Artificial Intelligence in Cyber Security

3 authors, including:

Prateek Dutta
Dataevolve Solutions Pvt. Ltd
15 PUBLICATIONS   **41** CITATIONS

SEE PROFILE

Artificial Intelligence in Cyber Security

*[1]**Swagat M. Karve**, [2]**ArpitYadav**, [2]**Prateek Datta**
[1]SKN Sinhgad college of Engineering, Pandharpur, Maharashtra, India.
[2]G H Raisoni College of Engineering, Nagpur, Maharashtra, India
*Corresponding author Email: **swagatkarve@gmail.com**

Abstract. Now days due to huge application of IOT, cyber attack is tremendously affecting all over the world under. Hence designing of cyber security approach in order to avoid cyber attack is today's basic need. Cyber security is the application of technologies, processes and controls to protect systems, networks, programs, devices and data from cyber attacks. It aims to reduce the risk of cyber attacks and protect against the unauthorized exploitation of systems, networks and technologies. Traditional security methods are not adequate to prevent data breaches in case of cyber attacks. Cybercriminals have learned how to use new techniques and robust tools to hack, attack, and breach data. Fortunately, Artificial Intelligence (AI) technologies have been introduced into cyberspace to construct smart models for defending systems from attacks. There is rapid development of technology; Artificial intelligence has shown the promising results in cyber security analyzing the data through its decision making. This paper represents AI technique which is being used in various applications in the battle against the Cyber attack.
Keywords: cyber security, artificial intelligence.

1. Introduction

Cyber security is important because it encompasses everything that relates to protecting our data from cyber attackers who want to steal this information and use it to cause harm[71][72][73][74][75]. This can be sensitive data, governmental and industry information, personal information, personally identifiable information (PII), intellectual property, and protected health information (PHI). Therefore, they are obviously vulnerable to cyber attacks. A cyber attack is an attack launched from one or more computers against cyber attacks is either to disable the target computer, or take the services offline, or get access to the target computer's data[77-80]. In response to the issues, artificial intelligence tools are commonly implemented to deal with cyber threats. Artificial intelligence (AI) has helped more organizations to improve the security posture effectively and reduce the breach risks. Machine learning and artificial intelligence are the essential tools in technology for information security as it helps companies and individuals to check and analyze the threats posed to the organization [80-85]

2. Types of Web Based Cyber Security Threats

These are the attacks which occur on a website or web applications. While the types of cyber threats continue to grow, there are some of the most common and prevalent cyber threats are as follows:
- Malware: It is malicious software, including spyware, ransomware, viruses, and worms, which gets installed into the system when the user clicks a dangerous link or email. Once inside the system, malware can block access to critical components of the network, damage the system, and gather confidential information, among others[[86-91].
- Phishing: 80% Cybercriminals send malicious emails that seem to come from legitimate resources. The user is then tricked into clicking the malicious link in the email, leading to malware installation or disclosure of sensitive information like credit card details and login credentials.
- Spare Phishing: 71% Spear phishing is a more sophisticated form of a phishing attack in which cybercriminals target only privileged users such as system administrators and C-suite executives.
- Man in the Middle Attack: 95% Man in the Middle (MitM) attack occurs when cyber criminals place themselves between a two-party communications. Once the attacker interprets the communication, they may filter and steal sensitive data and return different responses to the user [90-96].
- Denial of Service Attack 8.4 million: Denial of Service attacks aims at flooding systems, networks, or servers with massive traffic, thereby making the system unable to fulfill legitimate requests. Attacks can also use several infected devices to launch an attack on the target system. This is known as a Distributed Denial of Service (DDoS) attack.
- SQL Injection: 65.1% A Structured Query Language (SQL) injection attack occurs when cybercriminals attempt to access the database by uploading malicious SQL scripts. Once successful, the malicious actor can view, change, or delete data stored in the SQL database.
- Zero-day Exploit: A zero-day attack occurs when software or hardware vulnerability is announced, and the cybercriminals exploit the vulnerability before a patch or solution is implemented.
- Advanced Persistent Threats (APT): An advanced persistent threat occurs when a malicious actor gains unauthorized access to a system or network and remains undetected for an extended time.

➢ Ransom ware: Ransom ware is a type of malware attack in which the attacker locks or encrypts the victim's data and threatens to publish or block access to data unless a ransom is paid. Learning more about ransom ware threats can help companies prevent and cope with them better.

➢ DNS Attack: A DNS attack is a cyber attack in which cybercriminals exploit vulnerabilities in the Domain Name System (DNS)[1][2][3][4][5][6][7][8][9][10]. The attackers leverage the DNS vulnerabilities to divert site visitors to malicious pages (DNS Hijacking) and remove data from compromised systems (DNS Tunneling).

3. Types of Web Based Cyber Security Threats

These are the attacks which are intended to compromise a computer or a computer network. Some of the important system-based attacks are as follows-

➢ Virus: It is a type of malicious software program that spread throughout the computer files without the knowledge of a user. It is a self-replicating malicious computer program that replicates by inserting copies of it into other computer programs when executed. It can also execute instructions that cause harm to the system[11][12][13][14][15][16][17][18]19][20].

➢ Worm: It is a type of malware whose primary function is to replicate itself to spread to uninfected computers. It works same as the computer virus. Worms often originate from email attachments that appear to be from trusted senders.

➢ Trojan horse: It is a malicious program that occurs unexpected changes to computer setting and unusual activity, even when the computer should be idle. It misleads the user of its true intent. It appears to be a normal application but when opened/executed some malicious code will run in the background.

