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Health Monitoring based Cognitive IoT using Fast Machine Learning Technique

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Abstract: Diabetic patients' pleasant of life is advanced with continuous tracking. The usage of numerous technologies like the internet of factors (IoT), embedded software program, communications generation, synthetic intelligence, along with clever devices can assist to reduce the healthcare system's monetary prices. diverse communication technologies have enabled the availability of customised and remote fitness care. to meet the demands of development of sensible e-fitness apps, we have to construct clever health care structures and boom the amount of packages connected to the community. As a result, as a way to attain important wishes such as high bandwidth and strength efficiency, the 5G community need to consist of sensible healthcare applications. the usage of device getting to know methods, this research proposes an intelligent infrastructure for tracking diabetes sufferers. clever devices, sensors, and mobile phones had been used inside the architecture to enough exposure from the body. so one can produce a analysis, the sensible machine collected statistics from the patient and classified it the use of gadget getting to know. numerous machine getting to know methods were used to check the recommended prediction system, and the simulation results showed that the sequential minimum optimization (SMO) method gives extra category accuracy, sensitivity, and precision when compared to other strategies.

Keywords: *machine learning; internet of Things; healthcare ; diabetic patient monitoring and data classification.*

I. Introduction

Diabetic cases' affable of existence is advanced with nonstop shadowing. The operation of multitudinous technology like the internet of things (IoT), bedded software program, dispatches era, artificial intelligence, along side smart bias can help to reduce the healthcare system's economic fees. one of a kind communication technologies have enabled the vacuity of customized and far off health care. to satisfy the needs of development of sensible-health apps, we've got to assemble clever health care structures and increase the quantum of packages connected to the community. As a result, as a manner to acquire essential desires comparable as excessive bandwidth and energy, effectiveness, the 5G community wishes to correspond of practical healthcare operations. The operation of the tool studying patterns, this exploration proposes an sensible structure for monitoring diabetes victims. clever bias, detectors, and cell telephones have been used within the armature to sufficient publicity from the frame. in order to produce a analysis, the sensible machine accumulated records from the case and labeled it the use of contrivance getting to know. Multitudinous device studying styles have been used to check the encouraged vaticination device, and the simulation results showed that the successional minimal optimization (SMO) system offers redundant order delicacy, perceptivity, and perfection while compared to different techniques.

Diabetes is a ordinary state of affairs due to pancreatic disorder, which takes location while

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the organ does not make sufficient insulin or the frame does now not use it immediately(3). high or low blood sugar classes can cause organ malfunction and declination, conforming of the eyes, jitters, and blood vessels. As a stop end result, ordinary and diurnal monitoring is vital to prevent the diabetic case's health from deteriorating. The bettered variety of diabetes victims in rearmost times has wished the employment of redundant methods for masking these individualities. Diabetic instances' blood glucose degrees are covered on a everyday basis through monitoring outfit. consequently, instances, houses, and croakers may additionally cowl glucose levels at all times and respond unexpectedly if there may be an aberrant studying. movable tracking structures for diabetes cases deliver multitudinous blessings, such as perfecting diabetic instances' affable of life through dwindling inpatient time. As a end result, the deployment of a wi-fi generation with extraordinarily strong insurance that allows statistics to be despatched from sufferers to croakers is enough seductive. in this regard, fifth technology(5G) technology, appertained to as the ensuing generation of mobile networks, permits inordinate- velocity transmission, bettered community capability, and community scalability. however, the triumphing mindfulness of this era's evaluation is on boosting the records transfer determine(1).

