UDC: 004.421.4.052:005.92
Professional paper

INTERMODULAR SYSTEMS AND THE GENERATION OF CHARACTERISTIC VALUES FOR THE MANAGEMENT OF ELECTRONIC RESOURCES

Nderim Zeqiri[1], Ferit Idrizi[2], Eip Rufati[3], Bestar Zeqiri[4], Denis Sinani[5]

[1*,2,4] *University of Tetova, Faculty of Applied Sciences, n.n. 1200, Tetovo*
[3,5] *University of Tetova, Faculty of Natural Sciences and Mathematics n.n. 1200, Tetovo*
[*] *Corresponding author e-mail: nderim.zeqiri@unite.edu.mk*

Abstract

To find relevant values with characteristic parameters of the system, there is a need to create a structure that enables continuous communication within the system, and the ability to communicate with external devices considered objects that can be controlled. This requires the structuring of a stable environment, and the ordering of elements according to priority in command. If a system is set to regulate the flow of information then this system needs different resources, which represent the requirement to achieve the stabilization process through the inclusion of various electronic devices, auxiliary modules, etc. This paper deals with the analysis of the system which sets the structured parameters of the system based on the help of certain electronic modules. Also, the system is described in analytical and tabular form, the definition of constructive parameters which follow in detail the activation of the system according to certain conditions of control elements and software programs that control the application of the system through the so-called programmatic approach. The tabular presentation enables the construction of the working logic of the system. This enables the control in the physical aspect, of all the elements intertwined in the system which, however, integrates devices of different formats, and is interconnected through the computer platform.

Keywords: Technology, control algorithm, interfaces, computer, software-applications.

1 Introduction

The various requirements that arise for the management of the characteristic values of electronic resources create the opportunity to command processes that are related to the aspects of control systems. For these processes, there is a need for a central database that manages these resources and which interconnects these digital systems. The purpose of this paper is also the harmonization of command links, for different electronic systems, and management to create a common collection point, data that can be used for technological access or access through specific commands. To realize this model, it is necessary to build a relevant system with all the necessary elements, starting from the modeling and interconnections of electronic elements and introducing the computer control system, or with microprocessor systems. Of course, for this, it is necessary to carry out some concrete assessments, through tabular comparisons of the respective values which must meet certain conditions for the proper functioning of this system. So, it is very important to note that there will be analyzed the performance and characteristics of some parametric values, which are very relevant to the normal functioning of the modeled structure, and access to elements either within the system itself, or elements and external equipment and so on [1][3].

2 Intermodular system for electronic resources and management through the control system

In Figure 1, it is clear that a suitable and generalized model includes the control system, sensors and actuators, the controlled object, and computer networks of different categories. To have a suitable shape for the model, all relevant elements should be included as shown in the highlighted figure. The system that controls has the task of establishing communication bridges with intermediary elements such as sensors and actuators. Sensors and actuators are the most useful elements because the sensor converts physical phenomena into electrical signals and then these signals are processed in electronic systems, which are located in the computer system, or any system with a microprocessor [2][4]. While the actuator has the opposite task of the sensor, so the actuator mainly converts electrical signals into physical phenomena, and in fact, access to various objects is realized, which is the main purpose of access, for example, coordination of movements through different drivers.

