagem significativa de conteúdos de áreas exatas.

Palavras-chave: Robótica educacional; Ensino; Física

1 INTRODUCTION

Physics teaching has faced several challenges. The biggest challenge is associated with students' lack of interest in the discipline. The lack of motivation in Physics classes has been attributed in most studies to traditional teaching methodologies based solely on solving problems and memorizing concepts and formulas.

In this context, educational robotics (ER) as an active methodology for teaching Physics has been proven to be a promising tool for learning. In a brief review of the literature, several definitions of educational robotics can be found.

Baía *et al.* (2023) define ER as a learning environment that comprises the assembly, automation and programming of objects using different areas of knowledge such as Physics, Mathematics, electronics and computing. In this context, RE is understood as a tool to assist in the learning process. Moraes *et al.* (2023) defines educational robotics as a possibility to assist in the development of student's skills about 21st-century technology.

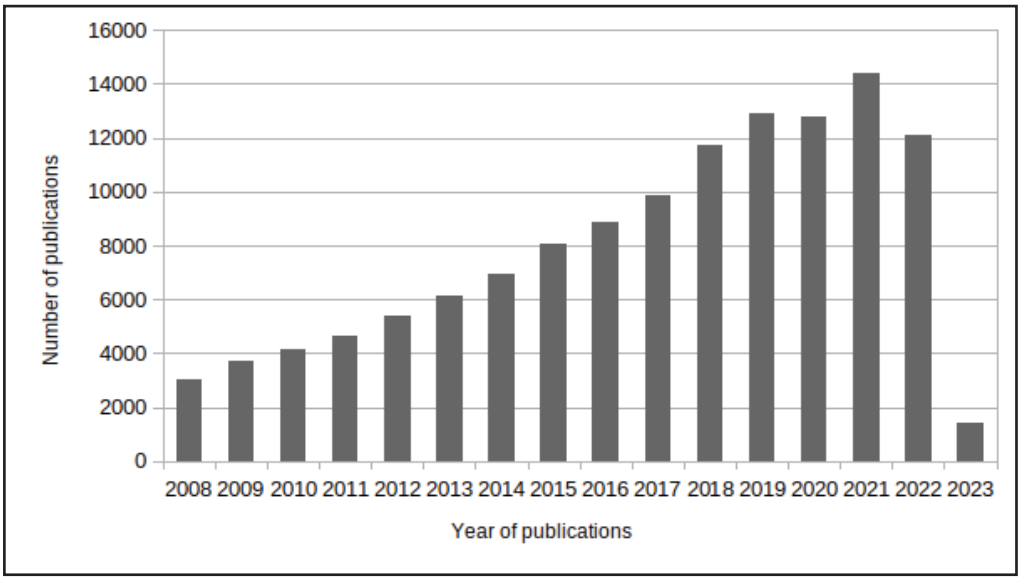
In Physics teaching, it is possible to find in the literature works associated with the use of educational robotics aimed at basic experiments in Physics and even proposals to help correct misconceptions. However, most studies are restricted to the use of ready-made robotic kits whose objective is limited to the motivational factor.

Thus, this work proposes the construction of a small non-programmable robot prototype as an educational proposal for multidisciplinary teaching for children.

2 MATERIALS AND METHODS

The first step of this study was to analyze what has been done in recent years associated with robotics and physics, in primary and secondary education. A superficial systematic review of educational robotics and Physics teaching was carried out. The Google Scholar search tool was employed using the keywords *"Robotics+physics"*. It was possible to observe that there are more than sixty-five thousand works associated with the selected search words, without performing a filtering process. Another important piece of information was the growth in production from 2008 to 2023, as shown in Figure 1.

Figure 1 – Published works on robotics and physic



Source: Authors (2023)

In total publications from 2008 to 2023, it was found that there was an increase of more than four hundred percent from 2008 to 2022, with a peak of production in 2021 with more than fourteen thousand works in the period of the covid-19 pandemic.

An analysis of the works showed that most of the studies were restricted to the purchase of robotics kits for use in the classroom. This makes it limiting the use of robotics in most schools. Thus, below, in Table 1 are described the necessary materials for the elaboration of a small non-programmable robot for children.

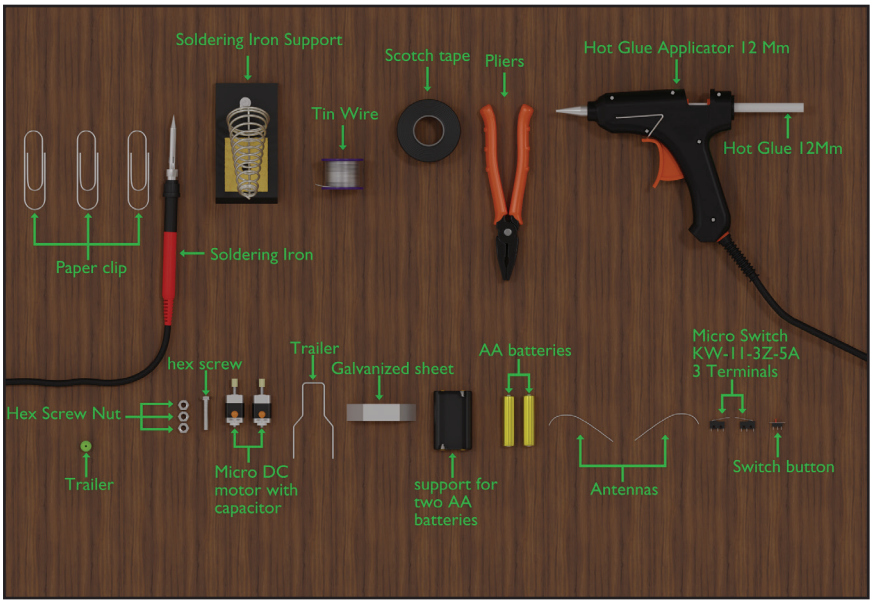
Table 1 – The materials necessary for the elaboration of the educational prototype