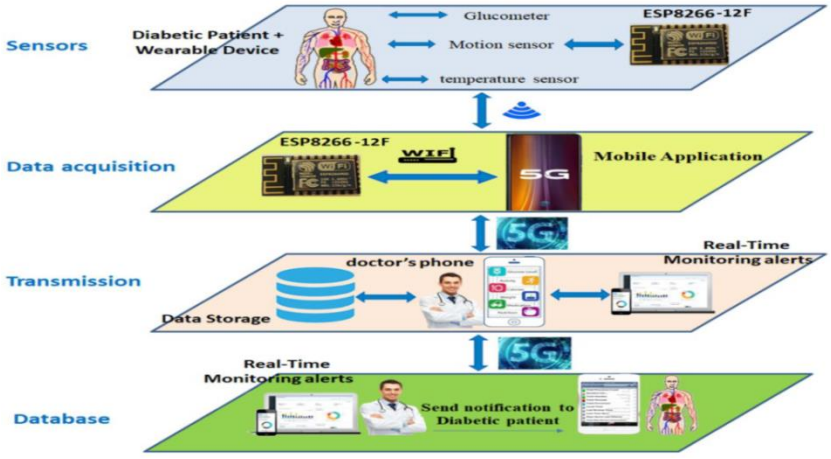

Fig 1. Proposed design structure for monitoring diabetic patient

We created a shape for smart, constant monitoring of diabetic sufferers the operation of a system gaining knowledge of set of rules with the statistical categorization on this oil. Our recommended layout includes movable detectors that could degree the case's blood sugar degree, temperature, and physical pastime. through the 5G cell community, a phone bear detector information to a database station. The information that got here collected and reused comprised order as well as vaticination the use of several order techniques. likewise, the recommended fashion supported diabetic cases in acquiring fortune blood sugar role vaticinations. The diabetes dataset come reused using naive Bayes, arbitrary wood (RF), simple logistic, successional minimum optimization (SMO), and J48 order algorithms to find out which fashion come the best in determining the affected person's diploma of chance. it's viable to cure diabetes the operation of deterministic fine fashions. however, there were many examinations on high-quality fashions of diabetes mellitus inside the literature to this point. the usage of stochastic numerical evaluation to take a look at the epidemic sickness propensity of diabetes mellitus remains an investigative style [5, 6]. To accumulate statistics for categorization, we employed a number one detector with low-price and espresso- energy answers for the glucose measures operation in our suggested result. every day, the case's information become streamlined on the pall. The acquired facts come utilized by croakers to cowl the case's blood glucose exchange and to provide the

proper sanitarium treatment within the event of an erroneous glucose function. several contrivance studying strategies have been used to make the forged. unique categorization algorithms were tested, tested, and in assessment, using exceptional norms a better way to gain the topmost delicacy.

The remainder of the paper is established as follows. The relevant work is included in section II. The proposed architecture for diabetic affected person monitoring is shown in section III. phase IV carries the findings and discussion. phase V concludes with a summary of the findings.

II. Literature Survey

On this work, we offer a summary of a few previously published paintings on 5G-primarily based gadgets for diabetic blood sugar level monitoring. The segment additionally consists of some current efforts on huge records and predictive analytics in healthcare that hire categorization to count on capability episodes of blood sugar spikes or dips. category in e-fitness tracking is crucial for contamination remedy inside the future.

In [7], a pinnacle function view of 5G technology and IoT- enabled clever healthcare applications is offered. The authors additionally talk the partitions, exploration trends, and fortune studies targets in 5G healthcare. In [8] describe an structure and protocol for 5G-commonly grounded clever nonstope-health shadowing. The plan is targeted on the gathering of sufferers' pivotal signs and symptoms and signs and symptoms using a 5G smartphone and wearable widgets. the public statistics is stored in a database, and the statistics is analysed the usage of huge records and system gaining knowledge of strategies to provide clever replies to elevate an alarm at the same time as the machine identifies an strange incidence. In(nine), the authors suggest a cellular health device ordinarily grounded on 5G for nonstop assessment and shadowing of diabetic cases. First, the authors describe the 5G-clever Diabetes system, which mixes being technologies conforming of Wearable2.0, gadget reading, and massive facts to provide whole diabetes tracking and evaluation. Following that, the authors display the records-sharing system and facts evaluation interpretation for 5G-smart Diabetes. in the end, the experimenters created a 5G-smart Diabetes test bed. The effects propose that the contrivance is in a position of presenting victims with knitter- made prognostic and remedy.

