IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 2, February 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 10, Issue 2, February 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1002042 |

The Review of Natural Language Processing Revolutionize Healthcare Industry

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ABSTRACT: Without any human intelligence, numerous data science models may deliver accurate and efficient outcomes in the health care industry in a short period of time. Machine learning models benefit the health-care industry in a variety of ways, including developing accurate and efficient recommendations and minimising the manual responsibilities of healthcare workers, permitting them to focus on research and improve their performance in emergency situations.NLP transforms unstructured data into structured data, understands large volumes of data, and delivers useful insights. According to this statistics, electronic health records are one of the most extensively utilised NLP technologies in the healthcare industry.

I. INTRODUCTION

Simply described, ML is a part of AI in which robots are taught to learn without the assistance of people. Here, ML is referred as the Machine Learning and AI is referred as the Artificial Intelligence. The core algorithms in machine learning are built using computational statistics.[3] Computers are given data, and the computers then "learn" from it. The knowledge "demonstrates" "the computer's complicated patterns and underlying algorithms" The "machine" becomes more powerful as the data sample grows larger." The more information you provide the computer, the more exact its result will be.[4]

In healthcare, machine learning is attractive more broadly used, and it is benefiting patients and clinicians in a number of methods. In the healthcare industry, machine learning is most typically used to automate medical billing, clinical decision support, and the creation of clinical care recommendations.[5] In medical, ML and healthcare models are used in a variety of ways. The world's initial healthcare machine learning system for detecting acute toxicities in patients undergoing radiation therapy for head and neck tumours has been developed by MD Anderson researchers.Deep learning in radiology aids radiologists in making educated decisions when assessing images for instance MRI, conventional radiography, CT radiology, andPET scans reports by automatically detecting difficult [6]patterns. Automatic discovery and diagnostic techniques depended on machine learning have been proven to accomplish and also an experienced radiologist. The accuracy of Google's healthcare ML programmes in detecting breast cancer was 89 percent, which is on par with or enhanced than that of radiologists. These are just a few of the numerous ways ML may be used in healthcare.[7]

Over 80% of the information retained or "locked" in electronic health record systems is unstructured healthcare data for machine learning. These are papers or text files, not data, that could not previously be studied without the presence of a human being. Human language, often known as "natural language," is very intricate, devoid of regularity, and full of ambiguity, jargon, and vagueness. Natural language processing (NLP) algorithms are commonly used in healthcare machine learning to transform these papers into more valuable and analyzable data. Medical machine learning is required for the majority of NLP-based deep learning in healthcare applications.[8]

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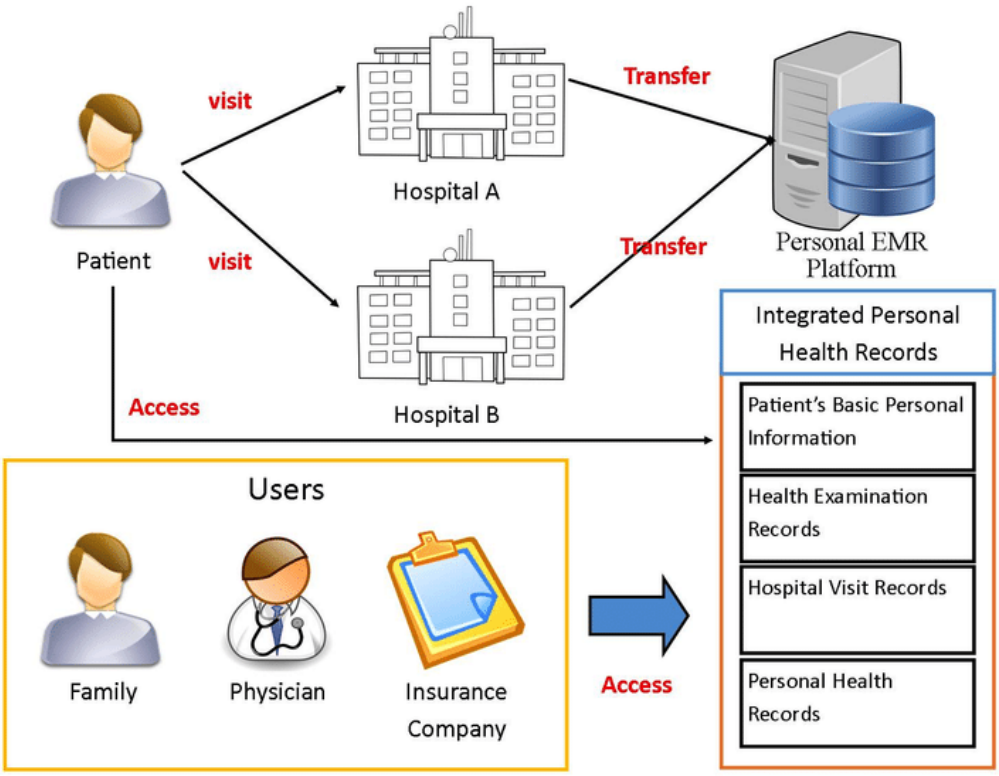

