Partners Universal International Research Journal (PUIRJ)
Volume: 01 Issue: 04 | October-December 2022 | ISSN: 2583-5602 | www.puirj.com

Use Of Microdevices to Computer Activities in Industrial Processes to Improve the Productivity and Reduces Costs in an Aerospace Industry of Mexicali as an Industry 4.0

Roberto Carlos Valdes Hernández[1], Juan Gabriel López Hernández[2], Omar Cesar Lomelí[3], Gerardo Vigil Rendón[4], Flaviano Sandoval Maldonado[5], Verónica Arredondo Robledo[6], José Guadalupe Pedro Méndez[7], Rogelio López Rodríguez[7]

[1]Facultad de Ciencias Administrativas, Universidad Autónoma de Baja California, Mexicali, Baja California, México.
[2]Departamento de Ciencias Básicas, Centro de Bachillerato Tecnológico Agropecuario # 146, San Quintín, Baja California, México.
[3]Departamento de Ingeniería Industrial, Instituto Tecnologico de Tijuana; Instituto Internacional para el Desarrollo Empresarial-INIDE, Tijuana, Baja California, México.
[4]Departamento de Ingeniería Industrial, Instituto Internacional para el Desarrollo Empresarial-INIDE, Tijuana, Baja California, México.
[5]Departamento de Metalmecánica-Industrial, Tecnológico Nacional de México, Instituto Tecnológico de Mexicali, Mexicali, Baja California, México.
[6]Departamento de Ingeniería Industrial, Universidad Autónoma de Baja California, Mexicali, Baja California, México.
[7]Departamento de Ciencias, Facultad de Ingeniería y Negocios, Universidad Autónoma de Baja California, San Quintín, Baja California, México.

----------***----------

Abstract - *The industry 4.0 is considered as the industrial companies with manufacturing areas where is applied the innovation with the developed of new devices or methods, to control parameters of the industrial processes or products, and with this improve the productivity and quality indexes and reduces costs in the production actions. One of thematic applied in industries, especially in the industrial processes, is the computer activities, where are a lot systems and in the industry 4.0 are applied microdevices. In this investigation, was evaluated the use of microdevices as computer memories, which was used to obtain information and with this compare with standard values of specific parameters and control the operations with an optimal functionability. These microdevices were the micro memories as a part of the Micro Electromechanical Systems (MEMS) in industrial processes of an industry that make activities of aircrafts, which is contemplated as aerospace industry and is installed in the Mexicali city. In this scientific study, the electronic scanning microscopy technique (SEM) was used, to evaluate the operation of the MEMS used and the MATLAB software for a multiple regression and correlation analysis. The investigation was developed from 2019 to 2020.*

***Keywords*:** Industry 4.0, MEMS, Industrial Processes, Productivity and Quality.

1. INTRODUCTION

The activities where are used micro memories as micro devices MEMS in the industries, is known as a

technological revolution that are applied in the industry 4.0, where innovations and applications of new industrial processes are contemplated, as well as use of novel methods and micro devices. These micro memories contemplated in this investigation, which is considered a microcomputer as a technological device, have the capacity of store lot information of parameters of the industrial processes used in liquids or solids, operating variables of electronic devices, as well as dimensions and areas of objects, being the most relevant variables. In addition, evaluations of distance parameters, speed and acceleration of objects in certain activities are contemplated.

2. INDUSTRY 4.0

It is considered the fourth transformation of the industry regarding factors of technology, economy and society; where innovations of industrial processes, system, equipment and innovative devices are concentrated, to achieve maximum efficiency in the manufacturing areas and the industrial processes involved in the manufacture of any industrial product. The first stage of the industry occurred with mechanization, followed by the second stage with assembly processes for mass production. The third stage was developed with the application of computing and automation, continuing with the fourth stage with physical cybernetic systems, managing to develop systems with artificial intelligence, with specialized computation algorithms, linking them with digital systems and devices; with the main objective of optimally planning the activities of the production processes in industrial companies. In the Mexicali city and the Baja California State located in the northwest of the Mexican Republic, are a few industries that apply the innovation as industry 4.0.

