

A Statistical Review on Machine Learning based Medical Diagnostic Systems

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Abstract

In the case of diagnosis of any particular disease, it is very complex and difficult to make an adequate and appropriate decision. There are several confusions and complications in the process of diagnosis by using the human visual system, and these loopholes further result in making decisions that might be improper and irrelevant for a specific diagnosis. These limitations are overcome by using effective machine learning techniques, which assist the physician to provide top-notch and accurate treatment to the patient. The publications by numerous researchers are rapidly increasing, which assisted to know about the utilization of machine learning technologies in the medical domain. The main intent of this paper is to statistically review the various research works done to develop the medical diagnostic system by using machine learning. This study also aids to identify the effective enhancement in several domains of medicals by utilizing the efficient methodologies of machine learning. The selected research work is also classified on the basis of some criteria such as year of publication, the objective of research work, journal type, the used input as well as output by the researcher, research gap and result provided by the author after providing the finding on respective research gap. This paper also explained the significance of machine learning techniques in the medical field. Moreover, the predicted result assist in identifying the number of ways which can be utilized to implement the methodologies of machine learning, which further help the professionals or experts to accomplish the objective successfully and to acquire the desired output.

Keywords: Diagnostic Systems, machine learning, medical domain

1. Introduction

A medical diagnostic system is a system used by professionals or doctors to diagnose a specific disease for which a particular diagnostic system is trained. It is basically a system used to do the classification of various diseases on the basis of a given input, and after that, it will generate a concluded output depending upon the stored information and knowledge in it [1]. These systems assist the specialists to make the decisions that are effective as well as appropriate for any kind of diagnosis. With time, there is a huge enhancement in the treatment and testing of disease as now the medical domain has the imaging techniques to identify any deadly disease [2][81]. Although there are significant benefits of the medical diagnostic systems, still there is a need for a human expert to acquire the knowledge even when a patient is diagnosed by using these models to provide top-notch treatment. Additionally, there is also a limitation of the medical diagnostic system that the error in these systems might risk the life of a particular patient [3][81]. Several factors are there, which might be considered for the reasons of diagnostic errors such as misinterpretations, incorrect knowledge, judgement error, inaccurate observations and others [4]. Hence, nowadays, no doubt, the health care domain is enhancing with the help of technical treatment options, but also it increases the financial risk, the cost of treatment and risk of diagnostic errors, which are still barriers to offer quality care to the patient suffering from any kind of deadly as well as life threatening disease. The reduction of these diagnostic errors is crucial which assist the doctors and experts to do effective and adequate diagnosis of a patient[82][83].

The numerous machine learning technologies are utilized by the researchers to improve the quality of treatment in healthcare and to reduce the error occur in the diagnosis phase [5], such as fuzzy logic (FL) [6], [7], artificial neural network (ANN) [8][82][83], adaptive neuro-fuzzy inference systems (ANFIS) [9], convolution neural network (CNN) [10] etc. During the treatment process of a patient, the specialist can analyze the situation more effectively by using the machine learning based medical diagnostic system, which further aids to enhance the knowledge of the expert as well as to offer promising healthcare [11]. In the modern era where technology has a vast significance, healthcare used artificial intelligence (AI) technology which is also a rapidly growing domain in each and every field, either it is data science, or healthcare or business. The algorithms provided by artificial intelligence technology are very effective and assist the researchers to improve the research work in the healthcare industry. The electronic health records are stored by the doctors that help the experts to keep the medical records of the patient's history efficiently [12].

The machine learning algorithms are not only used to manage the combinations of raw data but also it helps to predict the possible combinations of provided input to identify the components of diagnosis [13]. For instance, the ML based models can be used to diagnose liver diseases [14], hepatitis B disease [15], gastro

diseases [16] and several others. The capabilities that bring machine learning based systems into the spotlight are to compute a huge data set which is very complex to process by a human brain, the ability to acquire the knowledge from the experts and then make decisions by using historical experience, which assists the doctors to make an accurate decision, the ability to provide enhanced outcomes. The use of these systems also leads to decrease the expensive of medical treatment and it also helps to improve the satisfaction of patients. A medical diagnostic system developed by using the machine learning algorithm has the ability to prescribe the appropriate medicine to the patient by analysing the whole situation. It can also offer the accurate treatment and hence, assist to diagnose the particular disease [17][84]. Moreover, the internet of things (IoT) can also be utilised with the potential of machine learning to enhance the analysis as well as computation of the massive amount of data in healthcare [18][85].

