Anisha Rawat et al. International Journal of Recent Research Aspects ISSN: 2349-7688, Special Issue: Recent Innovation in Science, Engineering & Management, May 2022, pp. 160-167

Artificial Intelligence in Agriculture

Anisha Rawat, Jagannath International Management School, VasantKunj, rawatanisha04@gmail.com,
Deepali Jain, Jagannath International Management School, VasantKunj, dee.jain000@gmail.com
Ravish Kumar, Jagannath International Management School, VasantKunj,ravishk399@gmail.com
Dr. Sonal Kanungo Sharma, Associate Professor, Jagannath International Management School, Vasant Kunj, sonalkanungo@gmail.com

***Abstract*-This study aims at bringing the innovative application of Artificial Intelligence. Specifically, this research will study that why there is a need of Artificial Intelligence in Agriculture, what are the challenges faced by farmers and how AI helps to overcome those challenges.**

Keywords - Artificial Intelligence, Agriculture, Plantix, Precision Agriculture

2. ARTIFICIAL INTELLIGENCE

Artificial intelligence refers to the machines that are able to perform complex tasks which requires human intelligence or the machines having the ability to think like humans. Use of Artificial Intelligence can make our life easier and smoother with the help of virtual assistants like Siri, Alexa Cortana, and Google Assistant. Hate speech recognition by social media platforms, face unlock in mobile phone, image recognition, weather forecasting, navigation process optimization by sensors, marketing (recommendations on Netflix, Amazon based on our searches), gaming, banking, healthcare, etc. are the some of the common examples of AI[1]. Hardware devices which have AI capabilities like autopilot cars, drones, robots, IoT (smart home automation) and chess-playing computers which predict n number of moves to play with opponent, etc are the areas where AI is used[2].

AI was discovered by John McCarthy in 1956. AI has become important part of our life. AI machine have the ability to perform task automatically without being bored or having lack of concentration. AI has the ability to analyses larger datasets and find patterns at a faster rate than humans. Artificial Intelligence understand the environment and makes decision based on signals within a second. Therefore, AI has become inevitable part of our life. Let's discuss some of its application [3-5].

2.1. FILTERATION SPAM EMAILS

Various algorithms like Naive Bayes, Support vector machines, K- nearest neighbors and random forest are designed to sort out the spam emails or spam messages. Companies like Google uses advance spam detection techniques like neural networks to separate out the spam emails in Gmail [6].

2.2. AUTOCOMPLETE

It's is a word-completion process in which rest of the word us predicted with the help of Artificial Intelligence that a user is trying to search[7]. These applications usually work on concepts such as natural language processing.

2.3. FACE RECOGNITION

Face recognition, recognition of a human face along with the authorized face of the user in the database. Face detection is a method of differentiating the face of a human from the rest of the parts of body. Like Facebook, matches the identity of the people with the digitally stored information in the database [8-10]. Face recognition application can be used in security systems, surveillance, attendance systems, and in many more[11].

2.4. VIRTUAL ASSISTANT

AI based assistant, a program that converts human voice commands and finishes job for the user. Virtual Assistant like Google Assistant, Cortana, Siri, Alexa uses the speech recognition technology to interpret what the user is trying to say like sending messages, internet browsing, finding location, making calls. We also can have a conversation with these digital assistants and therefore act as a chatbot [12]. The power of Virtual Assistants is not up to the smart phones or computers; they are being used in IOT devices like home automation, to control your entire house with voice command [13-16]. It's a very useful device that uses list of languages using which it can connect the internet. The combination of AI with IoT has the capability of developing something profitable to society.

2.5. CHATBOTS

Chatbots are universally used in many websites to meet the customer's queries. One of the effective applications of Chabot is that it has no time foundation, a user can ask a question to chatbot anytime rather than contacting to the company's specific team. It gives you detailed instruction and guide with spontaneous replies [17]. Chabot saves time and reduces human labor and expenditure. To build the chatbot, the good approach is to look at the target audience, companies or any other specific area so that you can improve on the specific area [18].

2.6. FINANCE

With reference to time-series analysis, forecasting, quality results are obtained to solve real-time financial or economic problems like stock market predictions. Algorithmic Trading helps in making trading decisions at speeds and make millions of trades in a day without any human interference [19]. AI is helpful in predicting loan or financial risks especially for the company who are in view of increasing their value in the market, also, frauds can easily be detected using AI [20].

2.7. MEDICAL

With the help of AI and Data Science in medical, a

patient's disease can easily be identified. On the basis of some set of inputs and various factors, prediction can be made to detect one's disease. Deep learning and neural networks are used in scanning and in other medical applications [21-23].

2.8. HATE SPEECH RECOGNITION

With the help of AI, hate speeches and offensive statements can easily be identified in social media. Social media companies use machine learning algorithm to filter out these [24]. It analyses the patterns of the reactions and comments by the people in the post which are in the form of text.

