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RESEARCH ARTICLE

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WIRELESS COMMUNICATION NETWORK AND SUPERVISORY ROBOT IN AGRIBUSINESS 4.0 FOR INTEGRATION, MONITORING AND CONTROL IN OPERATIONS

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ABSTRACT

Agribusiness is responsible for the generation of economic wealth and food in the world. For this reason, there is a need to make it even more productive and with a lower production cost compared to agribusiness in the 20th century. This research sought to show the need to use the concepts and technologies of industry 4.0 starting with the wireless communication network that integrates distant points in addition to supervisory robots responsible for monitoring this information, presenting it in graphical and table form and also allowing interaction with the devices responsible for production. The exchange of reliable and wireless information is essential to streamline and optimize decision making by manager and thus be able to interact with production through supervisory robot. The results confirm the importance of applying the concepts and technologies of industry 4.0 in agribusiness 4.0 to be able to produce more and at the same time have a lower production cost compared to the 20th century. Agribusiness 4.0 integrates the value chains of new technologies and ecosystems, being able to generate more wealth and improve the meeting of global food needs.

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INTRODUCTION

Agribusiness has an important role in generating wealth and food in most nations of the world although, the current agribusiness or agribusiness of the 21st century, needs to increase its production capacity and reduce the costs involved due to the increased demand from nations, when compared to agribusiness of the 20th century. However, in order to improve the performance of the current agribusiness, it will need to use new concepts and new technologies that make this need feasible. The use of concepts and technologies of industry 4.0 can bring competitive advantages to the current agribusiness in relation to agribusiness of the 20th century. The advantages refer monitoring of operations, detection of faults and control in operation, use of automated machines remoted, generating reduction to the cost of production and with significant increase in production, which will depend on being connected to communicate through effective wireless communication network. The concept of a connected world, connecting people, equipment and services is being implemented. Connectivity becomes a keyword for engineering, improving the new generation (SUGAYAMA; NEGRELLI, 2015, p. 2).

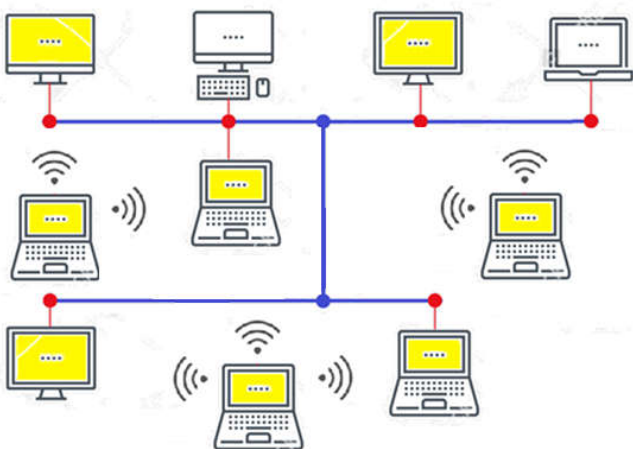
"The advancement of telecommunications combined with the development of technologies related to information systems, data processing and manipulation already provides the offer of products, systems and services with an apparently unlimited range of applications" (SUGAYAMA; NEGRELLI, 2015, p. 2). "Inside this new universe of possibilities, the industry can find solutions for the continuous search for competitiveness and productivity, taking advantage of this new tool to promote the innovation of products, services and optimization of internal processes" (SUGAYAMA; NEGRELLI, 2015, p. 2). In industry 4.0, the forms of manufacture and the selected products are interconnected, exchanging information with each other and allowing production decisions to be recovered autonomously by the company's machines and systems making it assume the status of "cyber industry" (SUGAYAMA; NEGRELLI, 2015, p. 2). The objective of the research was to show the importance and the need to use the concepts and technologies of industry 4.0 in the current agribusiness also called agribusiness 4.0 starting with the wireless communication network and supervisory robot. This research showed important data for agribusiness 4.0 that may represent 22% of the global gross domestic product but that will need to be integrated through effective wireless communication networks.