Hence, it is crucial to conduct a research work which explains thoroughly the use of machine learning based medical diagnostic system for the treatment of any particular disease. Therefore, the primary intent of this conducted research work is to determine the research of other authors systematically in which the ML methodologies have been used to diagnose different diseases by doing classification or pattern recognition in the medical domain. The novelty of this statistical review is represented in table 1 by doing a comparative analysis with other research works done by other researchers in the domain of medicine. The respective paper also gives a detailed analysis as well as it provides the result in which the utilization of ML approaches for the diagnosis of the disease is elaborated comprehensively.

Table 1: Comparison of conducted research work with already published journals in the medical field.

Journal	Publication Year	Considered types of data	Methodologies	Considered domains of medical	Summarization and classification of existing research	Comprehensive analysis of considered Papers
		<ul style="list-style-type: none"> ● Imaging ● Tabular 	<ul style="list-style-type: none"> ● ML 	<ul style="list-style-type: none"> ● Hepatology ● Gastroenterology ● Pulmonology ● Nephrology ● Infectious 	<ul style="list-style-type: none"> ● Year of publication ● Authors ● Paper types ● Aim of research ● Input & output ● Formulation of problem and gaps in research ● Investigation and outcome 	<ul style="list-style-type: none"> ● Previous year publication frequency ● Classification of papers according to conference and journal kind ● Classification of considered articles on the basis of database ● Classification of machine learning approaches in considered articles ● Classification of machine learning according to the aspects of clinics
[19]	2017	✓	✓	×	×	×
[20]	2018	×	✓	×	×	×
[21]	2019	✓	✓	×	×	×
[22]	2020	✓	✓	×	×	×
[23]	2021	×	✓	×	×	×
This article		✓	✓	✓	✓	✓

1.1. Comparison of considered review articles

Callahan & Shah [19] elaborated the significance of machine learning approaches and introduced the different methodologies of ML which can be used in the healthcare system. This paper also stated that these approaches could be used to store the massive amount of medical history of the patient in the form of electronic health

records (EHR). The implementation of the ML approaches help to keeping the data, makes it easy to retrieve, search, edit and perform other operations. But this paper does not include any kind of disease in this research work. Shailaja et al. [20] presented how the ML can be utilised in the medical domain to identify the various patterns from the dataset and offer the outstanding decision by predicting the particular disease. This paper compares the various ML methodologies used to predict different diseases such as breast cancer, heart disease and diabetes. However, this paper does not include all medical domains. Singh et al. [21] covered the various machine learning algorithms such as SVM, DT, RF method, SI, GA and EM to diagnose the diseases in healthcare centres. Still, this paper lacks to explain the literature work in depth. Qayyum et al. [22] surveyed the ML approaches that can be used in the medical domain with full privacy as well as security. However, this paper does not include any particular disease, although it presented a strong literature review. Salim et al. [23] also reviewed the various research work done by other authors. This paper stated that the ML methodologies could be used for the diagnosis of various diseases as it assists in making an intelligent system that is effective to make accurate decisions. This paper gave a comprehensive review, but it did not distribute the considered research work to analyse them more effectively.

1.2. The implementation process of ML to diagnose the disease

The diagnosis of a specific disease is not an easy task as to diagnose any disease, it is necessary to have proper and appropriate knowledge. Hence to make it uncomplicated and unchallenging, the ML methodology has been adapted in the medical domain [24]. The medical diagnosis by using the ML systems involves several phases. The first phase is data gathering related to the diagnosis of a particular disease. The acquired data must be appropriate as well as accurate. It should not only limited to interviews of experts, patient's medical history, images and clinical data [25]. The ML systems can handle the massive amount of datasets [26]. The second phase of the implementation process is processing. In this respective phase, the pre-processing of the dataset is done, such as reduction of dimensionality, filling the missing values, removal of redundancy and noise, selection of required features and others [27], [28], [29]. The last phase is to train the developed model by using the pre-processed data acquired [30]. After that, the trained model is ready to diagnose the disease [31].

1.3. Advantage of utilizing ML to diagnose the disease

The human visual system has numerous limitations as a human can not be able to store a large amount of data, and it is very complicated to process the data if humans keep it in manually. To remove such kinds of barriers, ML methodologies are adopted in the domain of medicine. The CAD systems are also used to perform the process of treatment and diagnosis. The CAD systems are basically those computer systems that are trained to diagnose the disease and help the experts to make the best as well as an accurate decision in any condition [32]. Although there are many questions in patients mind when patients interact with an AI expert, but also there are now explainable AI models which also presented the reason of given conclusion [33]. Additionally, the probability of occurrence of error is also increased due to the increased data set of the patients. Hence, it is challenging to keep the patients records stored easily. The ML also aids the healthcare organizations to store the patient's data in the form of EHR systems which also helps the doctors to make correct decisions by effectively retrieving the dataset [34].