3.COMPUTER ACTIVITIES IN INDUSTRY 4.0

They have been applied since the third stage of industrial transformation, for the development of innovations that generate improvements in industrial processes in manufacturing areas, managing to increase productivity and quality indices. This is why it has been promoted in higher-level educational institutions (universities and research institutes), in conjunction with industrial companies, anywhere in the world, for the development of innovative systems and devices, as well as methods applied to areas of manufacturing in all industrial processes. Computer systems and programs have been developed to control, count, compare levels, and pack; among the most relevant in the industry of the city of Mexicali considered as part of industry 4.0. One of the actions developed in the industry of this city, is the use of micromemories to control of industrial process and store relevant information.

4. MICRO MEMORIES IN THE AEROSPACE INDUSTRY

This scientific study is very relevant because improve the manufacturing activities and increase the productivity and quality indexes. This type of micro devices are very useful in the industry because store specific information and are connected to computer where the information is stored and to make statistical analysis and detect the wrong and good industrial processes to improve it. The micro memories are working with microsensors and micro actuators, by operating low and high-power mechanisms, to detect non-allowed tolerance levels and thus be able to determine the manufacture of defective products. In this investigation, were used MEMS as micro memories to detect and store values of voltage and electrical current levels of an electronic system used in the aircraft autopilot control. This electronic system must be very specific and properly operate, depending on the levels of voltage and electric current, by activity on aircraft flights, which is a high danger action, but is adequately activated in an emergency situation. MEMS have become micro devices of great importance in the aerospace industry, where microsensors and microactuators have been developed, for space savings and a

greater amount of operations in these tiny systems. These innovative microsystems have been developed and evaluated for A AIF Safety on Aviation Activities, where any error can be catastrophic. The use of MEMS in the industrial processes of the aerospace industry, guarantee that the manufacturing activities are developed adequately, with the correct levels as in the case of this investigation, when analyzing the operation with the correct voltage and current levels. Next, a process of operation and structure of micro memories as MEMS is shown in figure 1.

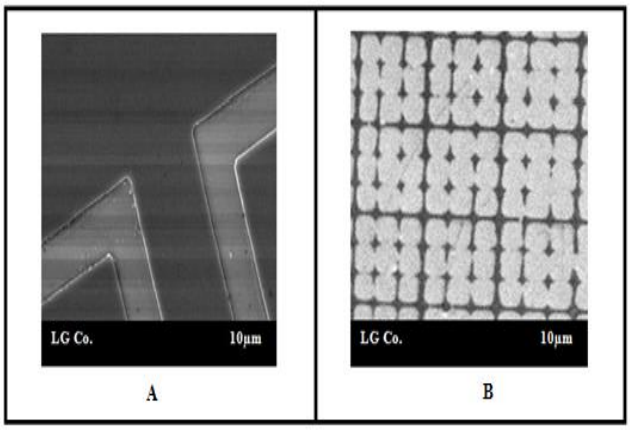

Fig -1: Micro memories as MEMS as (A) electrical operation and (B) formation of structures by segment

4.1 Source Analysis of the investigation

These two images could be obtained by using the electronic scanning microscopy technique, supported by an industrial enterprise, where said microscopic images were generated. In section A of Figure 1, electrical connections of a MEMS are observed evaluated with the SEM technique, where the electric current circulates, which generates a specific voltage for its optimum operation, with which it developed the electric current detection activities and voltage in the devices used by the automatic aircraft driver. In section B of Figure 1, a basis divided by segments is illustrated and having electrical microconnections, where the electric current circulates and generates a voltage. These microsystems carried out installation and pasted activities of electronic components in electronic plates used for the operation of the automatic pilot in the evaluated industry. In addition to these functions, MEMS can verify standardized reference values and compare them with real data, to verify that the operation of the manufactured products operate efficiently, elaborating the stop activity to stop the equipment operations and industrial machinery when it is required to verify at detail any situation outside the functional features of manufactured products. Likewise, MEMS can perform the ignition function to continue monitoring production. This microanalysis was developed to adequately know the operability of microsystems and evaluate productivity and determine if it was necessary develop some adjustment in the microconnections of the MEMS used in the automatic pilot.

