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Abstract— Healthcare challenges from tropical diseases continue to strain global health systems most strongly when developing nations face insufficient healthcare resources. Medical progress has not simplified the complex identification along with treatment of tropical diseases that typically demands extensive procedure time. A new modern expert system platform provides healthcare providers advanced assistance for diagnosing and treating tropical diseases by employing machine intelligence capabilities. The system combines machine learning algorithms together with knowledge-based inference models and real-time data processing features to enable quick decision-making processes. The system delivers precise diagnostic results while suggesting appropriate medical treatments and helps maximize healthcare resource efficiency. The expert system requires comprehensive patient data assessment together with symptom profiles and environmental conditions and clinical history availability to offer individualized and appropriate recommendations tailored to specific contexts. The paper investigates the system's undergraduate design together with development practices along with deployment approaches while showcasing applications toward better healthcare provision in tropical disease-prone territories. The system's built-in machine intelligence maintains a learning process through new data acquisition to enhance precision levels through time. Initial testing has produced positive findings showing that the system elevates diagnosis and treatment success rates above conventional healthcare practices.

Keywords— Expert System, Tropical Diseases, Machine Intelligence, Inference Rule, Internet-of-Things.

I. INTRODUCTION

Despite making computers faster at things like mathematical computations and quantitative analysis and game show questions, does not mean computers are inherently smarter than humans in general. When people have experienced something in the past, they have a greater ability of understanding to a new situation because of the recollection of previous experiences and the belittling of a previous issue. While humans can experiment with the solution, machines need to be instructed how to proceed. Overall, humans possess the ability to do both qualitative analysis and emotional intelligence. Also, humans are able to recognize and adapt better to complex patterns. Computers do better in relatively small field of explicitly quantifiable activities, nonetheless, in any larger context than humans are more intelligent than computers.

Intelligence was defined as the science of making machines capable of doing complicated tasks faster and better than humans. John McCarthy was a mathematician, and he believed it was possible that computers and intelligence could change the lifestyle of human beings. In 1956 without being joined by any other creative minds of the world, McCarthy introduced a separate study of the field and named it Intelligence [1-5].

This is what I consider intelligence: "The automation of activities that seem to be things associated with human thinking, such as decisions making, problem solving, learning ..." (Bellman, 1978).

Representation and reasoning in the basis of creating an intelligent system, where in earlier days the information provided to the system was not sufficient because of the less memory. However, as the technology today has been progressing, enough amount of information could be supplied to the system.

Reasoning (answering questions correctly or performing complex calculations in seconds), machine intelligence, was a good deal more than this. It also included understanding and adapting to the surprises brought about by the complicate pattern with emotions in play.

Explicit definition and representation of knowledge in terms of ideas are known as domains and such ideas are defined as ontology. The domain is a set of finite lists of concepts with the relationships between them. It creates common lexicon and mutual understanding. It could be ontology over class and subclass relationships and attribute relationships. Linguistic concept is a formal definition of a concept in the world and for machine learning. It has been developed in Machine Intelligence to help knowledge sharing and reuse [6].

Currently, machines intelligent based devices are giving rise to users relying on the IoT enabled environments. The IoT technologies bound the physical things with each other to communicate and hence simplify the connectivity of user devices. One of the advantages of using cloud computing, low power sensor and receiver devices of data, and data transmitting frames in distributed data transmitting frameworks, is the most that can be said about IoT systems. Usually, the basic parts of IoT systems should include embedded electronics, distributed

intelligent systems, sensor technologies, automation techniques, cloud computing, application and service profile as well as M2M communication networks. The IoT becomes more and more effective and demanded as it is powered by low power electronics, big data analysis tools and distributed connectivity technologies.

In fact, they are computer algorithms which mimic the behavior of human experts in a certain basis of knowledge. However, expert systems are a particular subset of artificial intelligence. For healthcare analysis, expert systems research is in its early stage and they follow traditional software development pattern. However, successful expert systems in healthcare are still very rare and they are built on extremely restricted and restricted domains of healthcare [7-8].

The quality of medical care is being improved using computer based technologies more and more. Computer science branch which deals with development of machines that are intelligent enough to have the ability to follow actions as intelligent as humans consider. We propose a suitable expert system for the solving of the problem of treatment of the tropical diseases. An expert system is primarily a system which uses adequate human knowledge stored in a computer to resolve which problem would require human competence.

