Construction of an interdisciplinary experiment with the Arduino platform in the classroom

Arquimedes LUCIANO

UniCesumar, Av. Guedner, 1610, 87050-900, Maringá, Brasil

Ana Paula GIACOMASSI-LUCIANO

University State of Maringá, Av. Colombo, 5790, 87020-900, Maringá, Brasil

Hélio TAKAI

Stony Brook University, 100 Nicolls Rd, Stony Brook, NY 11794, EUA

Abstract. Modern and contemporary physics constitutes a highly developed scientific field and form the basis for the manufacturing of numerous devices used in a wide range of applications in today's society. The problems associated with the inclusion of these subjects in the Brazilian high school are diverse. Among them we can mention the cost of implementing laboratories with modern physics experiments in public school. The present work discusses the construction of an experiment of the photoelectric effect, making use of the Arduino platform providing a greater accessibility to high school teachers.

1 Introduction

There is currently a quasi-natural quest for the use of multimedia or computer resources to aid the teaching process. The use of information technology has allowed to translate, in different forms, a set of data related to the same phenomenon, so collect data and select them eventually; find different models and test them on the computer. The use of experimental activities of topics covered in Modern and Contemporary Physics can help the student's motivation and understanding of the learning of these themes by approaching the concepts from the contact with physical phenomena. However, in several locations, the task of equipping schools with equipment capable of enabling such practices becomes complex, since such acquisition demands financial resources as well as rapidly training large groups of teachers able to carry out the activities [1]. It is considered an extremely time consuming task. An alternative to the problem of agile dissemination of laboratory equipment, especially in the case of more expensive equipment, is the open-source technologies.

2 Methodology

The objective of this work is to provide teachers with the necessary skills in the construction of low cost experiments in the classroom, thus aiding the teaching of Modern and Contemporary Physics. In this context, we chose to develop the experiment using the Arduino Platform, because it represents a possibility to implement a range of technological resources for teaching. In our proposal, due to the innovative possibilities that the current electronic embedded technologies allow, we built a system that uses hardware at an affordable cost and all the programming was done using open source software tools, that is, the source code is available freely so that other researchers who follow our proposal build their own laboratories.

In order to allow the realization of the proposed experiment, we used an Arduino UNO as interface board for the acquisition of analog data and the conversion of this data to digital values. Analog data were obtained from a light dependent resistor (LDR). Thus, when receiving photons

on its sensitive surface, LDR converts these radiant energy packets into electrical energy by reducing the electrical resistance in the Cadmium Sulfide (CdS) compound [2]. Thus, when illuminating the LDR with different luminous intensities, it presents a variation in its electrical resistance. Therefore, by associating the LDR with another resistor in an electrical circuit configuration called the voltage divider, it was possible to detect the variations of the electrical resistance in the LDR due to the changes of luminous intensity on the LDR.

We developed a sketch in programming language for the Arduino to collect the data and subtract the value of the calibration. Presenting this data to the computer through serial communication bus.

Thus, using a light source we obtained a standard of intensity and with this carry out the calibration of the system of perception of light. With the calibrated data acquisition system, we illuminated several leaves of plants of the Brazilian fauna and starting from the light reflected by the leaves, we identified a change in the intensity of light coming from the change in the reflectivity of the leaves.

In this way it was possible to identify the occurrence of the photoelectric effect and to promote the interdisciplinarity in the discussions fomented by the experiment that involve physical aspects related to the photosynthesis of such plants. In figure 1 (Fig. 1), we can see an illustration that represents the electronic circuit used, it is highlighted that the assembly took place on a prototype board to facilitate the construction of the prototype. With the accomplishment of this activity it was possible to produce a correlation between the intensity of light reflected by a surface and its color.

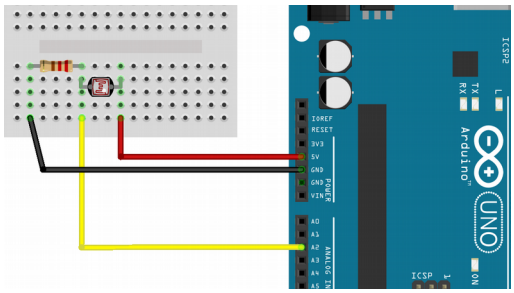

Fig. 1: Electrical Assembly Diagram

3 Conclusion

Researches in the construction of resources for experiments related to modern and contemporary physics have developed in education, but their effective insertion in school faces problems such as the lack of preparation of teachers, the difficulty of physical spaces and laboratories in schools, the lack of resources to acquire equipment, which, in many cases, are not very easily found in all of Brazilian cities.

In this way, reflecting on new formats of educational strategies is relevant to solving such difficulties. We verified in the developed experiment that the participating teachers were able to understand new technological resources that can be used in their classes. And this has developed more autonomy so that they can think of other experimental activities in the classroom, treating that contents that were previously present in textbooks and that the discussions did not go beyond the abstraction in the classroom.

References

[1] F. Ostermann and M.A. Moreira, Atualização do currículo de física na escola de nível médio: um estudo dessa problemática na perspectiva de uma experiência em sala de aula e da formação inicial de professores. Caderno Catarinense de Ensino Física, Florianópolis, v. 18, n. 2, p. 135-151, ago. 2001.

[2] E.C. Valadares and A.M. Moreira, Ensinando Física Moderna no Ensino Médio: Efeito Fotoelétrico, Laser e Emissão de Corpo Negro. Cad Cat de Ens de Fís, Florianópolis, v. 15, n. 2, p.359-372, ago. 1998.