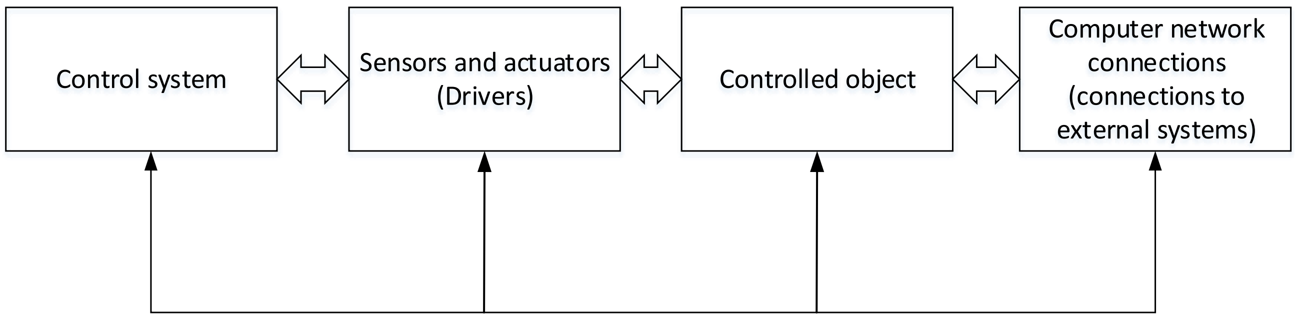

Figure 1. Sensors and actuators as elements of the management system

In Figure 2, the control system algorithm is constructed and structured, which is built for access to various electronic resources, including: computer and application software, sensors and actuators, external PLC systems or other auxiliary control systems, analog to digital and digital to analog conversions, shaft-encoder, as well as communication networks respecting international standards of access whether industrial or for institutional purposes, etc.

Another very characteristic part is the care for the obtained values, of the sensors and actuators. Digital systems accept only digital values, while analog systems accept only analog values. The following figure shows an intermediate structure that enables the conversion of digital values (D) to analog (A) and analog to digital. But the focus of the work is not the aspect of dealing with D / A or A / D conversion, because that requires another commitment. In the paper, this type of conversion is taken as an integral element of electronic resource management [3][8].