The inneranti-collision alarm system(IAAS) proposed in(10) is some other IoT-grounded solution. The generation, this is grounded on Radio frequence identification(RFID), can understand and screen unresistant RFID markers via the use of studying backscatter signals. To help eyeless druggies in protective off partitions, the authors recaptured the acquired signal energy index(RSSI) counting on the log-ordinary distance bypass loss(LWLR) style and section biographies as fingerprints. trials revealed that the system achieved duly in handicap avoidance, with an delicacy of ninety four.(11) recommend a clever home fitness examiner machine for detecting kind 2 diabetes and inordinate blood pressure. The contrivance's motive is to estimate the affected character's blood strain in addition to glucose levels atdomestic.however, the caregiver is communicated , If an irregularity is set up. To expect excessive blood stress and diabetes nation, the device also employs supervised machine analyzing type algorithms. In(12), experimenters provide a new contrivance mastering interpretation grounded on a decision tree(DT) algorithm to examine the excellent boom of site visitors manage in 5G IoT wireless detectors. The issue of this interpretation is to find out the first-magnificence parametric settings in a 5G scenario.(13) provide a singular system for soothsaying diabetes instances' glucose attention. The authors take a look at affected person information the usage of the GlucoSim application. To drop noise, the nonstop glucose tracking detector(CGS) and the Kalman clean out(KF) are hired on this contrivance. This fashion aids inside the forestallment of big

outcomes caused by hypo- or hyperglycemia.(14) intentions to enhance delicacy and other assessment norms in classifying the Pima Indians diabetes dataset. The authors present a deep neural community shape with piled autoencoders for diabetes facts categorization. For attempting out the gadget, the exams are finished utilising perfection, do not forget, particularity, further to F1 standing as assessment criteria.

In the end, we observe several research centered on the application of device analyzing techniques. [15] offers two strategies for coping with the magnificence suggested tactics are in comparison to modern-day algorithms via the author. [16] Create a type method for the arrival of biocompatible substances in scientific gadgets primarily based totally on the use of meticulous logistic regression to lower the probability of erroneous alloy identity. In [17] Compares the effects of performing statistics category obligations the use of the maximum accepted type techniques and describes a unique kind method based totally on the geometric transformation model's neural-like talents.

Our fundamental intention became to create a unique structure for tracking diabetic sufferers using 5G era. none of the examined publications focuses on the utility of tool studying algorithms to categorize statistics from a diabetic affected person the usage of a 5G-primarily based device. Our concept is furnished inside the subsequent section. despite the fact that we centered at the deployment of many gadget mastering algorithms to categorize statistics about diabetic patients and factors related to this situation, our machine is not constrained to monitoring this disease.

III. Proposed Design Methodology

This section describes in detail the proposed 5G architecture for a diabetic affected person tracking machine. The aim of this text has become to monitor a diabetic affected character's blood glucose level, making use of 5G technology to switch records and wireless intelligence to analyze the information and produce realistic judgments.

The cautioned machine became designed to collect information on diabetes sufferers' blood glucose degrees, temperature, and physical activity, and then upload the statistics to a base station the use of a cellular telephone and a 5G connection. Following that, the device intelligently analysed the records the use of machines learning and wi-wirelesscialwireless intelligence procedures to help users in controlling their glucose stages and forecasting destiny wireless.

A diabetic case calls for nonstop shadowing of their blood glucose position due to the fact small wi- wireless in glucose function don't indicate a hassle for the affected character's wiwireless in a normal script; nonetheless,non-forestall performances can imply assuredly crucial goods which consist of gradual state, blindness, or indeed loss of lifestyles(18). it is normally understood that diabetic mortal beings generally cleave to a diabetes treatment plan via taking their insulin on a normal basis. As a end result, we provided a manner for ever overlaying blood glucose levels at home and providing prompt backing in the occasion of a medical exigency. whilst a case entered wrong facts, croakers might get an alert communication. The croakers may additionally advocate uniquewireless conditioning to treatment the circumstance grounded on that knowledge.

