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Review article

DETERMINATION AND EVALUATION OF DATA FLOW IN TECHNOLOGICAL SYSTEMS THROUGH THE INTEROPERABILITY OF ELECTRICAL AND COMPUTER CIRCUITS

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Abstract

In different industrial systems and different industrial sectors, a specific analysis must be defined in the context of determining the data flow and its direction to the end elements and vice versa. This work is based on the analysis of the types of data that are transmitted, the orientation, and the management process of the connection in the electrical circuits and the connection with the computer system. To create a circuit diagram, it is required to establish a bridge connecting the electrical circuit and the computer circuit. This process enables us to establish a system that can be specifically controlled by a command system, which plays the role of the main operator. The paper presents specific schemes and blocks that represent an integrated system of elements that participate in the confidentiality and concrete positioning of elements in the given structure. In this paper, the state of the data values is determined, and characteristic evaluations of the parameters that take part in the construction of this scheme are given to handle a technological process, a process that applies to different types of products, depending from the nature of the work. The main goal is the management and systematization of the generalized work to create an approach that is as reliable and based mainly on a single system that offers high flexibility in the work, of the machines themselves and the elements that are part of a technological process.

Keywords: Technological System, Process, Management, Computer, Data flow.

1 Introduction

In the paper, were made a certain analysis about the processing of data which is important for the process of commanding an external object. To command the external objects through the command and control system, the relevant block diagram must first be constructed, which underlines the elements that take part, the modules, and the interoperability of the electrical circuits and the computer command system.

In a certain technological process, the command space, or location, must be determined where the main operator is located, together with the computer system, as well as the related software, for regular operation. Then, there is also the auxiliary room, where the electronic modules are placed, and the room for the distribution and transmission of beams through the contactor system, from where it continues with the electrical connection system to the last devices. During the examination of this activity, the interlocking process must be in operation, because through this system it is possible to connect the system with the electrical devices, and thus also the electrical circuits, with the computer system as an integrated and mutually dependent system.

Usually, the operator is the one who deals with the issue of command, and everything in the process of designing the system must also take into account the possibility of testing the system, to verify the state of

the system and the stability of the operation. During the implementation and design of the block schemes, the communication path between the elements, modules, and the communication path between the different components must be defined rigorously. in technological systems, whether they are productive or for service purposes, the path of data movement is duplex, or specifically on both sides. To realize this communication, it is necessary to design and place the network equipment in certain positions, through which the communication and transmission of data to the central system can be realized [1][2]. Therefore, the paper deals with the configuration of certain parameters to optimize the path of data movement through certain channels of analog transmission, and their conversion into concrete digital values, for adequate processing in the central computer system [1][3]. Also, the paper presents a part of the design of the electrical and computer circuit, the design of a part of the structure of the technological process, and a part of the software application that is responsible for the process of commanding and verifying the state of the system through the supervision process.

2 The process of interoperability as a block diagram of the interconnection of the electrical circuit and the computer system

The process of interoperability as a block diagram of the interconnection of the electrical circuit and the computer system represents a key part of the management of a technological system. In the contemporary world, special importance is given to the process of managing the interconnection of electrical and computer circuits. For example, the electrical circuit includes the electronic room (the placement of electronic devices) and the contactor room (bridges, voltages, and devices with relays, with contactors and safety devices of certain motors, or in general external devices).

