AGRICULTURE 5.0 - REVIEW

VANGHELE N.A.*[*1)], PETRE A. A.[1)], MATACHE A. [1)], STANCIU M.M.[1)]

[1)]**INMA Bucharest / Romania;**

Email: vanghelelrc@gmail.com

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ABSTRACT

Agriculture has always been an area of great interest when it comes to development and innovation. We are currently living in the age of agriculture 4.0 which is on the rise. That is why we will reach agriculture 5.0 which will be marked by the introduction of artificial intelligence, biotechnology and big data analysis, which will increase the performance, productivity and accuracy of automation.

INTRODUCTION

The concept of"agriculture 4.0" was created in accordance with the term "industry 4.0", which divides the evolution of the industrial sector in to four stages. If in the 1880s we had industry1.0, at the advent of vapor machines, then atthe advent of electricity was industry 2.0, the third phase was-o introduction of computer science and automation.

Industry,4.0 has made improvements in terms of the introduction of digitalization. The same changes have occurred inthe case of agriculture, which tends through the introduction of artificial intelligence(AI),at5.0[10].

Smart agriculture is based on remote data transmission and storage for decision-making on different agricultural data analyses [12].

Currently, research is being carried out around the world on the alternation of artificial intelligence and agricultural technology, based mainly on large agricultural data, mechanized agricultural network, closed ecosystems, smart factories forthe production ofplants, special agricultural sensors, biological knowledge,unmanned aerial vehicles, intelligent equipment research, precision agricultural technology,etc.[2,7].

The rapid growth of the population, as the *Food and Agriculture Organization of* the United Nations expects to reach 9 billion by 2050, but also climate change, the reduction of agricultural land, the reductionof natural resources or the requirements of the market that are constantly changing, will take the agricultural system into a new paradigm. In response to these problems, constant industrial innovation, made the European Commission in the year 2021 officially mark the beginning of the era of "Industry 5.0"[3].

This era, the fifth, in addition to artificial intelligence (AI) is also based on agricultural remote sensing (RS)or cloud computing applications. Each era of the evolution of agriculture has representative events and technologies [8].

This evolution of agriculture can also be seen inFigure 1.

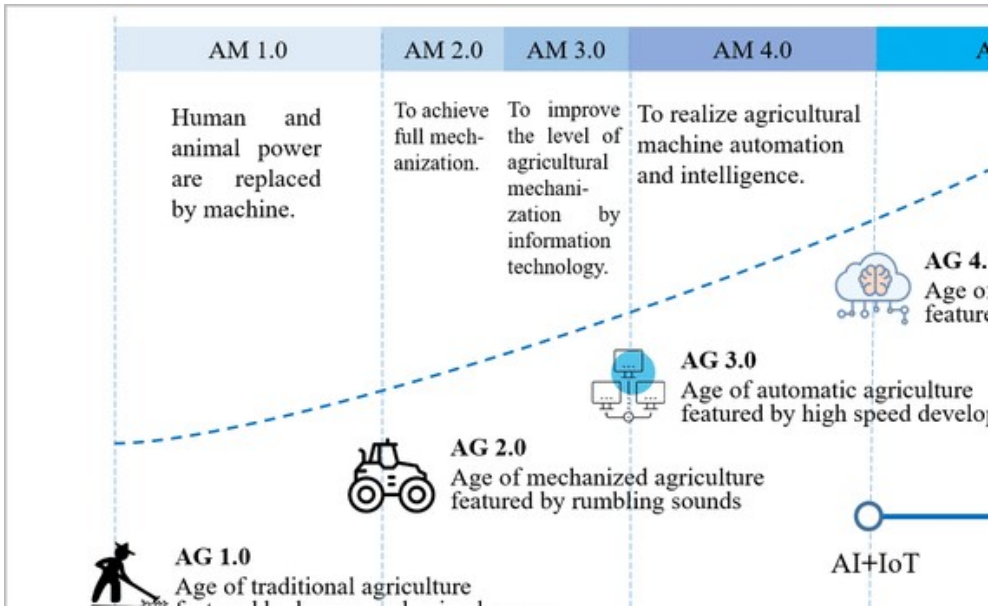

Fig.1 illustration of industrial revolutions, withregard to the evolution of agriculture [14].

