Hindawi
Journal of Food Quality
Volume 2022, Article ID 7456650, 7 pages
https://doi.org/10.1155/2022/7456650

Research Article

Model Optimization of Agricultural Machinery Information Control System Based on Artificial Intelligence

Chunhang Wang,[1] **Zhe An**,[1] **Supalux Jairueng**,[2] **Lakkana Ruekkasaem**,[3] **M. Jayasudha**,[4] **and Bhupesh Kumar Singh**[5]

[1]*Tangshan Vocational and Technical College, Hebei Tangshan, China*
[2]*Department of Architecture, Phranakhon Rajabhat University, Bangkok, Thailand*
[3]*Department of Industrial Management Technology, Phranakhon Rajabhat University, Bangkok, Thailand*
[4]*VIT University Chennai Campus, Chennai, India*
[5]*Arba Minch Institute of Technology, Arba Minch University, Arba Minch, Ethiopia*

Correspondence should be addressed to Zhe An; zhean69@126.com and Bhupesh Kumar Singh; dr.bhupeshkumarsingh@amu.edu.et

Received 15 March 2022; Accepted 1 April 2022; Published 30 April 2022

Academic Editor: Rijwan Khan

Agricultural mechanization information in our country has the main problems existing in the management and utilization. The analysis of China's agricultural mechanization management model and related software is presented based on combining modern science and technology as well as the development of agricultural mechanization management information system based on network software to standardize the management information collection, processing, storage and transmission, agricultural mechanization management information science, standardization, automation, etc. According to the analysis, the output target speed after fusion is more stable, and the stability is increased by 59.59% compared with the single-point GNSS velocity measurement data, and by 18.32% compared with the data measured by the binocular vision velocity measurement system. It has realized the goal of accurate speed measurement from low speed to high speed. In particular, it has solved the problems such as vehicles unable to complete positioning and vehicle skidding caused by trees blocking GNSS satellite signals during field operations.

1. Introduction

Artificial intelligence is a strategic technology leading the future development of the world. Major developed countries in the world regard the development of artificial intelligence as a major strategy to enhance national competitiveness and safeguard national security. Artificial intelligence is the new engine of economic development and the core driving force of a new round of industrial reform. China is a huge agricultural country, and strengthening agriculture's core position is an important part of China's socialist construction with Chinese characteristics. Since the reform and opening-up, China's rural economy has altered tremendously. To develop a rural economic development strategy, guide agricultural machinery industrial production, and promote agricultural mechanization development in China, it is critical to identify the factors influencing agricultural mechanization development as well as the degree of influence of each factor [1]. It will give birth to new technologies and new forms of business, profoundly change the way of production and life and thinking of human beings, and achieve an overall jump in social productivity [2]. With the development of the rural economy, the process of China's agricultural modernization is accelerating. Agricultural mechanization has become an important part of modern agriculture, and its information management has an immeasurable role in the development of agricultural modernization. Information on agricultural mechanization is not only conducive to the work of agricultural machinery management departments but also plays an important role in agricultural investment and decision making of governments at all levels, agricultural machinery market analysis, and improvement of economic income of agricultural machinery users [3]. China is a large agricultural country, and improving agriculture's fundamental position is a key component of China's socialist building with Chinese features. China's rural economic position has changed dramatically since the reform and opening-up. In the new situation, it is critical to identify the factors influencing agricultural mechanization development as well as the degree of influence of each factor in order to develop a rural economic development strategy, guide agricultural machinery industrial production, and promote agricultural mechanization development in China [4]. The application scenarios of speed control technology and extraction method in unmanned plant protection operations are growing more and more comprehensive as intelligent and informationized agricultural machinery and equipment improve. Traditional automated agricultural machinery navigation consists of three major components: position and attitude assessment, path planning, and motion control [5, 6]. Agricultural mechanization is an important part of modern agriculture, and the rational and effective utilization of agricultural mechanization information plays an immeasurable role in promoting the development of agricultural mechanization in China [7].