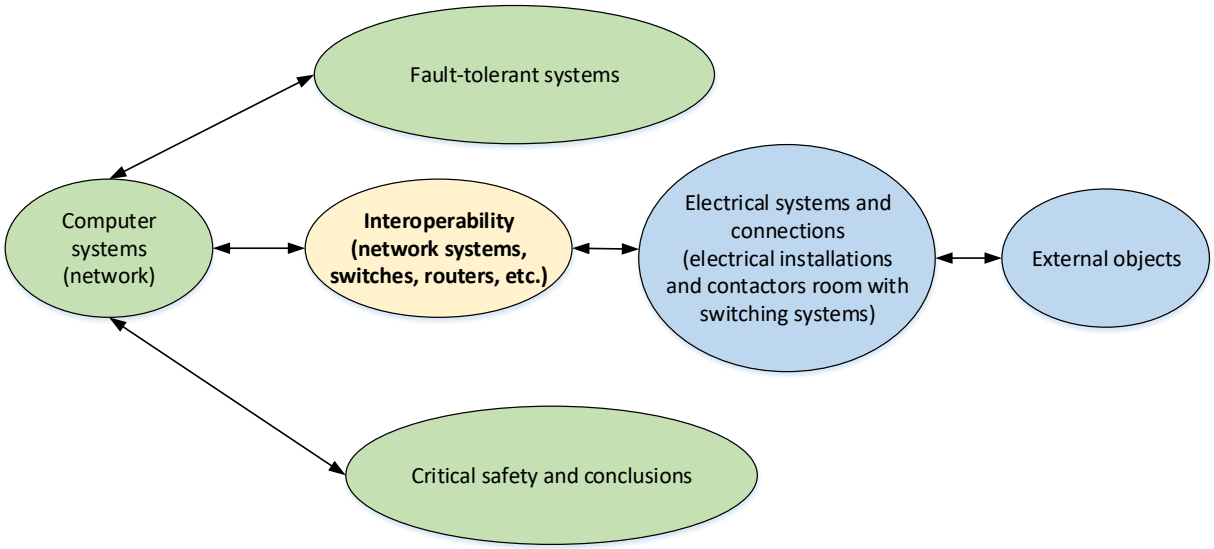

Figure 1- The process of interoperability as a block diagram of the interconnection of the electrical circuit and the computer system

3 Determining the capacity of a transmission channel and data flow

In the following text, some characteristic values of data transmission and the possibility of determining the capacity of the channel will be given, which help to find the relevant values in the transmission channel [3] [4].

C - channel capacity expressed in bits/s or in bits per second

B - channel bandwidth, expressed in Hertz [Hz]

S - total power of the received signal

N – total noise or interference power

S/N – signal-to-noise ratio (SNR) [W]

$$C = B \cdot log_2\left(1 + \frac{S}{N}\right) \quad (1)$$

Shannon's channel capacity should be calculated the above formula (1). B is the bandwidth of the system expressed in Hz. 3300Hz is a typical bandwidth for a telephone twisted pair line channel. Signal-to-noise ratio expressed in decibels - SNRdB. For the formula, it is necessary to enter the signal-to-noise ratio in Watts, and this is done according to the formula,

$$SNR\ [W] = 10^{\frac{SNRdB\ [dB]}{10}} \quad (2)$$

$$SNR_{dB}\ [dB] = 10 \log SNR\ [W] \quad (3)$$

TABLE 1- THE CAPACITY OF THE TRANSMISSION CHANNEL, DEPENDING ON THE RATIO, SIGNAL/NOISE, AND CONVERSION TO THE RESPECTIVE VALUES

	B - channel bandwidth (Hz)	S – Total power	N – Total noise	S/N – Signal-to-noise ratio (SNR) (W)	(1+S/N)	C - channel capacity bits/s C=B log2(1+S/N)	S/N – Signal-to-noise ratio (SNR) (dB)
1	600	500	400	1.25	2.25	701.96	0.97
2	900	600	450	1.33	2.33	1100.15	1.25
3	1200	700	450	1.56	2.56	1624.36	1.92
4	1500	800	450	1.78	2.78	2210.90	2.50
5	1800	900	450	2.00	3.00	2852.93	3.01
6	2100	1000	450	2.22	3.22	3544.92	3.47
7	2400	1100	450	2.44	3.44	4282.25	3.88
8	2700	1200	450	2.67	3.67	5061.07	4.26
9	3000	1300	450	2.89	3.89	5878.07	4.61
10	3300	1400	450	3.11	4.11	6730.44	4.93
11	3600	1500	450	3.33	4.33	7615.72	5.23
12	3900	1600	450	3.56	4.56	8531.75	5.51
13	4200	1700	450	3.78	4.78	9476.63	5.77
14	4500	1800	450	4.00	5.00	10448.68	6.02

15	4800	1900	450	4.22	5.22	11446.39	6.26
16	5100	2000	450	4.44	5.44	12468.40	6.48
17	5400	2100	450	4.67	5.67	13513.50	6.69
18	5700	2200	450	4.89	5.89	14580.57	6.89
19	6000	2300	450	5.11	6.11	15668.61	7.09
20	...						

