



DESIGN OF PROGRAMMABLE ELECTRONIC CIRCUITS WITH MID-RANGE PIC MICROCONTROLLERS FOR ROBOTICS LABORATORIES

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Abstract: *Through this document, it was possible to analyze the main characteristics of the volume of scientific production regarding the study of the variables Electronic Circuits, Robotics Laboratory in order to know the usefulness of programmable electronic circuits within the activities carried out in robotics laboratories. A bibliometric analysis was proposed to analyze details such as Year of Publication, Country of Origin of the publication, Area of Knowledge in which the published research is carried out and the Type of Publication most frequently used by the authors of each document published in high-impact journals indexed in the Scopus database during the period between 2017 and 2022. Among the main findings, it was possible to determine that, for the execution of the different research methodologies, the report of 16 scientific documents related to the study of Electronic Circuits and Robotics Laboratory was achieved. The maximum number of publications made in a year was 3 documents submitted in 2017 as well as in 2019, 2020 and 2021. The country of origin of the institutions that reported the highest number of records in Scopus, was Italy with 3 documents, the same number presented by authors affiliated with institutions in the United States. The area of knowledge with the greatest influence at the time of executing the research projects that resulted in scientific publications was Engineering, which contributed great theoretical material in a total of 12 publications, followed by Computer Science with 9 documents. Finally, the type of publication most frequently used to publicize findings from the analysis of the aforementioned variables was the Journal Article, which represented 50% of the total scientific production.*

Keywords: *Electronic Circuits, PIC Microcontrollers, Robotics Laboratories.*

1. INTRODUCTION

Since the invention of closed circuits and the constant development of electronics this has allowed the passage to increasingly complex devices, among which we find microcontrollers, which are integrated circuits that allow the incorporation of all the functional elements of a system of microprocessors, which are responsible for decoding Combinations of bits which constantly generate digital signals a sequence series which allows to control an electronic folding system or subsystem. Such attributes make the implementation of these circuits an important device to know and master, which generates the need to understand more thoroughly and with this obtain better knowledge



necessary for the proper programming of these devices and for the development of digital and analog systems.

The design of programmable electronic circuits with mid-range PIC microcontrollers for electronics laboratories has been designed in order that the circuit simulation trainer through the implementation of PIC microcontrollers incorporates a new laboratory equipment useful for due learning and practice for undergraduate students in training and electronics laboratories which implements the proper practice and knowledge of programming and Simulation of devices, so it is necessary the relationship of a small research focused on the investigation of the most common electronic programming systems and used in the industry, because of this, the model tends to incorporate various paradigms in such a way that they have the largest number of electronic elements for the proper application in both professional and academic practices.

The programmable circuits of microcontrollers allow the use of practical exercises which incorporates a series of electronic elements such as, stepper motor, servo, digital potentiometers, converters, among others, the results obtained in the application of these circuits have been favorable achieving the control of modules of the laboratories of mechatronics and electronics, In addition, this provides a series of documentation elaborated in an easy to understand and analyze incorporating features, programming, connection with IC-prog, MicroCode and multiple connections. For this reason, this article seeks to describe the main characteristics of the compendium of publications indexed in the Scopus database related to the variables Electronic Circuits, Robotics Laboratory in order to know the usefulness of programmable electronic circuits within the activities carried out in robotics laboratories Like this. As the description of the position of certain authors affiliated with institutions. during the period from 2017 to 2021.

2. GENERAL OBJECTIVE

Analyze from a bibliometric approach, the characteristics in the volume of scientific production related to the Electronic Circuits and Robotics Laboratory, registered in Scopus during the period 2017-2022.

3. METHODOLOGY

This article is carried out through a mixed orientation research that combines the quantitative and qualitative method.

On the one hand, a quantitative analysis of the information selected in Scopus is carried out under a bibliometric approach of the scientific production corresponding to the study of Electronic Circuits and Robotics Laboratory

On the other hand, examples of some research works published in the area of study indicated above are analyzed from a qualitative perspective, starting from a bibliographic approach that allows describing the position of different authors against the proposed topic.