4.2 The relevance by the use of micromemories

The micromemories as MEMS technology has been very relevant since the beginning of the 21st century to optimize activities in the areas of manufacturing in industries, being very useful for the control of various operations. This scientific study developed in an aerospace industry in the city of Mexicali, was to assess the use of these microsystems in the operation of equipment and industrial machinery and quickly and effectively evaluate the main operational characteristics of manufactured products used in the automatic pilot of aircraft. The realized investigation is of great importance, to ensure that occurs a high reliability in the manufactured products in the aerospace industry evaluated.

4.3 Micromemories and their development

The main objective of the manufacture of the micromemories as MEMS was to develop innovations in industrial processes and improve the levels of productivity and quality of manufactured

products. This was to achieve the mini-currency of simple and complex systems and together. This has generated savings in the manufacturing processes of MEMS, and achieved great increases in the total amount of production. In addition, operating costs have decreased, obtaining economic gains and generating prosperity in industries in the world.

4.4 Operational evaluation of micromemories

These microdevices are very useful in industrial processes, only in industrial enterprises installed in the city of Mexicali, there are few people who know how they operate, and this makes it a bit difficult at the time of applying them to manufacturing areas. There are very few industries in this city where staff is trained as the micromemories as MEMS operate, and those who know this topic have required to go to other cities of the Mexican Republic or other countries, with theoretical and practical courses with high costs. This is the reason of the relevance of this investigation, because in the industrial company, where the scientific study was developed, it has trained personnel for the application of MEMS in industrial processes.

5. PRODUCTIVITY AND COSTS

It is an important factor in the agricultural industry that has a great relationship between these terms and with the production processes where economic gains or losses can be determined. Productivity is considered an economic measurement action, managing to calculate goods (products manufactured in industrial companies) and services (activities that are offered by companies that provide services to consumers). Figure 4 represents the balance factor of costs and benefits in industrial companies, where productivity and costs are involved for a better understanding of this relevant relationship (Marin J et al., 2009). In productivity, certain aspects are determined such as the number of workers and their skills and abilities, as well as investment capital, production times, distribution and delivery to customers. Productivity is associated with the quality factor, which in turn is related to manufacturing costs and is a relevant aspect in the growth or decline of industries. The link between productivity and quality is essential and is focused on the application of a very strict discipline so as not to generate economic losses, which is associated with cost analysis

6. METHODOLOGY

Various activities were carried out in this investigation, which are shown below, to determine with an analysis of a scientific study, where it is shown that industry 4.0 in this city on the border with the state of California, United States; It has several commercial agreements, being indicated as an important area in the commerce of our country, being a relevant investigation for the development of this area of the Mexican Republic:

a) An analysis was made of the number of industrial companies in the city of Mexicali that carry out innovations such as Industry 4.0.

b) An evaluation of the use of micromemories in industrial processes was carried out, to determine their operational efficiency, and to be prepared by trained personnel from the technology and computing area.

c) An analysis of productivity, quality and cost levels was developed, when using micromemories in industrial processes in an aerospace industry, which was supported with the research.

7. RESULTS

The investigation generated important information regarding the use of high-resolution technology such as micromemories in industrial processes of industrial companies located in Mexicali city, to determine the positive impact of this type of technology. This was with the aim of reducing the size of the devices used as memories for the use of relevant information from the manufacturing areas

and generating more functions of these devices linked to computing systems. To this application process is called, be linked to industry 4.0.

8. ANALYSIS OF INDUSTRY 4.0 IN MEXICALI, BAJA CALIFORNIA

An analysis of number of industrial companies in the Mexicali city, to know the possible industrial plants that can be linked with educational and research centers, to develop research on the application of high technology application Resolution, which supports increasing productivity and quality indices. This information is observed in Table 1.

