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ANALYSING IOT SMART SYSTEM APPLICATION AND ENVIRONMENT BY USING SIMULATED ANNEALING TECHNIQUES

P.SENTHIL PANDIAN[1],P.SUNDARAVADIVEL[2], R.AUGUSTIAN ISAAC[3], P.HEMAVATHY[4], E.S.VINOTHKUMAR[5], P.JANAKI RAMAL[6]

[1]Associate Professor, Department of Computer Science and Engineering, Solamalai College of Engineering, Madurai, Tamilnadu,
[2]Associate Professor, Department of Artificial Intelligence and Machine Learning
[3]Associate Professor, Department of Artificial Intelligence and Machine Learning
[4]Associate Professor, Department of Computer Science and Engineering
[5]Assistant Professor, Department of Internet of Things
[6]Assistant Professor, Department of Computer Science and Engineering

[2,3,4,5,6]Saveetha Engineering College, Chennai, Tamilnadu, India
e-mail: : [1]psenthilpandian@gmail.com, [2]sundar.me2009@gmail.com, [3]sangam.naadu@gmail.com, [4]hemavathyp@saveetha.ac.in, [5]vinothkumar2k@gmail.com, [6]janakiramal424@gmail.com

ABSTRACT

A collection of online-connected devices, tools, and networks is known as the Internet of Things (IoT). It interacts with the environment both outwardly and internally. IoT detects its surroundings and responds to them. By supplying the environment with state-of-the-art techniques, it elevates people's living standards. IoT allows the devices to communicate with each other both electronically and physically. The environment can become intelligent and connect to any device at any time thanks to the Internet of Things (IoT). Through the use of IoT, data is collected and processed from a variety of actuators and sensors and wirelessly sent to computers or smartphones. To improve professionalism, IoT is used in supply chain, logistics, automation, and remote monitoring. By foreseeing the market's early growth, IoT greatly raises people's quality of life, is widely embraced by the device network, and establishes a new environment for application development. In today's fast-paced world, IoT can keep up with people's needs and demands. An overview of IoT ecosystem usages and smart system applications is given in this article.

Keywords: *Internet of Things, Smart Energy, Sensors, Wireless Networks, Simulated Annealing Techniques, Cluster Algorithms*.

1. INTRODUCTION

These days, almost every country in the world has internet connection, which is drastically altering people's daily lives. A large range of appliances will soon be available online as we move into a period of increased connectivity. There has been a rise in the popularity of the Internet of Things (IoT) on several fronts. Smart cities, clever regions, smart transportation, smart homes and assisted housing, smart industries, community safety, energy and environmental protection, agriculture, and tourism as elements of a future IoT ecosystem have all been discussed extensively as potential IoT application domains. The Internet of Things, or IoT, is a physical network of objects that includes automobiles, buildings, instruments, and other items. It is made possible for various gadgets to gather and disseminate data using semiconductor technology, software, detectors, and network connections with other elements. In order to strengthen the link between the real world and computer-based systems and increase accuracy and efficacy, the Internet of things enables

objects to be remotely monitored and controlled over the current network infrastructure [1]–[5]. The Internet of Things, or IoT, is a conglomeration of various technologies, comprising, among others, internet technologies, communication technologies, actuators, ambient intelligence, embedded systems, and ubiquitous computing. IoT is categorized into various groups based on how each technology functions.

This system consists of three components: Internet-oriented, Things-oriented, and Semantic-oriented [6]–[10]. Enabling end users, remote access control, setup, and operational simplicity are the main objectives of the Internet of Things. The Internet of Things not only provides various networks but also seamless connectivity. The Internet of Things is analogous to tactics and procedures that prohibit intelligent machines from communicating with various objects, constraints, bases, and modules, as well as sensors strategically placed to spark a revolution in order to address its problems.

2. LITERATURE REVIEW

A vast amount of information has been created and put to good use in ways that improve security and reduce exploitation. The problem calls for employees who are dedicated to that specific circumstance and who ought to have prior knowledge to take the alliance's and the proffer's consideration into account [11]–[15]. These cellular networks offer essential technology for Internet of Things development. One good network example of inelastic traffic is video streaming [16]–[20]. IoT must meet traffic's needs for improved service quality as well as their main source of entertainment. The efficacy of the network environment, the flexibility of network extension, the addition of new junctions, and an increase in traffic are all accommodated by these network designs. Two categories make up the fundamental 5G IoT procedure: those that deal with technology, wireless difficulties, data processing, and regulations pertaining to data privacy and security [21]–[25].