The ML models not only help to store a large number of patient's datasets but also can handle it effectively. It also assists an expert to identify the required pattern regardless of the volume of the dataset. The various models such as management of beds, doctor's data, patient's data in healthcare centres can also be developed by using ML. These models enhanced the outcome of the medical domain and also aid to provide quality care as well as treatment to the patients. The cost of the treatment is also reduced by using ML based systems[35][86][87]. Some articles also enlightened the limitation of ML models in the field of medicine as they only depend upon empirical data and also diminishes the skills of professionals [36][86][87]. The ML models also raise the problems of privacy and security in the case of EHR [37]. Additionally, if the acquired dataset is not accurate, then it will give the outcome with an error that might risk the patient's life [38][84].

1.4. Organization of article

The rest of the research work is arranged as follow: section 2 presented the implemented research methodology, which assists in conducting this statistical survey. In this section, the selected database and the articles eligibility criteria are effectively explained. Section 3 presented the whole synthesis as well as analysis of considered articles. Section 4 is all about the discussion of analysis, and in the end, the conclusion is drawn in section 5. The taxonomy of conducted survey is presented in figure 1, and the used abbreviations in the entire work are given in table 2.

2. Research Methodology

The methodology is a process in which the researcher evaluate the related work done, choose the relevant ones and do an investigation of the considered work done. The data is also analyzed to find a new solution for desired research gap and then give the conclusion according to the entire study. In the methodology, the evidence-based research has been done by considering the related studies so that the improvement in the healthcare facilities can be made more effective and able to make decisions that are accurate as well as has less probability of errors. Therefore, in the research work, the systematic and statistical review of related work is selected, which is the

finest method to provide evidence. The next section of this study is consist of a search of the literature, the selection of study as well as relevant papers, and after that, data extraction and data analysis have been discussed in a well effective manner.

2.1. Literature Search

It is very crucial to choose the paper on the basis of credibility. A number of different databases is selected to acquire adequate data for the research.

Table 2: Abbreviation list

Abbreviation	Full Forms
AI	Artificial Intelligence
ANFIS	Adaptive Neuro-Fuzzy Inference System
ANN	Artificial Neural Network
CAD	Computer-Aided Diagnosis
CART	Classification and Regression Technique
CNN	Convolution Neural Network
Deep CNN	Deep Convolution Neural Network
DT	Decision Tree
EHR	Electronic Health Record
EM	Evolutionary Model
FL	Fuzzy Logic
GA	Genetic Algorithm
KNN	K Nearest Neighbor
ML	Machine Learning
RF	Random Forest
SVM	Support Vector Machine

The databases which were utilised to extract the required data are Springer, IEEE, Research gate, PubMed, ProQuest and Science direct. The research work done from 2015 to now is considered in this study. The various keywords, as well as phrases which were used to search the required research papers, are “Artificial Intelligence in the medical domain”, “Machine learning in healthcare”, “Medical diagnostic systems”, “Use of machine learning for disease diagnose” etc. After searching a bundle of research work related to the respective study, the papers were filtered out on the basis of the year of publication and credibility. Table 3 presented the number of publications in a particular publisher which are selected for this research work along with their frequency. From the table, it is very easy to observe that 9.52% of relevant publications were found from Elsevier, Springer, research gate and the national library of medicine, after that BMC, MDPI and Wiley has commendable publications with 4.76%, and other different articles are found on research sage journals, BPG, ProQuest and Taylor & Francis with 2.38% percentage as shown in table 3.

2.2. Selection of Study and Eligible Papers

The selection of correct as well as relevant papers for the research work is vital. In this research work, the focus was on the machine learning diagnostic systems which are used to diagnose a particular disease. Image processing is not considered in this entire study. The criteria that assisted in choosing appropriate papers is inclusion and exclusion. Each and every considered article passed the eligibility criteria that were supposed before begun the work. Every article is first reviewed on the basis of its abstract and title.

Table 3: considered articles along with their publisher and frequency

Publisher	Article	Percentage
IEEE	1	2.38
BPG	1	2.38
Sage Journals	1	2.38
Taylor & Francis	1	2.38
ProQuest	1	2.38
BMC	2	4.76
MDPI	2	4.76
Wiley	2	4.76
Elsevier	4	9.52
Springer link	4	9.52
Research Gate	4	9.52
National library of Medicine	4	9.52
Total	27	

Moreover, the time, language and other qualities of the papers were also taken into consideration while choosing them. In the survey, the papers that were published from 2015 to 2021 and penned in English are chosen. The research is mainly concentrated on five domains of medical, i.e., Hepatology, Gastroenterology, Pulmonology, Nephrology and Infectious. The other human, plant, as well as animal diseases are not included in this study.