Artificial intelligence can be defined by several forms, some of these are:

- The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings;
- A machine that performs tasks involving a certain degree of intelligence that was previously considered to be done only by humans;

- Itis the simulation of human intelligence processes by machines, especially computer systems. These processes include learning, reasoning and self-correction;
- The ability of a machine to imitate intelligent human behavior [1,5,11].

MATERIAL AND METHOD

Artificial intelligence (AI) can be classified according to several criteria,but the main classification involves two types, namely:

The first type (depending on theload):

- **Weak** AI or **narrow AI:** it relies on a narrow ***load***, building machines that are not too smart to do their own work,but may seem smart. Here each possible scenario must be entered in advance manually. But weakAI creation will make it essential to develop strong AI.
- **Powerful**AI**:** refers to the machines that can think and perform tasks by themselves, just like a human ***being***.

Type 2(by functionality):

- ***Reactive machines***: They are the first formsof artificial intelligence, whichdue to the lack of past memory cannot use the previous information for future actions.
- ***Limited memory***: AI systems can use past experiences to inform future decisions. Some of the decision-making functions in self-driving cars have been designed in this way. Observations used to inform actions that happen in a not-so-distant future, such as a car that has changed lanes.
- ***Theory of mind: this type of***AI theoretically, should understand the emotion, faith, thoughts, expectations of people and be able to interact socially. Although multiple upgrades have been made in this regard, this type of AI is not yet complete.
- ***Self-awareness***: an AI that has its own conscious, super intelligent, self-ware and sensitive (in simple words, a complete human being). This type isnot yet functional either, but if this is successful it would be the greatest achievement in the field of AI [6].

Artificial intelligence canbe carried out in several ways (fig.2), but the bestknownare:

- ***Machine learning*** (ML), is a component of AI that provides intelligence to machines so that they can gain the ability to learn automatically through experiences without being explicitly programmed;
- ***Natural language processing*** (NLP) allows a computer system to understand and process human language, such as English, whether text or speech. NLP acts as a language embed tool for AI. With NLP, human language can actuality be used to make machines learn and work.
- ***Vision*** is an application of computer vision that allows a machine to recognize an object. Machine Vision captures and analyzes visual information using one or more cameras, analog-to-digital conversations, and digital signal processing. Machine viewing systems are programmed to perform strictly defined tasks such as counting objects, reading the serial number, etc.
- ***Robotics*** is an interdisciplinary field of science and engineering consolidated with mechanical engineering, electrical engineering, computer science and more. This strategy is the design, production, operation and use of robots. Manages information systems for management, acquisition of intelligent results and data change.
- ***Autonomous vehicles***, areUnmanned Aeronautical Vehicles (UAV) or Ethereal Unmanned Personnel (UAS), otherwise called automatic, in a mechanical setting are unmanned aircraft that can be controlled remotely[13].

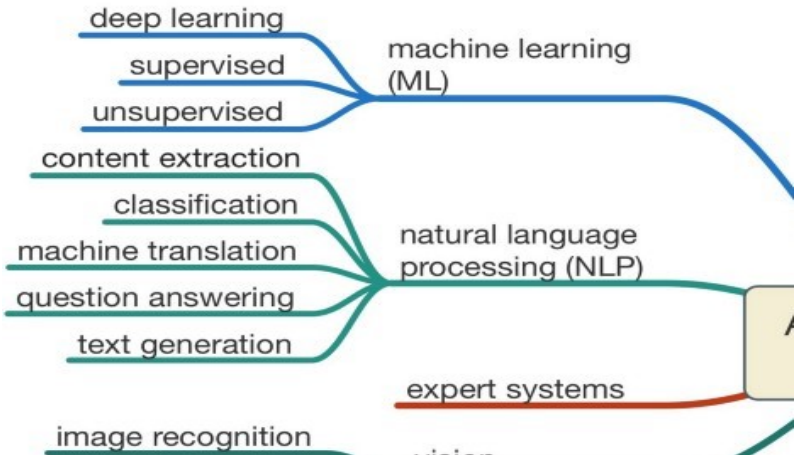

Fig.2 Ways in which artificial intelligence can be achieved [15].