With the help of IoT, we can see big, intelligent gadgets in our environment, as seen in Figure 1. The next generation of IoT smart systems based on current problems, trends, and possible consequences. The suggested study offers a comprehensive and complete assessment of fifth-generation IoT due to the increased data rates that require both edge and cloud computing platforms.

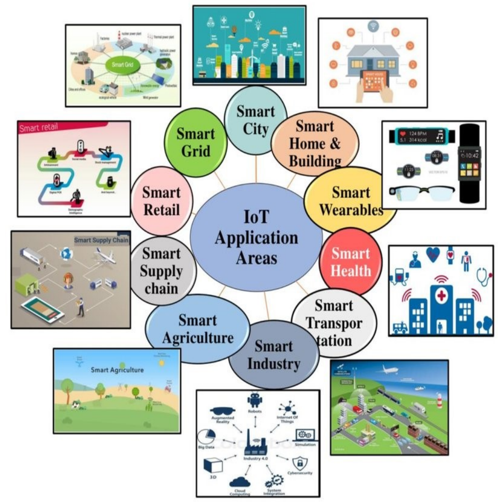

Figure.1. IoT Application Areas

Data regarding the environment and the physiological responses of the patients can be continuously collected by the SHS. Data is located and sent to a command center, where a sophisticated Monitoring Application (MA) and a REST web API enable easy local and remote user access. The tool makes it possible for patients and doctors to communicate in both directions. This initiative's main objective is to help remote cardiac patients access state-of-the-art care that they otherwise would not be able to because of a low doctor-to-patient ratio [26]–[29]. From the references it is essential to improve the energy level, increase energy efficiency, data transmissions, decrease the traffic and improve classification results by using SAT.

The method is a combination of the restricted memory Broyden, Fletcher, Goldfarb-Shannon (L-BFGS) algorithm and the Hybrid Modified Water Wave Optimization method. The proposed SAT model aims to simplify the process of quickly gathering and analyzing data in order to find patterns. Using the contrast limited adaptive histogram equalization (CLAHE) model, the preprocessing stage will enhance the images' contrast. The preprocessed image is then separated using a histogram-based recognition model. The relevant attributes are then collected from the segmented image using the HPTI-v4 prototype, and a Multilayer

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Perceptron (MLP) is used for categorization. Retinal ophthalmology datasets are used in several researches to investigate the accuracy of the HPTI-v4 approach.

3. APPROCH OF OPTIMZATION TECHNIQUES IN IoT

The Internet of Things (IoT) is the term used to describe the use of the Internet to access and administer widely utilized technology. More data is available to support cities, businesses, energy, health, and many other facets of our daily lives wherever the physical, digital, and virtual worlds come together to generate intelligent environments. In our setting, appliance automation is the preferable setup since it allows us to control and manage even in emergency situations. A variety of technologies are made accessible to help the entities communicate with one another. The internet of things (IoT) makes it easier to wirelessly gather, analyse, and resend device data to computers or mobile devices. Concerns about the Internet of Things have increased yearly in the communication and information technology domains. The primary requirements of the security automation system are risks such as infiltration and data theft. It paves the way for objects to be managed from a distance, identified across the network, and results in further benefits. In certain applications, the Internet of Things (IoT) imitates the most well-known class of cyber-physical systems, which includes a range of automation technologies such as smart cities, smart homes, etc. It might be able to communicate with the internet's supporting infrastructure.

3.1. IR instructions and web-based automation

There is a connection, or interface, between the user and the device, which the device operates. One advantage of home automation is that it allows the infrastructure to move on its own. Together with other electrical instruments, these automation tools can be utilized to capture activity that is under control. Relevant equipment may be linked to the IR receiver to operate other devices and even enable communication between them. To qualify a large number of device controls that just use IR instructions to manage the power vent, more frameworks and actions might be created. It's also possible that the computer's programming has to be updated. It should offer authentication security and be easy to use. Additionally, basic remote control can be achieved through web-based automation. Because its applications are not limited to a certain industry, the internet of things is currently one of the most popular study topics.