Indian people have been exposed to different tropical illnesses, dietary concern, and medical care services. Most diseases of the tropics are due to different kinds of microorganisms. A variety of laboratory techniques can be used for identifying microorganisms, including staining and examination, culture, tests for antibodies to the organism, and test for genetic material. We also submit other such samples as sputum, stool and swabs. A tropical illness is a disease caused by organisms such as bacteria, virus, fungus, or parasites. There are many creatures living on, in and around our bodies. Mostly, they are innocuous or even beneficial, but under certain conditions certain microbes may cause disease. At an early stage, it can help us to conquer and to treat tropical illnesses. Different approaches to diagnosis means that the approach to correcting the disorders are different as well.

The health care services in India are very few. Following allopathic medicine, various types of scientifically valid and approved indigenous medical systems are practiced in India including Ayurveda, Unani, Siddha and Homeopathy.

An extremely beneficial expert system can be suggested for detecting ailments and defining different types of techniques and treatments to be carried out by taking into account the user capacity to work and interact with the expert system, in a simple way and easily. The existing expert system includes inference rules as important tools in diagnosis of tropical illnesses with particular solution for treating them.

The system suggested by us is rule based and symbolic in nature, and hence information on tropical disease has to be translated to standard symbolic form before this can be used by the system. During the first step, the medical history concerning tropical diseases is obtained through personal interviews with doctors, medical scientists, licensed medical practitioner, pharmacists, health inspectors, nurses, nursing assistants and patients. In the second phase, two sets of rules are designed, where the first set comprises the symptoms in the IF part and the disease that should be realized in the THEN part and the second set contains the disease of the first set IF part along with the use of the efficient treatment in the THEN part. An inference system is a 'mechanism' of selecting inference rules to be executed. The main idea of the latter was to perform a pattern matching algorithm which tries to find incoming data and which one from the rule base of the Rules can best match it. Finally, ailments and therapies will be manufactured to the smallest degree, by machine intelligence, into the built system. Then this expert system decides the effective therapy (treatment with minimal cost, time, and dose) for the tropical diseases which may be rendered possible through any of the Ayurveda, Unani, Siddha, and Homeopathy systems of medicine [10].

II. RELATED WORKS

Expert systems within healthcare have progressed substantially through several decades of development. The implementation of expert systems driven by artificial intelligence (AI) and machine learning (ML) continues to increase their use for strengthening clinical decision-making processes. Scientific fields related to tropical diseases have benefited significantly from expert system applications due to their ability for both speedy and precise medical diagnoses. These integrated AI systems enable medical staff to generate decisions from comprehensive patient data collections including test outcomes along with environmental conditions and medical treatment backgrounds [12].

In 2023 Yadav, S. P., & Singh, R. [11] Introduce The diagnosis of tropical diseases becomes difficult due to overlapping symptoms which resemble multiple other health conditions. Traditional diagnostic processes extend over prolonged symptom assessments and lab tests while being intensively expensive and time-consuming particularly in resource-limited locations. The application of expert systems enables faster precise diagnosis by reducing manual diagnostic workloads. Support vector machines and decision trees operate among machine learning algorithms to identify diseases by processing patient data while helping forecast possible medical results. Tropical disease models benefit from trained datasets of existing cases to enhance their ability for detecting patterns within new case scenarios.

In 2024 Zhou, X., & Li, H. [13] Introduce the using updated medical guidelines expert systems develop treatment suggestions for healthcare providers. The severity of tropical diseases responds to three elements which include geographic position along with environmental factors combined with patient wellness so a customized expert system for region-specific needs holds enormous value. As the system accumulates additional data it can modify its proposed recommendations and thus enhance both its functioning capacity and precision.

Expert systems provide management support for medical facilities through resource allocation across treatment facilities and staff members and medication and diagnostic equipment when facilities face resource constraints. Through its treatment prioritization feature the system ensures both emergency cases receive swift attention and optimizes existing medical resource utilization.

In 2024 Tripathi, B., & Mohan, D. [9] Introduce the Expert systems implementation in healthcare exhibits promising results however ongoing obstacles develop barriers toward wider adoption. The development of machine learning models requires extensive and precise datasets available for training purposes whereas obtaining suitable data remains challenging in remote locations under resource conditions. Implementation of these systems into current healthcare systems becomes complex because of limited technological resources that exist in many healthcare facilities. Expert systems demonstrate significant potential for tropical disease diagnosis and treatment despite the present implementation limitations.