Values in the table, 3300Hz is a typical bandwidth for a telephone twisted pair line channel. Otherwise, all other values have been increased symmetrically, with the aim of only a visual explanation of the change in ratios (signal-noise) based on the data formula of the capacity of the transmission channel. In practice, these values can be different, and rigorously determined according to practical measurements in the laboratory or the practical part. However, this table has more of an informatic nature for calculating values and signal-to-noise ratios.

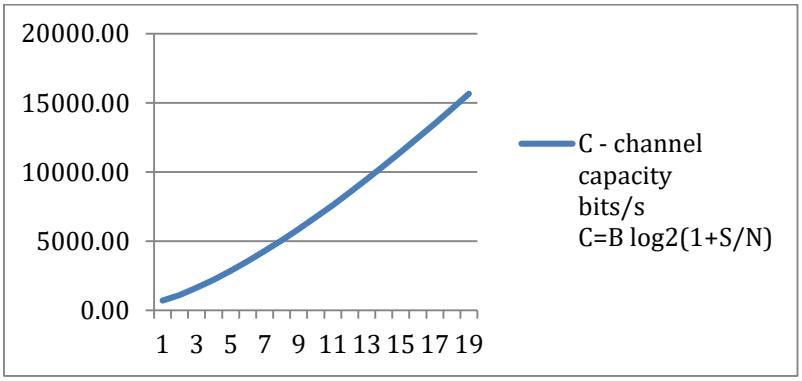

Figure 2- Graphic representation of the acquired values of the channel capacity

4 Determining the algorithmic structure, such as the necessary sequence in the stable flow of the given process

In the way of managing various technological processes, an extremely important role is to determine the path of information flow. Information and information management (in terms of electronics, and signal flow management) are appropriate in terms of managing technological resources: mechanical, electrical, and computer parts, but also in terms of structural construction and the algorithm of the relevant process [10][11]. If a corresponding algorithm has been followed for processing and command issues, then this ensures that the process will generally move in the right direction, and the likelihood of presenting problems or errors will be minimal. Below is a part of the algorithmic structure that allows us to determine the definition of the system variables, the initiation of the system, and the creation of a corresponding level in the management of the input and output variables, which are related to the programming process [5][6]. But, in an industrial sequence, a suitable structure must be built that connects the electrical circuit and the computer circuit, so that there is a stable approach to the process of monitoring and leading the system.