3.2. IOT protocols

IoT is widely used because of its many advantages. This study paper presents an overview of numerous IoT systems to provide background information. The IOT Ecosystem consists of CPUs such as Arm Cortex-M, Arc, and Quark, and platforms such as BeagleBone, Rasberry PI, Arduino, and others. It also contains operating systems such as TinyOS, Ubuntu, Embedded Linux, uCLinux, and Android Auto. Two further essential components are IOT protocols and interoperability. Figure 2 shows how the Internet of Things (IoT) is used in nearly every aspect of contemporary life that has an internet connection or can be accessed, such as computers, wearable technology, household lights, cellphones, and many more applications.

Figure 2. Applications of the Internet of Things (IoT)

A lot of data is generated by Internet of Things applications. In actuality, it is not required to store this data on a cloud since a significant amount of the data generated by IoT applications is meaningless noise from devices whose statuses remain constant. The primary challenge

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in this scenario is figuring out how to selectively store data on the cloud to avoid storage issues down the road when utilizing IoT devices. It further says that the user will receive pertinent and correct data, and that any leftover (junk) data produced by IoT devices would be appropriately disposed of.

3. SIMULATED ANNEALING TECHNIQUES [SAT]

Numerous public and private sector organizations worldwide have become aware of the significant security dangers associated with the Internet of Things. Adding so many more hubs to the systems and the web will give attackers a wider access point to the system, especially because many systems already have security weaknesses. According to indications, the malware used an infinite number of Internet of Things devices against its own servers, such as smart home appliances and closed-circuit televisions. Another important security measure will come from the way IoT is incorporated into our daily lives.

Connecting different devices will be the hardest thing the Internet of Things has to deal with in the future. In the end, this communication will battle against the established framework and the associated technologies. Figure 3 illustrates how many terminals in a network are now connected using centralized server/client architecture for permission and authentication. When there are billions of devices linked to a single network in the future, this model will not be scalable to satisfy demand. It is only appropriate for the present. The current, centralized system would become clogged in this situation. Maintaining cloud clusters of servers that can manage massive quantities of information exchange requires large investments and expenditures because server outages could result in a complete system shutdown. IoT is growing at a rapid pace.

It is incorporating several technologies, and it will soon become standard practice. It will be extremely difficult to establish connectivity between the devices and require additional hardware and software to be set up. The lack of defined M2M protocols is one of the additional issues causing incompatibilities amongst IoT devices. Devices that rely on these technologies will eventually become useless as they soon become outdated.

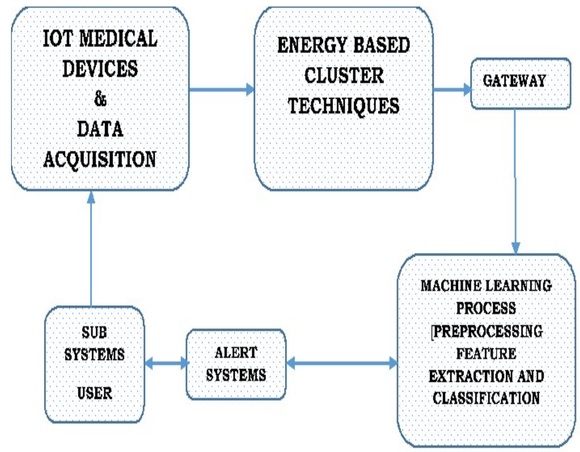

Figure.3. Optimization Techniques Using IoT

Technology conventions that combine communication and network protocols with data-aggregation conventions are the gathering of activities for managing, analyzing, and storing data gathered from numerous sensors. They enhance the data by increasing the amount, range, and regularity of data that are available for analysis. The release of the data for analysis is the final stage of IoT installation. The structural design of the IoT-enabled data management systems must address a variety of challenges in order to handle SAT, such as intelligent decision-making, data heterogeneity from several multimedia sources, and data processing and storage at enormous volumes.

This paper proposes architecture to efficiently process and store SAT in an Internet of Things environment. A distributed and parallel module, together with a tiered architecture, is offered to implement big data analytics for multimedia data. The proposed system additionally has a preprocessing module to get the SAT ready and speed up the processing mechanism. To prove the effectiveness of the proposed system, real-time multimedia big data sets from reliable sources are used for implementation and experimental testing. The idea of SAT is gaining popularity in tandem with the expansion of IoT. IoT devices generate enormous volumes of multimedia data. The massive volumes of data utilized to handle

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information for intelligent applications are referred to as "big data."