Artificial intelligence systems can anticipate which crop to plant in a given year and when to sow and harvest in a given place by analyzing data such as heat, climate, soil, humidity, and crop performance in prior years [8]. As a consequence, this method improves crop yields while using less water and pesticides to promote soil fertility and fight pests. The impact on natural ecosystems may be reduced, and workers can produce more food, lowering food costs and meeting the food demands of an expanding population [9, 10]. Rotating machinery and tools typically result in instability because of the visible uneven intensity of components, physical imbalance, and configuration problems throughout operation [11]. Strong vibrations accelerate component degradation, increase replacement time, and cause considerable property loss. Rotating equipment vibration monitoring and fault detection techniques are those that observe and recognise vibration restrictions caused by causes such as imbalance [12, 13]. Dong et al. studied how coordinating multidisciplinary technologies and reasonably integrating them into the system is the key to the success of intelligent agricultural machinery. According to the requirements of China's land scale management development, intelligent agricultural machinery should make use of advanced aviation and aerospace ground technology to realize high-speed calculation and data information transmission in a dynamic environment and command the executing agency to efficiently and effectively complete the task [14].

Jin et al. developed a vibration detection and control system based on intelligent sensor nodes to detect and control the frame vibration caused by high-power engines of agricultural machinery in view of the problem that the vibration of agricultural machinery not only affects the operation quality and effect but also reduces the service life of the machinery. Each intelligent detection node can work independently or can be networked as an Internet of Things system [15]. Precision agriculture is based on the automated navigation technology of agricultural equipment, which can help minimize the amount of labour required for agricultural machinery operators while enhancing implementation efficiency and accuracy [16, 17]. Mironenko et al. improve the efficiency of agricultural industrial production. The possibility of improving agricultural production efficiency by establishing a hardware-based control system with artificial intelligence elements was analyzed [18]. The growth trends of new agricultural technologies such as artificial intelligence are based on intelligent agriculture, agricultural Internet of Things, and the function of agricultural Internet of Things in intelligent agricultural large-scale systems [19]. The agricultural machinery management system, which is mainly focused on advanced IoT and cloud computing technology, could greatly assist specific organizations in providing greater efficiency and low-price production services to Chinese farmers by implementing remote monitoring stations on smart farm equipment and enhancing mobile application and server software [20, 21].

2. Application of Artificial Intelligence in Agricultural Production

Agriculture entails a variety of procedures and phases, the majority of which are performed manually. AI can help with the most complicated and ordinary jobs by supplementing existing technology. When integrated with other technologies, it can gather and evaluate massive data on a digital platform, determine the best course of action, and even take that action. Artificial intelligence (AI) and machine learning (ML) are being used in agriculture to provide cognitive solutions in agricultural and field farming technologies [22]. In particular, cognitive computing will become the most disruptive technology in agricultural services. Cognitive computing is able to understand, learn, and respond to different situations, improving efficiency. Microsoft has worked with 17 farmers in the Indian state of Andhra Pradesh to help them increase the average yield per hectare by 30 percent compared with the same period last year by advising them on sowing, land, and fertilizer.

(1) The Internet of things drives production growth: the Internet of Things generates vast amounts of structured and unstructured data every day [23]. The data are related to historical weather patterns, soil reports, new research, rainfall, insect pests, drone and camera images, and so on, to boost yields. Everything that can be operated via the Internet is an Internet of Things (IoT) device. With wearable IoWT (Internet of Wearable Things), IoT devices have grown rather common in consumer markets. IoT applications in farming are aimed at traditional farming activities in order to fulfil rising needs and reduce output losses [24]. Robots, drones, remote sensors, and computer imagery, along with ever-improving machine learning and analytical tools, are used in agriculture to monitor crops, survey and map fields, and deliver data to farmers for sensible farm management plans, saving time and money [25].