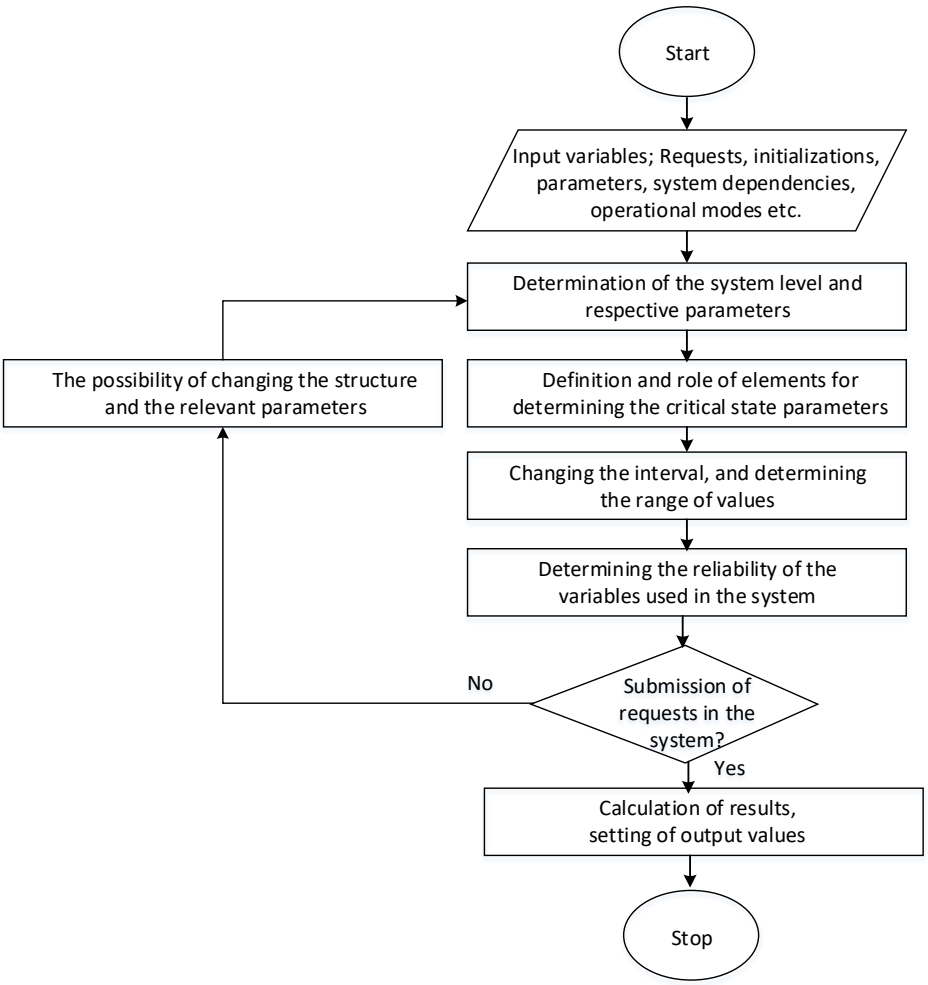

Figure 3- Algorithm for the analysis of the characteristics of responsiveness, comprehensibility and reliability of system parameters

Usually, an algorithm should include the requirements for the system. The system can be designed in terms of hardware and software [7][8]. The suitability of the elements, in terms of technical, electrical, and computer materials, is made up of hardware elements together with the collection of other connecting elements. While also in the process of planning and design, the construction of the corresponding software that realizes the complete management of a technological process or several processes connected in a whole functionality [9][12]. For all this, structuring in terms of engineering software is required, then the planning of design software, and the software that creates a fictitious application in terms of direct access to the devices that the process owns.

During the communication of the computer system, it should be noted that the relevant communication modules should be installed here, for example with the serial port, and the communication standard RS232/485 should be respected, as it is a suitable interface to achieve access at certain distances. This view is presented in Figure 4.

In Figure 4 are the modules of circuits with contactors as a connection between the computer system and external objects. Also, in the block is placed the part of the microcontrollers which can function independently, but also be simultaneously connected to the central computer [13][14]. Other characteristic parts are drives and servo systems, and the management system of the system's testing (as a self-control).