- Sensors: the blood glucose degree sensor, temperature sensor, and motion sensor are all discovered on this layer. this accretion additionally includes the ESP8266 module, which links the sensors and offers a wi-wiwireless interface for data transmission to the affected man or woman's cellphone. As a cease result, the sensors are in fee of accumulating facts and moving it to the affected person's cellphone.
- wireless acquisition layer: this segment consists of the patient's phone and the records collection software. The sensor information are shown on the cellular application. The 5G community also sends the statistics to the

lowest station, deliberating a big quantity of simultaneous connections consistent with blanketed place. wi-fiwireless, its aims for one million gadgets in line with kilometer, this is 10 instances more than 4G.

• Transmission layer: the phone makes use of 5G to supply statistics to the database for processing earlier than sending it to the wiwireless practitioners' cellphone for exam.

• Database layer: a processing unit that shops sensor records to be analyzed and labeled the use of numerous c084d04ddacadd4b971ae3d98fecfb2a intelligence techniques. The server determines whether or not the statistics acquired is high-quality (genuine awesome wireless (TP)) or terrible (faux terrible (FN)) the usage of device studying strategies. A observe is issued when the machine wi-ficationwireless-wi-fish an abnormal scenario. The health practitioner receives a message from the server. The medical doctor responds to the notice with the resource of sending recommendation and remedies, which can be provided on the affected character's phone.

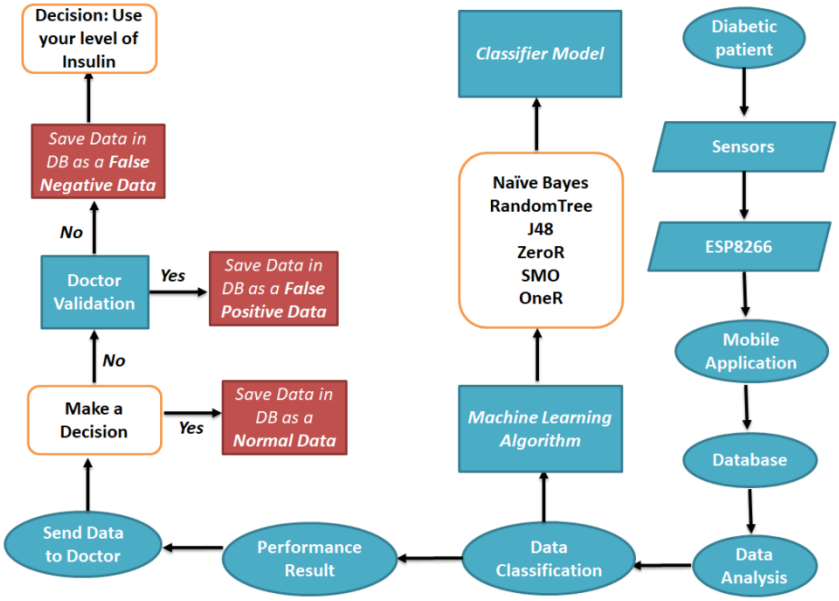

Fig 2. Flow of proposed design structures

To check the blood glucose degree, the diabetic affected person need to take a drop of blood from the stop of his or her wirelessnger and region it in a glucometer at the least 3 instances each day. We located it pretty difwiwireless to do the sensible take a look at at the diabetic affected person for the set up of our software. Which served as a station node, and often transferred records from the stay sensor toward the internet database. this means that, further to performing all of the computation, the ESP8266-12F serves as a sensor transfer or hub and a wi-fi communique tool.

IV. Results And Discussion

This section consists of the performance findings in terms of precision, receiver working traits (ROC), and accuracy, in addition to the outcomes of the discussion.

This segment demonstrates the number one and maximum important phase of gadget studying algorithms in records series and processing. The dataset implemented is proven in table 1. The dataset made use of a database collecting records on some of diabetes individuals. We applied this dataset to test the numerous machine studying techniques for detecting and forecasting diabetes. The measurements had been taken, body temperature, and physical activity have been all included within the dataset.