(2) Soil testing: near remote sensing and remote sensing are two technologies mainly used for intelligent data fusion. Both technologies are realized with the help of sensors. In particular, the former requires sensors that are in contact with the soil or very close to the soil so that soil properties can be determined according to the soil below the surface of a specific location. Rowbot, a company dedicated to providing artificial intelligence hardware solutions, has combined data collection software with robotics to prepare the best fertilizer for corn planting to maximize yields.

2.1. Agricultural Mechanization Information System. In recent years, in order to meet the requirements of the socialist market economic system, agricultural machinery management departments at all levels have been developing rapidly in the process of deepening reform and transforming functions. Although management departments at all levels have developed some application software, it is not suitable for nationwide promotion due to its strong pertinence (all aimed at specific problems at all levels), long development cycle, and relatively backward technical means. At present, there is no unified application software available for all levels of the country in the agricultural machinery management department. In our nation, Internet and Intranet technologies have been widely employed in information management, and the use of its network database has yielded significant results, but agricultural mechanization information management research is still in its early stages. The application of computer technology and network technology in agricultural mechanization in foreign countries is primarily for farms and agricultural machinery enterprises, and the software developed in our country cannot be directly used in the management of agricultural mechanization information. China's agricultural mechanization management system is a top-down tree structure system since it has its own peculiarities (as shown in Figure 1), and each level of the system not only corresponds to the agricultural mechanization management department at the next level but also corresponds to the relevant government departments at the same level.

Agricultural mechanization management information system (BNAMMIS) based on a network makes full use of modern network technology and database technology to solve the input, modification, addition, deletion, inquiry, and transmission of information in agricultural mechanization information management so as to solve the abovementioned problems existing in agricultural mechanization information management. This system provides a common interface with other software, which will not cause the waste of existing resources and supports the query function of the network database so as to have a good data sharing. The specific research ideas of the network-based agricultural mechanization management information system are shown in Figure 2.

2.2. Principle of GNSS Velocity Measurement. GNSS mainly includes the United States Global Navigation Satellite System, Russia's GLONASS, Europe's Galileo, and China's BeiDou Navigation Satellite System. The common speed measurement methods of GNSS include single-point speed measurement and differential speed measurement. Differential positioning has a fixed and immovable reference station. The reference station transmits the differential correction signal to the onboard mobile receiver through the wireless link. The onboard mobile receiver constantly corrects its positioning error by combining the differential correction information to achieve centimeter-level accuracy. In general, the accuracy of differential velocimetry is higher than that of single-point velocimetry, but similar to differential positioning, its velocimetry accuracy is easily affected by the distance between the receiver and the base station, while the single-point velocimetry system only needs to rely on a single GNSS receiver on the applicator. Considering the particularity and complexity of pesticide application in an orchard environment, this project plans to adopt GNSS single-point velocity measurement method and use the original Doppler observation value to measure velocity so as to achieve the purpose of real-time acquisition of operating vehicle velocity in this project. Pseudodistance observation equation is shown in equation (1):

$$\widetilde{p}_j^j(t) = p_j^j(t) + c\delta t_i(t) - c\delta t^j(t) + \Delta_{j,I_g}^j + \Delta_{j,T}^j(t) + \varepsilon_p, \quad (1)$$

where $\widetilde{p}_j^j(t)$ is the pseudodistance between satellite and receiver, $p_j^j(t)$ is the geometric distance between the satellite and the receiver, $\delta t_i(t)$ is the clock difference of the receiver at time t, $\delta t^j(t)$ is the time difference of the satellite at time t, Δ_{i,I_g}^j is the ionospheric delay, $\Delta_{j,T}^j(t)$ is the tropospheric delay, and εp is the observation noise;