Table -1: Table Analysis of industrial companies considered as industry 4.0 in the Mexicali city (2019-2020)

Factors / Industry	Industrial processes (Qty)	Persons (Qty)	Industrial equipments and machines (Qty)	Improvements
Aerospace	12	1290	18	Use of micromemories and microprocessors of high technology
Biomedical	8	840	13	Use of microprocessors of high technology
Electronic	15	1560	25	Use of micromemories and microprocessors of high technology
Metallic	8	660	11	Use of microprocessors of high technology
Plastic	9	790	13	Use of microprocessors of high technology
Textile	7	570	12	Use of microprocessors of high technology

The table 1 shows the representation of industrial plants that have some industrial processes with high technology as industry 4.0, being the industrial company with major industrial processes, people and industrial machinery and equipments, the electronics industry because are the most quantity of industrial plants.

9. EVALUATION OF OPERATION OF MICROMEMORIES

For the development of this evaluation, relevant aspects were considered, which are explained below:

a) Volatility. It represents in a basic way, the way in which information is stored, only when the computer system is turned on with electricity. In this research for industrial plants installed in the city of Mexicali, the use of micro-memories is proposed that do not require the need for a computer system to be turned on with electrical energy.

b) Accessibility to information. Indicates that the information of the memories can be accessed easily and quickly. In this research for industrial plants installed in the city of Mexicali, the use of micro-memories is proposed, with which information can be accessed quickly and easily.

c) Ability to change information. It is mentioned to have easy and fast access to modify any type of information. In this research for industrial plants installed in the city of Mexicali, the use of micro-memories is proposed, with which information can be accessed quickly and easily.

d) Addressing the information. Represents the locations of the memories, where the information can be stored. In this research for industrial plants installed in the city of Mexicali, it is proposed to focus on the use of micro-memories, with which it is possible to have quick and easy access to information, and with a large capacity of information storage locations.

e) Memory capacity. The amount of information that can be stored in the memories is considered. In this research for industrial plants installed in the city of Mexicali, the use of micro-memories is proposed, with which a large information storage capacity can be achieved.

f) Operation speed. Indicates the fast way of operating the memories. In this research for industrial plants installed in the city of Mexicali, the use of micromemories is proposed, with which it is possible at high speed in the operation and storage capacity of the information.

The information described above is illustrated in Figure 2.

Partners Universal International Research Journal (PUIRJ)
Volume: 01 Issue: 04 | October-December 2022 | ISSN: 2583-5602 | www.puirj.com

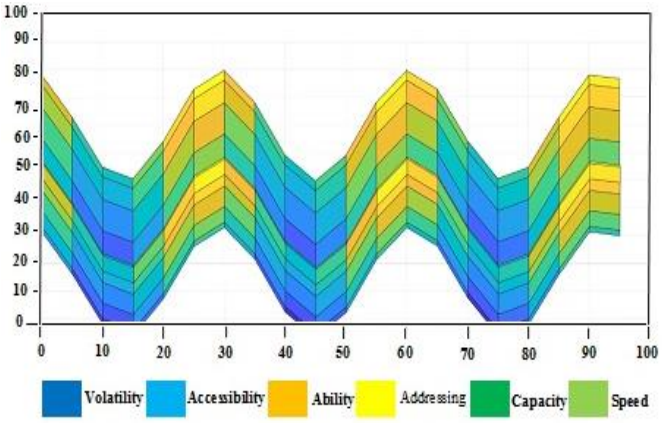

Fig -2:Analysis of features of micromemories

Figure 2 illustrates the analysis of the principal features of micromemories showing by colors each feature, using the Matlab software as specialized software.

10. COMPARATIVE ANALYSIS OF PRODUCTIVITY AND COSTS WITH OR WITHOUT MICROMEMORIES

A comparative analysis of the use of micro-memories was carried out in the industrial processes of three industrial plants of each type of companies mentioned, observing an increase in the productivity and quality indices, and with this representing lower cost levels, than by not having the opportunity to use the micro-memories, indicating a relationship of 35% of the generation of costs and 15% of costs when using the micro-memories, as illustrated in table 2.