Table 1. Temperature, Physical activity and Glucose level [19]

Day	Temperature	Blood Sugar Level (mg/dL)			No. of Steps
		Morning	Afternoon	Evening	
Day1	36	97	101	101	4312
Day2	35	155	142	113	5211
Day3	36	102	100	103	3765
Day4	36	123	61	87	3546
Day5	37	151	136	77	7400
Day6	35	140	67	112	3580
Day7	37	59	103	71	7657
Day8	36	90	76	101	3010
Day9	36	89	60	75	6712
Day10	37	51	50	66	7432

The accuracy, sensitivity, specificity, and precision of data categorization are measured (see Equation (1)). The following equation is used to define accuracy:

$$\text{Accuracy} = \frac{\text{TP+TN}}{\text{TP+TN+FP+FN}}\ (\%) \quad (1)$$

$$\text{Precision} = \text{TP}/(\text{TP} + \text{FP}) \quad (2)$$

$$\text{Specificity} = \text{TN}/(\text{TN} + \text{FP}) \quad (3)$$

$$\text{Sensitivity} = \text{TP}/(\text{TP} + \text{FN}) \quad (4)$$

$$\text{Recall} = \text{FN}/(\text{TP} + \text{FN}) \quad (5)$$

$$\text{F} - \text{Measure} = \frac{2\times\text{Precision}\times\text{Recall}}{\text{Precision}\times\text{Recall}} \quad (6)$$

Table 2. Different algorithms with different parameters Values like TP rate, FP rate, Precision, Recall and F-measure

Algorithms	TP Rate	FP Rate	Precision	Recall	F-Measure
Naïve Bayes [20]	0.730	0.242	0.751	0.730	0.813
J48 [21]	0.887	0.003	0.887	0.887	0.987
SMO [22]	0.701	0.315	0.727	0.701	0.770
Simple Logistic [23]	0.586	0.580	0.375	0.586	0.561
Random Forest [24]	0.885	0.005	0.885	0.885	0.985

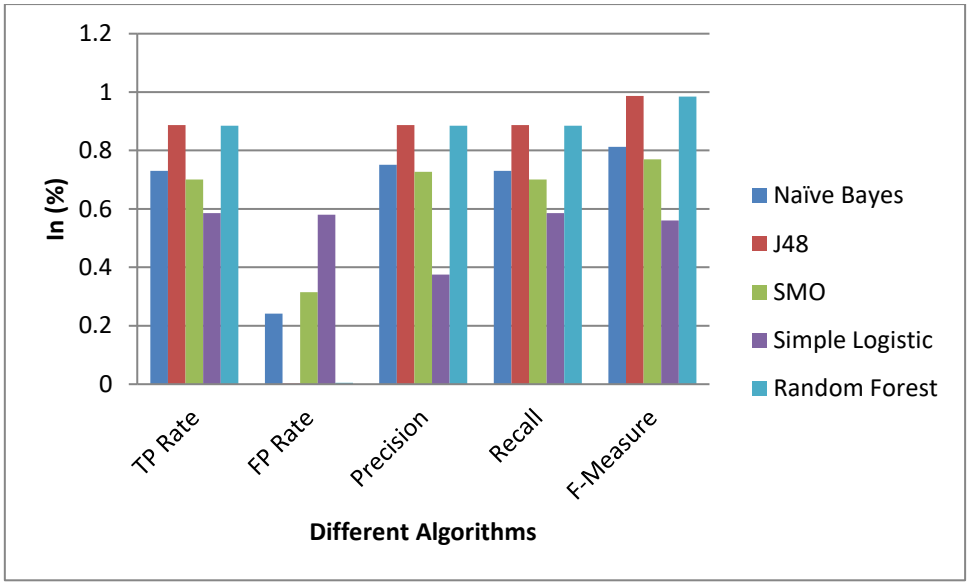

Fig 3. Different algorithms with different parameters Values like TP rate, FP rate, Precision, Recall and F-measure

Table 3. Different algorithms with different parameters Values like sensitivity , specificity, precision and accuracy.