Number	Materials
2	motor 1,5 v
2	Micro Switch KW-11-3Z-5A 3 Terminals
1	Support for AA batteries
2	AA batteries
1	piece of galvanized sheet
1	small switch
1	Soldering Iron
1	Soldering Tin Base Tube
1	Scotch tape
1	applicator glue gun
1	hot glue stick
2	galvanized paper clip

Source: Authors (2023)

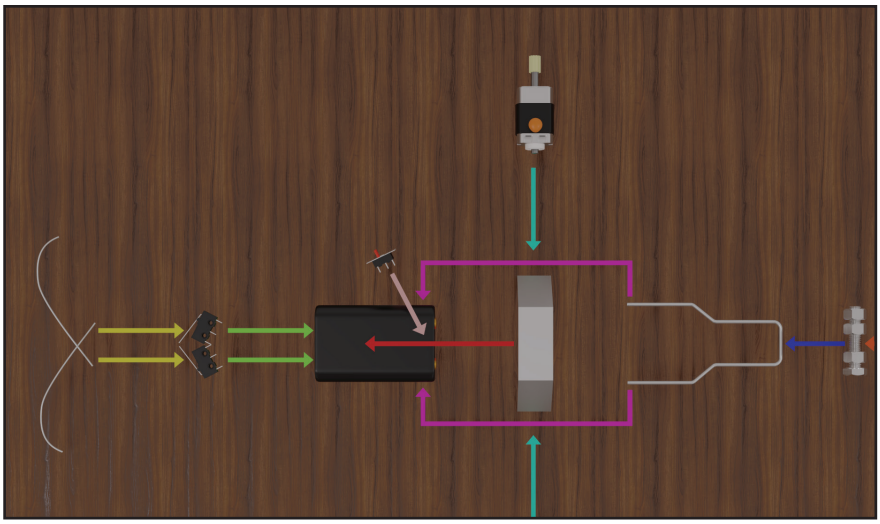
Figure 2 shows the materials used in making the robot, according to Table 1. Figure 3 shows the connection of the robot components.

Figure 2 – Materials used to build the Robot



Source: Authors (2023)

Figure 3 – Robot Schematic

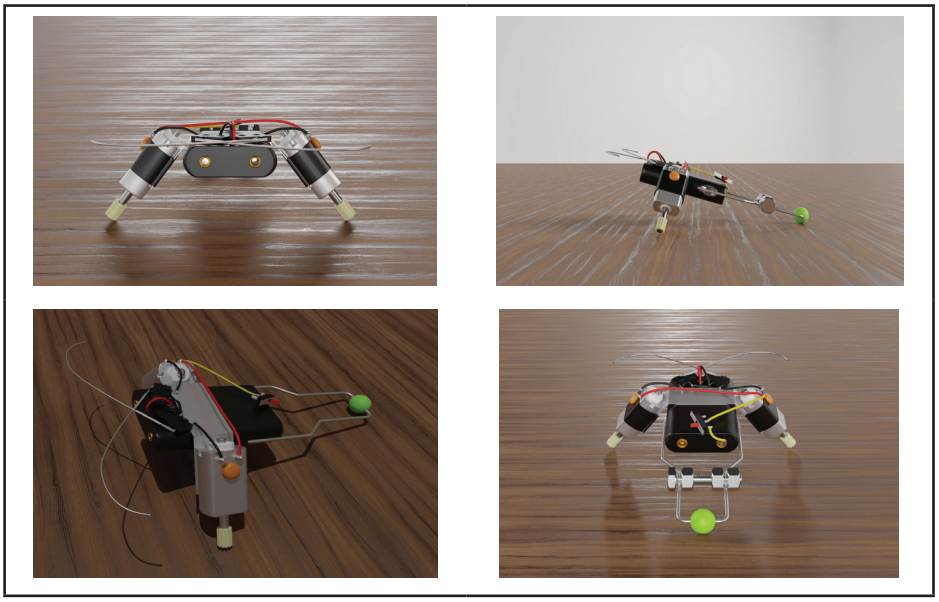


Source: Authors (2023)

3 Results And Discussion

Figure 4 presents the educational prototype that was developed from the materials presented in Table 1. In Figure 4, it is possible to observe the prototype in top and bottom views. This prototype was presented at the 1st Science, Technology and Innovation Fair - UFSM-CS.

Figure 4 – Non-program Robot prototype



Source: Authors (2023)

The robot's movement is controlled by the switch's drive system, which controls the connection of the motors. In situations where the robot encounters an obstacle, it collides with it and the on/off system allows changing the direction and the sense of movement.

4 CONCLUSIONS

The robot, designed and exhibited at the 1st Science, Technology and Innovation Fair - UFSM-CS, allowed for the presentation and discussion of content such as vectors, circuits and electric current in a playful way. Teaching the electrical circuit involved in the prototype, and its assembly, can transform physics and science classes in general into something more attractive to the student and promote meaningful learning of contents in exact areas.

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