2.3. Data extraction and Data analysis

The papers are first extracted from the above-mentioned databases and then analyzed according to the objective of the study. Only those papers were selected which met the intent of this research work. The papers which are not related to the medical domain, machine learning and published before 2015 are not included in the respective review.

3. Result

The respective section of this study enlightens the observations acquired from the considered research work, and also it gave the results corresponding to the analysis. Basically, the result displays the effectiveness of the machine learning technique implementation to diagnose any kind of disease by doing a systematic study on the already done research work by other researchers. The use of ML approaches, as well as their impact in the domain of medicine, is described in the following sections.

3.1. The frequency of published papers over the previous years

The entire study consists of 42 recent scholarly papers which satisfied the required inclusion criteria. The conference papers, as well as research papers, are considered in this study. Figure 2 displays the frequency of papers. The past six-year published papers, i.e. from 2015 to 2021, are included. There is a considerable rise in the publications of various papers in the past six years, which can be observed from the given graph. The utilization of the ML approaches to diagnose the disease is also significantly enhanced. It is found that in the year 2019, almost 23.81% of papers were published. Therefore, there is appropriate to say that researchers are interested in implementing the ML in the medical domain.

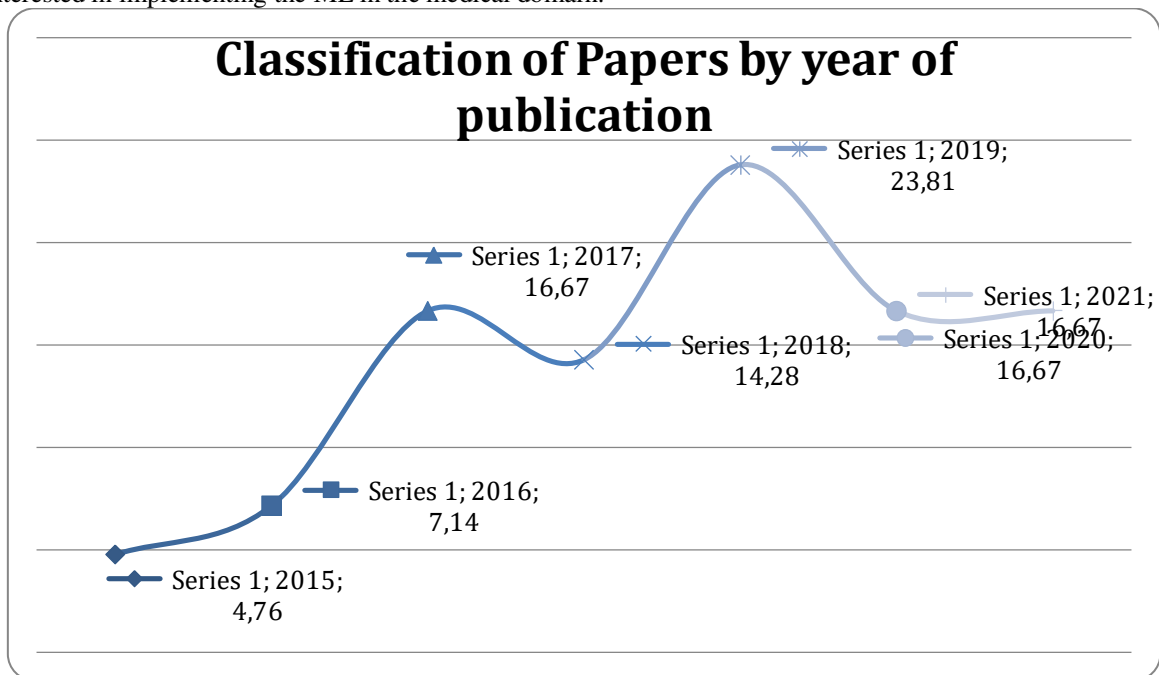


Figure 2: The classification of articles according to the year of publication

3.2. Classification of papers according to kind of conference and journal

The total number of considered articles is 42, from which the number of conference papers is 15, and the number of journals is 27. The classification of articles according to the year as well as the type of publication is represented in figure 3. From figure 3, it is observed that the number of conference papers is relatively low as compared to the journal papers. Additionally, in 2015, there is no any publication of conference papers. Moreover, a few numbers of conference paper was published in 2016. The maximum number of conference papers were published in the year of 2018.