By differentiating equation (1), the Doppler velocimetry observation equation can be obtained. In this way, the onboard GNSS receiver operating in the process of the relative position of observation satellite station spacing rate varies depending on the location, in which, the speed of acquisition field, has nothing to do with the choice of frequency speed measuring precision, but the error is influenced by the selected receiver model is more obvious. During the experiment, the GNSS receiver needs to be fixed above the rear of the application vehicle to obtain relatively stable satellite information. Finally, the speed at different moments is determined according to the different satellite signals resolved by the application vehicle at different positions. The choice of core control chip for the GNSS single-point speed measurement system is very important to the whole system. In the process of selecting the core control chip, the actual requirements should be combined with the function of the chip. As shown in Figure 1, is the comparison of several common single-chip control chip parameters, the MSP430 chip can achieve low power consumption mode, fast running speed, strong processing capacity, and rich resources in the chip, suitable for commercial development and use. STM32 has rich peripheral resources and fast running speed, in line with the development environment requirements of this subject. Table 1 shows the parameter comparison of the three chips:

The core controller of the GNSS single-point velocity measurement system uses ARM Cortex-M3 as the core chip

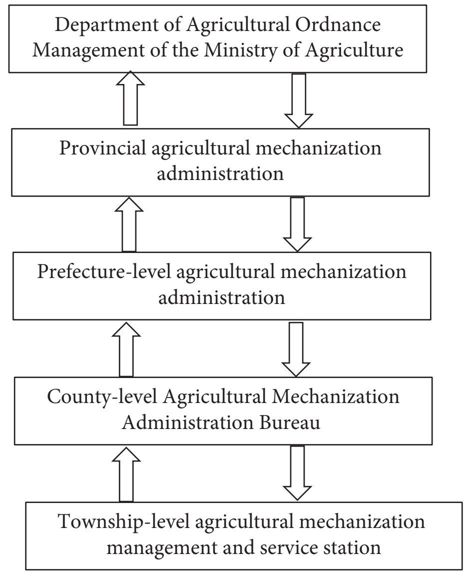

Figure 1: Structure composition of agricultural machinery management information system.

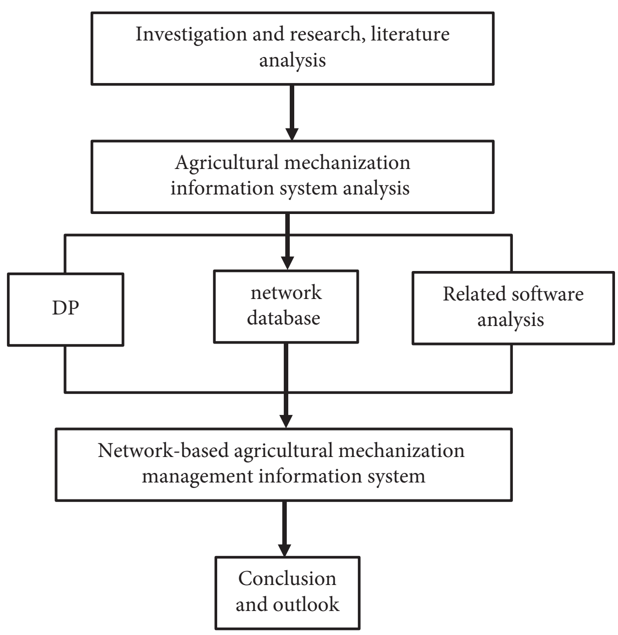

Figure 2: Idea diagram of network-based agricultural mechanization management information system.

Table 1: Comparison of parameters of several common microcontroller core chips.

Chip model	Owned by the company	CPU (bits)	RAM (k)	ROM (k)	I/O
MCS51	Intel	8	5	128	32
MSP430	TI	16	5–31	512	48
STM32	ARM	32	31	512	112

STM32F 103 VET6, which is used to parse the satellite information obtained by the receiver. The number of pins of this chip can meet the requirements of this design. In addition, the chip also has first-class peripheral resources: flash memory size is 512 kB; the main frequency is 72 MHz. It has a maximum operating voltage of 3.6 V, 112 GPIO interfaces, and 3 12 bit ADC conversion units.