It is important to note that the entire research was carried out through Scopus, managing to establish the parameters referenced in *Figure 1*.

3.1 Methodological design

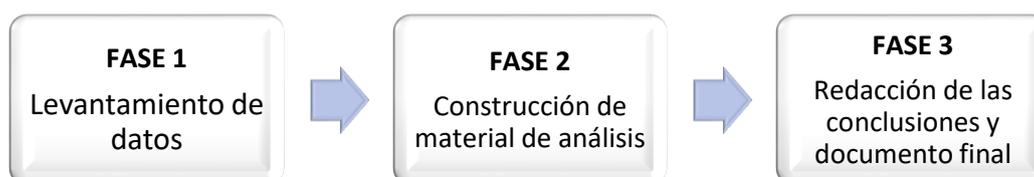


Figure 1. Methodological design

Source: Authors.

3.1.1 Phase 1: Data collection

Data collection was executed from the Search tool on the Scopus website, where 16 publications were obtained from the choice of the following filters:

- TITLE-ABS-KEY (electronic AND circuits, AND robotics AND laboratory) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017))
- Published documents whose study variables are related to the study of Electronic Circuits and Robotics Laboratory.
- Works published in journals indexed in Scopus during the period 2017-2022.
- No distinction by country of origin
- Without distinction in areas of knowledge.
- Regardless of type of publication.

3.1.2 Phase 2: Construction of analysis material

The information collected in Scopus during the previous phase is organized and subsequently classified by graphs, figures and tables as follows:

- Co-occurrence of Words.
- Year of publication.
- Country of origin of the publication.
- Area of knowledge.
- Type of Publication.

3.1.3 Phase 3: Drafting of conclusions and outcome document

In this phase, we proceed with the analysis of the results previously yielded resulting in the determination of conclusions and, consequently, the obtaining of the final document.

4. RESULTADOS

4.1 Co-occurrence of words

Figure 2 shows the co-occurrence of keywords found in the publications identified in the Scopus database.

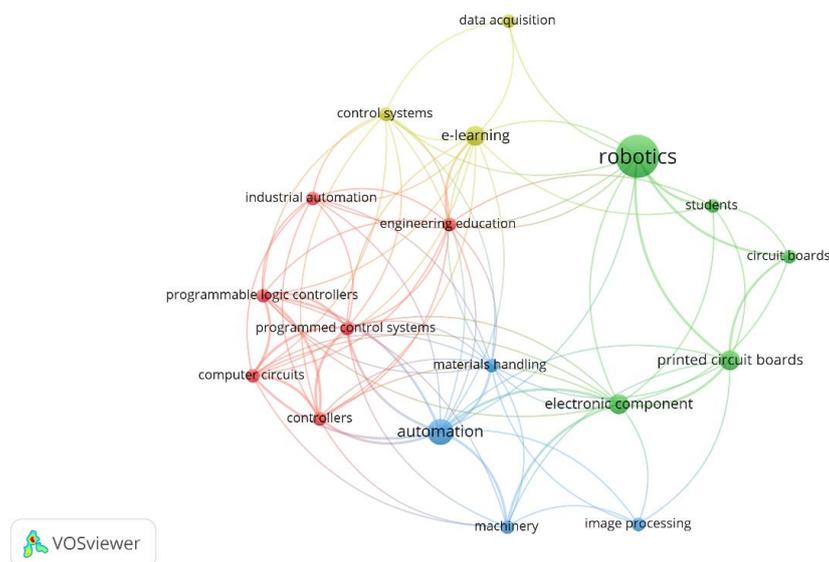


Figure 2. Co-occurrence of words

Source: Own elaboration (2023); based on data exported from Scopus.