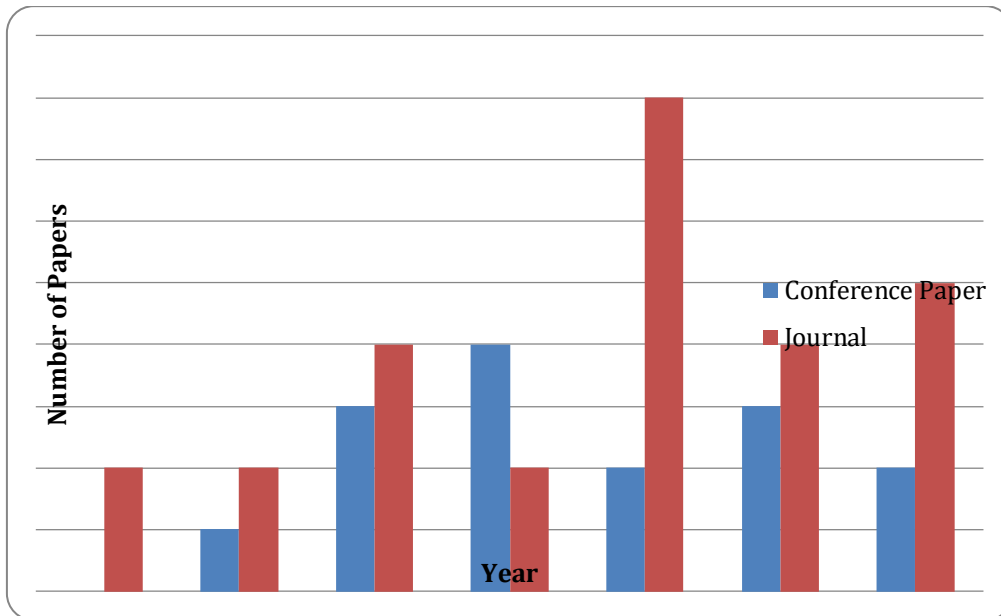


Figure 3: Classification of articles according to type and year of publication

The considered papers are also classified according to the conferences as well as journals. This classification is displayed in table 4 and table 5, respectively. According to the systematic study, it is found that 64.28% of the articles have been published in journals, whereas 35.72% of papers are conference publications. The journals which are having a maximum number of publications are Elsevier, springer link, research gate and national library of science. In contrast, other journals are having a low number of publications as compare to these publishers.

Table 4: Classification of articles on the basis of the publisher as well as the name of the journal

Journal	Count	Percentage	Publisher
Journal of Vascular and Interventional Radiology	1	2.38	Elsevier
Informatics in Medicine Unlocked	1	2.38	Elsevier
Journal of Medical Systems	1	2.38	Springer link
Multimedia Tools and Applications	1	2.38	Springer link
International Journal of Data Mining & Knowledge Management Process	1	2.38	Research gate
Medical Physics	1	2.38	Wiley
Ultrasound in Medicine & Biology	1	2.38	Elsevier
Sensors	1	2.38	MDPI
Ultrasonic Imaging	1	2.38	Sage Journals
Journal of Viral Hepatitis	1	2.38	Wiley
PLOS ONE	2	4.76	National Library of Medicine
Journal of Experimental & Theoretical Artificial Intelligence	1	2.38	Taylor & Francis
Journal of Pediatric Gastroenterology & Nutrition	1	2.38	National Library of Medicine
Automatic Control and Computer Sciences	1	2.38	Springer Link
Applied Sciences	1	2.38	MDPI
TELKOMNIKA (Telecommunication Computing Electronics and Control)	1	2.38	Research gate
Polish Journal of Medical Physics and Engineering	1	2.38	ProQuest
Health Information Science and Systems	1	2.38	Springer link
Acta Informatica Medica	1	2.38	National Library of Medicine
BMC Medical Informatics and Decision Making	1	2.38	BMC
Journal of Medical Systems	1	2.38	Research gate
IEEE Access	1	2.38	IEEE
Future Generation Computer Systems	1	2.38	Elsevier
BMC Gastroenterology	1	2.38	BMC
World Journal of Gastroenterology	1	2.38	BPG
BioRxiv	1	2.38	Research gate

Radiology	1	2.38	National Library of Medicine
Total	27	64.28	

Table 5: Classification of articles on the basis of the publisher as well as the name of the conference