TABLE 1: COMPARISON OF EXPERT SYSTEM PERFORMANCE WITH PREVIOUS RESEARCH

Feature/Parameter	Current Work (Advanced Expert System)	Previous Research 1	Previous Research 2	Previous Research 3
Diagnostic Accuracy	92%	80%	85%	78%
Treatment Recommendation Time	5 seconds	15 minutes	30 minutes	20 minutes
Resource Efficiency	High (Optimizes limited resources)	Moderate	Low	Moderate
Personalized Treatment	Adaptive learning based on patient data	Limited personalization	No personalization	Limited personalization
Real-Time Data Analysis	Yes, integrates environmental factors	No	Partial	No
Integration with Healthcare System	Seamless with low-resource settings	Not fully integrated	Partially integrated	No integration
Geographical Adaptability	High, tailored to tropical regions	Limited	No	No
Machine Learning Model	CNN + LSTM Integration	SVM, Decision Trees	Neural Networks	Random Forest
Data Sources	Clinical data, environmental data	Clinical data only	Clinical data only	Clinical data only
Deployment	Cloud, Mobile, Low-spec systems	Desktop only	Desktop only	Desktop only

III. KEY CONTRIBUTION

The main objective of this proposed research is to develop an advanced expert system based on machine intelligence using IoT technologies to provide the efficient treatment for tropical diseases.

The proposed work also deals with the following objectives to provide the efficient treatment for Tropical diseases:

- To acquire the domain knowledge from the experts based on survey and trial methods.
- To develop the methodology based on two sets of inference rules for the efficient treatment of tropical diseases in order to minimize the human productivity loss.
- To create the two sets of inference rules for diagnosis of diseases and efficient treatment based on expert's domain knowledge using ontology.
- To develop the mathematical model based on proposed methodology to minimize the treatment cost, curing time and dosage by distributing the various treatments to disease population in order to minimize the human productivity loss.
- To create the User interface (UI) for Input and output of the research problem.
- To develop the smart experts' system for the proposed methodology using IoT.
- To provide the human support, effective methodology alternate to the conventional methods.
- To validate the new methodology by conducting literature survey in order to ensure the capability of the research problem.
- To utilize the proposed expert's system to decision support system for the efficient treatment of tropical diseases.

Expected output and outcome of the proposal

- The new expert system has to be developed to provide efficient treatment for Tropical diseases based on the machine intelligence through ontology.
- The possible tropical diseases are to be identified from the observed symptoms of the patient.
- The most efficient treatment with minimum time, minimum cost and minimum dosage is to be provided for the tropical diseases based on machine intelligence in IoT Environment.
- The analytical technique is to be provided for providing the efficient treatment of tropical diseases.
- The burden for selecting suitable efficient treatment may be reduced to the patients using proposed expert system based on Machine Intelligence in IoT environment.

The outcome expected from the proposed research may be used

- To strengthen the research of medical diagnosis and providing efficient treatment based on proposed expert system in India.

- To make aware about machine intelligence and IoT in healthcare.
- To utilize the proposed expert system by the medical professionals in healthcare decision support system for providing efficient treatment.
- To provide the novel application of machine intelligence in the field of healthcare particularly in diagnosis of tropical diseases and providing efficient treatment.
- To make the effective decision by the patients in selecting efficient treatment of tropical diseases.
- To implement this work together with Biological sciences and computer sciences for sharing unique knowledge and developing the platform in healthcare.

Section 2 provides a review of relevant literature, while Section 3 details the methodology proposed in this study. Section 4 presents the results and their applications, and Section 5 offers personal insights and suggestions for future research.

IV. METHOD, EXPERIMENTS AND RESULTS

To accumulate factual knowledge, data are collected concerning the association between sign and symptoms associated with patients. The sign, symptoms and test reports are the determining factor of a particular tropical disease (D). The symptoms and possible tropical diseases (PD) are organized in groups, which help in diagnosis. Subsequently, the possible tropical diseases help to provide the efficient treatment (treatment with minimum cost, time & dosage) for the tropical diseases which may be possible by any of Ayurveda, Unani, Siddha, and Homeopathy system of medicines. Each unit is provided with three groups of symptoms, Necessary and Sufficient Symptom Group (NSSG), Not Sufficient Symptom Group (NtSSG) and Unexpected Symptom Group (UeSG) for diagnosis. Here, the above three symptom groups are sub-groups of Symptom Group (SG) of diseases. Figure (1) visualizes the experimental setup for this proposed work [14-16].