Robotics was the most frequently used keyword within the studies identified through the execution of Phase 1 of the Methodological Design proposed for the development of this article. Electronic Components is also among the most frequently used variables, associated with variables Electronic

Circuits, Robotics Laboratory in order to know the usefulness of programmable electronic circuits within the activities carried out in robotics laboratories. From the above, the relationship between the implementation of microcontrollers is striking since it has a versatile low-cost system which allows detecting input and output signals of equipment, systems and other electronic and mechatronic instruments which has features that allow the easy implementation of intelligence systems throughout many more complex systems, Since microcontrollers have great features like which we enter that these are the most abundant semiconductors that we know today.

4.2 Distribution of scientific production by year of publication

Figure 3 shows how scientific production is distributed according to the year of publication.

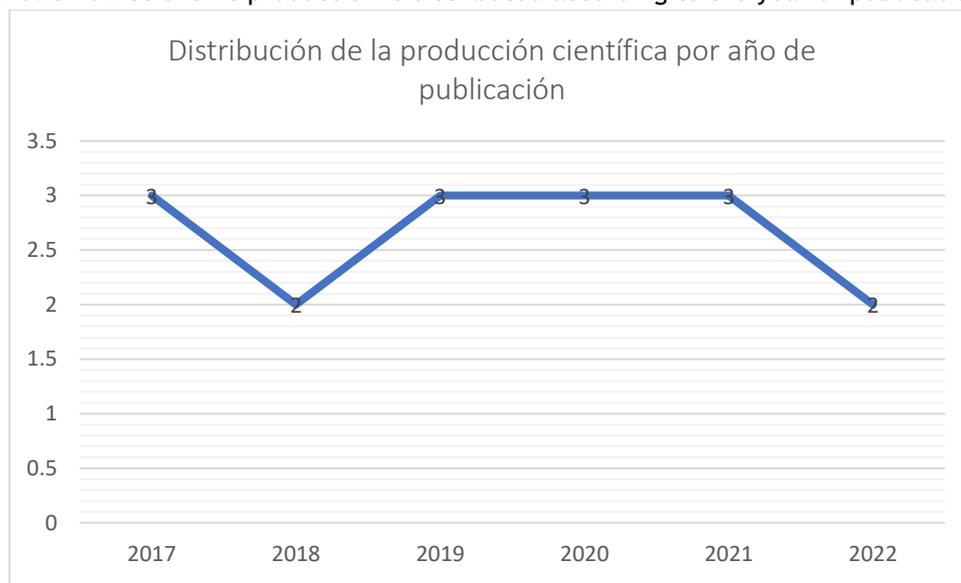


Figure 3. Distribution of scientific production by year of publication.

Source: Own elaboration (2023); based on data exported from Scopus

Among the main characteristics evidenced by the distribution of scientific production by year of publication, a level of number of publications registered in Scopus is notorious in the years 2019, 2020 and 2021, reaching a total of 3 documents published in journals indexed in said platform. The above can be explained thanks to articles such as the one entitled "autonomous quadcopter with method of detection of objects in image as a sender of assistance for covid-1 patients" (Judge, 2021) this article aims at an image processing system such as a QR code detector in a quadcopter. The quadcopter will detect the presence of a QR Code, after the QR Code is detected, the mechanical system of the quadcopter will drop objects, in this case, medicines for Covid-19 patients, at a predetermined point. The steps necessary to complete this investigation are the design and assembly of the quadcopter, the black box test, and the direct test of the quadcopter that sends medical help. The design and assembly process is carried out in the robotics laboratory of Yogyakarta State University. The black box testing process is used to test the performance of the software in the quadcopter, which uses 3 different types of QR Code. The experimental testing process is used to test the electronic and mechanical circuits of the quadcopter, whether the circuit works properly or not. The software used in this research is python IDLE 3.6. The results of the black box test show that the system works optimally, where the quadcopter can detect all existing QR codes. While in the experimental results, the quadcopter can drop objects in predetermined locations.

4.3 Distribution of scientific production by country of origin.

Figure 4 shows how scientific production is distributed according to the nationality of the authors.