Information that contains a range of media, including text, audio, animations, and videos, is referred to as "multimedia data". In addition, governments and companies will use mechanisms that make everyday multimedia communication easier and more enjoyable. For more pressing problems, multimedia communication uses large amounts of data. Some researchers recommend using IPSec in an IoT environment through an adaptation layer, although there are concerns that this is impractical due to device limitations. In addition, research is underway to develop lightweight authentication based on public key management. Authentication research is discussed in detail in the next section. In addition, there may be disagreements regarding the effectiveness of using the product. However, it can be beneficial to use light encryption on devices to protect user privacy and security. Vulnerabilities such as insecure web and cloud interfaces can It is difficult to find security standards and evaluation frameworks that fully assess and disclose the security level of IoT-based smart environments and those that best meet security requirements. The article examines current security standards and evaluation frameworks, as well as a series of NIST special publications on security techniques that highlight key research areas to identify those that may be able to partially address security vulnerabilities in IoT-based intelligent systems.

4. RESULTS AND DISCUSSION

In this article, the author defines a number of middleware characteristics, including scalability, spontaneous interaction, zero infrastructure, multiplicity, interoperability, context awareness, device discovery and management, security and confidentiality, abstraction and large data management. all crucial elements in the development of IOT middleware. In this work, the author examined three middleware systems, including the three-way distributed middleware UBWARE and the SOA-based middleware, to better understand the architecture and identify the functionality included in each. When space-based triple processing is used for communication, instead of message-based communication, shared space is used to represent the semantic data of the resource description structure.

In middleware, objects run in multiple environments and communicate without the user's knowledge. Service providers (who provide services) and customers (who seek services) are two separate elements. The middleware suggests using an API to run the middleware. To perform the orchestration task (coordinating objects to produce the desired effect), a UBWARE-based middleware with automatic integration is recommended, aiming to create autonomous and self-managing components. The middleware uses agent technology to configure complex functions, query service requests, monitor the state of objects for decision making, and identify additional objects.

The Internet of Things (IoT), currently the fastest growing technology with a significant impact on both social life and the business environment, has recently experienced rapid development. A concept called the Internet of Things (IoT) has the potential to fundamentally change the way we interact with technology. A future in which every electronic device in our environment would be part of a single interconnected network was considered science fiction. But the Internet of Things hasn't just infiltrated the non-fiction genre; it also covers the entire world. Even if these devices are hacked and exploited, the hacker can't help but ruin 's breakfast. Since IoT is still in its early stages of development, the market is currently focused on these areas. The emergence of the Internet of Things (IoT) has influenced and revolutionized computing and information systems. IoT is an IT idea in which everyday physical objects are identified by connecting to the Internet. As a result, IoT ensures constant connectivity for everyone and everything.

The Internet of Things (IoT) is expected to connect many technologies in the coming years, paving the way for new applications and helping make intelligent decisions by connecting physical objects. Global Navigation Satellite Systems (GNSS) have become a key component of today's major technological developments, particularly the Internet of Things (IoT), big data, smart cities and multimodal logistics. The Internet of Things (IoT) refers to the vast number of interconnected devices that make up our increasingly connected society and can be found everywhere, from smart homes and offices to logistics and retail companies to transportation systems and smart cities. The development of new methods and tools in the areas of communication systems/middleware, embedded and high-performance computing, and WSNs, among others, will be crucial in an ever-expanding world of apparent ubiquity and ubiquitous connectivity of networked objects.

The importance of standardizing communication protocols and IoT technical solutions cannot be overemphasized. This is particularly important as artificial intelligence and machine learning become more widely used. Device users need to be aware of the choices they make when sharing their data with service providers. In a connected society, policies and regulations need to be revised to take into account the data generated by IoT devices and the power they give to the owners of that data. Device users should receive more information about who collects their data and how it is used.

The industry is likely to advance IoT standards faster than the government can issue regulations. By regulating public procurement, the public sector can influence the development and implementation of standards. The dynamic nature of IoT creates problems that need to be solved. We also discover the key elements that need to be researched and developed to make large-scale IoT implementation a reality.
Benchmark healthcare data are used to properly assess the performance of the SAT approach. Numerous IoT devices and situations are used to assess the results. Some classification methods that are compared with the SSAC-MDC technology include the Naive Bayes (NB) and Decision Tree (DT) in Table 1 and the results are shown in Figure 4.