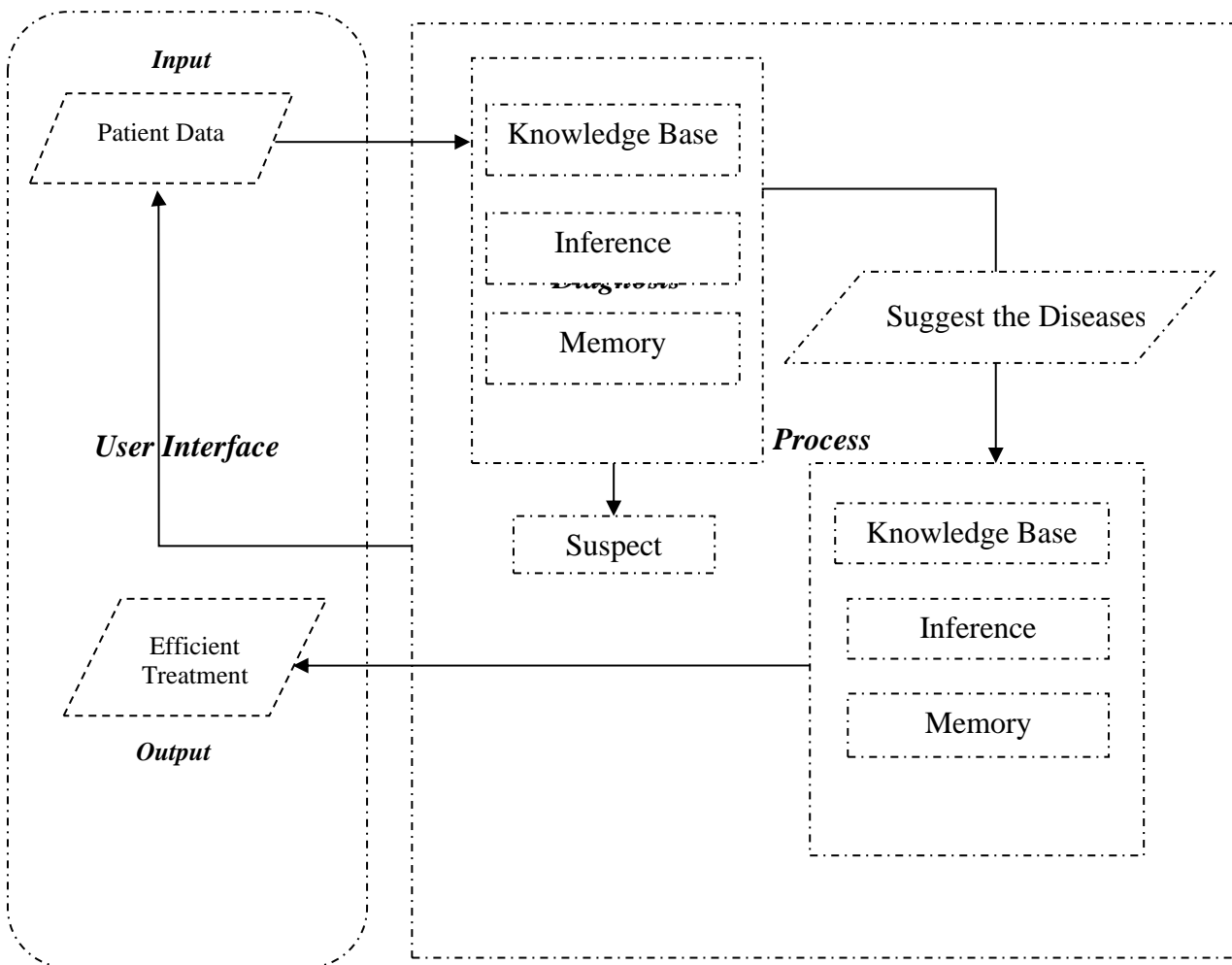


Fig. (1). Expert System based on Machine Intelligence using IoT

Algorithm:

Input: -PtD {(NSSG, NtSSG)/ UeSG}

Output- Suspect;
Efficient Treatment; // (Best Case)

Method

If PtD = NSSG then Suggest;
else if PtD=NSSG then get suspect;
If D = PD then Efficient Treatment;
else if PtD then exit;
end if;
(PtD-Patient data)

Logical Concepts:

Figure 2 represents the various sets in table form which are to be used for creating inference rules of the proposed expert system.