3. Experimental Analysis

The data before and after Kalman filter fusion are collected, and the comparative analysis is completed. The experimental data obtained from 20 experiments are processed simply to make the obtained data more stable. On this basis, the mean value, root mean square value, and the distribution of error interval of each group of data are analyzed. In order to realize the stable extraction of the speed data of the application vehicle and the fine control of variable application, 10 groups of experiments were carried out in the open environment and the environment covered by trees, respectively. The test distance of each group was 15 m, and the distance between fruit trees was about 2 m. The speed values measured by GNSS at a single point, the number of satellites, DOP values, and the speed values measured by the binocular vision range velocimetry module during the application vehicle's movement were collected in real time. In order to reduce the deviation of experimental data and optimize the structure, the average value of the speed data of more than 1000 sampling points acquired in real time in each group was calculated by sliding window sampling in this experiment. Taking the data collected by GNSS at a single point as an example, the calculation process was shown as follows:

$$V_{11} = \frac{\sum_{i=0}^{i=5} V_i}{5}, \tag{2}$$

where V_{11} is the first speed data (m/s) after the average value of sampling in the sliding window, V_i is the velocity measurement data of each sampling point (m/s), and 5 is the sampling interval.

It can be adjusted continuously according to different sampling points to obtain smoother and optimized results. In the above formula, the first data result after smoothing is the average value of the data measured by the first five single points of GNSS, and so on, the second data after smoothing is the average value after summing the second value to the sixth value of the single point of GNSS data. The sliding window sampling average value of the binocular vision odometry system is also calculated in this way, taking the data collected in experiment 1 as an example. A total of 1321 data of sampling points were obtained, and the velocity measurement data of the two systems were respectively saved as .CSV files, wherein, the files saved in the binocular vision velocimetry system include minute, second, and binocular velocimetry data. The files saved in the single-point velocity measurement system include the number of receiving satellites, number of pixel points, DOP value, and GNSS real-time speed data. Taking the first group of experiments as an example, in an open environment, the vehicle operating speed was adjusted to low gear. A total of 1321 sampling points were collected from the starting position to the ending position. A comparison of real-time data of GNSS single-point velocity measurement and real-time data of the binocular velocity measurement system is shown in Figure 3.

As can be seen from Figure 4, under the condition of low-speed driving in GNSS single-point log data, there is a drift phenomenon with high and low speed, and the binocular vision system to measure the data in most cases is relatively stable, with speed generally stable at about 0.2 m/s, occasionally appearing beyond the scope of the high or low, whereas orchard pesticide applying low speed compared with GNSS velocity measurement, C is relatively stable. The changes in the number of feature points of velocity measurement in different environments are shown in Figure 4.

In the first set of experiments of velocity measurement, the errors were analyzed. In addition to comparative analysis of the two groups of measured data, the mean value and root mean square formula of GNSS speed measurement are also shown as follows:

$$\overline{V}_{\mathrm{GPS}} = \frac{\sum_0^n V_n}{n}, \tag{3}$$

where $\overline{V}_{\mathrm{GPS}}$ is the average value of GNSS velocity measurement at a single point in low speed and open environment (m/s), V_n is the real-time velocity value measured by GNSS at each moment (m/s), and n is the number of sampling points.

Through calculation, in the first group of velocity measurement experiments, the mean value of the GNSS single-point velocity measurement system is shown as follows:

$$\overline{V}_{\mathrm{GPS}} = \frac{\sum_0^{1321} V_n}{1321} = 0.3716\,\mathrm{m/s}. \tag{4}$$

Similarly, in the first group of velocity measurement experiments, the mean value of the binocular velocity measurement system is shown as follows:

$$\overline{V}_{\mathrm{GPS}} = \frac{\sum_0^{1321} V_n}{1321} = 0.1721\,\mathrm{m/s}. \tag{5}$$

