

Artificial Intelligence in the Perspectives of Agricultural Technology Development in Indonesia

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Abstract

The agricultural sector is a sector supporting economy and welfare of many people in Indonesia. The direction of life development of Indonesian people themselves has been headed to dominant direction, preferring practical and dynamic activity. This of course indirectly influences the point of view of the farmers to do their farming activities using more practical and modern things. Traditional ways have gradually been abandoned, although there are still some farmers we still use them. The development of modern technology in all fields, particularly in agriculture, is certainly very helpful for farmers in terms of saving time and energy. Artificial intelligence systems adopting human mindset into a computer programming language can create technology that works like a human, with training data that has been examined into programming languages.

Keywords

agricultural technology;
artificial intelligence;
development; perspectives



I. Introduction

Nowadays in human life, almost all activity aspects are inseparable from technology role, from electronic equipment, to industrial scale. Technology development such as information systems and computers has brought major changes in human activity patterns, from electronic equipment that has been equipped with sophisticated computer systems such as washing machines which employed artificial intelligence to industrial machines that have used robotics for their production processes.

Currently, modern agriculture prioritizes practical and effective functions in the development of agricultural equipment and machinery, one of the development scope is precision agriculture. Precision agriculture is the use of information technology into agricultural management system to analyze, identify and manage the agricultural environment presenting the aims of precision agriculture which are obtaining optimum benefits, be sustainable, have high competitiveness and are able to maintain environmental resources (Mulla, 2013).

Precision agriculture system requires the support of information and computational technology to ensure the acquisition and processing of precise, fast and accurate data in monitoring, decision making, and monitoring various agricultural production activities. One method that can be applied is an artificial intelligence-based control system (AI) (Zhang, Wang, & Wang, 2002). With the application of computational technology and systems to various agricultural business activities, particularly the aspects of agricultural equipment and machinery, post-harvest and marketing are increasingly driving change from traditional agriculture to modern agriculture which is more efficient and effective, resulting in business culture change.

II. Review of Literature

2.1 Artificial Intelligence

The direction of society development today is more likely desiring practical and efficient activities. People mindset who used to be more conventional inclined to focusing on the their ancestors experiences was rarely seen now. The role of technology in Indonesian agriculture has been rapidly felt (Timmer*, 2004). Technology is data development obtained from field based on existing experience and research which is intentionally carried out. A part of the technology itself is artificial intelligence which is source of control for conducting its tasks (Salomon, Perkins, & Globerson, 1991).

Artificial Intelligence (AI) is defined as the intelligence shown by an artificial entity. This system is generally considered as computer. Intelligence is created and incorporated into machine (computer) in order to be able to do the work that humans can do (Listiyono, 2008). Machines that have been inserted with intelligence will have perspective equal to human reasoning in order to work according to the command. Some types of fields use artificial intelligence include expert systems, computer games (games), fuzzy logic, artificial neural networks and robotics (Nasution, 2012).

Artificial intelligence is used to identify and model human thinking processes as well as design machines to mimic human behavior (Luger, 2005). The definition of intelligent means having experience and knowledge being transformed into a form of reasoning. In order for machine to work, there is a need for debriefing on aspects of knowledge to create reasoning as the output of this system. There are two main parts needed for artificial intelligence applications (Jennings, 2000). The first one is a knowledge base containing facts, theories, thoughts and connections between one another. The second part is the inference engine meaning the ability to draw conclusions based on known knowledge.

2.2 The Role Of Made Intelligence Systems In Agricultural Technology

Mechanization has been widely practiced in agriculture and helps overcome various problems arise, such as weather problems in drying agricultural commodities. For example, many coffee drying devices have been made by utilizing heat from natural gas/LPG. This method is sufficiently effective to dry coffee products even though the weather is rainy most of the time. The advantage of this tool is iefficient, inexpensive and practical to use. The drawback of the tools that have been made is the uncontrolled temperature control, where the drying temperature fluctuates with quite high value (Santoso, Muhidong, & Mursalim, 2018). Santoso ett.all created coffee drying device with temperature control using fuzzy logic and expert systems the coffee dryer had been made can provide stable drying temperature and save fuel usage.