Algorithms	Sensitivity (%)	Specificity (%)	Precision (%)	Accuracy (%)
Naïve Bayes [20]	38.67	99.10	83.03	81.89
J48 [21]	78.58	99.40	98.06	99.12
SMO [22]	87.81	99.58	98.55	99.44
Simple Logistic [23]	81.21	99.36	75.68	99.14
Random Forest [24]	44.56	99.04	85.68	93.81

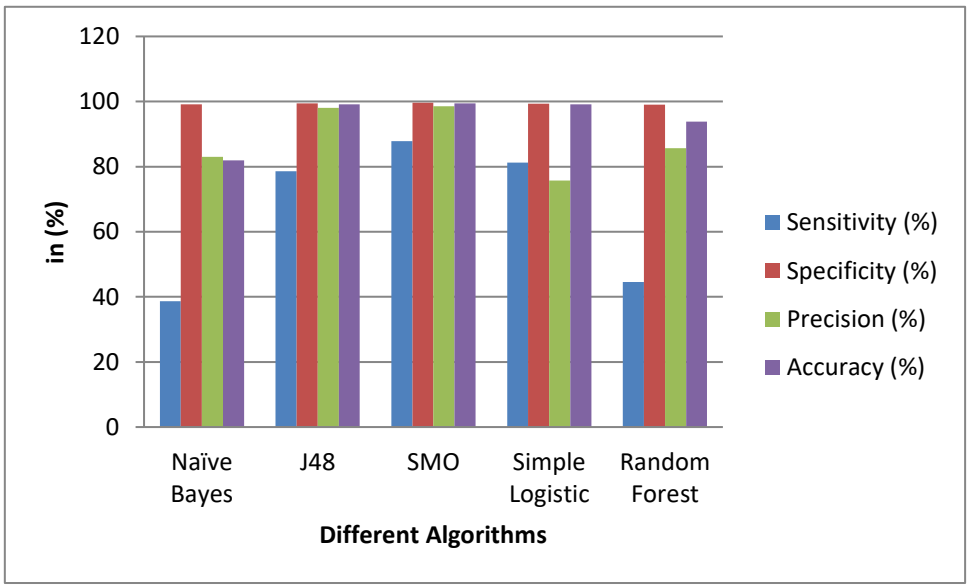

Fig 4. Different algorithms with different parameters Values like sensitivity , specificity, precision and accuracy.

Table 4. Different algorithms with different parameters Values like mean absolute error (MAE), and mean squared error (MSE)

Algorithms	MSE (%)	MSE (%)
Naïve Bayes [20]	28.68	98.42
J48 [21]	7.82	68.68
SMO [22]	42.2	97.52
Simple Logistic [23]	45.81	61.98
Random Forest [24]	8.65	96.69

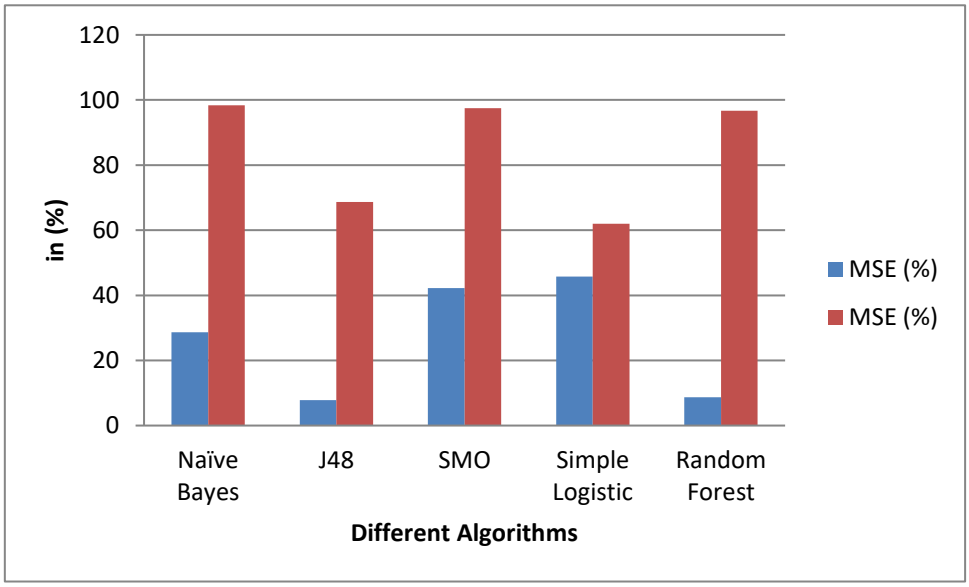

Fig 5. Different algorithms with different parameters Values like mean absolute error (MAE), and mean squared error (MSE)