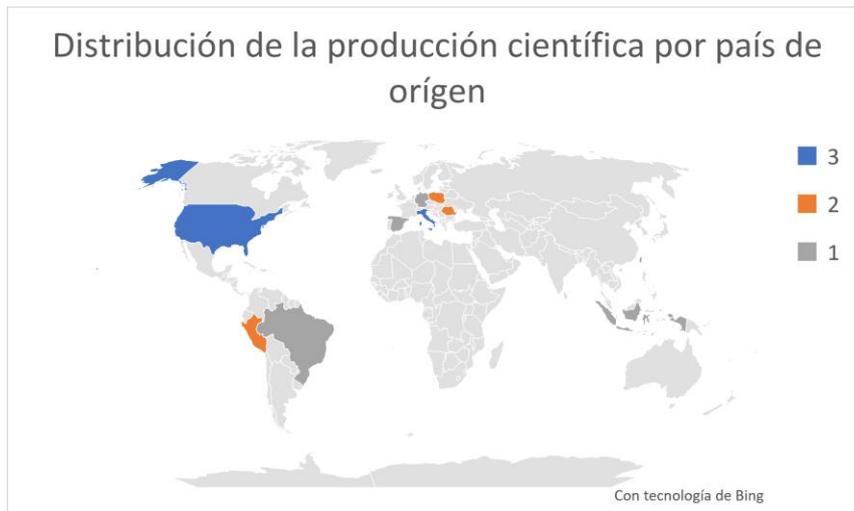


Figure 4. Distribution of scientific production by country of origin. Source: Own elaboration (2023); based on data provided by Scopus.

Within the distribution of scientific production by country of origin, records from institutions were taken into account, establishing the United States, as the country of that community, with the highest number of publications indexed in Scopus during the period 2017-2021, with a total of 3 publications in total. In second place, Italy with 2 scientific papers, and Brazil occupying the third place presenting to the scientific community, with a total of 1 documents among which is the article entitled "Conversion methodologies from Signal Interpreted Petri Nets to Ladder Diagram and C language in Arduino " (Borges, 2018) The purpose of this work is to formally define the Interpreted Petri Network of Signals and develop two didactic methodologies to be used in laboratory classes: convert the Petri Network Interpreted of Signals in Ladder Diagram for Programmable Logic Controller and convert the Petri Network Interpreted of Signals in C language for Arduino Microcontroller. These methodologies will be illustrated by applying the formal definition of Signal Interpreted Petri Net in an example.

4.4 Distribution of scientific production by area of knowledge

Figure 5 shows the distribution of the elaboration of scientific publications from the area of knowledge through which the different research methodologies are implemented.

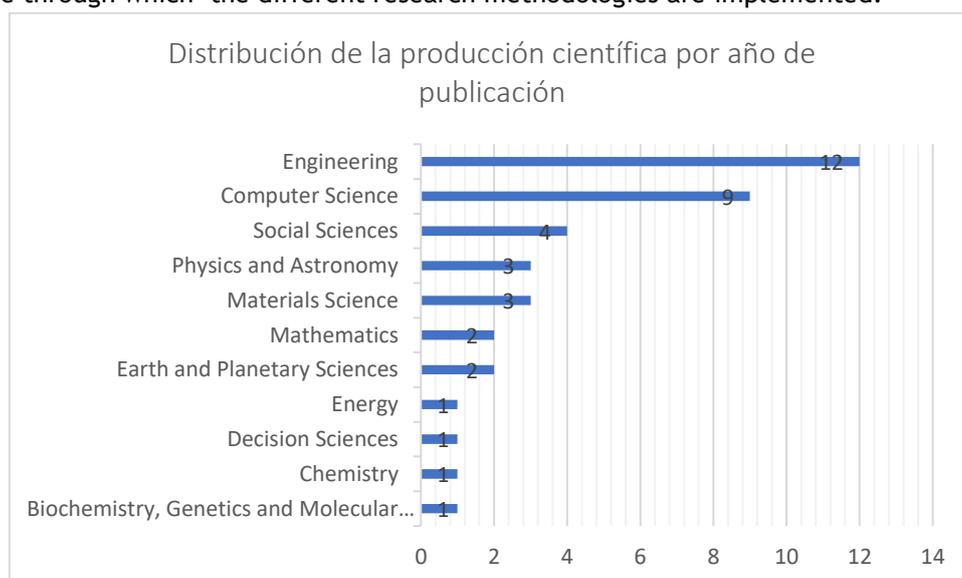


Figure 5. Distribution of scientific production by area of knowledge. Source: Own elaboration (2023); based on data provided by Scopus.