➢ Backdoors: It is a method that bypasses the normal authentication process. A developer may create a backdoor so that an application or operating system can be accessed for troubleshooting or other purposes.

➢ Bots: A bot (short for "robot") is an automated process that interacts with other network services. Some bots program run automatically, while others only execute commands when they receive specific input. Common examples of bots program are the crawler, chartroom bots, and malicious bots.

4. Types of Cyber Attackers

In order to respond effectively to a cyber attack, it's imperative to know the threat actors and understand their tactics, techniques, and procedures.

➢ Nation States: Cyber attacks by a nation can inflict detrimental impact by disrupting communications, military activities, and everyday life.

➢ Criminal Groups: Criminal groups aim to infiltrate systems or networks for financial gain. These groups use phishing, spam, spyware, and malware to conduct identity theft, online fraud, and system extortion.

➢ Hackers: Hackers explore various cyber techniques to breach defenses and exploit vulnerabilities in a computer system or network. They are motivated by personal gain, revenge, stalking, financial gain, and political activism. Hackers develop new types of threats for the thrill of challenge or bragging rights in the hacker community.

➢ Terrorist Groups: Terrorists conduct cyber attacks to destroy, infiltrate, or exploit critical infrastructure to threaten national security, compromise military equipment, disrupt the economy, and cause mass casualties.

➢ Activists: Activists carry out cyber attacks in support of political causes rather than for financial gain. They target industries, organizations, or individuals who don't align with their political ideas and agenda.

➢ Malicious Insiders: 97% of surveyed IT leaders expressed concerns about insider threats in cyber security. Insiders can include employees, third-party vendors, contractors, or other business associates who have legitimate access to enterprise assets but misuse that access to steal or destroy information for financial or personal gain.

➢ Corporate Spies: Corporate spies conduct industrial or business espionage to either make a profit or disrupt a competitor's business by attacking critical infrastructure, stealing trade secrets, and gaining access.

5. Number of cyber crimes reported across India from 2012 to 2020

	2012	2013	2014	2015	2016	2017	2018	2019	2020
No. of Cyber Crimes	347	569	962	115	123	217	272	445	500
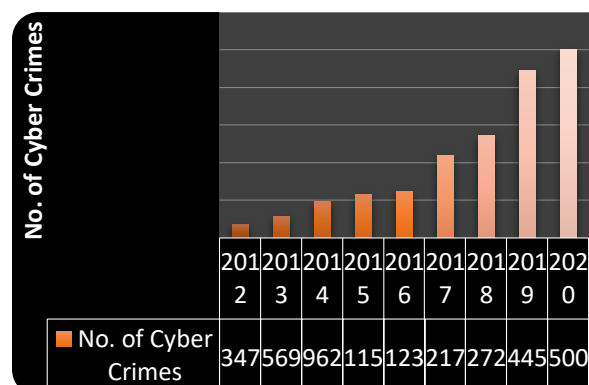
6. Machine Learning Applications in Cyber Security

As cyber security threats are changing and developing constantly, immediate response is required and an automatic. Therefore, machine learning techniques, specifically deep learning that does not generally require prior experience or dependence on previous expert classifications may be particularly important as an implementation of cyber security AI approaches. The study [71-77] analysis to the effectiveness for cyber security purposes of machine learning approaches. This research included the implementation of methods of machine learning to identify intrusions, spam and malware.
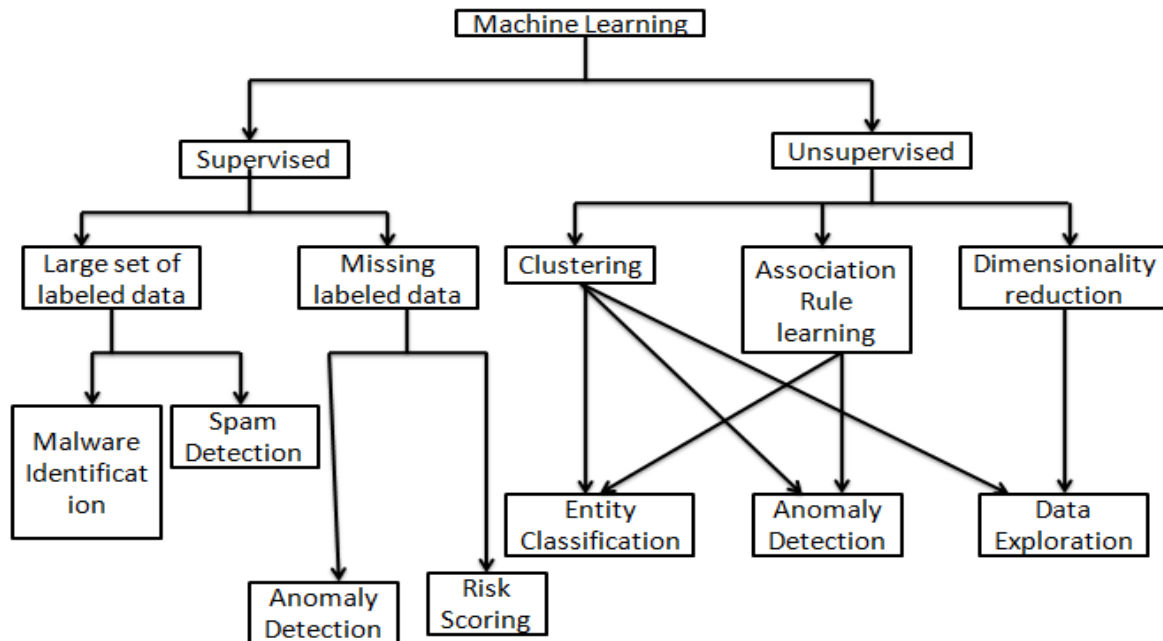
Focus was put on the effectiveness and significant drawbacks of computer-based technologies that prevent the direct implementation of cyber security of machine learning approaches