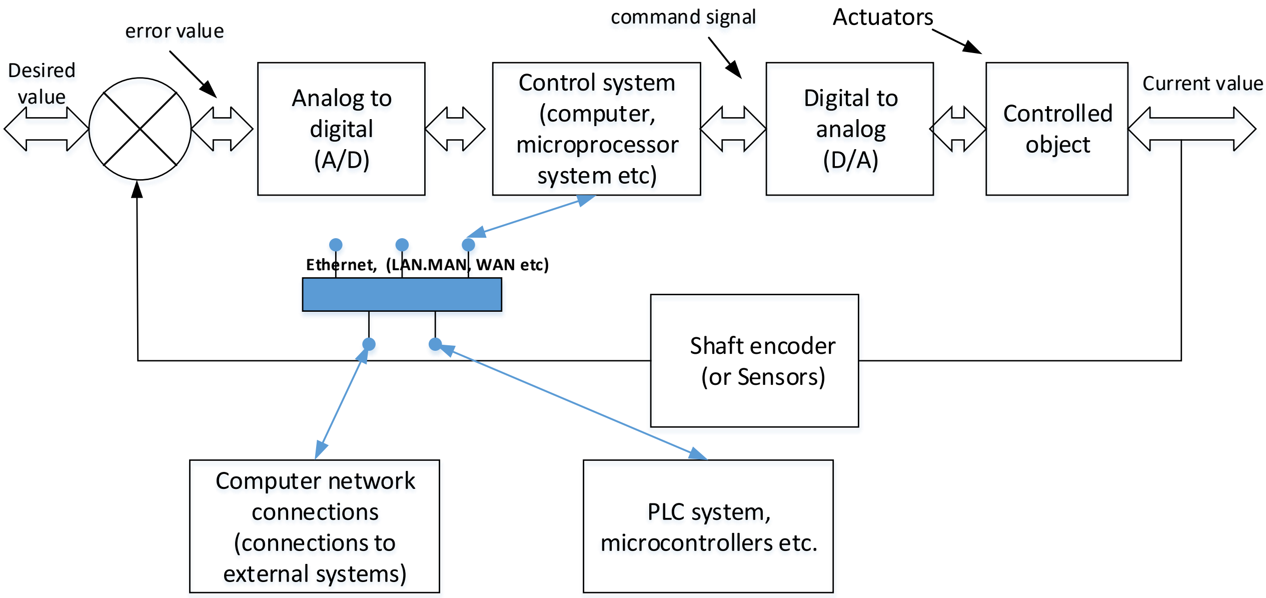

Figure 2. The control system algorithm and respective elements

Microprocessors, microcontrollers, and personal computers are widely used in computer control systems. It is increasingly important to understand how to directly access analog information and data from the surrounding environment with these devices. It can record the signal with an analog device such as a graphic recorder for the respective control systems etc. Another option is to store data using a microprocessor or computer. This process is called computer data retrieval and provides more compact data storage, and can result in greater data accuracy, which allows data to be used in a real-time control system, and enables data processing over time after the events have occurred. To be able to input analog data to a digital circuit, or microprocessor, then the analog data must be converted to digital values. The first step is the numerical evaluation of the signal at specific moments in time. This process is called sampling, and the result is a digitized signal consisting of discrete values corresponding to each sample. A digitized signal is a sequence of numbers that is an approximation to an analog signal. An important question is how quickly or often should the signal be sampled to get an accurate representation. The answer may be "as soon as possible." The problems with this conclusion are that a specialized, high-speed device is required and a large amount of computer memory is needed to store the data. A better answer is to choose the minimum sampling rate required for a given application that stores all the important signal information. The sampling theorem, also called the Shannon sampling theorem, says that we must sample a signal, then the sampling frequency must be twice as large as the maximum signal frequency [4][5].

In the next step, the characteristic sampling frequency formula is given:

$$f_s > 2f_{max} \qquad (1)$$

f_{max}- maximal frequency of the given signal
f_s -sampling frequency.

The following table gives some characteristic values, which represent different types of signals, such as: frequency of certain data, sound (audio, eg-4 KHz), video signals (e.g.32 KHz) etc., where for each of these are required the respective maximum frequencies, because through this is determined the bandwidth of the frequency band and the speed of transmission of signals through communication media and electronic resources [7][11].

Table 1. Sampling rate (sampling frequency)

	Maximal frequency [Hz]	**Sampling rate (sampling frequency) fs>=2fmax [Hz]**	**Sampling rate (sampling frequency) fs>=2fmax [kHz]**
1	2000	4000	4
2	3000	6000	6
3	**4000**	**8000**	**8**
4	5000	10000	10
5	6000	12000	12
6	7000	14000	14
7	**8000**	**16000**	**16**
8	9000	18000	18
9	10000	20000	20
10	11000	22000	22
11	12000	24000	24
12	13000	26000	26
13	14000	28000	28
14	15000	30000	30
15	**16000**	**32000**	**32**
...	...	...	...
31	**32000**	**64000**	**64**
...	**...**	**...**	**...**

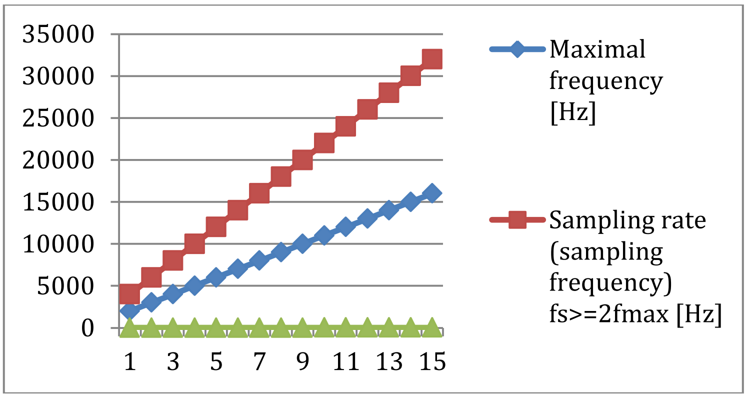

Figure 3- Graphical representation of maximum frequency and sampling frequency

The time interval between digital samples is:

$$\Delta t = 1/f_s \qquad (2)$$

The purpose of the values generated in Table 2, these values are more important because can be predetermined the time step, respectively by the time interval, to determine the specific frequency and deterministic band of the respective signal. As an example, if the sampling rate is 8000 Hz, the time interval between samples would be 0.125 ms.

Table 2. The time interval between samples

	Sampling rate	**The time interval between samples Δt=1⁄fs (ms)**
1	2500	0.400
2	3000	0.333
3	3500	0.286
4	4000	0.250
5	4500	0.222
6	**5000**	**0.200**
7	5500	0.182
8	6000	0.167
9	6500	0.154
10	7000	0.143
11	7500	0.133
12	**8000**	**0.125**
13	8500	0.118
14	9000	0.111
15	9500	0.105
16	...	...

3 Reconstruction of the original signal, some formulations in terms of conversion

Reconstruction of sample signals-As an example of a continuous analog signal, it can be digitized through sampling and then reconstruct [6][7].