METHODOLOGY

This research was justified due to the advancement of industry 4.0 concepts and technologies in all areas and also in agribusiness. It was an exploratory and bibliographic research, which was developed in the Federal University of Mato Grosso do Sul, Brazil, in the period from July 2020 to April 2021 and which should obtain data on the application of communication network and communication network and use of supervisory robot for monitoring information, and interaction with machines in production through remote control in agribusiness 4.0. In addition, a quantitative and qualitative approach was adopted to demonstrate the need to demonstrate the importance of these technologies and the research emphasized the importance of industry 4.0 technologies applied in agribusiness. In this research, tried not to exclusively consider the implementation of agribusiness 4.0 in Brazil due to recessionary factors in the economy. It sought to obtain data on agribusiness 4.0 world wide mainly from the most advanced countries in Europe, North America and Asia. For the development of this research, the following databases were used: Scopus, Web of Science, Scielo and Academic Google. The data were obtained to be framed, interpreted and used in consonance with the objective of the research. The most recent and most relevant data were accepted. The data sought to show the importance of using wireless communication and also the supervisory robot in agribusiness 4.0. The data data did not undergo statistical treatment because they are not a case study.

RESULTS

Communication Network: The network for wireless communication are used as a strategy when applying a set of activities, improved within an organization (MASHINCHI, 2019). These optimizations are possible due to the interconnection between the production processes, generating information in real time with the help of supervisory robot who select the data. With this resource is possible to make quick and assertive decisions in the management of agribusiness and that allows interaction with production remotely. This communication is very valid because it connects machines that operate in agriculture with the remote super-supplying that can occur in the city or in the agriculture. Figure 01 shows the mixed connection that allows the supervisory robot to obtain, analyze data accurate and real-time data. In addition to optimizing processes, the remote communication system contributes to improving the company's organizational climate, according to Caldas (2010).



Source: author only (2021)

Figure 01. Communication network: physical and wireless

“The effective management of communication improves the organizational climate and thus helps to motivate people who come to rely more on the company where they work, to get to know it better and to deepen its internal processes, also to give their opinion and

participate in the strategic decisions”. Another aspect to be highlighted for the effective use of wireless networks is the necessity to perform as an incentives promoted as a persuasion for the acceptance of the use of the system by the employees, according to Ferreira (2004, p. 60). “A basis for this persuasion is a total acceptance of the system, starting with customers and covering employees, companies, suppliers and society. This process must reach all company's communication”. The use of the wireless networks is becoming more and more essential to ensure optimal functioning in agribusiness. One of the ways to obtain access to remote points of agriculture or livestock is through the WAN (Wide Area Network), which is the technological evolution of the environment and industrial protocols. The WAN was designed to use dynamic points allowing excellent data traffic. As for the advantages, we can mention the possibility of separating a command and control network from the information for remote management and monitoring. In addition, information can be made available to multiple locations and at a low investment cost for implementation. As disadvantages, however, are the possibility of offering an intrusion of hackers in the network, which can cause the loss of information integrity or even the theft of information related to agricultural production.

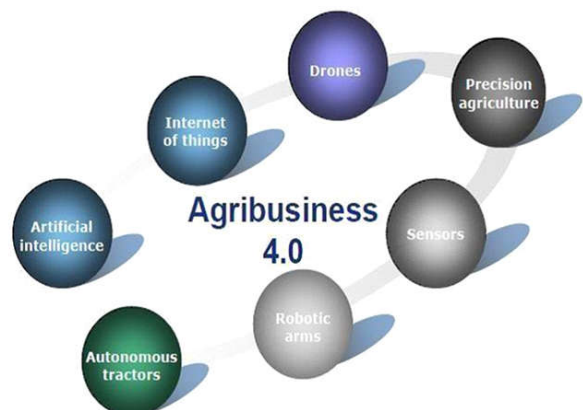
Supervisory Robot: The supervisory robot according to Wang (2005) is a computer program focused on the acquisition, monitoring, data analysis, graph plotting and remote operation control, designed from a new concept of management system. The information managed by this system is collected through sensors dedicated to the capture of specific data. In addition to collecting data, it also offers a practical environment for configuring machines and processes that also use in agribusiness. Figure 02 shows the information collected by the robot and presented to the manager and also shows the manager's computer monitor containing the presentation of numerical and graphical data.