7. Advantages of AI in Cyber Security

AI systems are being trained to identify malware, execute pattern recognition, and detect even the tiniest characteristics of malware or ransom ware assaults before they reach the system using complex algorithms. With natural language processing, AI can provide greater predictive intelligence by skimming through articles, news, and research on cyber risks and curating material on its own. Every day, a mid-sized firm receives warnings for around 200,000 cyber incidents, according to Tech Republic. An ordinary company's security staff would be overwhelmed by this amount of attacks. As a result, some of these threats will go undiscovered and inflict significant network damage. To operate effectively and protect their organizations from cyber threats, security professionals require significant help from intelligent machines and modern technology such as AI.

AI Is Capable of Handling Large Amounts of Data: There is a lot of activity on a company's network. There is a lot of traffic in a normal mid-sized firm. That implies a lot of data is exchanged between customers and the company on a daily basis. This information must be safeguarded from harmful persons and software[21][22][23][24][25]26]6][27][28][29] [30][31][32]. However, cyber security experts are unable to inspect all data for potential threats. AI is the greatest option for detecting threats that are disguised as routine activities. Because of its automated nature, it can sift through large amounts of data and traffic. AI-based technology, such as a personal proxy, can assist you in data transfer. It can also detect and identify any hazards that may be lurking in the midst of the chaos[33][34][35].

Duplicative Processes Reduce*:* As previously stated, attackers frequently modify their methods. The fundamental security practices, on the other hand, do not change. If you employ someone to do these duties, they may become bored and endanger your network in the process [36][37][38][39][40][41][42][42][43][44][45]. AI takes care of redundant cyber security operations that might wear your cyber security worker while imitating the best of human traits and leaving out the flaws. It aids in the detection and prevention of fundamental security risks on a regular basis[46][47][48][49][50][51][52][53][54] [55][56][57][58]. It also does a thorough analysis of your network to check if there are any security flaws that might be harmful to your network.

Detection and response times are boosted: The first step in securing your company's network is to detect threats. It would be ideal if you could immediately recognize issues like untrustworthy data. It will protect your network from permanent harm. Integrating AI with cyber security is the greatest method to detect and respond to attacks in real-time. Artificial

intelligence (AI) examines your whole system for risks. Unlike humans, AI will detect risks early and make your security operations easier[59][60][61]62][63][64][65][66][67][68][69][70].

Authenticity Protection: The majority of websites offer a user account function that allows users to log in and access services or make purchases. Some websites include contact forms that visitors must complete with personal information. Because such a site contains private information and sensitive material, you'll need an extra degree of protection as a business. Your guests will be safe while accessing your network thanks to the enhanced security layer. When a user wishes to connect to their account, AI secures authentication. For identification, AI uses a variety of techniques like face recognition, CAPTCHA, and fingerprint recognition, among others. These characteristics' data can be used to determine if a log-in attempt is legitimate or not. To gain access to business networks, hackers utilize credential stuffing and brute force assaults.

References

[1]. S.G Akojwar, P Kshirsagar-2016 "A Novel Probabilistic-PSO Based Learning Algorithm for Optimization of Neural Networks for Benchmark Problems"- WSEAS TRANSACTIONS on ELECTRONICS, Volume 7, 2016.

[2]. P. Kshirsagar and S. Akojwar, "Classification & Detection of Neurological Disorders using ICA & AR as Feature Extractor", Int. J. Ser. Eng. Sci. IJSES, vol. 1, no. 1, Jan. 2015.

[3]. Pravin Kshirsagar, Sudhir Akojwar & Nidhi Bajaj(2020),"A hybridised neural network and optimisation algorithms for prediction and classication of neurological disorders", International Journal of Biomedical Engineering and Technology Volume 28, Issue 4 ,DOI: 10.1504/IJBET.2018.095981

[4]. P. Kshirsagar and S. Akojwar, "Novel approach for classification and prediction of non- linear chaotic databases," 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), 2016, pp. 514-518, doi: 10.1109/ICEEOT.2016.7755667.

[5]. P. R. Kshirsagar, H. Manoharan, F. Al-Turjman, and K. Kumar, Design and testing of automated smoke monitoring sensors in vehicles," IEEE Sensors Journal, vol. 1, p. 1, 2020.

[6]. H. Manoharan, Y. Teekaraman, P. R. Kshirsagar, S. Sundaramurthy, and A. Manoharan, "Examining the effect of aquaculture using sensor-based technology with machine learning algorithm," Aquaculture Research, vol. 51, no. 11, pp. 4748–4758, 2020.

[7]. Golda Dilip, Ramakrishna Guttula, Sivaram Rajeyyagari, Hemalatha S, Radha Raman Pandey, Ashim Bora, Pravin R Kshirsagar, Khanapurkar M M, Venkatesa Prabhu Sundramurthy, "Artificial Intelligence-Based Smart Comrade Robot for Elders Healthcare with Strait Rescue System", Journal of Healthcare Engineering, vol. 2022, Article ID 9904870, 12 pages, 2022. https://doi.org/10.1155/2022/9904870.