According to the above two data, the mean value measured by GNSS is 0.3716 m/s, and the mean value measured by the binocular velocimetry system is 0.1721 m/s. The data measured by GNSS at a single point is relatively high at low speed, while at low speed, the number of pixel points obtained by the binocular speed measurement system is relatively stable and the measured data is more authentic. In order to compare the fluctuation of the measured data between the two, the variance of the first group of experiments was analyzed. The variance was the square operation based on the difference between each data and the mean. The smaller the variance was, the more stable the data would be. The calculation formula of variance is as follows:

$$s^2 = \frac{\sum_{i=1}^{n} \left(x_i - \overline{x}\right)^2}{n}, \tag{6}$$

where s^2 is the variance of each set of data calculated, $\overline{x}$ is the average of each set of data, and n is the number of sampling points.According to the above formula and also taking the first group of experimental data as an example, the variance measured by GNSS at a single point is shown as follows:

$$s^2 = \frac{\sum_{i=1}^{1321} \left(x_i - \overline{x}\right)^2}{1321}. \tag{7}$$

The variance of the single-point GNSS velocimetry system in the first group of trials was 0.1589, and the variance of the binocular velocimetry system in the first group of experiments was 0.0786, according to the calculation findings of the square difference between the two groups above. The lower the variance, the more stable the data being measured is. When driving at moderate speeds, binocular

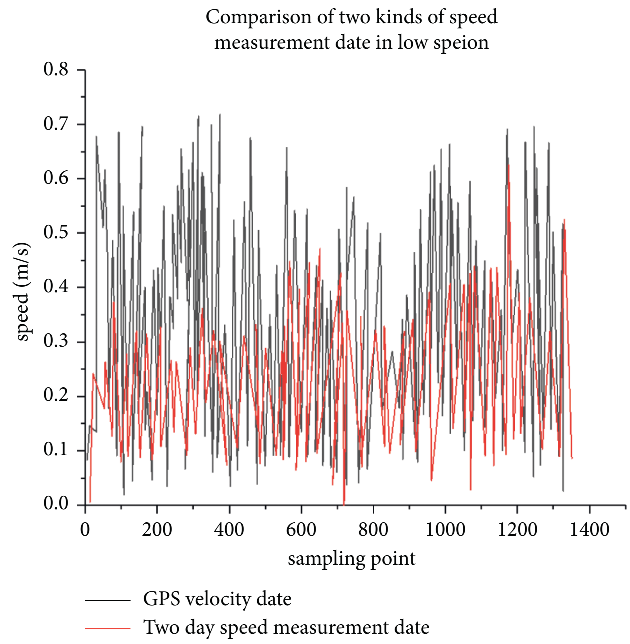

FIGURE 3: Comparison of two kinds of velocity measurement data in low speed and open environment.

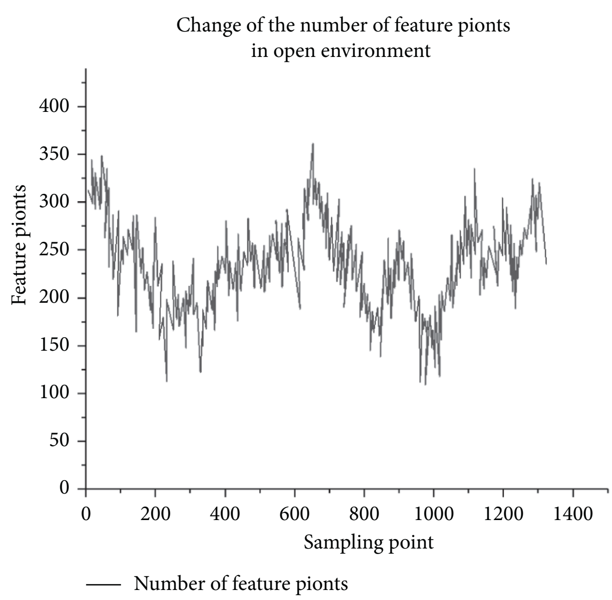

FIGURE 4: Variation of the number of feature points in an open environment.

speed measurement data tends to be quite steady, whereas GNSS speed measurement data fluctuates substantially.