Engineering was the area of knowledge with the highest number of publications registered in Scopus with a total of 12 documents that have based their methodologies Electronic Circuits, Robotics Laboratory in order to know the usefulness of programmable electronic circuits within the activities carried out in robotics laboratories. In second place, Computer Science with 9 articles and Social Sciences in third place with 4. The above can be explained thanks to the contribution and study of different branches, the article with the greatest impact was registered by the Engineering area entitled "Interconnected machinery for the automated disassembly, separation and recovery of valuable materials from electronic equipment - advances of the ADIR project" (Noll R, 2019) The aim of the ADIR project is to obtain a new quality of valuable sorting fractions of electronic products at the end of their useful life (EOL) with a high enrichment of valuable materials by physical separation [1]. Massive flows of EOL electronics come from mobile phones (MPH) and printed circuit boards (PCBs) from servers and switching electronics for telecommunications purposes. While for conventional production the input materials and components are, as a rule, well known, the situation of reverse production is much more challenging. The variety of characteristics of the material to be processed is very wide and often there is no or little information available. Therefore, for automated selective processing the following processes are required: - pre-classification and singling of the input material, - image processing to recognize types of models, orientations; positions of MPH, PCB, - robotic handling of MPH and PCB: collection, transfer, dismantling actions, - training of dismantling actions by test sets, elaboration of sets of dismantling recipes.

4.5 Type of publication

In the following graph, you will observe the distribution of the bibliographic finding according to the type of publication made by each of the authors found in Scopus.



Figure 6. Type of publication.

Source: Own elaboration (2023); based on data provided by Scopus.

The type of publication most frequently used by the researchers referenced in the body of this document was Session Paper with 50% of the total production identified for analysis, followed by Articles with 44%. The Review Conferences are part of this classification, representing 6% of the research papers published in journals indexed in Scopus. In this last category, the one entitled "A PBL approach to teaching the fundamentals of electronics through the development of robotics projects" stands out. (Moon, 2020) In this paper we present a project-based learning approach to teach basic concepts of electronics to university students of commercial and information engineering. In each lab session, students complete a project using robotics tools and various electronics basics. In this way, students develop skills in electronic circuit design, problem solving, and teamwork. In addition, the course includes programming in Arduino. The results indicate that learning the fundamentals of

electronics through various robotic projects not only motivates students but allows them to experiment and discover the link between physics, technology and engineering.

5. CONCLUSIONS

Through the bibliometric analysis carried out in the present research work, it was established that the United States was the country that has the largest number of records published for the variables Electronic Circuits, Robotics Laboratory in order to know the usefulness of programmable electronic circuits within the activities carried out in robotics laboratories in order to know the impact that good practices of electronic circuit designs in total electronics laboratories with a total of 3 publications in Scopus database. In the same way, it was established that the application of theories framed in the area of Engineering, were the most frequently used in the measurement of the impact generated by the implementation of programmable electronic circuit designs with mid-range PIC microcontrollers for electronics laboratories. allow the development of new tools, which facilitate access to the execution of any program or simulations allowing electronics and mechatronics laboratories to develop and work several PIC models, hence the recommendation of new models. The implementation of remote and virtual laboratories are, of greater importance for the use of complex digital circuits and microcontrollers, in learning systems of logical, analog and programmable power devices are of greater relevance for student learning, on the other hand, the laboratory practices of electronics and mechatronics are often more enjoyable and at the same time allows the ability to relate between logical values and The values of voltage and intensity in order to bring them closer to the reality of the electronics industry.

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