[8]. Kshirsagar, P. R., Chippalkatti, P. P., & Karve, S. M. (2018). Performance optimization of neural network using GA incorporated PSO. Journal of Advanced Research in Dynamical and Control Systems, 10(4).

[9]. Kshirsagar, P., & Akojwar, S. (2016). Prediction of neurological disorders using optimized neural network. In International conference on signal processing, communication, power and embedded system (SCOPES).

[10]. Kshirsagar, P., & Akojwar, S. (2016). Optimization of BPNN parameters using PSO for EEG signals. In Proceedings of the international conference on communication and signal processing, 2016 (ICCASP 2016).

[11]. Kshirsagar, P., & Akojwar, S. (2016). Hybrid heuristic optimization for benchmark datasets. International Journal of Computer Applications, 146(7), 11–16.

[12]. Kshirsagar, P., & Akojwar, S. (2015). Classification and prediction of epilepsy using FFBPNN with PSO. In IEEE international conference on communication networks.

[13]. Kshirsagar, P., Balakrishnan, N., & Yadav, A. D. (2020). Modelling of optimised neural network for classification and prediction of benchmark datasets. Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, 8(4), 426–435.

[14]. Akojwar, S., Kshirsagar, P., & Pai, V. (2014). Feature extraction of EEG signals using wavelet and principal component analysis. National Conference on Research Trends in Electronics, Computer Science & Information Technology and Doctoral Research Meet, Feb 21st &22nd

[15]. Pravin Kshirsagar et.al (2016), "Brain Tumor classification and Detection using Neural Network", DOI: 10.13140/RG.2.2.26169.72805.

[16]. Pravin Kshirsagar and Sudhir Akojwar (2017), "Classification of ECG-signals using Artificial Neural Networks", Researchgate.net

[17]. Pravin Kshirsagar and Sudhir Akojwar (2016) "Classification of Human Emotions using EEG Signals" International Journal of Computer Applications (0975 – 8887) Volume 146 – No.7, July 2016.

[18]. Pravin Kshirsagar and Sudhir Akojwar(2015), "Classification and Prediction of Epilepsy using FFBPNN with PSO", IEEE International Conference on Communication Networks, 2015.

[19]. Alterazi HA, Kshirsagar PR, Manoharan H, Selvarajan S, Alhebaishi N, Srivastava G, Lin JC-W. Prevention of Cyber Security with the Internet of Things Using Particle Swarm Optimization. Sensors. 2022; 22(16):6117. https://doi.org/10.3390/s22166117.

[20]. Shitharth, S.; Prasad, K.M.; Sangeetha, K.; Kshirsagar, P.R.; Babu, T.S.; Alhelou, H.H. An Enriched RPCO-BCNN Mechanisms for Attack Detection and Classification in SCADA Systems. IEEE Access 2021, 9, 156297–156312

[21]. Shitharth, S.; Prasad, K.M.; Sangeetha, K.; Kshirsagar, P.R.; Babu, T.S.; Alhelou, H.H. An Enriched RPCO-BCNN Mechanisms for Attack Detection and Classification in SCADA Systems. IEEE Access 2021, 9, 156297–156312

[22]. Akojwar, S.; Kshirsagar, P. A Novel Probabilistic-PSO Based Learning Algorithm for Optimization of Neural Networks for Benchmark Problems. Wseas Trans. Electron. 2016, 7, 79–84.

[23]. Kshirsagar, Pravin R., Hariprasath Manoharan, Shitharth Selvarajan, Sara A. Althubiti, Fayadh Alenezi, Gautam Srivastava, and Jerry Chun-Wei Lin. 2022. "A Radical Safety Measure for Identifying Environmental Changes Using Machine Learning Algorithms" Electronics 11, no. 13: 1950. https://doi.org/10.3390/electronics11131950

[24]. Sundaramurthy, S.; Saravanabhavan, C.; Kshirsagar, P. Prediction and Classification of Rheumatoid Arthritis using Ensemble Machine Learning Approaches. In Proceedings of the 2020 International Conference on Decision Aid Sciences and Application (DASA), Sakheer, Bahrain, 8–9 November 2020; pp. 17–21.

[25]. S. Oza, "IoT: the future for quality of services," in Proceedings of the ICCCE 2019, A. Kumar and S. Mozar, Eds., vol. 570, Springer, Singapore, December 2019, Lecture Notes in Electrical Engineering.

[26]. P. Kshirsar, V. More, V. Hendre, P. Chippalkatti, and K. Paliwal, "IOT based baby incubator for clinic," in Proceedings of the ICCCE 2019, A. Kumar and S. Mozar, Eds., vol. 570, Springer, Singapore, August 2020, Lecture Notes in Electrical Engineering

[27]. Pravin R. Kshirsagar, Hariprasath Manoharan, Samir Kasim, Asif Irshad Khan, Md Mottahir Alam, Yoosef B. Abushark, Worku Abera, "Expedite Quantification of Landslides Using Wireless Sensors and Artificial Intelligence for Data Controlling Practices", Computational Intelligence and Neuroscience, vol. 2022, Article ID 3211512, 11 pages, 2022. https://doi.org/10.1155/2022/3211512.

[28]. Kshirsar P., More V., Hendre V., Chippalkatti P., Paliwal K. (2020) IOT Based Baby Incubator for Clinic. In: Kumar A., Mozar S. (eds) ICCCE 2019. Lecture Notes in Electrical Engineering, vol 570. Springer, Singapore. https://doi.org/10.1007/978-981-13-8715-9_42.