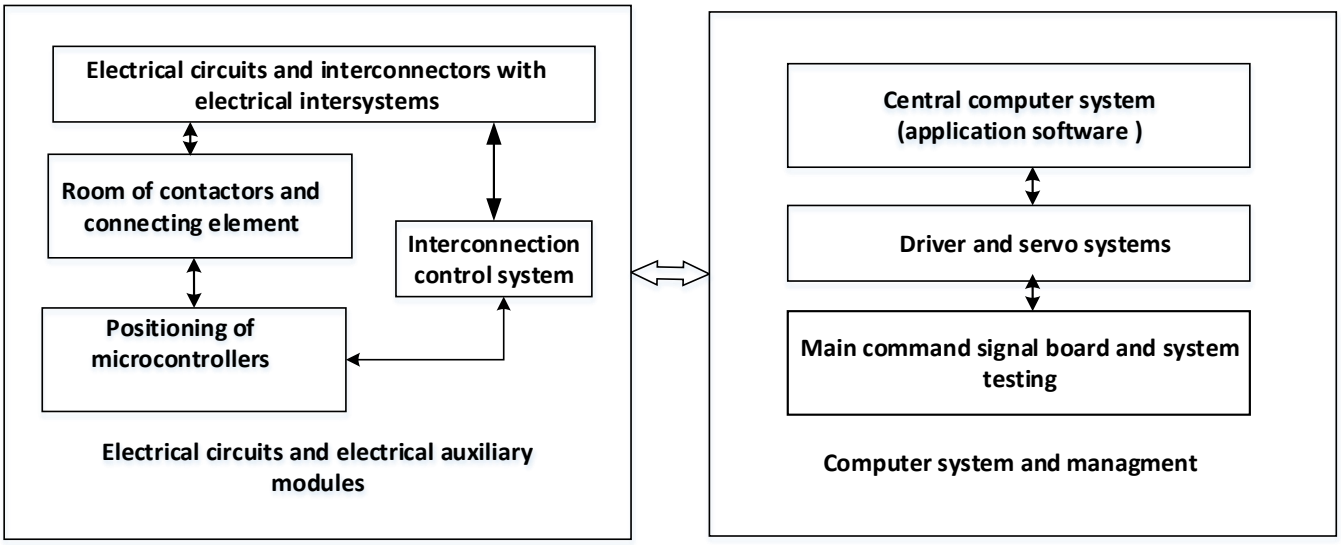

Figure 4- Schematic representation of the connection of the electrical circuit system and the computer control system

All the data are collected in a central computer system, which plays the role of the database and the placement of system applications that command any given process.

Conclusions

The paper presents the management and analysis of the interconnection systems of electrical and computer circuits. Also in the paper is presented the corresponding logarithm which enables the definition of the system parameters, the initialization, and the establishment of a unique system for the recycling of the necessary data for an automatic process. The analysis of the transmission channel is presented in the paper, as a necessary flow of the whole process, in terms of managing external elements through a central system.

The results regarding the signal-noise ratio are also given in tabular form, as characteristic data that the system does not have distortions, in terms of signal distortions and other similar effects. The installation of certain applications in the computer system also means the possibility of command from a central operator; where the central command unit, application software, and signaling boards are located with the possibility of action through manual intervention, if the system needs such intervention, in terms of system stabilization.

The importance of this paper lies in the design of a sustainable system, in terms of hardware and software use. Also, another important is incorporating the input-output values through the relevant algorithms, as well as in the conception of a proper technological system, which gives the possibility to have a controllable flow and more concrete data in terms of the management of the digital process (analog-to-digital and vice versa). The importance of this work lies in the design of a sustainable system, in terms of hardware and software. Also, the importance of incorporating the input-output values through the relevant algorithms, as well as in the conception of a proper technological system, gives the possibility to have a controllable flow and more concrete data in terms of the management of the digital process.

Also, in this paper, the method of connecting the electrical network to the computer system is given. Characteristic are the data extracted based on the evaluation of the capacity of the transmission channel, also calculating the ratio between the signal and the noise, which represents a conclusion for the overall management of the characteristics of the transmission network and the related communications. This approach creates a consolidated system through advanced action to various and external devices and vice versa to the central system.

References

[1] Security of Computer Systems A Complete Guide - 2020 Edition. Publisher: Emereo Pty Limited. ISBN:9781867408369, 186740836

[2] Darrell W Hajek, Cesar Herrera. Introduction to Computers 2020 Edition. ISBN-13: 979-8634285603 Publisher : Independently published -2020.

[3] Hemanth, D.J., Kumar, V.D.A., Malathi, S. Intelligent Systems and Computer Technology. ISBN print 978-1-64368-102-3. 2020.

[4] David Terrell. Electronics for Computer Technology. ISBN: 9780766838727. 2003.

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

[6] Noam Nisan, Shimon Schocken. The Elements of Computing Systems Building a Modern Computer from First Principles. 2008.

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

[8] Computing Handbook Information Systems and Information Technology. ISBN: 9781439898567. 2014

[9] Irv Englander, Wilson Wong. The Architecture of Computer Hardware, Systems Software, and Networking an Information Technology Approach. 2021

[10] 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.

[11] 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.

[12] Computer Systems and Software Engineering Concepts, Methodologies, Tools, and Applications. ISBN: 9781522539247, 1522539247. 2017.

[13] Jerome H. Saltzer, M. Frans Kaashoek. Principles of Computer System Design: An Introduction. 2009

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