In agriculture, artificial intelligence helps to improve efficiency and reduce the aspimpacton the environment.

Currently, to increase the efficiency of agricultural production, most startups in agriculture, use AI. By implementing AI-based approaches,it could detect climate change or certain diseasesof crops to actovertimeand intelligently. Drones or agricultural robots with artificial intelligence can also be used, whichcan harvest crops in a larger volume and at a faster rate than human workers[4].

RESULTS AND DISCUSSIONS

Agricultureis constantly evolving - technology is becoming an indispensable part of every commercial farm. New precision agricultural companies are developing technologies that allow farmers to maximize yields, controlling every variable of agricultural crops, such as humidity level, pest stress, soil conditions and microclimates. By providing more accurate techniques for planting and growing crops, precision farming enables farmers to increase efficiency and manage costs [9].

A recent market study predicts an increase in the global artificial intelligence market in agriculture, which will reach 1550 million dollarsin2025 [4].

It is already known that the development of agricultural digital platforms, intelligent water management systems, agricultural machinery manufacturers, are indispensable in the development of digital solutionsthat support farmers.

Several projectshave beenlaunched withinthe European Commissionto encouragedigitalinnovation inagriculture. The most important projects would be:

IoF2020, is a project launched in 2017 that is based on facilitating the use of the Internet of Things (IoT) in food and agriculture. The project is already carried out in 22 EU member countries and covers 5 different sectors of agricultural studies: arable, dairy, fruit, vegetables and meat [16].

ATLAS is a systemof interoperability and agricultural analysis, launched in October 2019 and which refers to the development of a digitalservices platform for agricultural applications.This allows for the flexible combination of agricultural machines, sensor systems and analysis tools, and iscreated around a data exchange network using a uniform application program interface. Within the project, the 13 commercial research farms from 6 European countries promote the

benefits ofnew technologies inthe agricultural sector byconducting pilot studies. Theaim is to define the next generation standards for data-driven agriculture with regard to the knowledge gained from these studies [17].

DEMETER, consists of a large-scale deployment of interoperable intelligent agriculture platforms, delivered through 20 pilots in 18 European countries including Romania. The project aims to demonstrate the potential of interoperability based on advanced standards for IoT in agriculture,and to show that an integrated approach can support sustainable agriculture. The main objective would be to create an IoT stem of safe and sustainable business with the protection ofnatural resources, which can have an impact in the food and agricultural sector[18].

Other projects that encourage the digitization of agriculture are: **ROMI** (robotics for microfarms), **BACCHUS** (mobile robotic platforms for active inspection and harvesting in agricultural areas), **DataBio** (data-driven bioeconomy), a **BigData LSP** platform in agriculture, forestry and fisheries.

The University Politehnica of Bucharest has started aproject,**SmartAgro,** through which it aims to implement andtest a precision agricultural platform by using M2M / IoT radio-telemetry systems and a Cloud platform for processing the collected data.

The university also has an **NGI-UAV-AGRO** project ("New Generation Internet based on 5G and UAV for precision agriculture") project, which has as main purpose the development and implementation of a monitoring and prevention platformfor precision agriculture. The platform will bedesigned using the current 5G specifications and UAVs (Unmanned Aerial Vehicle) for Smart City and Smart Neighbour hood use cases [19].

CONCLUSIONS

Innovation and technology are used together for the production of high-quality food, rationalization of efficiency and adaptation to a changing environment.

The introduction of artificial intelligence in agriculture has multiple benefit ssuchas:

- AI is used in applications such as automatic machine adjustments, for weather fore casting and the identification of diseases orpests;

- comparation of the results due to the access to the data base;
- improving farmers' working conditions, not eliminating jobs;
- AI focuses on healthy crop production by checking for defectivecrops;
- improving crop management practices, helping many tech companies to invest in algorithms that become useful in agriculture.

In otherwords, artificial intelligence, is effective both in evaluating problems but also in finding solutions ina short time.

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