[29]. Kshirsar P., More V., Hendre V., Chippalkatti P., Paliwal K. (2020) IOT Based Baby Incubator for Clinic. In: Kumar A., Mozar S. (eds) ICCCE 2019. Lecture Notes in Electrical Engineering, vol 570. Springer, Singapore. https://doi.org/10.1007/978-981-13-8715-9_42

[30]. Shitharth, S.; Meshram, P.; Kshirsagar, P.R.; Manoharan, H.; Tirth, V.; Sundramurthy, V.P. Impact of Big Data Analysis on Nanosensors for Applied Sciences using Neural Networks. J. Nanomater. 2021, 2021, 4927607

[31]. V. Velvizhi, S.R. Billewar, G. Londhe, P. Kshirsagar, N. Kumar Big data for time series and trend analysis of poly waste management in India Mater. Today:. Proc., 37 (Part 2) (2021), pp. 2607-2611, 10.1016/j.matpr.2020.08.507,2021

[32]. Hariprasath Manoharan, Radha Krishna Rambola, Pravin R. Kshirsagar, Prasun Chakrabarti, Jarallah Alqahtani, Quadri Noorulhasan Naveed, Saiful Islam, Walelign Dinku Mekuriyaw, "Aerial Separation and Receiver Arrangements on Identifying Lung Syndromes Using the Artificial Neural Network", Computational Intelligence and Neuroscience, vol. 2022, Article ID 7298903, 8 pages, 2022. https://doi.org/10.1155/2022/7298903

[33]. G. Dilip, R. Guttula, S. Rajeyyagari et al., "Artificial intelligence-based smart comrade robot for elders healthcare with strait rescue system," Journal of Healthcare Engineering, vol. 2022, Article ID 9904870, 12 pages, 2022.

[34]. Kshirsagar, Pravin&Manoharan, and Hariprasath, "An operational collection strategy for monitoring smart waste management system using shortest path algorithm," Journal of Environmental Protection and Ecology, vol. 22, pp. 566–577, 2021.

[35]. P. Kshirsagar, "Brain Tumor Classification and Detection Using Neural Network," in Proceedings of the 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT), pp. 83–88, IEEE, Tiruchengode, India, January, 2020

[36]. Nabeel Albishry, Rayed AlGhamdi, Abdulmohsen Almalawi, Asif Irshad Khan, Pravin R. Kshirsagar, undefined BaruDebtera, "An Attribute Extraction for Automated Malware Attack Classification and Detection Using Soft Computing Techniques", Computational Intelligence and Neuroscience, vol. 2022, Article ID 5061059, 13 pages, 2022. https://doi.org/10.1155/2022/5061059.

[37]. Jude, A.B., Singh, D., Islam, S. et al. An Artificial Intelligence Based Predictive Approach for Smart Waste Management. Wireless Pers Commun (2021). https://doi.org/10.1007/s11277-021-08803-7.

[38]. B. Prabhu Kavin, Sagar Karki, S. Hemalatha, Deepmala Singh, R. Vijayalakshmi, M. Thangamani, Sulaima Lebbe Abdul Haleem, Deepa Jose, Vineet Tirth, Pravin R. Kshirsagar, Amsalu Gosu Adigo, "Machine Learning-Based Secure Data Acquisition for Fake Accounts Detection in Future Mobile Communication Networks", Wireless Communications and Mobile Computing, vol. 2022, Article ID 6356152, 10 pages, 2022. https://doi.org/10.1155/2022/6356152

[39]. Praveen Kumar Kollu, Kailash Kumar, Pravin R. Kshirsagar, Saiful Islam, Quadri Noorulhasan Naveed, Mohammad Rashid Hussain, Venkatesa Prabhu Sundramurthy, "Development of Advanced Artificial Intelligence and IoT Automation in the Crisis of COVID-19 Detection", Journal of Healthcare Engineering, vol. 2022, Article ID 1987917, 12 pages, 2022. https://doi.org/10.1155/2022/1987917.

[40]. M A Berlin*, N Upadhayaya, A Alghatani, V Tirth, S Islam, K Murali, P R Kshirsagar*, Bui Thanh Hung, Prasun Chakrabarti, Pankaj Dadheech, "Novel hybrid artificial intelligence based algorithm to determine the effects of air pollution on human electroencephalogram signals", Journal of Environmental Protection and Ecology, 22(5): 1825-1835,2021.

[41]. M Abul Hasan*, K Raghuveer, P S Pandey, Ashok Kumar, Ashim Bora, Deepa Jose, P R Kshirsagar*, Bui Thanh Hung, Prasun Chakrabarti, M M Khanapurkar, "Internet of Things and its applications in Industry 4.0 for Smart Waste Management", Journal of Environmental Protection and Ecology, 22(6): 2368-2378,2021

[42]. S. Hemalatha, Pravin R. Kshirsagar, Hariprasath Manoharan, N. Vasantha Gowri, A. Vani, Sana Qaiyum, P. Vijayakumar, Vineet Tirth,Sulaima Lebbe Abdul Haleem, Prasun Chakrabarti and Dawit Mamiru Teressa "Novel Link Establishment Communication Scheme against Selfish Attack Using Node Reward with Trust Level Evaluation Algorithm in MANET", Wireless Communications and Mobile Computing, 2022 https://www.hindawi.com/journals/wcmc/2022/6776378/

[43]. S. Hemalatha, Pravin R. Kshirsagar, Hariprasath Manoharan, N. Vasantha Gowri, A. Vani, Sana Qaiyum, P. Vijayakumar, Vineet Tirth,Sulaima Lebbe Abdul Haleem, Prasun Chakrabarti and Dawit Mamiru Teressa "Novel Link Establishment Communication Scheme against Selfish Attack Using Node Reward with Trust Level Evaluation Algorithm in MANET", Wireless Communications and Mobile Computing, 2022 https://www.hindawi.com/journals/wcmc/2022/6776378/

[44]. Padmaja, M., Shitharth, S., Prasuna, K. et al. Grow of Artificial Intelligence to Challenge Security in IoT Application. Wireless Pers Commun (2021). https://doi.org/10.1007/s11277-021-08725-4

[45]. Kshirsagar, P.R.; Yadav, A.D.; Joshi, K.A.; Chippalkatti, P.; Nerkar, R.Y. Classification and Detection of Brain Tumor by using GLCM Texture Feature and ANFIS. J. Res. Image Signal Processing 2020, 5, 15–31.