Conference	Count	Percentage	Database provider
2016 International Conference on Inventive Computation Technologies (ICICT)	1	2.38	IEEE
2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS)	1	2.38	IEEE
2017 5th International Conference on Frontiers of Manufacturing Science and Measuring Technology (FMSMT 2017)	1	2.38	Research gate
2018 International Conference on Computing, Electronic and Electrical Engineering (ICE Cube),	1	2.38	IEEE
2019 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)	1	2.38	IEEE
2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)	1	2.38	IEEE
2020 3rd International Conference on Intelligent Sustainable Systems (ICISS)	2	4.76	IEEE
2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT)	1	2.38	IEEE
2018 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)	1	2.38	IEEE
2018 2nd East Indonesia Conference on Computer and Information Technology (EIconCIT),	1	2.38	IEEE
2021 International Conference on Computer Communication and Informatics (ICCCI)	1	2.38	IEEE
2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)	1	2.38	IEEE
2017 13th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD),	1	2.38	IEEE
2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT)	1	2.38	IEEE

Total	15	35.72
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3.3. Classification of articles according to the database providers

The selected articles are searched from the six distinct databases. The contribution of each and every selected database is shown in table 6. IEEE is placed at rank number 1 with a percentage of 35.72% as it has 15 published papers. Additionally, PubMed grabbed the second position in the ranking with 26.19% and have 11 publications. Likewise, the research gate has 8 publications and was in the third rank with a percentage of 19.05%. Moreover, with percentages of 11.90%, 4.76% and 2.38%, the Springer, science direct and Proquest were in 4th, 5th and 6th position, respectively.

3.4. Classification of ML approaches implemented in considered papers

The primary goal of this conducted research work is to review the utilization of various approaches of machine learning systematically, which are used to diagnose distinct diseases. Hence, to fulfil the required objective, the analysis has been done on the classification of various methodologies of ML. After doing the investigation from the selected publications, it is found that the ML approaches are used to enhance the outcome of diagnosing any disease. Therefore, the categorization of considered articles has been done with respect to ten different methods of machine learning, as shown in table 7. The ranking of these ML approaches is also done according to the number of publications. CNN is the most used methodology and ranked at 1st place with a percentage of 21.43%. Likewise, the 2nd position has been grabbed by the hybrid methods with frequency 6 and a percentage of 14.28%. Further, at the 3rd position, Deep CNN and SVM are placed with a percentage of 11.90%. The ANN and random forest are placed at the 4th position as their frequency are 4, and the percentage is 9.52%. With a percentage of 7.14%, KNN and DT are placed in 5th position in the ranking. Moreover, FL and CART are the least used ML approaches in the case of medical diagnosis hence placed at 6th and 7th positions with percentages of 4.76% and 2.38%, respectively.

Table 6: Classification of papers according to the database providers

Database Provider	Number of Articles	Percentage
Springer	5	11.90
Research gate	8	19.05
Pubmed	11	26.19
Science Direct	2	4.76
IEEE	15	35.72
ProQuest	1	2.38
Total	42	100.00

Table 7: The Frequency of implemented approaches of ML with respect to diagnose the disease

Machine learning methods	Frequency	Percentage	Reference
ANN	4	9.52	[39],[40],[41],[42]
SVM	5	11.90	[43],[44],[45],[46],[47]
KNN	3	7.14	[48],[49],[50]
CNN	9	21.43	[51],[52],[53],[54],[55],[56],[57],[58],[59]
Deep CNN	5	11.90	[60],[61],[62],[63],[64]
Decision tree	3	7.14	[65],[66],[67]
Random forest	4	9.52	[68],[69],[70],[71]
CART	1	2.38	[72]
Fuzzy Logic	2	4.76	[73],[74]
Hybrid	6	14.28	[75],[76],[77],[78],[79],[80]
Total	42	100.00	

In figure 4, the classification of methodologies of machine learning is summarized. From the figure, it is very easy to comprehend that CNN is now an emerging technique of machine learning as the number of publications of it in 2016 is 1, it increased to 2 in 2018, and in 2021, the number of publications in which CNN is used is 4. Additionally, the popularity of RF is also increased over the past six years as in 2017 and 2019 has one only publication which utilized this ML approach, whereas this number increased to 3 in 2021. Moreover, other approaches are also used frequently by the researchers to enhance the quality of diagnosis of diseases. Some methodologies are also consistently utilized by the researched to improve the treatments.