Table.1. Sensitivity analysis for Existing and Proposed SAT method's

No of Instances	KNN	NB	SSAC-MDC	SAT
2000	0.9850	0.8890	0.9603	0.9925
4000	0.8850	0.8450	0.9854	0.9958
6000	0.9200	0.8650	0.9653	0.9865
8000	0.9280	0.8960	0.9223	0.9956
10000	0.9380	0.8980	0.9568	0.9958

Algorithm 1: Model SAT

Input: No. of particles from a middle swarm s, Cognitive coefficients t, weight w
While lfit> 0 do
For each i=1: s do

Ri ← wRi-1 + t1rand 1(Vibest -Vi-1)+t2 rand2(gbest – Vi-1)

Gi ← Vi-1 + Vi
Compute Vifit(i) by applying Vi
If lfit(i)<lfit(i-1) do

Vibest ← Vi
If lfit(i)<lfit(i-1) do

gfit ← Vfit(i)

gbest ← Vibest
End If
End If
End for
End while
Return gfit, gbest

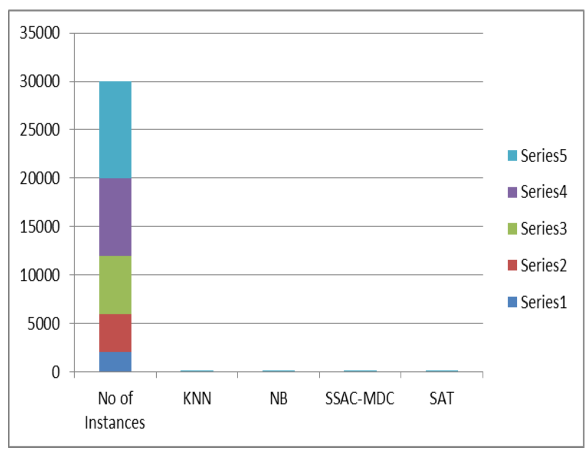

Figure.4. Existing and proposed SAT in Classification Methods

The KNN, NB, SVM, DT, EEPSOC-ANN and SSAC MDC techniques only able to obtain lowered specificities of 0.8500, 0.8200, 0.7690, 0.8890, 0.9522 and 0.9857 respectively, while the EEMWSO approach managed to get a maximum specificity of 0.9980 with 10,000 instances. In Table 2 the F-Score analysis of the SAT approach under various scenarios is discussed. The results are shown in

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Figure 5 demonstrated that the F-Score values provided by the SAT approach were the highest. The KNN, NB, SVM, DT, EEPSOC-ANN and SSAC-MDC approaches only managed to attain minimum F-Scores of 0.8220,0.8560, 0.8250, 0.8250 respectively. In fact, the EEMWSO method boosted its F-Score to 0.9925 with 10000 instances.

Table.2 Existing and proposed EEMWSO approach's F-Score comparison

F-Score					
Amount of instances	2000	4000	6000	8000	10000
KNN Model	0.9580	0.9050	0.9580	0.9250	0.9050
Naïve Bayes	0.8250	0.8560	0.8560	0.8560	0.8250
SVM Algorithm	0.8220	0.8560	0.8250	0.8250	0.8650
Decision Tree	0.9580	0.9850	0.9560	0.9880	0.9560
EEPSOC-ANN	0.9254	0.9690	0.9897	0.9252	0.9891
SSAC-MDC	0.9850	0.9509	0.9555	0.9859	0.9750
SAT	0.9780	0.9782	0.9850	0.9856	0.9925

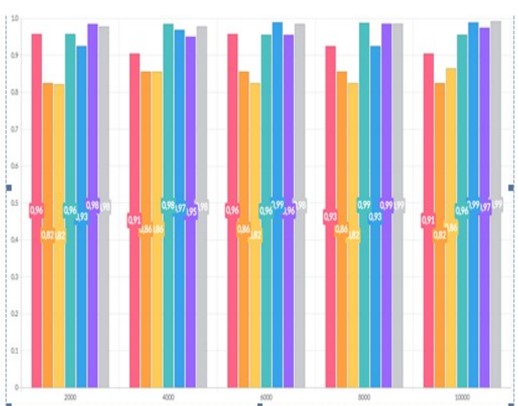

Figure.5. Existing and proposed SAT approach's F-Score analysis

According to Figure 6, the GWO and ACO algorithms use the most energy and hasten the battery depletion of IoT devices. The ABC algorithm utilizes a tiny bit less energy than the GWO and ACO algorithms, it should be mentioned. But when used with a range of IoT sensors, the theorized SAT algorithm has been shown to have the greatest energy-efficient qualities by using the least amount of energy.