V. Conclusion

In healthcare, predictive analytics can also assist clinicians and scientific researchers in obtaining know-how from medical information and making informed and green decisions. in this work, we presented a diabetic patient tracking system primarily based on 5G generation with system mastering algorithms. We developed an shrewd software the use of synthetic intelligence and huge information that could examine the records of diabetes patients and difficulty an alert in the event of an emergency. We categorised diabetic patients the use of the WEKA tool the use of six classifiers based totally on machine gaining knowledge of strategies, consisting of naive Bayes, J48, SMO, random wooded area, in addition to simple logistic. The precision and accuracy of these algorithms had been compared. numerous device mastering techniques (nave Bayes, SMO, J48, basic logistic, and random woodland) have been used to assess the recommended machine.

References:

[1] Hussein, M.; Galal, A.I.; Abd-Elrahman, E.; Zorkany, M. Internet of Things (IoT) Platform for Multi-Topic Messaging. Energies 2020, 13, 3346.

[2] Osifeko, M.O.; Hancke, G.P.; Abu-Mahfouz, A.M. Artificial Intelligence Techniques for Cognitive Sensing in Future IoT: State-ofthe-Art, Potentials, and

Challenges. J. Sens. Actuator Netw. 2020, 9, 1–31.

[3] Priyanka, E.B.; Maheswari, C.; Thangavel, S. A smart-integrated IoT module for intelligent transportation in oil industry. Int. J. Numer. Model. Electr. Netw. Dev. Fields 2020, 34, e2731.

[4] Charanjeet Singh, Syed Asif Basha, A Vinay Bhushan, Mithra Venkatesan, Abhay Chaturvedi, Anurag Shrivastava, A Secure IoT Based Wireless Sensor Network Data Aggregation and Dissemination System,Cybernetics and Systems, Taylor & Francis https://doi.org/10.1080/01969722.2023.2176653

[5] Anurag Shrivastava, MidhunChakkaravathy, Mohd Asif Shah, A Comprehensive Analysis of Machine Learning Techniques in Biomedical Image ProcessingUsing Convolutional Neural Network,2022 5th International Conference on Contemporary Computing and Informatics (IC3I) https://doi.org/10.1109/IC3I56241.2022.10072911

[6] Keshav Kumar, Amanpreet Kaur, KR Ramkumar, Anurag Shrivastava, Vishal Moyal, Yogendra Kumar,A Design of Power-Efficient AES Algorithm on Artix-7 FPGA for Green Communication, 2021 International Conference on Technological Advancements and Innovations (ICTAI) 10.1109/ICTAI53825.2021.9673435

[7] Fayaz, F.A.; Malik, A.; Yatoo, A.A. Cognitive Internet of things (CIoT) a success for data collection. In Proceedings of the 2021 Sixth International Conference on Image Information Processing (ICIIP), Shimla, India, 26–28 November 2021; pp. 284-287.

[8] García, Á.L.; De Lucas, J.M.; Antonacci, M.; Zu Castell, W.; David, M.; Hardt, M.; Lloret Iglesias, L.; Moltó, G.; Plociennik, M.; Tran, V.; et al. A cloud-based framework for machine learning workloads and applications. IEEE Access 2020, 8, 18681–18692.

[9] Sarker, I.H. AI-Based Modeling: Techniques, Applications and Research Issues Towards Automation, Intelligent and Smart Systems. Comput. Sci. 2022, 3, 158.