COMPOSITION OF MUSIC

Artificial Intelligence has shifted from manual composition to digital tune making process. Companies like Open AI have released their powerful models called Musenet and Jukebox that are capable of generating music. Earlier too much time was required to compose the melody of a song from the instruments but today [24-27]. We are able to use number of different beats in a song within seconds.

2.9. AGRICULTURE

AI based machines has enhanced agriculture crop production. Farmers can do real time monitoring, harvesting, processing and marketing in a better way. Artificial Intelligence helps farmer to understand the data such as temperature, precipitation, wind speed and solar radiation and take preventive measures for their crop from these weather conditions[28-30].While using the machine learning algorithm in connection with the images captured by the satellite and drones, AI enabled technologies predict the weather conditions, analyses the crop sustainability[31].

3. LITERATURE REVIEW

3.1. Bharat K, stated that "Artificial Intelligence is the rising technology in the modern world. According to fortune, the statistics say that the hirings for AI specialists have grown by 74% over the last four years."

3.2. According to Grand View Research, the global intelligent virtual assistant market size was valued at USD 3.7 billion in 2019, growing at a Compound Annual Growth Rate (CAGR) of 34.0% over the forecastperiod.

3.3. Paul Turner, said that "Agriculture is one such industry that has the potential for massive disruption fueled bydata."

4. NEED OF AI INAGRICULTURE

Agriculture has always been a field which requires a lot of hard work and human supervision to complete even a smallest of tasks. It also requires skilled eyes to be able to recognize when the crop is ready to pick or recognizing diseases in crops or even detecting insects in them which can cause harm to the crops [32]. Therefore, lots of human labor is needed in order to increase the productivity in the field. Also, by 2050 world's population will increaseto9.7billion people [33] . On the planet that means food production needs to be increased by 70% and this is where AI comes in [34].

5. ROLE OF AI IN AGRICULTURE

5.1. IN FIELD MONITORING

Using computer vision, AI helps in monitoring the health and progress of crops in the agricultural field. Pests are the major issue in agriculture. Being one of the major sources of reduction in crops, pests are the major source of transmitting fungal or bacterial infections to a crop which spreads rapidly among the other crops of the same field resulting in major losses [35]. Pests and diseases lead to 40% yield losses per year. And this is where AI comes in. With the use of drones, images are clicked to identify insects and pests in the crops, once identified, the drone will proceed with the spraying of pesticides. Not only this, with the help of computer vision farmers will get notified when the disease is spreading and can take immediate and appropriate step to control it and ensure better quality production [36]. Soil diagnosis has become possible with the help of Computer Vision, Algorithm are designed which can identify the health of soil with the aim to reduces the possibility of underdeveloped crops and producing healthy crop production [37].

Plantix is a mobile based application in which farmers are given the guidance that how to look after their crops, what measures are to be taken to produce better production of the crop [38]. It was developed by Germany based AI-start-up. This application has the capability to detect crop illness caused by pests and nutrient deficiencies affecting crops and also provides preventive measures against it. Farmers can even participate in the online community where they find scientists, farmers and plant experts to discuss about plant health risks [39-40]. Farmers can also access the weather reports, get good crop advice throughout the season and receive disease alerts once a disease spreads in the crop surrounding [41].

5.2. PREDICTIVEANALYTICS

Current state of agriculture requires lot of guess work. Farmers distribute pesticides and water uniformly to the crops. But problem is that there are some plants which are in need of additional amount of water and pesticides and the plants which gets additional water and pesticides is of no use causes massive wastage of water and pesticides. Therefore, precision farming which helps in identifying the crops that requires water or pesticides or gives it to the plants which are in need of it[42].

5.3. AUTONOMOUS ROBOTS

Harvesting and picking of crops is one of the most prominent use of robots in agriculture. They can determine that what is the best time to collect the crop from the field. With the great accuracy and speed, robots can increase the production and

yield of crops thus reduces the wastage of crops being left in the field[43]. With the use of autonomous robots, computer vision machine can identify the ripeness of thecrops.

Water is the scanty resource especially for the farmers whose livelihood depends solely on farming for their survival. Conventional system of irrigation demands extensive piping which is costly to install and difficult to repair. Pipes have the chances of water leakage. Plant Irrigation Water Sprinkler Agriculture Robot, this automatic irrigation robot precisely irrigates the crops in desired area due to which there is no water wastage [44-46]. Traditional methods of hand sowing were extremely about intensive, demanding a lot of human efforts.

But with the introduction of Automatic Seed Sowing Robot, the problem has solved to some extent. This low-cost seed showing robot helps to reduce the human effort involved by automating the process of sowing [47-50]. It's simple design makes it extra user friendly and easy to service and repair. Along with being lightweight, this robot's compact size makes it easy to move around [51].

5.4. ANALYSING MARKET DEMAND

With the help of crop selection, AI can help farmers identify what crop is more profitable in the market by analyzing the market demand. Various algorithms such as decision trees, support vector machines, neural networks, deep learning, etc. can be used for prediction of crop price and its demand in the market [52-55]. This allows farmers to reduce their problem and increase theirincome.