[46]. Pravin Kshirsagar, Sudhir Akojwar Prediction of neurological disorders using optimized neural network, proceeding of international conference on signal processing, communication, power and embedded system (October 2016)

[47]. P. Vijayakumar et. Al., "Machine learning algorithm for improving the efficient of forgery detection" AIP Conference Proceedings ,Volume 2393, Issue 1 ,10.1063/5.0074086.

[48]. P. Vijayakumar et. Al., "Network security using multi-layer neural network", AIP Conference Proceedings ,Volume 2393, Issue1 ,10.1063/5.0074089.

[49]. Pravin R. Kshirsagar et. al., "Machine learning algorithm for leaf disease detection", AIP Conference Proceedings ,Volume 2393, Issue 1 ,10.1063/5.0074122.

[50]. P. VijayakumarArtificial intelligence based algorithm to support disable person, AIP Conference Proceedings.Volume 2393, Issue 1 ,10.1063/5.0074090

[51]. Pravin R. Kshirsagar, Hariprasath Manoharan, Samir Kasim, Asif Irshad Khan, Md Mottahir Alam, Yoosef B. Abushark, Worku Abera, "Expedite Quantification of Landslides Using Wireless Sensors and Artificial Intelligence for Data Controlling Practices", Computational Intelligence and Neuroscience, vol. 2022, Article ID 3211512, 11 pages, 2022. https://doi.org/10.1155/2022/3211512

[52]. Salem Algarni, Vineet Tirth, Talal Alqahtani, Pravin R. Kshirsagar, Baru Debtera, "Scrutiny of Solar Water Heating System Employing Supercritical Fluid", Mathematical Problems in Engineering, vol. 2022, Article ID 6752289, 9 pages, 2022. https://doi.org/10.1155/2022/6752289.

[53]. Pravin R. Kshirsagar, D. B. V. Jagannadham, Hamed Alqahtani, Quadri Noorulhasan Naveed, Saiful Islam, M. Thangamani, Minilu Dejene, "Human Intelligence Analysis through Perception of AI in Teaching and Learning", Computational Intelligence and Neuroscience, vol. 2022, Article ID 9160727, 9 pages, 2022. https://doi.org/10.1155/2022/9160727

[54]. Pravin R. Kshirsagar, Hariprasath Manoharan, V Siva Nagaraju, Hamed Alqahtani, Quadri Noorulhasan, Saiful Islam, M. Thangamani, Varsha Sahni, Amsalu Gosu Adigo, "Accrual and Dismemberment of Brain Tumours Using Fuzzy Interface and Grey Textures for Image Disproportion", Computational Intelligence and Neuroscience, vol. 2022, Article ID 2609387, 9 pages, 2022. https://doi.org/10.1155/2022/2609387.

[55]. Kshirsagar PR, Manoharan H, Selvarajan S, Alterazi HA, Singh D and Lee H-N (2022) Perception Exploration on Robustness Syndromes With Pre-processing Entities Using Machine Learning Algorithm. Front. Public Health 10:893989. doi: 10.3389/fpubh.2022.893989.

[56]. Kshirsagar, P.R.; Manoharan, H.; Shitharth, S.; Alshareef, A.M.; Singh, D.; Lee, H.-N. Probabilistic Framework Allocation on Underwater Vehicular Systems Using Hydrophone Sensor Networks. Water 2022, 14, 1292. https://doi.org/10.3390/w14081292.

[57]. Narendar Singh D, Murugamani C, Pravin R. Kshirsagar, Vineet Tirth, Saiful Islam, Sana Qaiyum, Suneela B, Mesfer Al Duhayyim, Yosef Asrat Waji, "IOT Based Smart Wastewater Treatment Model for Industry 4.0 Using Artificial Intelligence", Scientific Programming, vol. 2022, Article ID 5134013, 11 pages, 2022. https://doi.org/10.1155/2022/5134013.

[58]. Kshirsagar, P.R.; Manoharan, H.; Shitharth, S.; Alshareef, A.M.; Albishry, N.; Balachandran, P.K. Deep Learning Approaches for Prognosis of Automated Skin Disease. Life 2022, 12, 426. https://doi.org/10.3390/life12030426.

[59]. Nabeel Albishry, Rayed AlGhamdi, Abdulmohsen Almalawi, Asif Irshad Khan, Pravin R. Kshirsagar, undefined BaruDebtera, "An Attribute Extraction for Automated Malware Attack Classification and Detection Using Soft Computing Techniques", Computational Intelligence and Neuroscience, vol. 2022, Article ID 5061059, 13 pages, 2022. https://doi.org/10.1155/2022/5061059.