Electronic health records (EHR) are computerised versions of paper patient charts, often known as integrated electronic medical records (IEMR). The objective is for EHRs to adopt standard formats so that healthcare practitioners may communicate patient information. For both patients and providers, standardised formats improve the transportability and interoperability of digital health records.[9]

EHRs, which are interactive, diagnosis,hold medical history, treatment strategies, prescriptions, test output, radiological images, immunisation records, and allergies. However what good is EHR software if it can't communicate with other systems? When interoperability is operating effectively, EHR software permitsconsumers to track patients' treatment evolution across many healthcare providers and experts. This provides whole stakeholders with a comprehensive image of patient care as well as a single view of a patient's long-term medical information.[10]

NLP :

The healthcare industry must strengthen its technical capabilities in order to maintain value-based treatment for all patients.[11,12] One of the most useful technologies is natural language processing. The greatest practical use of NLP technology in the healthcare field is clinical documentation. It includes the patient's current report status, prior and current medical history, symptoms, and diagnosis. Natural language processing can help translate raw data into useful insights in the healthcare business, improving patient outcomes.[13]

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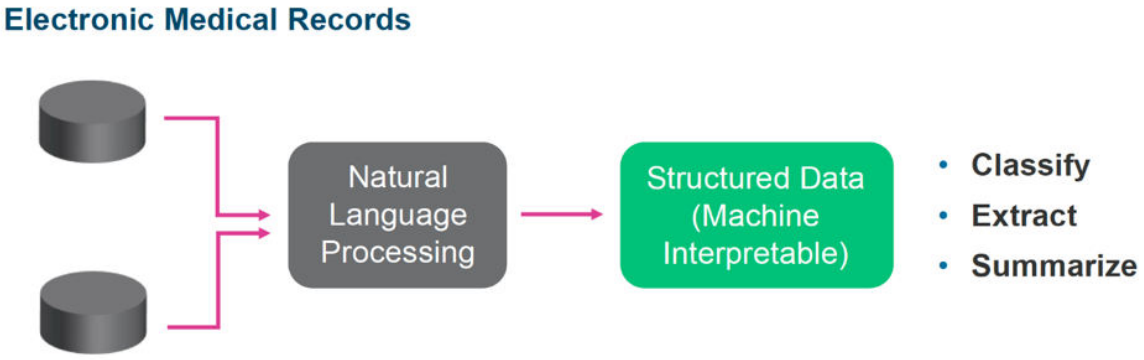

Natural language processing is the process of using a computer system to recognise and extract information from unstructured data, such as voice or written text, and then summarising that information into structured data.[14,15]
NLP can help with the following tasks:

- Organizing and summarising unstructured, extensive clinical notes.
- Mapping useful data from unstructured to structured data in electronic health records (EHR).[15]
- Converting data from machine-readable forms to natural language for reporting and teaching.
- Converting data from machine-readable forms to natural language for reporting and teaching.
- Responding to text inquiries with a natural language interface
- Convert the photos into useful information and reports.[16]

NLP transforms unstructured data into structured data, understands large volumes of data, and delivers useful insights. According to this statistics, electronic health records are one of the most extensively utilised NLP technologies in the healthcare industry.[17] A patient's medical history is stored in a large amount of detail in an electronic record. It includes unstructured information such as demographics, age, test results, radiology reports, illness concerns, medicines, and previous medical history. An NLP technology converts the unstructured input into structured data, which is subsequently analysed and summarised to create actionable insight.[18]
By visualising the patient's data in the form of charts, NLP technology saves time for physicians, allowing them to interpret the information more quickly and focus on patient care.[19] NLP technology can help healthcare practitioners improve the quality of therapy offered to patients by enabling rapid access to patient information and thereby diagnosing patients more swiftly and efficiently.[20]