Although SLZW compression has been utilized in an IoT scenario, the SAT methodology is more effective. The two approaches are compared based on sensitivity, specificity, Accuracy and F-score. Based the Figures and tables it clearly demonstrate improvement in energy level, increase in energy efficiency, data transmissions, decrease the traffic and improve classification results by using SAT.

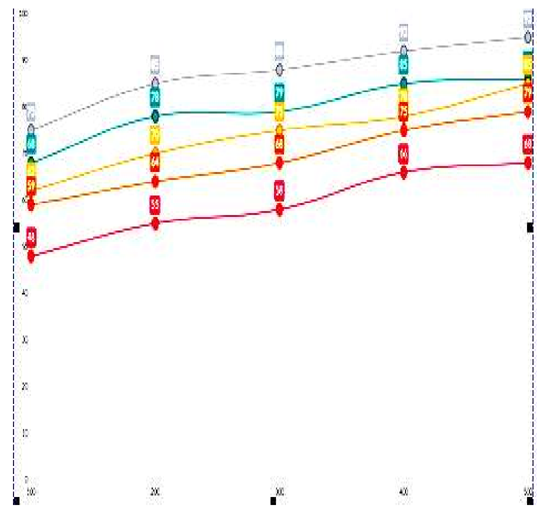

Figure.6. Total Energy Consumption Analysis

The energy usage comparison between the two approaches with various numbers of IoT sensors is portrayed in Table 3. Again, it is inferred that the EEPSOC-ANN approach utilizes less power and achieves maximum energy efficiency when compared to the SAT model is shown in Figure 7.

Table.3. Total Energy Consumption

No. IoT Sensors	EEPSOC-ANN	SAT
100	38.00	58.00
200	45.00	65.00
300	49.00	72.00
400	56.00	80.00
500	60.00	85.00

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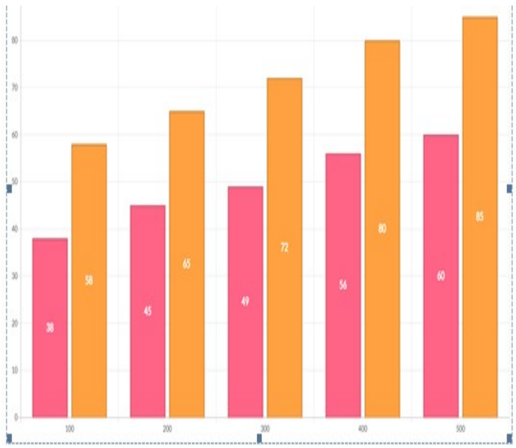

Figure.7 Energy Consumption of EEPSOC-ANN and SAT

5. CONCLUSION

Energy savings and health monitoring in the context of the WoT have been accomplished using an SAT approach. Data collection, SSAC-based cluster construction, and medical data categorization make up the three main parts of the proposed SAT approach. Numerous components of the collected medical data are evaluated to identify any diseases throughout the categorization process. AE-based categorization, IBSA-based parameter modifying, and data pre-processing are all included in the medical data classification module. The AE model's parameter tuning method makes use of the IBSA technique to improve classifier performance. The performance improvement of the SSAC-MDC technique was evaluated through a series of experimental evaluations and the comparative results demonstrated the superiority of this technology compared to more modern approaches.

As experiments show, the SAT model is a reliable and effective diagnostic model. To achieve energy efficiency and disease detection, advanced SSAC-MDC technology was developed. Data collection, SSAC-based clustering and medical data categorization form the three main components of the SAT approach. AE-based categorization, IBSA-based parameter editing and data preprocessing are included in the medical data classification module. Experimental evaluations were conducted to verify the performance and the comparison results showed that this technology was superior to the more sophisticated approaches.

It is an IoT-based method of collecting and providing medical data that is energy efficient and based on predictive models. Energy efficient particle swarm optimization based clustering, artificial neural network based clustering (EEPSOC-ANN), and simulated annealing with medical data classification (SAT) are two methods that have been proposed to increase the energy efficiency of IoT devices during processing.

Health data and after comparing the two approaches, the study found that the SAT performed significantly better. In terms of reliability and scalability, this IoT system monitors patients well. By developing outlier removal and feature selection algorithms, it will be possible in the future to use data reduction tactics to reduce redundant data transmissions, increase energy efficiency, and improve classification results. Compressive sensing techniques can also significantly improve the performance of the SAT model. IoT solutions can be improved by increasing security and flexibility.

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