[60]. R. R. Chandan, P. R. Kshirsagar, H. Manoharan et al., "Substantial Phase Exploration for Intuiting Covid using form Expedient with Variance Sensor," International Journal Of Computers Communications & Control, vol. 17, no. 3, 2022.

[61]. C. Murugamani, S. Shitharth, S. Hemalatha, Pravin R. Kshirsagar, K. Riyazuddin, Quadri Noorulhasan Naveed, Saiful Islam, Syed Parween Mazher Ali, Areda Batu, "Machine Learning Technique for Precision Agriculture Applications in 5G-Based Internet of Things", Wireless Communications and Mobile Computing, vol. 2022, Article ID 6534238, 11 pages, 2022. https://doi.org/10.1155/2022/6534238

[62]. Pravin R. Kshirsagar, Hariprasath Manoharan, Hassan A. Alterazi, Nawaf Alhebaishi, Osama Bassam J. Rabie, S. Shitharth, "Construal Attacks on Wireless Data Storage Applications and Unraveling Using Machine Learning Algorithm", Journal of Sensors, vol. 2022, Article ID 9386989, 13 pages, 2022. https://doi.org/10.1155/2022/9386989.

[63]. A. Vani et. Al., "Supervise the data security and performance in cloud using artificial intelligence", AIP Conference Proceedings 2393, 020094 (2022); https://doi.org/10.1063/5.0074225.

[64]. Mohd Naved et. al., "Artificial intelligence based women security and safety measure system", AIP Conference Proceedings 2393, 020072 (2022); https://doi.org/10.1063/5.0074211

[65]. A.Narasima Venkatesh, "An approach for smart city applications using artificial intelligence", AIP Conference Proceedings 2393, 020068 (2022); https://doi.org/10.1063/5.0074166

[66]. Pravin R. Kshirsagar, "Covid heuristic analysis using machine learning", AIP Conference Proceedings 2393, 020077 (2022); https://doi.org/10.1063/5.0074120.

[67]. H. Manoharan, S. L. A. Haleem, S. Shitharth et al., "A machine learning algorithm for classification of mental tasks," Computers and Electrical Engineering, vol. 99, article 107785, 2022.

[68]. NEERAJKUMAR S SATHAWANE, PRAVIN KSHIRSAGAR, "PREDICTION AND ANALYSIS OF ECG SIGNAL BEHAVIOR USING SOFT COMPUTING",International Journal of Research in Engineering &Technology (IMPACT: IJRET) ISSN(E): 2321-884

[69]. Pravin R. Kshirsagar, Neeraj Kumar, Ahmed H. Almulihi, Fawaz Alassery, Asif Irshad Khan, Saiful Islam, Jyoti P. Rothe, D. B. V. Jagannadham, Kenenisa Dekeba, "Artificial Intelligence-Based Robotic Technique for Reusable Waste Materials", Computational Intelligence and Neuroscience, vol. 2022, Article ID 2073482, 9 pages, 2022. https://doi.org/10.1155/2022/20734823; ISSN(P): 2347-4599 Vol. 2, Issue 5, May 2014, 199-206.

[70]. C. Murugamani, Santosh Kumar Sahoo, Pravin R. Kshirsagar, Boppuru Rudra Prathap, Saiful Islam, Quadri Noorulhasan Naveed, Mohammad Rashid Hussain, Bui Thanh Hung, Dawit Mamiru Teressa, "Wireless Communication for Robotic Process Automation Using Machine Learning Technique", Wireless Communications and Mobile Computing, vol. 2022, Article ID 4723138, 12 pages, 2022. https://doi.org/10.1155/2022/4723138

[71]. Pravin R. Kshirsagar, Hariprasath Manaoharan, Vineet Tirth, Saiful Islam, Sandeep Srivastava, Varsha Sahni, M. Thangamani, M. M. Khanapurkar, Venkatesa Prabhu Sundramurthy, "Implementation of Whale Optimization for Budding Healthiness of Fishes with Preprocessing Approach", Journal of Healthcare Engineering, vol. 2022, Article ID 2345600, 7 pages, 2022. https://doi.org/10.1155/2022/2345600

[72]. Hariprasath Manaoharan et al., "Autonomous Robotic Technology and Conveyance for Supply Chain Management Using 5G Standards",DOI: 10.4018/978-1-7998-9640-1.ch02, 2022..

[73]. SulaimaLebbe Abdul Haleem., "Wireless Sensor Data Acquisition and Control Monitoring Model for Internet of Things Applications", Scientific Programming, Volume 2022, Article ID 9099163, 9 pages, https://doi.org/10.1155/2022/9099163.

[74]. Asif Irshad Khan., "Computational Approach for Detection of Diabetes from Ocular Scans", Computational Intelligence and Neuroscience, vol. 2022, Article ID 5066147, 8 pages, 2022. https://doi.org/10.1155/2022/5066147

[75]. Pravin R. Kshirsagar, HariprasathManoharan, PratikshaMeshram, JarallahAlqahtani, QuadriNoorulhasan Naveed, Saiful Islam, TewodrosGetinetAbebe, "Recognition of Diabetic Retinopathy with Ground Truth Segmentation Using Fundus Images and Neural Network Algorithm", Computational Intelligence and Neuroscience, vol. 2022, Article ID 8356081, 7 pages, 2022. https://doi.org/10.1155/2022/8356081

[76]. S. Shitharth, P. R. Kshirsagar, P. K. Balachandran, K. H. Alyoubi and A. O. Khadidos, "An Innovative Perceptual Pigeon Galvanized Optimization (PPGO) Based Likelihood Naïve Bayes (LNB) Classification Approach for Network Intrusion Detection System," in IEEE Access, vol. 10, pp. 46424-46441, 2022, doi: 10.1109/ACCESS.2022.3171660.