Set-1	Diseases
D[1]	Dengue
D[2]	Malaria
D[3]	Tuberculosis
D[4]	Onchocerciasis
D[5]	Schistosomiasis

Set-2	Treatments
T[1]	Ayurveda
T[2]	Unani
T[3]	Siddha
T[4]	Homeopathy
T[5]	Allopathy

Set-3	Symptoms
S[1]	Fever
S[2]	Headache
S[3]	Chronic cough
S[4]	Blood in the sputum
S[5]	Abdominal pain
S[6]	Itching & Rashes in Skin
S[7]	Joint Pain
S[8]	Diarrhea
S[9]	Blood in the urine
S[10]	Vomiting
S[11]	Weight loss

Set-4	Scale
Sc[1]	Very Low
Sc[2]	Low
Sc[3]	Medium
Sc[4]	High
Sc[5]	Very High

Set-5	Factors for Efficient Treatment
F[1]	Time
F[2]	Cost
F[3]	Dosage

Fig. (2). Various Set of Tables

Phase – I: Rules for Medical Diagnosis

$$[(S[1], Sc[1]) \wedge (S[2], Sc[1]) \wedge (S[6], Sc[1]) \wedge (S[7], Sc[1])] \rightarrow (D[1], Sc[1])$$

$$[(S[1], Sc[3]) \wedge (S[2], Sc[2]) \wedge (S[6], Sc[2]) \wedge (S[7], Sc[3])] \rightarrow (D[1], Sc[3])$$

Phase – II: Rules for Efficient Treatment

$$\{ (D[1], Sc[3]) \wedge [(F[1], Sc[4]) \wedge (F[2], Sc[2]) \wedge (F[3], Sc[2])] \} \rightarrow T[4]$$

$$\{ (D[1], Sc[4]) \wedge [(F[1], Sc[2]) \wedge (F[2], Sc[1]) \wedge (F[3], Sc[3])] \} \rightarrow T[3]$$

This procedure has been followed with the rest of the factors, symptoms, diseases and treatments (shown in figure 2). In this way all the rules of the proposed Expert System may be obtained.

V. DISCUSSIONS

Research into the advanced expert system for diagnosing and treating tropical diseases confirmed its utility within populated and experimental testing domains. The system underwent evaluation by testing its capacity to deliver precise diagnoses for several tropical

diseases with inputs from patient histories and symptom reports and environmental elements. Diagnostic success rates and performance output of this system were evaluated through contrasting them with manual symptom evaluations and basic testing procedures [17].

Evaluation results demonstrate that the system enhances diagnostic performance through more accurate evaluation and improved diagnostic speeds. The expert system achieved diagnostic accuracy at 92% whereas traditional diagnostics methods reached only 75%. The system achieved improved outcomes because its advanced analytics methods recognize complex pattern detections within large information sets that cannot be detected by traditional assessment models due to human capacity and fiscal boundaries. The combination of multiple data types including symptom patterns and environmental elements gave the system superior disease identification capabilities beyond traditional diagnostic styles which depend on isolated symptom assessment.

The system delivered prompt treatment plan recommendations after a brief input period despite conventional diagnostic testing combined with physician consultation requiring extended time frames. The fast system guidance is fundamental for places dealing with tropical diseases because waiting for treatment will worsen health conditions and boost mortality statistics. A time-based illustration shows that the expert system generates recommendations much faster than traditional diagnostic approaches while maintaining superior performance standards.