Table -2: Analysis of use or no use the micromemories (2019-2020)

Factors	Not Use Micromemories		Use Micromemories	
Industry	Productivity, %	Quality, %	Productivity, %	Quality, %
Aerospace	66	57	78	80
Biomedical	68	58	77	77
Electronic	63	59	79	79
Metallic	66	60	82	80
Plastic	69	58	80	83
Textile	65	59	81	82

11. CONCLUSIONS

The use of specialized microdevices in industrial processes of industrial plants located in the city of Mexicali, being considered as Industry 4.0, is a great advance in this northwestern region of the Mexican Republic, which has great commercial relations with the state of California, United States, as an adjoining zone in this border region between Mexico and the United States. This has helped to receive more industrial companies from our neighbor Mexico and generate more job opportunities for the population of this city. In this research, the need to use high resolution technology was shown, with the use of specialized micro-memory to increase productivity and quality levels.

REFERENCES

[1] Ervural, B. C. (2018). Overview of Cyber Security in the Industry 4.0 Era. In Industry 4.0: Managing the Digital Transformation Journal, Vol. 4, No. 2, pp 267-284.

[2] Faller C., Feldmüller D. (2015). Industry 4.0 learning factory for regional SMEs.Procedia CIRP, Vol. 5, No. 2, pp 88-91.

[3] Feldmann, H. (2013). Technological unemployment in industrial countries, Journal of Evolutionary Economics, Vol. 23, No. 5, pp 1099-1126.

[4] A SHAHUL HAMEED, & Dr. A. SHAJI GEORGE. (2019). A SECURE NETWORK CODE BASED SERVER STORAGE SYSTEM WITH SECURE PROXY RE-ENCRYPTION. Scientific Computing & Instrumentation JSC: Journal of Scientific Computing, 8(12), 222–233. https://doi.org/10.5281/zenodo.6795766

[5] Fujii, T., Guo, T., Kamoshida, A. (2018). A Consideration of Service Strategy of Japanese Electric Manufacturers to Realize Super Smart Society (SOCIETY 5.0). In International Conference on Knowledge Management in Organizations, pp. 634-645.

[6] Dr. A.SHAJI GEORGE, & A.S.HOVAN GEORGE. (2020). INDUSTRIAL REVOLUTION 5.0: THE TRANSFORMATION OF THE MODERN MANUFACTURING PROCESS TO ENABLE MAN AND MACHINE TO WORK HAND IN HAND. Journal of

Seybold Report, 15(9), 214–234. https://doi.org/10.5281/zenodo.6548092

[7] Geissbauer, R., Vedso, J., Schrauf, S. (2015). Industry 4.0: Building the digital enterprise and evaluating the costs, Industry, Technology and Economy Journal, Vol. 8, No. 5, pp 27-40.

[8] Dr. A. Shaji George, & A.S. Hovan George. (2022). Data Sharing Made Easy by Technology Trends: New Data Sharing and Privacy Preserving Technologies that Bring in a New Era of Data Monetization. Partners Universal International Research Journal (PUIRJ), 01(03), 13–19. https://doi.org/10.5281/zenodo.7111123

[9] Heng, S. (2014). Industry 4.0: Upgrading of Germany's Industrial Capabilities on the Horizon, Journal of. High Technology, Vol. 5, No. 2, pp 88-102.

[10] Dr. A. SHAJI GEORGE, & A. S. HOVAN GEORGE. (2020). THE TRANSFORMATION OF THE AGRICULTURE SECTOR AND LABOUR MARKET DUE TO THE FOURTH INDUSTRIAL REVOLUTION (4.0). Strad Research, 7(6), 205–219. https://doi.org/10.5281/zenodo.6657942

[11] Kenneth, A., Hendrickson, P. (2016). Toward realization of the new economy and society, Journal of Computer Science, Vol. 12, No. 8, pp 44- 56.

[12] Lee, J., Bagheri, B., Kao, H. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems, Manufacturing, Computer and Technology Journal, Vol. 3, No. 1, pp 18–23.

[13] Monostori, L. (2014). Cyber-physical production systems: Roots, Expectations and Technology

[14] Systems, Journal, Vol. 11, No. 7, pp 18-34.

[15] Penprase, B. (2018). Higher Education in the Era of the Fourth Industrial Revolution, Computer Science Journal, Vol. 8, No. 3, pp 47-62.