5.5. MONITORING LIVE STOCK

Using a IoT device with inbuilt sensor, worn around the neck of the livestock animals which inspects the live location, temperature, blood pressure and pulse rate of livestock and sends data to the farmer's mobile application. This IoT device provides all the data about livestock health to the farmers. This device is the combination of tracker and sensor which checks the movement of the livestock every time[56]. Since the device is connected to the mobile application, farmers can set the boundaries to where their animals can move freely. If they walk out of the location, farmers get a warning on their mobile. Also, if animals eat something toxic, an alert is sent to farmer's mobile application. By these farmers keep on checking the health risk to their livestock [57-60].

5.6. WEATHER FORECASTING

With the climatic change it is difficult for the farmers to determine the right time to sow the seeds for crops but with the help of Artificial Intelligence it is possible to determine the weather conditions. Farmers can use the data from weather forecasting and with the help of AI; predictable analysis can be done in order to avoid crop failure which will help farmers in their businesses [61-70].

5.7. AUTOMATED FARM SECURITY Animals such as rodents, goats, birds, wild pigs pose a serious threat to quality and quantity of yield. Manually monitoring the field round the clock isn't feasible. But this AI system, on detecting any signs of movement will immediately send out an alert to the user's phone [71-73]. Therefore, eliminating the need to continuousvigilance

5.8. PORTABLE ELECTRIC POWER TILLERMACHINE

Farm tilling, most labor required task in agriculture. Manual tilling of agricultural fields is immensely hard, also, tractors are not affordable by all farmers as it requires large amount of fuel for its working [74]. But this machine is cost-effective, portable, and runs from charged battery. It is the modern method to enhance the traditional agricultural methods. With the introduction of this machine, human labor, time and cost has reduced, therefore results in better productivity of the agricultural produce [75-79].

5.9. AUTOMATED IRRIGATION MACHINE Timely and controlled irrigation is crucial to ensure good health of the crops. The amount of water required for irrigation varies depending on the rate of evaporation of water from the soil but with the help of AI, using a capacitive moisture sensor, the Automatic irrigation system levels the moisture in the soil [80-81]. If the moisture level drops below the predefine limit, this system triggers the water pump and supplies water to the crops. With the use of this machine, human efforts are saved [82].

5.10. SOLAR GRASSCUTTER

Before cultivation begins, it is essential to clear all the weeds and unwanted plants from the field as they can absorb the essential nutrients from the soil and affects the crop production [83]. But this solar glass cutter trim down the weeds. It has large wheels for off road operations and do auto lawn coverage using AI algorithms. Also, it runs on solar energy and it has sharp blade cutter which instantly cut down the weeds [84-85].

AI has improved crop production by collecting data like moisture, nutrients level and fertilizers from sensors and visuals or real-time video streaming captured from drones. And with the help of these data sets, it has become easier for agricultural experts to use that data for analysis [86-89]. Yield monitoring is a process of using data collected from GPS and sensors and using it to analyses crop yield, moisture content in a given agricultural field. Various researchers are now using the data assembled from drones and sensors in order to check the health level of plants, regulating pest management, and which portion of the plants is most infected [90-94].

CONCLUSION

The aim of this paper is to give the detailed analysis of the innovative application of Artificial Intelligence in Agriculture. As we all know that the population is increasing day after day, in order to feed the increasing population, the food production also needs to increase. Since, agriculture requires lots of human labor and continuous eye-keeping on the crops, therefore it's necessary to overcome these problems and this is where AI comes in. AI is the emerging technology in the field of agriculture and this paper and this paper also touches the part i.e., technologies used in AI machines in agriculture like robots, computer vision, Deep learning algorithm, predictive analysis to observe the data taken from drones and other AI machines.

Therefore, Artificial Intelligence is helping to improve the overall harvest quality and accuracy of the crops for the futuregenerations.

REFERENCES

[1]. Bannerjee, G., Sarkar, U., Das, S., & Ghosh, I. (2018). Artificial intelligence in agriculture A literature survey. Scientific Research in Computer Science Applications and Management Studies by International Journal of 7(3),1-6.

[2]. Eli-Chukwu, N. C. (2019). Applications of artificial intelligence in agriculture A review. Engineering, Technology & Applied Science Research, 9(4),4377-4383.

[3]. Dharmaraj, V., &Vijayanand, C. (2018). Artificial intelligence (AI) in agriculture Current Microbiology and Applied Sciences, International Journal,7(12),2122-2128.

[4]. Jung, J., Maeda, M., Chang, A., Bhandari,M., Ashapure, A., &Landivar-Bowles, J. (2021). The potential of remote sensing and artificial intelligence as tools to improve the resilience of agriculture production systems. Current Opinion in Biotechnology, 70,15-22.

[5]. Khan, R., Dhingra, N., &Bhati, N. (2022). Role of Artificial Intelligence inAgriculture: A Comparative Study. In Transforming Management with AI, Big-Data,and IoT (pp. 73-83). Springer, Cham.