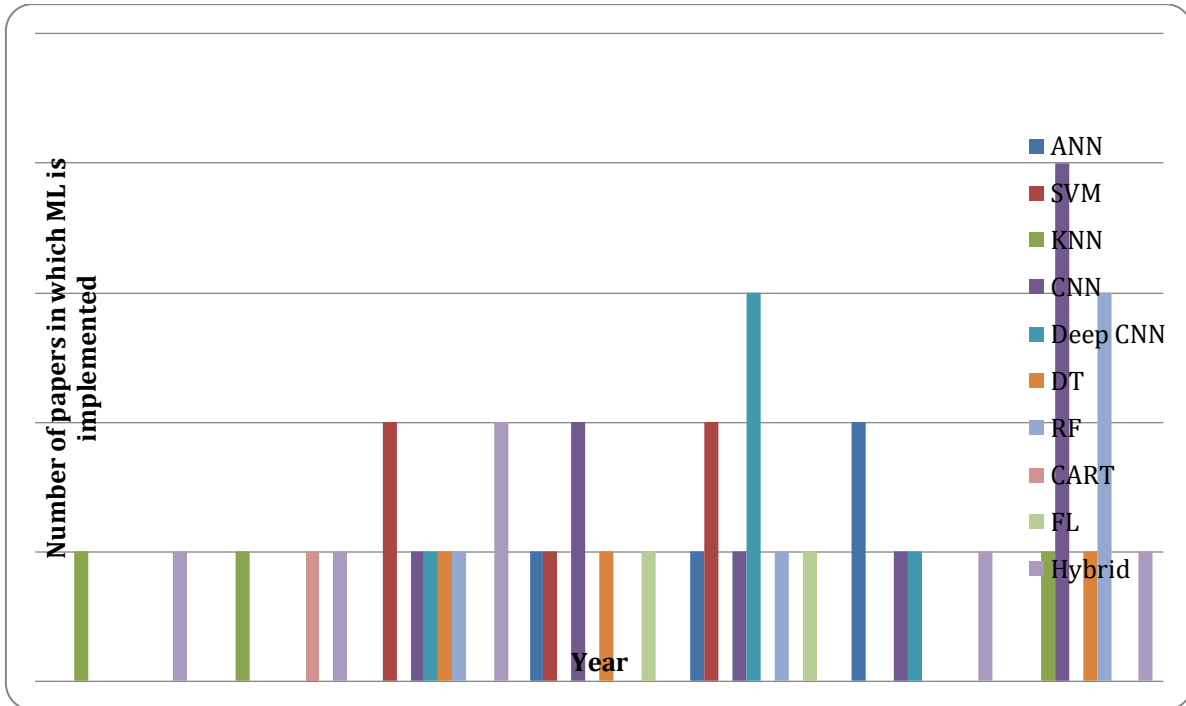


Figure 4: Classification of ML approaches with respect to the year

3.5. Classification of techniques of machine learning implemented in considered articles according to the clinical aspects

After doing the various distributions of research work, now it is crucial to know which diseases are taken under consideration in this respective work. This study will also enlighten that in which disease the researchers are doing more research and have more aims to accomplish. Hence, the classification of considered papers has been done on the basis of applied ML approaches as well as the diseases. The investigation of these papers has been done with respect to the fields of medicine, which further assist in comprehending the classification of ML approaches to diagnose deadly diseases. The pie chart is shown in figure 5, which depicts the frequency of various domains of medical that are considered in this survey. The total numbers of medical disciplines that are taken user consideration are 5. The observations that are obtained from figure 5 is that 28.57% of the conducted study was accomplished in hepatology as there are numerous diseases that are included in this medical domain. 23.81% of the investigation is done on pulmonology disease. Likewise, nephrology is placed at 3rd position as 19.45% of the survey is done on the associated diseases with this domain. Further, the next position, i.e. 4th is acquired by infectious diseases with a percentage of 16.67%. At last, the gastroenterology diseases are studied in the conducted research work with a percentage of 11.9%.