Source: Author own (may, 2021)

<https://pixabay.com/pt/photos/gr%C3%A1fico-negocia%C3%A7%C3%A3o-cursos-forex-1905225/>

Figure 2. Digital Interface of the Supervisory System



Source: Affonso (may, 2021). Authorized use <https://professorannibal.com.br/2017/11/16/agribusiness-4-0-the-field-of-the-future-has-arrived>

Figure 3. Agribusiness Pillars

With an intuitive look, the supervisory system allow the inclusion of screens, the generation of graphics and reports in various formats. They also have alarm monitoring, remote communication and have an encrypted base, providing greater security to company data (TATSUMOTO, 2018). In addition to allowing monitoring and control, the system presents the data collected in real-time, graphically and visually, which allows the use of information in various ways (ROSSI, 2016). This data can be stored as presented by means of reports, shared via remote connection. In this way, they return accurate and quick analysis for decision making, resulting in minor losses and a high quality index. Another relevant application is to allow the remote control of the manager with automated machines in the production process. This is due to the installed software communicating with the PLC (programmable logical controller of each machine). Network Communication is the most wide spread connection method and used in industry 4.0 today to ensure the smooth operation of machinery connected to the network. The speed and reliability of information exchanged between supervisory robots ensures the best quality of decision making 4.0.



Source: Pixabay (may, 2021). Authorized use <https://pixabay.com/pt/photos/dji-uav-fitofarmac%C3%AAAuticos-drone-5331570/>

Figure 4. Intelligent control, monitoring and planning via wireless communication of drone



Source: Pixabay (may, 2021). Authorized use <https://pixabay.com/pt/photos/colheitadeira-colheita-poeira-5437608/>

Figure 5. Intelligent control of via wireless communication of harvester

In Figure 03 is presented as areas of agribusiness 4.0 are connected due to remote communication. We can present as innovation the use of sensors, robotic arms, autonomous tractors and the use of the internet of things in conjunction with artificial intelligence and drones (AFFONSO, 2017). In Figure 03, is possible to notice that the technologies mentioned above form what is called agribusiness 4.0, involving an entire agricultural production chain using technology. In addition to data interconnection, supervisory also allow the visualization of plantations and detects the quality of agribusiness. PLCs allow the manager to interact with production and being able to remotely control. It is still possible to check trends, monitor failures in real time, record data, generate reports and optimize decision making (NIEUWSBERICHT, 2019). The critical point of using

supervisory system is that they must be able to identify what data is really relevant. Once they have mastered data science, this allows the manager more time to make decision. With the development of agribusiness, several startups have appeared in the sector. As an example of a startup, we can mention a Brazilian company that created a system that is able to identify healthy and sick grains (CHALFOON, 2020). The system with hundreds of images of types of grains and seeds, uses an artificial intelligence algorithm in which it manages to identify the health of the seed and grains. According to one of the startup partners, they have reduced the time to evaluate the grain by up to 80% and managed to reduce the cost by up to 50% (TBIT, 2017). As an example of the integration of the production chain, we can mention the use of wireless networks, which enables remote management via the use of the Internet of Things (IoT) resource (EUROPEAN COMMISSION, 2017). Figure 04 shows an integration of an automatic drone providing the plantation and communicating with the manager through a wireless communication network. Figure 05 shows an integration of an automatic harvester in the plantation and communicating with the manager through a wireless communication network. The use of drones and autonomous machines (tractors and harvesters) are capable of fertilizing, reforming the pasture, nourishing, applying products without the use of human force (NIEUWSBERICHT, 2017).

DISCUSSION

Based on the research carried out, it was found that agribusiness 4.0 assumes an important role in the generation of economic and food resources for the world. This sector has been gaining strength due to the use of remote communications networks that connect distant areas of the crop and allows better quality decision making. In addition, the supervisory robot analyzes, offers graphical and tabulated data that allows the manager to decide (CARRARO, 2019). The use of communication networks with different resources can lower the cost and become viable for different sizes and capabilities of agribusiness. However, despite the various advantages of communication networks in agribusiness 4.0, the difficulty lies in having money to enable investment.

CONCLUSION

The concepts and technologies of industry 4.0 have strengthened agribusiness in the 21st century, mainly with the use of wireless communication system that integrates remotely and allows the articulation in real time of operation. The agribusiness 4.0 sector seeks to evolve and today, as wireless networks are present, facilitating control and optimizing processes in real time, enabling remote management. The use of supervisory systems in autonomous machines that are connected to each other facilitates the synchronization of the operation, also allowing the production manager to adequately control the system. Therefore, the wireless communication network is essential in today's agribusiness operations. In addition, a new way of managing (remotely) agribusiness demands new products and new business models that will impact an entire society. The fact is that Industry 4.0 also becomes strong in agribusiness and highlights the quantity and quality of the results obtained when compared to agribusiness in the 20th century.

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