[6]. Di Vaio, A., Boccia, F., Landriani, L., &Palladino, R. (2020). Artificial intelligence in the agri-food system: Rethinking sustainable business models in the COVID-19 scenario. Sustainability, 12(12), 4851.

[7]. McBratney, A., Whelan, B., Ancev, T,(2005). Future Directions of Precision Agriculture. Precision Agriculture, 6,7-23.

[8]. Jha, K., Doshi, A., Patel, P., & Shah, M. (2019). A comprehensive review on automation in agriculture using artificial intelligence. Artificial Intelligence in Agriculture, 2,1-12.

[9]. Talaviya, T., Shah, D., Patel, N., Yagnik, H., & Shah, M. (2020). Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides. Artificial Intelligence in Agriculture, 4,58-73.

[10]. Kakani, V., Nguyen, V. H., Kumar, B. P., Kim, H., &Pasupuleti, V. R. (2020). A critical review on computer vision. Journal of Agriculture and Food Research, 2, 100033.

[11]. Dalal, S., Seth, B., Radulescu, M., Secara, C., &Tolea, C. (2022). Predicting Fraud in Financial Payment Services through Optimized Hyper-Parameter-Tuned XGBoost Model. Mathematics, 10(24), 4679.

[12]. Dalal, S., Onyema, E. M., & Malik, A. (2022). Hybrid XGBoost model with hyperparameter tuning for prediction of liver disease with better accuracy. World Journal of Gastroenterology, 28(46), 6551-6563.

[13]. Edeh, M. O., Dalal, S., Obagbuwa, I. C., Prasad, B. V. V., Ninoria, S. Z., Wajid, M. A., &Adesina, A. O. (2022). Bootstrapping random forest and CHAID for prediction of white spot disease among shrimp farmers. Scientific Reports, 12(1), 1-12.

[14]. Zaki, J., Nayyar, A., Dalal, S., & Ali, Z. H. (2022). House price prediction using hedonic pricing model and machine learning techniques. Concurrency and Computation: Practice and Experience, 34(27), e7342.

[15]. Dalal, S., Onyema, E., Romero, C., Ndufeiya-Kumasi, L., Maryann, D., Nnedimkpa, A. & Bhatia, T. (2022). Machine learning-based forecasting of potability of drinking water through adaptive boosting model. Open Chemistry, 20(1), 816-828. https://doi.org/10.1515/chem-2022-0187

[16]. Onyema, E. M., Dalal, S., Romero, C. A. T., Seth, B., Young, P., &Wajid, M. A. (2022). Design of Intrusion Detection System based on Cyborg intelligence for security of Cloud Network Traffic of Smart Cities. Journal of Cloud Computing, 11(1), 1-20.

[17]. Dalal, S., Onyema, E. M., Kumar, P., Maryann, D. C., Roselyn, A. O., &Obichili, M. I. (2022). A Hybrid machine learning model for timely prediction of breast cancer. International Journal of Modeling, Simulation, and Scientific Computing, 2023, 1-21.

[18]. Dalal, S., Seth, B., Jaglan, V., Malik, M., Dahiya, N., Rani, U., ...& Hu, Y. C. (2022). An adaptive traffic routing approach toward load balancing and congestion control in Cloud–MANET ad hoc networks. Soft Computing, 26(11), 5377-5388.

[19]. Edeh, M. O., Dalal, S., Dhaou, I. B., Agubosim, C. C., Umoke, C. C., Richard-Nnabu, N. E., &Dahiya, N. (2022). Artificial Intelligence-Based Ensemble Learning Model for Prediction of Hepatitis C Disease. Frontiers in Public Health, 847.

[20]. Seth, B., Dalal, S., Jaglan, V., Le, D. N., Mohan, S., & Srivastava, G. (2022). Integrating encryption techniques for secure data storage in the cloud. Transactions on Emerging Telecommunications Technologies, 33(4), e4108.

[21]. Malik, M., Nandal, R., Dalal, S., Maan, U., & Le, D. N. An efficient driver behavioral pattern analysis based on fuzzy logical feature selection and classification in big data analysis. Journal of Intelligent & Fuzzy Systems, 43(3), 3283-3292.

[22]. Malik, M., Nandal, R., Dalal, S., Jalglan, V., & Le, D. N. (2022). Deriving driver behavioral pattern analysis and performance using neural network approaches. Intelligent Automation & Soft Computing, 32(1), 87-99.

[23]. Shetty, S., & Dalal, S. (2022, December). Bi-Directional Long Short-Term Memory Neural Networks for Music Composition. In 2022 Fourth International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT) (pp. 1-6). IEEE.

[24]. Onyema, E. M., Shukla, P. K., Dalal, S., Mathur, M. N., Zakariah, M., & Tiwari, B. (2021). Enhancement of patient facial recognition through deep learning algorithm: ConvNet. Journal of Healthcare Engineering, 2021.