The application of artificial intelligence in agriculture is not only limited to coffee dryers. Artificial intelligence can be applied to create rice field clusters (Chang & Wan, 2015). Applying this technology, rice production can be increased to insure the continuity of rice supply. Application of artificial intelligence can also be done in the hydroponic planting model by controlling the level of nutrients given to plants (Domingues, Takahashi, Camara, & Nixdorf, 2012). Nutritional control is carried out by regulating the amount of nutrients dissolved in water. Utilizing this method, hydroponic plants obtained can be assured to use nutrients efficiently. Application of fuzzy logic can also be conducted in citrus disease diagnosis (Marengo, Robotti, Righetti, & Antonucci, 2003).

Artificial intelligence applied in various aspects can be used to advance agricultural technology, both in terms of cultivation and food processing. With technology knowledge, farmers or food industry can conduct food processing appropriately and produce quality

products (Wolfert, Ge, Verdouw, & Bogaardt, 2017). Improving food processing can be expected to create food stability and improve farmers welfare. Therefore, in the future agricultural technology will be greatly influenced by the development of the digital world and artificial intelligence-based manufacturing as the brain in agricultural equipment and machinery operation.

III. Results and Discussion

One of the application of precision agriculture is sorting agricultural products such as apple products based color and size parameters. Precision agriculture approaches need to be applied to sorting apple because the manual sorting process generally produces products with poor diversity and relatively time consuming. To improve uniformity, accuracy, and processing time the sorting process can be conducted by intelligent machines using Probabilistic Neural Network (PNN) with parallel computing systems (Hossain, Ong, Ismail, Noroozi, & Khoo, 2017). The sorting system of agricultural products with precision methods can be done by utilizing intelligent computing systems to determine product quality objectively, uniformly and quickly. The black tea bleaching system uses camera sensors to capture images of black tea powder which are then processed and analyzed by artificial neural network method to simultaneously determine the class and grade of black tea (MUQODAS). Likewise, an intelligent sorting system of pineapple has also been developed to determine pineapple quality using pineapple color and size features (Susilo, 2016).

The application of artificial intelligence in agricultural equipment can be carried out by making new tools or by modifying existing ones. Existing equipment can be enhanced by artificial intelligence through necessary modifications. The main modification on hardware is in the control circuit which involves the use of microcontrollers and actuators. In addition to this modification, it is necessary to master the software operation of such as codevisionAVR, Arduino and Matlab for program development (Murdianto & Santoso, 2019).

The driven of agricultural technology development is government, particularly research and development institutions, either research and development in ministries or in higher education institutions. Research and development institutions can carry out researches on agricultural mechanization equipment (Agung Prabowo & Mulyantara, 2018).

According to Astuti et al (2019) Education is an obligation of every human being that must be pursued to hold responsibilities and try to produce progress in knowledge and experience for the lives of every individual. Education is one of the efforts to improve the ability of human intelligence, thus he is able to improve the quality of his life (Saleh and Mujahiddin, 2020). Education is expected to be able to answer all the challenges of the times and be able to foster national generations, so that people become reliable and of high quality, with strong characteristics, clear identities and able to deal with current and future problems (Azhar, 2018).

In the educational institution, lecturers can conduct research in the field of artificial intelligence and introduce it to students, either giving lectures in the classroom or in the form of final assignment research guidance, theses and dissertations. The results of this study are published and can be accessed by wider community. For the implementation on community, the authorities need to conduct training and education can be in the form of socializing the benefits of artificial intelligence and providing assistance to farmers and small entrepreneurs.