4. Result

Artificial intelligence researchers are working really hard, and we are confident that the future of artificial intelligence is quite bright as a result of their tireless efforts. Artificial intelligence technology will be able to better assist humans in the near future, considerably improving human lives and bringing tremendous social and economic advantages. Agriculture will enter a new era of digital information under its leadership. It is crucial for encouraging the use of electronic information technology in agricultural machines. The data were compared and examined after and before fusion. The target velocity output after fusion is more stable, with a stability increase of 59.59 percent when compared to single-point GNSS velocity measurement data and an increase of 18.32 percent when compared to data measured by the binocular vision velocity measurement system, according to the results of the analysis. It has achieved the aim of precise speed measuring at all speeds, from low to high. It has specifically addressed issues such as vehicle positioning failure and vehicle skidding caused by trees obstructing GNSS satellite signals during field operations. The data report's automated summary feature prevents data distortion due to human factors while also relieving report workers of tedious work.

Data Availability

The data used to support the findings of this study will be made available on request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

The present research work is self-funded.

References

[1] Y. Xu, J. Li, and J. Wan, "Agriculture and crop science in China: innovation and sustainability," *The Crop Journal*, vol. 5, no. 2, pp. 95–99, 2017.

[2] Y. Shi, W. Zhong, X. Chen, A. B. Yu, and J. Li, "Combustion optimization of ultra supercritical boiler based on artificial intelligence," *Energy*, vol. 170, pp. 804–817, 2019.

[3] S. K. Gupta, K. Pandey, and R. Kumar, "Artificial intelligence-based modelling and multi-objective optimization of friction stir welding of dissimilar AA5083-O and AA6063-T6 aluminium alloys," *Proceedings of the Institution of Mechanical Engineers-Part L: Journal of Materials: Design and Applications*, vol. 232, no. 4, pp. 333–342, 2018.

[4] R. Al-Jawadi and M. Studniarski, "An optimization algorithm based on multi-dynamic schema of chromosomes," in *Proceedings of the International Conference on Artificial Intelligence and Soft Computing*, pp. 279–289, Zakopane, Poland, June 2018.

[5] V. Sahni, S. Srivastava, and R. Khan, "Modelling techniques to improve the quality of food using artificial intelligence," *Journal of Food Quality*, vol. 2021, Article ID 2140010, 10 pages, 2021.

[6] G. S. Sriram, "Resolving security and data concerns in cloud computing by utilizing a decentralized cloud computing Option," *International Research Journal of Modernization in Engineering Technology and Science*, vol. 4, no. 1, pp. 1269–1273, 2022.

[7] S. Li, "Structure optimization of e-commerce platform based on artificial intelligence and blockchain technology," *Wireless Communications and Mobile Computing*, vol. 2020, Article ID 8825825, 8 pages, 2020.

[8] M. Yang, P. Kumar, J. Bhola, and M. Shabaz, "Development of image recognition software based on artificial intelligence algorithm for the efficient sorting of apple fruit," *International Journal of System Assurance Engineering and Management*, vol. 13, pp. 322–330, 2021.

[9] L. Wang, P. Kumar, M. E. Makhatha, and V. Jagota, "Numerical simulation of air distribution for monitoring the central air conditioning in large atrium," *International Journal of System Assurance Engineering and Management*, vol. 13, pp. 340–352, 2021.

[10] U. Iqbal and A. H. Mir, "Efficient and dynamic access control mechanism for secure data acquisition in IoT environment," *International Journal of Computing and Digital Systems*, vol. 10, no. 1, pp. 9–28, 2021.

[11] M. Rakhra, R. Singh, T. K. Lohani, and M. Shabaz, "Meta-heuristic and machine learning-based smart engine for renting and sharing of agriculture equipment," *Mathematical Problems in Engineering*, vol. 2021, Article ID 5561065, 13 pages, 2021.