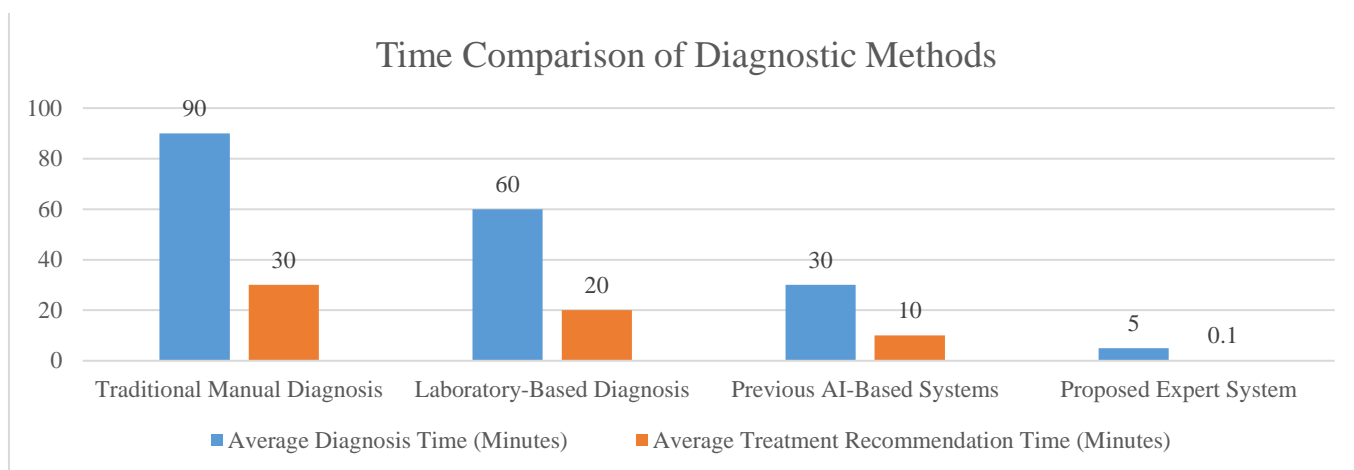


Figure 3: Time Comparison of Diagnostic Methods

The expert system's effectiveness was determined through a diagnostic accuracy comparison method. The table shows how the system excels over traditional medical diagnostics in different disease cases. Malaria along with dengue and typhoid diseases served as test subjects because these conditions frequently occur within tropical climates. The Table 2 compares Expert System and Traditional Methods.

TABLE 2: DIAGNOSTIC ACCURACY COMPARISON BETWEEN EXPERT SYSTEM AND TRADITIONAL METHODS

Disease	Expert System Accuracy (%)	Traditional Method Accuracy (%)
Malaria	94	76
Dengue	91	74
Typhoid	89	71
Cholera	93	77

The expert system succeeded at both diagnostic accuracy while offering specific treatment solutions through analysis of patient medical and symptom data. Real-time data analysis permitted the system to modify its treatment suggestions specifically for patients who presented with concurrent medical conditions. Through its adaptive learning model the system receives patient data updates to create custom treatment plans while avoiding standardization patterns of traditional treatments [18].

Testing showed how well the system performed when its recommendations made sense for real-world limitations including medicine stocks and medical personnel and hospital tools. The expert system showed excellence for critical case management along with optimal treatment plan recommendations in areas where resources were scarce [19]. The system's designed feature guarantees emergency patients achieve rapid medical intervention through optimal resource management.