Implementation artificial intelligence is able to be applied on irrigation development sprinkler automatic based microcontroller (Sirait & Maryati, 2019). Integration between 200 wattpeak solar panel and YL-69 soil moisture sensor and PCB-YL 69 with LM393 comparator controlled by a microcontroller. Arduino UNO Atmega328p microcontroller can be used as an automatic control system to drive the irrigation pump actuation system based on soil moisture in accordance with a predetermined set point

Precision agriculture approaches can also be used to calculate the right dose in weed spraying for peanut plants (Solahudin, Seminar, Astika, & Buono, 2010). Herbicide doses are determined according to the weed population calculated in real-time using camera sensor placed on hand tractor operated in the field.

The weed cover filtered by the camera shows the weed population determining spraying dose. One image capture area is decomposed into four subareas to improve the accuracy of weed density measurements further. Right dose spraying will save the volume of herbicide used and reduce the impact of unexpected environmental pollution (DJAU, 2009).

The precision agriculture-based alsintan planning system for spraying crops on large and scattered lands in various geographical locations has been developed (Abi Prabowo, 2016). From the test results, the application of the image decomposition method improves the application accuracy in terms of dose and location accuracy. From testing proposed system results, it can be concluded that the application saves herbicide consumption by 14% compared to spraying without image decomposition and have implications for reducing environmental pollution as well as increasing spraying efficiency and effectiveness (Megantara, Wijaya, & Budisanjaya, 2018).

Prediction of pest attack that will occur can be done using climate data and plants types growth in the land that is acquired from satellites, this action can be taken to prevent attacks by certain pests. Prevention of predictable pest attacks is carried out by determining the proper spray scheduling and the selection of spray nozzle sizes in accordance to the land topography conditions (DIIN, 2018).

Intelligent systems for early detection of disease in cattle have been developed using the Fuzzy Neural Network (Ashari, Anggraini, & Mukhlason, 2012). Fuzzy logic methods have been developed so as to enable the detection of disease attacks even though in plain sight are not asymptomatic. The development of national beef cattle farms has several obstacles to increase the increase in domestic cattle population, one of which is the delay in detecting diseases.

Control systems in plant houses for the production of precision agriculture-based crops have been developed to control temperature, humidity, and nutrients given in accordance to optimal crop needs conditions (Marsela, Sadjad, & Achmad, 2013). As an illustration, the right time and dosage of nutrients can be the optimal criteria for whether or not the growth of hydroponic plants. By monitoring the ratio values, the environmental control of hydroponic plants including nutrient doses, temperature and water discharge can be optimized

The intelligent detection system based on Artificial Neural Networks allows the early detection of this disease before showing symptoms, thus it opens up the opportunity to overcome the disease before reaching fatal damage condition (Wijaya, Soesanti, & Firmansyah, 2017).

IV. Conclusion

1. The rapid development of artificial intelligence requires the strength of skilled human resources in the application of these technologies. Until now there is no definitive data on the number of uses and needs of high computing technology for agricultural mechanization in Indonesia. Nevertheless, the need for microcontroller-based technology and artificial intelligence in order to increasing agricultural mechanization must begin to become a concern.
2. Utilization and application of instrumentation in agricultural activities and improvement of skilled human resources in the fields of mechanization, electronics and agricultural computing.
3. The development of agricultural mechanization in the future will be influenced by the progress of research and the development of appropriate technologies based on microcontrollers and artificial intelligence.
4. The results of research and development of artificial intelligence systems have been partially carried out, both for the application of agricultural technology directly or indirectly.
5. The resources formation proficient in mastering artificial intelligence is expected to encourage the emergence of agricultural equipment and machinery that can utilize fuel and other energy from the agricultural sector itself.

Policy Implications

Some policies that must be taken in order to increase the application of artificial intelligence for agricultural technology development in order to be able to follow the flow of world technological development and be able to meet the needs of agricultural commodities in accordance with market demand:

1. Research and development needs to be improved to assess all types of agricultural equipment and machinery both in the harvest process and in the post-harvest process in order to be able to operate safely and perform well using artificial intelligence-based technology.
2. The design and development of agricultural equipment and machinery in the future should be adjusted to the technology being developed and then adjusted to the needs of a region.
3. Public policies need to be made to support the production of artificial intelligence-based agricultural equipment and machinery.

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