[77]. PravinKshirsagar and SudhirAkojwar, " Hybrid Heuristic Optimization for Benchmark Datasets" , International Journal of Computer Application (0975-8887),Vol.146- No.7,July 2016 .

[78]. PravinKshirsagar and Dr.SudhirAkojwar, Novel Approach for Classification and Predict ion of Non Linear Chaotic Databases, International Conference on Electrical, Electronics, and Optimization Techniques, M arch 2016.

[79]. PravinKshirsagar and Dr.SudhirAkojwar, Prediction of Neurological Disorders using Optimized Neural Network, In the proceeding of International Conference on signal processing, Communicat ion, Power and Embedded System ,October (2016).

[80]. SudhirAkojwar, PravinKshirsagar, " A Novel Probabilistic-PSO Based Learning Algorithm for Optimization of Neural Networks for Benchmark Problems" , WSEAS International conference on Neural Network-2016, Rome, Italy.

[81]. SudhirAkojwar, PravinKshirsagar, " Performance Evolution of Optimization Techniques for M at hematical Benchmark Functions" , WSEAS International conference on Neural Netw ork-2016, Rome,Italy.

[82]. PravinKshirsagar, Dr.SudhirAkojwar, " Classification&Detection of Neurological Disorders using ICA & AR as Feature Extractor" , International Journal Series in Engineering Science (IJSES), Volume 1, Issue 1, 2015.

[83]. PravinKshirsagar, Dr.SudhirAkojwar, " Classification and Prediction of Epilepsy using FFBPNN w ith PSO" , IEEE International Conference on Communication Networks, 2015.

[84]. PravinKshirsagar, Dr.SudhirAkojwar, " Chaotic Time Series Prediction using correlation Dimension and Adapt ive Neuro-Fuzzy Inference System International Journal of Engineering Research and General Science Volume 3, Issue 5, Sept ember-October, 2015, ISSN 2091-2730.

[85]. SudhirAkojwar, PravinKshirsagar, VijetalaxmiPai " Feature Ext raction of EEG Signals using Wavelet and Principal Component analysis" , National Conference on Research Trends In Electronics, Computer Science & Information Technology and Doctoral Research M eet, Feb 21st & 22nd ,2014.

[86]. Venkatesh, Dr.A. Narasima and Bhati, Parulkumari and Agarwal, Shradha and Maitri and Kshirsagar, Pravin R., Employee Association, Commitment and Habituation in the Time of COVID-19: Imputation for Human Resource Management (July 14, 2021). PSYCHOLOGY AND EDUCATION 2021, ISSN: 00333077, Available at SSRN: https://ssrn.com/abstract=3886475

[87]. V. Deshmukh and P. Kshirsagar, "Intelligent Vehicle Navigation using Fuzzy Logic," National Conference on Innovative Paradigms in Engineering & Technology. Proceedings published by International Journal of Computer Applications® (IJCA), pp. 13-16, 2013.

[88]. Tafhim, M. O. H. A. M. M. A. D., and P. R. A. V. I. N. Kshirsagar. "A Review on EMG Signal Classification for neurological disorder using neural network." In International conference on Advances in Engineering & Technology– 2014 (ICAET-2014), pp. 21-23. 2014.

[89]. Dubey, Ankur C., and PravinKshirsagar. "Feature Extraction of EEG Signals by Auto-Regression." International Journal on Recent and Innovation Trends in Computing and Communication 3.2: 090-092.

[90]. Kshirsagar, Pravin, AmbarishSalodkar, and Roshan Bhaiswar. "Generic Approach in Automation and Sensors for Enhanced Efficiency." International Journal of Emerging Technology and Advanced Engineering 2, no. 3 (2012): 152-156.

[91]. PravinKshirsagar, "Chaotic Time Series Prediction using Correlation Dimension and Adaptive Neuro-Fuzzy Inference System",International Journal of Engineering Research and General Science Volume 3, Issue 5, September-October, 2015 ISSN 2091-2730

[92]. Dravyakar, Saurabh P., and PravinKshirsagar. "Hybrid approach for Feature Extraction and Chaotic Time Series Prediction using ANFIS Model."2015.

[93]. Arpit D. Yadav, "Deep Learning Approach for Identification of Students Emotion",Journal of Xi'an University of Architecture & Technology,Volume XII, Issue V, 2020.

[94]. RAJKUMAR, A. "ARTIFICIAL INTELLIGENCE APPROACH FOR BREAST CANCER CLASSIFICATION USING MACHINE LEARNING CLASSIFIERS" 2021.

[95]. Mohammad Naushad, "An Overview to Various Image Compression Techniques",International Journal of Applied Information Systems (IJAIS) – ISSN : 2249-0868,Foundation of Computer Science FCS, New York, USA.

[96]. ANUSHA, ANAMDAS, SAHITHI DESANI, BANALA MANASA, DENDI SINDHU, B. SWATHI, and DR B. RAVEENDRANADH SINGH. "HEART DISEASE PREDICTION USING MACHINELEARNING ALGORITHM." Complexity International 25, no. 02 (2021).

[97]. YOGESWARI, Y., M. MOUNIKA, M. DHARANI, CH BHANU PRAKASH, and DR PRAVIN R. KSHIRSAGAR. "A CASE STUDY ON SMART WEATHER FORECASTING USING MACHINE LEARNING." Complexity International 25, no. 02 (2021).