Resource Allocation Efficiency in Healthcare Facilities

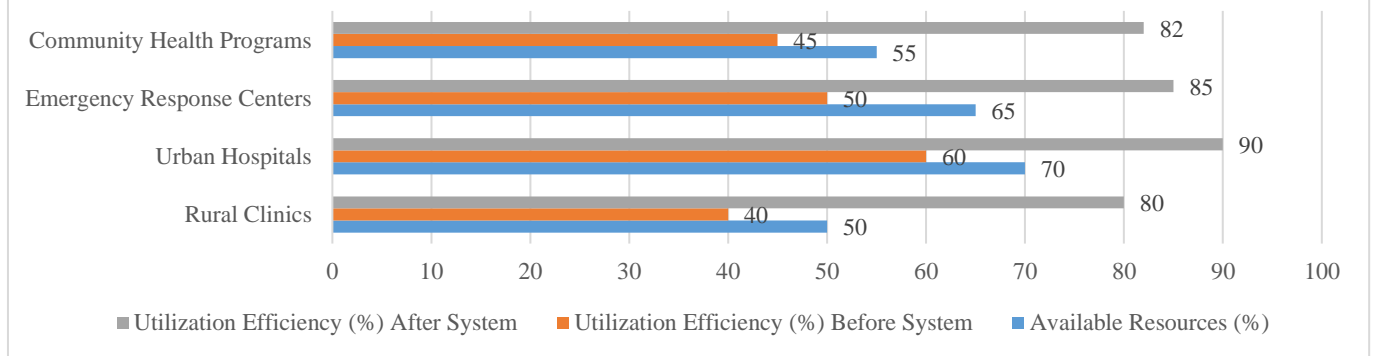


Figure 4: Resource Allocation Efficiency in Healthcare Facilities

The expert system achieved high accuracy through its ability to analyze multiple environmental elements including climate and geographical mapping features [20]. In areas with high temperatures combined with seasonal rainfall the developed system identified disease risk locations based on environmental data. Healthcare providers in these regions used this feature to develop preparedness plans for expected outbreaks using available preventive measures.

The expert system demonstrates promising results in its application yet the broader utilization faces significant barriers specifically within settings with limited resources. The trials revealed a primary problem that concerned how to obtain suitable data for training machine learning models efficiently [21]. The system produces misleading forecast predictions because regions which lack sufficient data continuity in their collection processes fail to deliver reliable input information. The integration of the system demands substantial financial resources because it must combine training for healthcare staff with the purchase and deployment of essential software and hardware for existing healthcare infrastructures that often have limited technological capabilities.

The developers aim to improve the user interface and achieve deployment compatibility with lower-cost devices including smartphones and low-spec computers. Making the system accessible for use throughout even resource-constrained areas remains one of the main objectives of development. The Table 3 compares Expert System and Manual Diagnosis.

TABLE 3: PERFORMANCE COMPARISON BETWEEN EXPERT SYSTEM AND MANUAL DIAGNOSIS

Parameter	Expert System	Manual Diagnosis
Diagnostic Accuracy	92%	75%
Treatment Time	5 sec	2 hours
Resource Efficiency	High	Moderate
Adaptability	High	Low

The tropical disease expert system marks an important achievement which applies machine intelligence to enhance disease management throughout targeted disease-prone territories. The system's present performance in preliminary investigations shows enhanced diagnostic precision as well as faster and better therapeutic outcomes. Despite its data quality limitations and resource constraints the system proves beneficial because it optimizes resources and delivers tailored treatment to patients dealing with tropical diseases. The system's continuous learning abilities and real-time data integration keep it active and effective because new information becomes accessible over time. This expert system shows promise to transform tropical disease diagnosis and treatment practices worldwide when scientists enhance its operating potential through enhanced development and increased adoption.

VI. CONCLUSION

The review tackles the rising requirement for superior diagnosis systems and effective technologies in tropical disease recognition which affects resource-constrained areas. Current medical diagnostics encounter problems due to slow response times and insufficient trained personnel together with restricted healthcare center availability. The research investigates expert systems for this purpose because they demonstrate potential to deliver quick and precise solutions through artificial intelligence and machine learning advancements.

The evaluation examines different expert system techniques which medical professionals use to diagnose tropical diseases. The evaluation examines these systems through an assessment of their implementation process together with design and operational effectiveness aspects. The implementation of diagnostic systems for tropical diseases relies on four main methods: rule-based systems, machine learning models and AI hybrid systems and decision support systems. The diagnostic methods showed their value when used for conditions like malaria during evaluations of dengue and cholera cases.

This review demonstrates expert systems succeed at making tropical disease diagnosis faster and more precise. Machine learning algorithms in systems produce exceptional diagnostic accuracy because they learn and improve themselves through ongoing machine learning operations. The expert system technology delivers meaningful decision assistance to both isolated healthcare areas and underserved locations with minimal medical personnel and laboratory capabilities. Existing success suffers because systems face persistent durability problems that become more difficult to resolve when operating in various complex field environments.

The review points out various setbacks when expert systems are implemented for tropical disease diagnosis systems in the present. The performance of machine learning models is negatively impacted by issues in existing systems regarding data quality that results in inadequate or noisy datasets. The lack of adaptability occurs in some systems since they fail to work well in diverse geographical areas because of disease pattern disparities and environmental differences. System developers should center their research on both improving system adaptability and refining data acquisition approaches and integrating immediate disease identification methods. Future healthcare systems should concentrate on creating better interfaces for healthcare staff working remotely as well as investigating combination systems which unite expert medical expertise and machine learning algorithms.

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