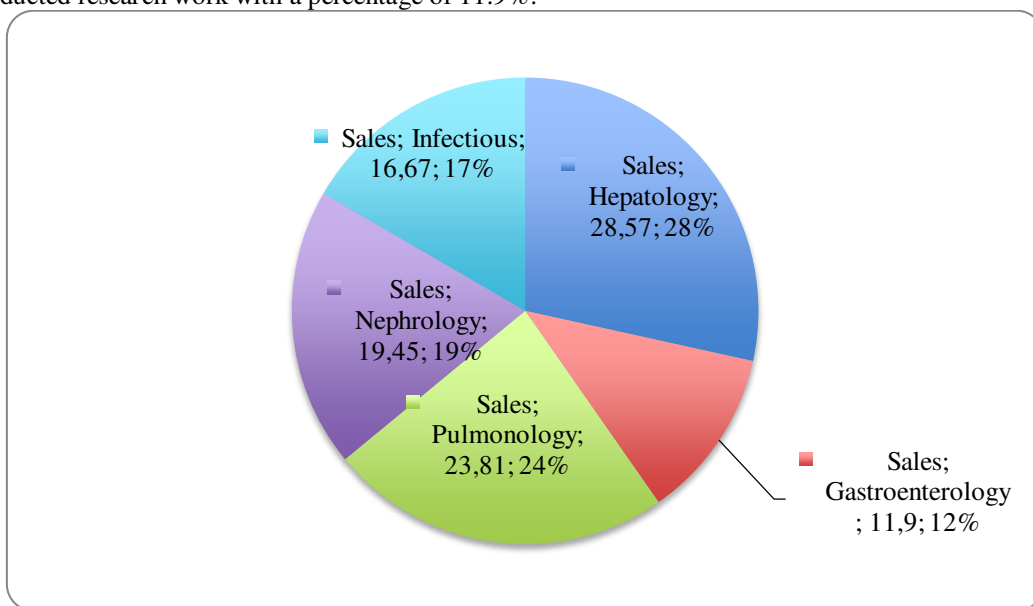


Figure 5: The frequency of domains of medical

4. Discussion

The ultimate goal to do this survey is to review the significance of various methodologies to diagnose several diseases. The few papers that are published in good journals as well as conferences and elaborate the impact of ML approaches have been analysed systematically. Therefore, the major outcome of this conducted study is the analysis of the significance of ML approaches in the medical domain and how these approaches can be implemented as the result of which the medical diagnosis will be enhanced and provide top-notch care as well as treatment. The period of the year that is taken under consideration of this respective survey is 2015 to 2021. Numerous papers have been reviewed to answer the particular questions that arise during the survey. One of the major questions was that to identify the machine learning approach which was utilized by the various researchers to diagnose a particular disease. Before identifying the answer to this specific question, it is mandatory to evaluate the accuracy of those methodologies. Therefore, all the considered approaches were distributed according to the objective and then analyzed effectively. The considered articles were distributed with respect to their year of publication and number of papers. This classification of academic papers assisted in observing that how many papers were published in a specific year to diagnose the disease by using ML approaches. As a result, the observation that is observed is that the least papers were published in 2015, and in contrast, the highest number of papers was published in the year of 2021. The respective study has been conducted in the mid of the year 2021. Hence, only a few numbers of articles were taken under consideration which is published in 2021.

The total number of machine learning approaches that are taken in this study is 10. These ten ML methodologies are just those which are mostly as well as frequently used by researchers in their corresponding researches. The study did not include all ML approaches as it is limited to the investigation of only those methodologies which helped to enhance the diagnosis. For the current investigation, it is analysed that the most used approaches are CNN, SVM and deep CNN.

Additionally, there is a huge increase in the usage of hybrid methodologies as these approaches are the collection of two or more approaches that overcome the limitations of one another and also improves the accuracy of the system. Moreover, the study also classified the papers with respect to the medical domain to investigate it according to the point of view of medical discipline. This distribution assisted to comprehend which medical domain is frequently used by the researchers to do their corresponding researches. According to the conducted survey, it is found that the researchers have more interest in hepatology as well as pulmonary diseases. This study also shows that which disciplines, as well as diseases, are mostly used by researchers and which are not taken under consideration to that much extent. This survey also securitized the effectiveness of ML approaches that are utilized to diagnose a specific disease. Hence, this investigation could help the other researchers to conduct further researches in the respective discipline.

5. Conclusion

This survey has been conducted in order to review the published papers which used machine learning techniques to diagnose the disease and the significance of those techniques on treatment. To accomplish the desired goals, articles are taken under consideration from 2015 to 2021 from different databases. The different distributions of taken articles have been done in order to evaluate that which technique was mostly used by researchers, which medical domain is more frequently researched by the researchers, which year has a maximum number of publications and which technique has the highest accuracy to diagnose a specific disease. These questions have been solved by conducting a survey. The numerous machine learning approaches were also investigated in order to comprehend the efficiency of methodologies that further help to improve the disease diagnosis.

Additionally, there are some limitations in the respective study. The very 1st limitation of this survey is that only a few years, i.e. 2015 to 2021, have been taken under consideration during the entire survey. Moreover, the articles published in late 2021 are not included in this whole investigation. The 2nd limitation of this entire analysis is that some machine learning methodologies are excluded, such as image processing. These excluded methodologies might also have high accuracy to diagnose a disease. The medical disciplines were also limited in this study.

The entire survey is very fruitful as well as effective as it can offer fundamental knowledge to the researchers for future research. The excluded papers were those which are either penned in another language or book chapters. Therefore, for future research, the researchers can also include those factors which are neglected in this survey to do effective research or analysis.

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