The technique used to reconstruct a continuous analog signal from a sampled data set is called a synchronization reconstruction filter. The equation used to perform the reconstruction is as follows:

$$f(t) = \sum_{i=0}^{N_s} F_i \cdot \sin\left(\pi \cdot \frac{t - t_i}{\Delta t}\right) \qquad (3)$$

Where f(t) is the reconstructed analog signal, based on Ns + 1, Fi samples recorded at ti moments at a fixed interval Δt.The sinc function (pronounced "sink") is defined as:

$$sinc(x) = \frac{\sin(x)}{x} \qquad (4)$$

A graph of the sinc function with x scaled by π, is shown in Figure 4.

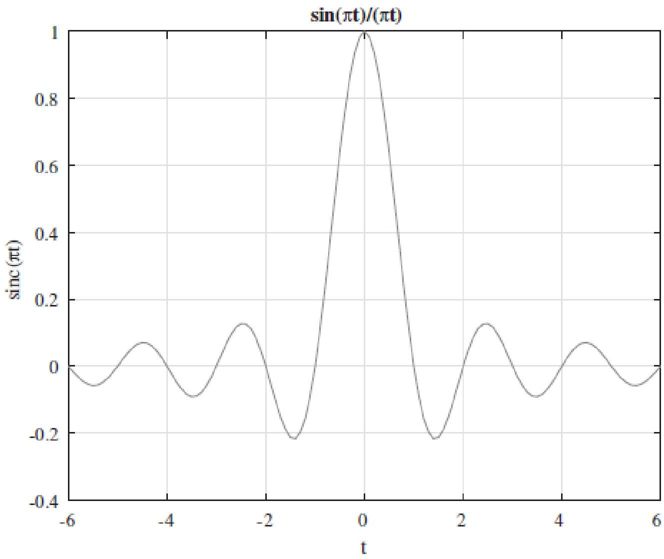

Figure 4. sinc function, with x scaled by π

Any analog signal with any number of frequency components can be reproduced similarly with high accuracy, assuming that there are sufficient samples on both sides of the areas of interest, and even then, the filter can be modified to handle start and end, applying the filter does not spoil the processed signal sample. Also, the signal can be processed with other more complex techniques which serve to reconstruct the signal.

For example to do -Analog to digital conversion and to properly receive an analog voltage signal for digital processing, the following components must be properly selected and applied in this sequence:

- buffer amplifier
- low-pass filter
- sample and hold amplifier
- analog to digital converter (A / D converter)
- computer / memory.

The components required for A / D conversion along with an illustration of their respective outputs is shown in Figure 5, [1][2].

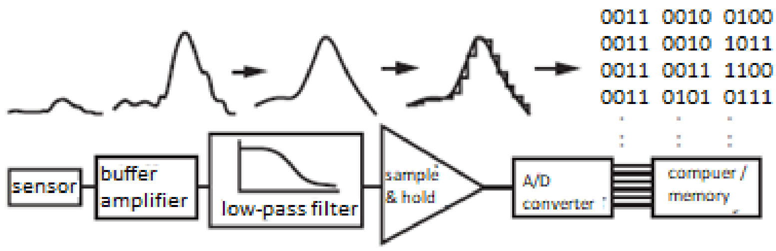

Figure 5. Sensor and other elements of the control algorithm and A / D conversion

While the process of transformation from D/A, occurs at the moment when we approach the external object, which accepts analog values. Of course, for this module there are relevant transformations until the conversion of these values from digital to analog [3][4].

4 Application and management of electronic resources

For more specific access to the parameters of the system of different electronic resources, it is necessary to create a relevant application, which demonstrates specific access to the input and output units of the system, and the object to be managed. Of course, this requires a wider space of research, of the generalized [9][10].

In the next step we will present only some modular aspects of the application with the possibility of expanding, and updating the data in the management of the respective units of the integrated system, or interconnected with computer networks with the possibility of creating a unified platform with more parameters, relevant and which are suitable, even with the change of platforms, both in terms of hardware and software. Usually, this way gives real opportunities for better access, and more sophistication, because this application also serves as a bridge for different systems with different electronic resources.