[10] Llisterri Giménez, N.; Monfort Grau, M.; Pueyo Centelles, R.; Freitag, F. On-Device Training of Machine Learning Models on Microcontrollers with Federated Learning. Electronics 2022, 11, 573. [CrossRef] 11. Sakr, F.; Bellotti, F.; Berta, R.; de Gloria, A. Machine Learning on Mainstream Microcontrollers. Sensors 2020, 20, 2638.

[11] Yan, C. Audience Evaluation and Analysis of Symphony Performance Effects Based on the Genetic Neural Network Algorithm for the Multilayer Perceptron (GA-MLP-NN). Comput. Intell. Neurosci. 2021, 2021, 4133892.

[12] Priya, C.V. Behavioral Biometrics based Authentication System using MLP-NN and MVPA. In Proceedings of the 2021 IEEE International Power and Renewable Energy Conference (IPRECON), Kollam, India, 24–26 September 2021; pp. 1–6.

[13] Alqadhi, S.; Mallick, J.; Balha, A.; Bindajam, A.; Singh, C.K.; Viet Hoa, P. Spatial and decadal prediction of land use/land cover using multi-layer perceptron-neural network (MLP-NN) algorithm for a semi-arid region of Asir, Saudi Arabia. Earth Sci. Inf. 2021, 14, 1547–1562.

[14] Javed, Y.; Rajabi, N. Multi-Layer Perceptron Artificial Neural Network Based IoT Botnet Traffic Classification. In Proceedings of the Future Technologies Conference (FTC) 2019, San Francisco, CA, USA, 24–25 October 2019; Arai, K., Bhatia, R., Kapoor, S. Eds.; Advances in Intelligent Systems and Computing; Springer: Cham, Switzerland, 2020; Volume 1069._69.

[15] Ball, J.E.; Tang, B. Machine Learning and Embedded Computing in Advanced Driver Assistance Systems (ADAS). Electronics 2019, 8, 748.

[16] Jachimczyk, B.; Dziak, D.; Czapla, J.; Damps, P.; Kulesza, W.J. IoT On-Board System for Driving Style Assessment. Sensors 2018, 18, 1233.

[17] Guimarães, C.J.B.V.; Fernandes, M.A.C. Real-time Neural Networks Implementation Proposal for Microcontrollers. Electronics 2020, 9, 1597.

[18] Uma, S.V.; Eswari, R. Accident prevention and safety assistance using IOT and machine learning. J. Reliab. Intell. Environ. 2022 8, 79–103.

[19] Thevendran, H.; Nagendran, A.; Hydher, H.; Bandara, A.; Oruthota, U. Deep Learning and Computer Vision for IoT based Intelligent Driver Assistant System. In Proceedings of the 2021 10th International Conference on Information and Automation for Sustainability (ICIAfS), Negambo, Sri Lanka, 11–13 August 2021; pp. 340–345.

[20] De-Las-Heras, G.; Sánchez-Soriano, J.; Puertas, E. Advanced Driver Assistance Systems (ADAS) Based on Machine Learning Techniques for the Detection and Transcription of Variable Message Signs on Roads. Sensors 2021, 21, 5866.

[21] Krishnarao, S.; Wang, H.C.; Sharma, A.; Iqbal, M. Enhancement of Advanced Driver Assistance System (Adas) Using Machine Learning. In Proceedings of the Fifth International Congress on Information and Communication Technology, London, UK, 20–21 February 2020; Yang, X.S., Sherratt, R.S., Dey, N., Joshi, A., Eds.; Advances in Intelligent Systems and Computing; Springer: Singapore, 2021; Volume 1183._13.

[22] Sharma, N.; Garg, R.D. Cost reduction for advanced driver assistance systems through hardware downscaling and deep learning. Syst. Eng. 2022, 25, 133–143.

[23] Tokody, D.; Albini, A.; Ady, L.; Rajnai, Z.; Pongrácz, F. Safety and Security through the Design of Autonomous Intelligent Vehicle Systems and Intelligent Infrastructure in the Smart City. Interdiscip. Descr. Complex Syst. 2018, 16, 384–396.