[25]. Dalal, S., &Khalaf, O. I. (2021). Prediction of

occupation stress by implementing convolutional neural network techniques. Journal of Cases on Information Technology (JCIT), 23(3), 27-42.

[26]. Dalal, S., Jaglan, V., & Le, D.-N. (Eds.). (2021). Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges (1st ed.). CRC Press. https://doi.org/10.1201/9781003032397.

[27]. Dahiya, N., Dalal, S., &Jaglan, V. (2021). 8 Mobility in Green Management IoT. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, 125.

[28]. Dahiya, N., Dalal, S., &Jaglan, V. (2021). 7 Efficient Green Solution. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, 113.

[29]. Seth, B., Dalal, S., &Dahiya, N. (2021). 4 Practical Implications. Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges, 61.

[30]. Malik, M., Nandal, R., Dalal, S., Jalglan, V., & Le, D. N. (2021). Driving pattern profiling and classification using deep learning. Intelligent Automation & Soft Computing, 28(3), 887-906.

[31]. Jindal, U., Dalal, S., Rajesh, G., Sama, N. U., Jhanjhi, N. Z., &Humayun, M. (2021). An integrated approach on verification of signatures using multiple classifiers (SVM and Decision Tree): A multi-classification approach.

[32]. Seth, B., Dalal, S., Le, D. N., Jaglan, V., Dahiya, N., Agrawal, A., ...&Verma, K. D. (2021). Secure Cloud Data Storage System Using Hybrid Paillier–Blowfish Algorithm. Computers, Materials & Continua, 67(1), 779-798.

[33]. Vijarania, M., Dahiya, N., Dalal, S., &Jaglan, V. (2021). WSN Based Efficient Multi-Metric Routing for IoT Networks. In Green Internet of Things for Smart Cities (pp. 249-262). CRC Press.

[34]. Goel, M., Hayat, A., Husain, A., & Dalal, S. (2021). Green-IoT (G-IoT) Architectures and Their Applications in the Smart City. In Green Internet of Things for Smart Cities (pp. 47-59). CRC Press.

[35]. Chawla, N., & Dalal, S. (2021). Edge AI with Wearable IoT: A Review on Leveraging Edge Intelligence in Wearables for Smart Healthcare. Green Internet of Things for Smart Cities, 205-231.

[36]. Dahiya, N., Dalal, S., &Jaglan, V. (2021). Efficient Green Solution for a Balanced Energy Consumption and Delay in the IoT-Fog-Cloud Computing. In Green Internet of Things for Smart Cities (pp. 113-123). CRC Press.

[37]. Dahiya, N., Dalal, S., &Jaglan, V. (2021). Mobility Management in Green IoT. In Green Internet of Things for Smart Cities (pp. 125-134). CRC Press.

[38]. Seth, B., Dalal, S., &Dahiya, N. (2021). Practical Implications of Green Internet of Things (G-IoT) for Smart Cities. In Green Internet of Things for Smart Cities (pp. 61-81). CRC Press.

[39]. Dalal, S., Agrawal, A., Dahiya, N., &Verma, J. (2020, July). Software Process Improvement Assessment for Cloud Application Based on Fuzzy Analytical Hierarchy Process Method. In International Conference on Computational Science and Its Applications (pp. 989-1001). Springer, Cham.

[40]. Seth, B., Dalal, S., Jaglan, V., Le, D. N., Mohan, S., & Srivastava, G. (2020). Integrating encryption techniques for secure data storage in the cloud. Transactions on Emerging Telecommunications Technologies.

[41]. Hooda, M., &ShravankumarBachu, P. (2020). Artificial Intelligence Technique for Detecting Bone Irregularity Using Fastai. In International Conference on Industrial Engineering and Operations Management Dubai, UAE (pp. 2392-2399).

[42]. Arora, S., & Dalal, S. (2019). An optimized cloud architecture for integrity verification. Journal of Computational and Theoretical Nanoscience, 16(12), 5067-5072.

[43]. Arora, S., & Dalal, S. (2019). Trust Evaluation Factors in Cloud Computing with Open Stack. Journal of Computational and Theoretical Nanoscience, 16(12), 5073-5077.

[44]. Shakti Arora, S. (2019). DDoS Attacks Simulation in Cloud Computing Environment. International Journal of Innovative Technology and Exploring Engineering, 9(1), 414-417.

[45]. Shakti Arora, S. (2019). Integrity Verification Mechanisms Adopted in Cloud Environment. International Journal of Engineering and Advanced Technology (IJEAT), 8, 1713-1717.

[46]. Sudha, B., Dalal, S., & Srinivasan, K. (2019). Early Detection of Glaucoma Disease in Retinal Fundus Images Using Spatial FCM with Level Set Segmentation. International Journal of Engineering and Advanced Technology (IJEAT), 8(5C), 1342-1349.

[47]. Sikri, A., Dalal, S., Singh, N. P., & Le, D. N. (2019). Mapping of e-Wallets With Features. Cyber Security in Parallel and Distributed Computing: Concepts, Techniques, Applications and Case Studies, 245-261.