[12] B. Prasanalakshmi, K. Murugan, K. Srinivasan, S. Shridevi, S. Shamsudheen, and Y.-C. Hu, "Improved authentication and computation of medical data transmission in the secure IoT using hyperelliptic curve cryptography," *The Journal of Supercomputing*, vol. 78, no. 1, pp. 361–378, 2022.

[13] V. Jagota, M. Luthra, J. Bhola, A. Sharma, and M. Shabaz, "A secure energy-aware game theory (SEGaT) mechanism for coordination in WSANs," *International Journal of Swarm Intelligence Research*, vol. 13, no. 2, pp. 1–16, 2022.

[14] S. Dong, Z. Yuan, C. Gu et al., "Research on intelligent agricultural machinery control platform based on multi-discipline technology integration," *Transactions of the Chinese Society of Agricultural Engineering*, vol. 33, no. 8, pp. 1–11, 2017.

[15] X. Jin, K. Chen, J. Ji, K. Zhao, X. Du, and H. Ma, "Intelligent vibration detection and control system of agricultural machinery engine," *Measurement*, vol. 145, pp. 503–510, 2019.

[16] S. Mohanasundaram, E. Ramirez-Asis, A. Quispe-Talla, M. W. Bhatt, and M. Shabaz, "Experimental replacement of hops by mango in beer: production and comparison of total phenolics, flavonoids, minerals, carbohydrates, proteins and toxic substances," *International Journal of System Assurance Engineering and Management*, vol. 13, pp. 132–145, 2021.

[17] S. Saralch, V. Jagota, D. Pathak, and V. Singh, "Response surface methodology based analysis of the impact of nanoclay addition on the wear resistance of polypropylene," *The European Physical Journal-Applied Physics*, vol. 86, no. 1, Article ID 10401, 2019.

[18] V. Mironenko, "Information technology as a basis of creating "smart" agricultural machinery," *Mehanization and Electrification of Agricultural*, vol. 9, no. 108, pp. 171–174, 2019.

[19] V. Meshram, K. Patil, V. Meshram, D. Hanchate, and S. D. Ramkteke, "Machine learning in agriculture domain: A state-of-art survey," *Artificial Intelligence in the Life Sciences*, vol. 1, 2021.

[20] R. Khan, S. Kumar, N. Dhingra, and N. Bhati, "The use of different image recognition techniques in food safety: a study," *Journal of Food Quality*, vol. 2021, Article ID 7223164, 10 pages, 2021.

[21] T. K. Lohani, M. T. Ayana, A. K. Mohammed, M. Shabaz, G. Dhiman, and V. Jagota, "A comprehensive approach of hydrological issues related to ground water using GIS in the Hindu holy city of Gaya, India," *World Journal of Engineering*, vol. 29, p. 6, 2021.

[22] M. Ayaz, M. Ammad-Uddin, Z. Sharif, A. Mansour, and E.-H. M. Aggoune, "Internet-of-Things (IoT)-Based smart agriculture: toward making the fields talk," *IEEE Access*, vol. 7, pp. 129551–129583, 2019.

[23] Y. Zhang, X. Kou, Z. Song, Y. Fan, M. Usman, and V. Jagota, "Research on logistics management layout optimization and real-time application based on nonlinear programming," *Nonlinear Engineering*, vol. 10, no. 1, pp. 526–534, 2021.

[24] D. M. Quan and T. T. H. Van, "Potential and trends of IoT application in agriculture in vietnam," *Open Journal of Social Sciences*, vol. 10, no. 1, pp. 170–182, 2022.

[25] A. Rehman, T. Saba, M. Kashif, S. M. Fati, S. A. Bahaj, and H. Chaudhry, "A revisit of internet of things technologies for monitoring and control strategies in smart agriculture," *Agronomy*, vol. 12, no. 1, p. 127, 2022.