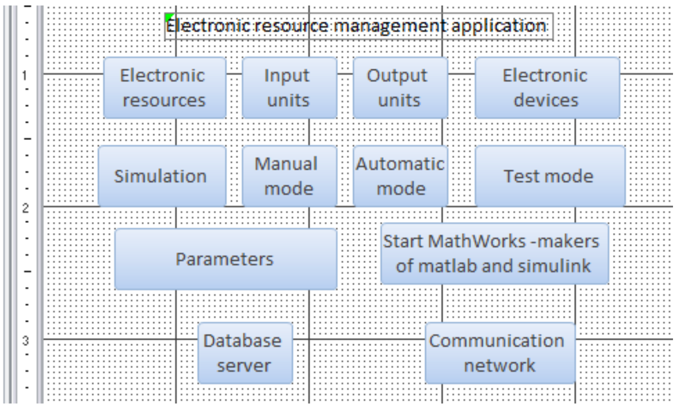

Figure 6. Electronic resource management application

The application system can be built through the database (Sql, MySql, Oracle, Access, etc.),while programming languages can be used, Visual Studio programming, or through the connection with web languages). In figure 6, only a form view sequence is given, which has an active function in processing various data, and which can be expanded and used for different aspects of technological needs and beyond.

Conclusion

In conclusion, we can say that the construction of control algorithms (assisted by software applications) are relevant and current part of the management of various electronic resources, which provides efficient opportunities in commanding various processes.

The paper presents the results of the algorithm design and the way of processing the data through the Shannon and Nyquist formula. This is the basis for generating relevant values for practical purposes, given that data, audio, video and other signals have strictly defined values, which need appropriate criteria for converting analog values to digital and vice versa. This paper also serves as a good basis for designing in the future, even more, complex systems of various electronic communications, through telecommunication systems, etc.

The other importance of the paper is that the determination of sampling values and the determination of time intervals gives real possibilities for the design of other electronic systems, in terms of access to communication systems, construction of multiplexers, determination of signal speed through transmission channels, the amplitude of frequency band (bandwidth), etc.

In this paper, some variants of finding values are given, but there are other possibilities, because the form of the algorithm in figure 2, gives different possibilities, and the replacement of computer systems with different systems based on a microprocessor, and for access to internal, external objects, etc. It is also emphasized in the paper that the role of communication devices (computer networks) is an important part because through this system it is possible to interconnect different electronic platforms, different operating systems, and interference in the process which enables the backup of data for deployment temporary or permanent in other auxiliary media.

References

[1]. Annie Kent. Control Algorithm Designs in Power Electronics. Publisher: Willford Press. ISBN-10: 168285096X. 2016.

[2]. Frank Pasquale. The Black Box Society: The Secret Algorithms That Control Money and Information. Publisher : Harvard University Press; Reprint edition. ISBN-10: 0674970845. 2016.

[3]. Randal Bryant, David O'Hallaron. Computer Systems: A Programmer's Perspective. Publisher: Pearson; 3rd edition. 2015.

[4]. Peter Corke. Robotics, Vision and Control. Fundamental Algorithms in MATLAB® Second, Completely Revised, Extended and Updated Edition. Part of the book series: Springer Tracts in Advanced Robotics (STAR, volume 118). 2017

[5]. Thomas H. Cormen. Introduction to Algorithms, 3rd Edition. Publisher: MIT Press; 3rd edition. 2009

[6]. Goodwin, G. C., S. F. Graebe, and M. E. Salgado, "Control System Design," Prentice Hall, 2001.

[7]. Dorf, R. C., and R. H. Bishop, "Modern Control Systems," 9th ed., Prentice Hall, 2001.

[8]. N.Zeqiri, A. Luma. A/D Conversion, Synchronization and Control and Algorithm for Hardware Realization. Croatian Society for Information and Communication Technology, Electronics and Microelectronics, MIPRO, Croatia. ISBN 977-852-233-044. Pages197-201. 2009.

[9]. N.Zeqiri, E.Rufati, B.Zeqiri. Functional parameters and performance requirement in the industrial system. JAS-SUT Journal of Applied Sciences-SUT 5 (9-10), 14-21. 2019.

[10]. N.Zeqiri, F.Idrizi. Software management and algorithms for real-time control systems. Journal of Applied Sciences-JAS-SUT (ISSN: 1857-9930/print & ISSN: 2671-304.2018.

[11]. N.Zeqiri, A.Luma. Control systems, smart sensors, controller, elements in a control loop, Java Card and Security. WSEAS Transactions on Systems and Control. 2008.