[48]. Seth, B., Dalal, S., & Kumar, R. (2019). Hybrid homomorphic encryption scheme for secure cloud data storage. In Recent Advances in Computational Intelligence (pp. 71-92). Springer, Cham.

[49]. Seth, B., Dalal, S., & Kumar, R. (2019). Securing bioinformatics cloud for big data: Budding buzzword or a glance of the future. In Recent advances in computational intelligence (pp. 121-147). Springer, Cham.

[50]. Jindal, U., & Dalal, S. (2019). A hybrid approach to authentication of signature using DTSVM. In Emerging Trends in Expert Applications and Security (pp. 327-335). Springer, Singapore.

[51]. Le, D. N., Seth, B., & Dalal, S. (2018). A hybrid approach of secret sharing with fragmentation and encryption in cloud environment for securing outsourced medical database: a revolutionary approach. Journal of Cyber Security and Mobility, 7(4), 379-408.

[52]. Sikri, A., Dalal, S., Singh, N. P., &Dahiya, N. (2018). Data Mining and its Various Concepts. Kalpa Publications in Engineering, 2, 95-102.

[53]. Sameer Nagpal, S. (2018). Analysis of LrMu Power Algorithm in the Cloud Computing Environment

using CloudSim Toolkit. International Journal of Research in Electronics and Computer Engineering (IJRECE), 6(3), 1175-1177.

[54]. Nagpal, S., Dahiya, N., & Dalal, S. (2018). Comparative Analysis of the Power Consumption Techniques in the Cloud Computing Environment. Journal Homepage: http://www. ijmra.us, 8(8), 1.

[55]. Kumar, N., Dalal, S., &Dahiya, N. (2018). Approach of Lion Optimization Algorithm for Efficient Load Balancing in Cloud Computing. Journal Homepage: http://www. ijmra.us, 8(8), 1.

[56]. Sameer Nagpal, S. (2018). Comparison of Task Scheduling in Cloud Computing Using various Optimization Algorithms. Journal of Computational Information Systems, 14(4), 43-57.

[57]. Arora, S., & Dalal, S. (2018). Hybrid algorithm designed for handling remote integrity check mechanism over dynamic cloud environment. International Journal of Engineering & Technology, 7(2.4), 161-164.

[58]. Kukreja, S., & Dalal, S. (2018). Modified drosophila optimization algorithm for managing re-sources in cloud environment. International Journal of Engineering & Technology, 7(2.4), 165-169.

[59]. Jindal, U., Dalal, S., &Dahiya, N. (2018). A combine approach of preprocessing in integrated signature verification (ISV). International Journal of Engineering & Technology, 7(1.2), 155-159.

[60]. Nagpal, S., Dahiya, N., & Dalal, S. (2018). Comparison of Task Scheduling in Cloud Computing Using various Optimization Algorithms. Journal of Computational Information Systems ISSN, 1553-9105.

[61]. Jindal, U., Dalal, S., &Dahiya, N. (2018). A combine approach of preprocessing in integrated signature verification (ISV). International Journal of Engineering & Technology, 7(1.2), 155-159

[62]. Shakti Arora, S. (2018). Resolving problem of Trust context in Cloud Computing. International Journal of Engineering Research in Computer Science and Engineering (IJERCSE), 5(1), 138-142.

[63]. Dalal, S., Dahiya, N., &Jaglan, V. (2018). Efficient tuning of COCOMO model cost drivers through generalized reduced gradient (GRG) nonlinear optimization with best-fit analysis. In Progress in Advanced Computing and Intelligent Engineering (pp. 347-354). Springer, Singapore

[64]. Seth, B., & Dalal, S. (2018). Analytical assessment of security mechanisms of cloud environment. In Progress in Advanced Computing and Intelligent Engineering (pp. 211-220). Springer, Singapore.

[65]. Kukreja, S., & Dalal, S. (2018). Performance analysis of cloud resource provisioning algorithms. In Progress in Advanced Computing and Intelligent Engineering (pp. 593-602). Springer, Singapore.

[66]. Rani, U., Dalal, S., & Kumar, J. (2018). Optimizing performance of fuzzy decision support system with multiple parameter dependency for cloud provider evaluation. Int. J. Eng. Technol, 7(1.2), 61-65.

[67]. Dahiya, N., Dalal, S., & Khatri, S. (2017). An Enhanced Bat Algorithm for Data Clustering Problems. International Journal of Advanced Research in Computer Science, 8(3).

[68]. Dahiya, N., Dalal, S., & Khatri, S. (2017). Data clustering and its Application to numerical function optimization algorithm. International Journal of Advanced Research in Computer Science, 8(1).

[69]. Arora, S., & Dalal, S. (2017). Adaptive Model For Integrity Verification In Cloud Computing System. International Journal of Advanced Research in Computer Science, 8(1), 233-236.

[70]. NeerajDahiya, S. (2017). Numerical Function Optimization: Model, Procedure And Uses. International Journal of Engineering Science and Technology (IJEST), 9(4), 266-270.

[71]. Dahiya, N., Dalal, S., & Khatri, S. (2016). Refinement with Image clustering using Self-Organizing Map and Numerical Function Optimization. International Journal of Computer Science and Information Security, 14(11), 909.

[72]. NeerajDahiya, S. (2016). A Review on Numerical function optimization Algorithm and its Applications to Data Clustering & Classification. International Journal of Recent Research Aspects, 3(3), 115-121.

[73]. Arora, S., & Dalal, S. (2016). Novel Approach of Integrity Verification in Dynamic Cloud Environment. International Journal of Computer Science and Information Security, 14(8), 207.

[74]. Dalal, S., &Kukreja, S. (2016). Genetic Algorithm based Novel approach for Load Balancing problem in Cloud environment. International Journal of computer science and information security, 14(7), 88.

[75]. Arora, S., & Dalal, S. (2016). Study of Integrity Based Algorithm in Decentralized Cloud Computing Environment. International Journal of Institutional & Industrial Research, 1(1), 15-17.

[76]. Vishakha, S. D. (2016). Performance Analysis of Cloud Load Balancing Algorithms. International Journal of Institutional and Industrial Research, 1(01), 1-5.

[77]. Dalal, S., & Jindal, U. (2016, March). Performance of integrated signature verification approach. In 2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 3369-3373). IEEE.

[78]. Dahiya, N., Dalal, S., &Tanwar, G. (2016, March). Refining of image using self-organizing map with clustering. In AIP Conference Proceedings (Vol. 1715, No. 1, p. 020064). AIP Publishing LLC.

[79]. Dahiya, N., Dalal, S., & Khatri, S. (2016). A Review on Numerical function optimization Algorithm and its Applications to Data Clustering & Classification. International Journal of Recent Research Aspects, 3(3), 111-115.

[80]. Arora, S., & Dalal, S. (2016). Enhanced Privacy Preserving Access Control in the Cloud. International Journal of Recent Research Aspects, 3(4), 66-70.

[81]. Dahiya, N., Dalal, S., Khatri, S., & Kumar, Y. (2016). Cat Swarm Optimization: Applications And Experimental Illustrations To Data Clustering. International Journal of Control Theory and Applications, 9(41), 759-765.

[82]. Rani, U., & Dalal, S. (2016). Neural Network Applications in Design Process of Decision Support System. International Journal of Recent Research Aspects, 4(2), 40-44.
[83]. Seth, B., & Dalal, S. (2016). Designing Hybrid Security Architecture in Multi Cloud System. International Journal of Control Theory and Applications, 9(41), 767-776.
[84]. Seth, B., & Dalal, S. (2016). Analysis of cryptographic approaches. International Journal of Recent Research Aspect, 3(1), 21-24.
[85]. Jindal, U., & Dalal, S. (2016). Survey on Signature verification and recognition using SIFT and its variant. International Journal of Recent Research Aspects, 3(3), 26-29.
[86]. Sharma, P., & Dalal, S. (2014). Reviewing MANET Network Security Threats. identity, 25-30.
[87]. Sharma, D., Dalal, S., & Sharma, K. K. (2014). Evaluating Heuristic based Load Balancing Algorithm through Ant Colony Optimization. environment, 5-9.
[88]. Sharma, D., Sharma, K., & Dalal, S. (2014). Optimized load balancing in grid computing using tentative ant colony algorithm. International Journal of Recent Research Aspects, 1(1), 35-39.
[89]. Jindal, K., Dalal, S., & Sharma, K. K. (2014, February). Analyzing spoofing attacks in wireless networks. In 2014 Fourth International Conference on Advanced Computing & Communication Technologies (pp. 398-402). IEEE.
[90]. Dalal, Surjeet & Srinivasan, S, Approach of multi agent system in controlling bullwhip effect of supply chain management system using case based reasoning, Department of Computer Science, Suresh GyanVihar University, 20/01/2014, http://hdl.handle.net/10603/36464
[91]. Sharma, S., & Dalal, S. (2014). Recognition and identification schemes for the development of Eigen feature extraction based iris recognition system. International Journal of Recent Research Aspects ISSN, 2349-7688.
[92]. Sharma, P., Sharma, K., & Dalal, S. (2014). Preventing Sybil Attack in MANET using Super nodes approach. International Journal of Recent Research Aspects, 1(1), 30-34.
[93]. Simi Gupta, D., & Dalal, S. (2014). Efficient broker scheduling in Cloud Computing. International Journal of Recent Research Aspects, 1(2), 74-77.
[94]. Sharma, S., & Dalal, S. (2014). Feature Recognition from Histogram and Eigen Algorithm in Digital Image Processing.
[95]. Gupta, S., Sharma, K. K., & Dalal, S. (2014). Multi objective parameters for real time scheduling in cloud computing.
[96]. Mittal, A., & Dalal, S. (2014). Implying p-Cure algorithm in case retrieval stage of the case-based reasoning. International Journal of Recent Research Aspects, 3(3), 91-98.
[97]. Mittal, A., Sharma, K. K., & Dalal, S. (2014). Approach of BPEL in supply chain activities for managing bullwhip effect of SCM system. Int. J. Res. Asp. Eng. Manag, 1(2), 26-30.
[98]. Sharma, P., & Dalal, S. (2014). Shortest Path Algorithms Technique for Nearly Acyclic Graphs. International Journal of Recent Research Aspects, 3(3), 36-39.
[99]. Dalal, S., Jaglan, V., & Sharma, K. K. (2014). Designing architecture of demand forecasting tool using multi-agent system. International Journal of Advanced Research in Engineering and Applied Sciences, 3(1), 11-20.
[100]. Sheikh, M., Sharma, K., & Dalal, S. (2014). Efficient method for WiMAX soft handover in VOIP and IPTV. International Journal of Research Aspects of Engineering & Management, 1(2), 5-48.
[101]. Kumar, S., & Dalal, S. (2014). Optimizing Intrusion Detection System using Genetic Algorithm. International Journal of Research Aspects of Engineering and Management ISSN, 2348-6627.
[102]. Mittal, A., Sharma, K. K., & Dalal, S. (2014). Applying clustering algorithm in case retrieval phase of the case-based reasoning. International Journal of Research Aspects of Engineering and Management, 1(2), 14-16.
[103]. Dalal, S., Jaglan, V., & Sharma, K. K. (2014). Integrating Multi-case-base-reasoning with Distributed case-based reasoning. International Journal of Advanced Research in IT and Engineering ISSN, 2278-6244.
[104]. Saini, A., Sharma, K. K., & Dalal, S. (2014). A survey on outlier detection in WSN. International Journal of Research Aspects of Engineering and Management ISSN, 2348-6627.
[105]. Sharma, P., Sharma, D. K., & Dalal, S. (2014). Preventing Sybil Attack In MANET Using Super Node Using Approach. International Journal of Recent Research Aspects, ISSN, 2349-7688.
[106]. Chahar, P., & Dalal, S. (2013). Deadlock resolution techniques: an overview. International Journal of Scientific and Research Publications, 3(7), 1-5.
[107]. Dalal, Surjeet, Keshav Jindal, and Monika Nirwal. "Developing Flexible Decision Support Systems Using Case-Base Reasoning System." International Journal of Engineering and Management Research (IJEMR) 3.4 (2013): 13-17.
[108]. Dalal, S., & Sharma, K. K. (2013). Simulating supply chain activities in multi-agent based supply chain management system with plasma simulator. International journal of Computer Science & Communication, 4(1), 80-85.
[109]. Dalal, S., Tanwar, G., &Alhawat, N. (2013). Designing CBRBDI agent for implementing supply chain system. system, 3(1), 1288-1292.
[110]. Dalal, S., &Athavale, V. (2012). Challenging Bullwhip Effect of Supply Chain Through Case Based Multi Agent System: A Review. International Journal of Advanced Research in Computer Science and Software Engineering, 2(12), 267-272.
[111]. Dalal, S., Tanwar, G., & Jindal, K. (2012). Agent Oriented Programming In Trading System Automation. International Journal of Research in IT, Management and Engineering, 2(8), 51-59.
[112]. Dalal, Surjeet, and Vijay Athavale. "Analysing

Supply Chain Strategy Using Case-Based Reasoning." Journal of Supply Chain Management Systems 1.3 (2012).

[113]. Jindal, K., Dalal, S., &Jaglan, V. (2012). Comparative Study On IEEE 802.11 Wireless Local Area Network Securities. International Journal of Advanced Research in Computer Science, 3(1).

[114]. Jindal, K., Dalal, S., &Tanwar, G. (2012). Congestion Control Framework in Ad-Hoc Wireless using Neural Networks in QoS. International Journal of Research in Computer Engineering and Electronics, ISSN, 15-18.

[115]. Dalal, S., Athavale, V., & Jindal, K. (2012). Designing Case-based reasoning applications with Colibri Studio. International Journal of Research in Computer Engineering and Electronics, 1(1), 15-18.

[116]. Jaglan, V., Dalal, S., & Srinivasan, S. (2011). Improving performance of business intelligence through case based reasoning. International Journal of Engineering Science and Technology, 3(4), 2880-2886.

[117]. Jaglan, V., Dalai, S., & Srinivasan, S. (2011). Enhancing security of agent-oriented techniques programs code using jar files. International Journal on Computer Science and Engineering, 3(4), 1627-1632.

[118]. Dalal, S., Athavale, V., & Jindal, K. (2011). Case retrieval optimization of Case-based reasoning through Knowledge-intensive Similarity measures. Int. J. Comput. Appl, 34(3), 12-18.

[119]. Surjeet Dalal, V., & Kumar, S. (2010). Designing of business tool using intelligent agent. In National Conference Advanced Computing & Communication tech ACCT (pp. 751-754