Model Of Machine Learning in Healthcare:

During an outbreak, machine learning-based decision support systems can assist physicians. Effective medical resource management may be achieved by accurate patient outcome projections and effective diagnostics.[21]Machine learning technologies, in contrast to traditional approaches, allow feature selection and the building of non-linear models that improve clinical outcome prediction, and on-line training methods allow decision support systems to be adjusted as the amount of data about the epidemic grows.[22]

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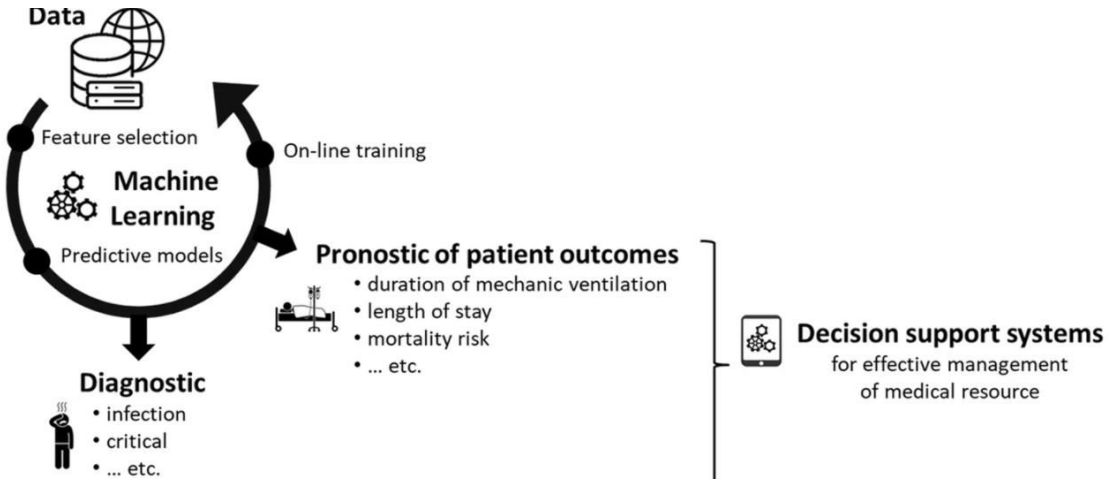

The main thing to remember is that machine learning contains a varied range of data analysis strategies, ranging from somewhat machine-guided to completely machine-guided. Deep learning, for example, is a completely machine-guided technique that makes use of massive groupings of mathematical functions termed as “artificial neurons."[23] Despite modern promising contributions some in the healthcare sector do not feel deep learning is particularly effective since it creates black box models that are difficult for doctors to comprehend. Machine learning technologies, in contrast to traditional approaches, allow feature selection and the building of non-linear models that improve clinical outcome prediction, and on-line training techniques allow decision support systems to be adjusted as the amount of data about the epidemic grows.[24]As a result, attempts to BUILD ML depended clinical decision support systems should concentrate on structure that incorporate as much historical medical data as possible.[25]

In classical decision-making procedures, the choice of elements (often referred to as "features") to be involved in the prediction structure is a controversial phase. Experts in the field operation together to identify attributes that they feel are significant to the research problem. Feature selection is crucial in model construction since include unnecessary features might harm the model's knowledge and performance, while disregarding pertinent characteristics can be just as detrimental [26]. In recent years, the growth of "big" healthcare data has expanded the number of possible features. We suggest in this study that feature selection should be handled by machine learning procedures rather than persons.[27]

A reductionist approach, like with most scoring systems, contends that the sum of risk variables is utilised to predict patient outcomes. In terms of properly forecasting patient outcomes, we feel a reductionist approach has limits. The majority of health problems (for instance asymptomatic, critical, or infectious) are caused by nonlinear interactions among a web of determinants rather than linear interactions between isolated components (biological,genetic,social, clinicaland so on). Neural networks are a type of nonlinear model in machine learning (of which deep learning is a form), have the universal approximation quality that makes them a particularly interesting tool for simulating this.[28]

Simultaneously, in an epidemic situation, there is a considerable risk of medical tools shortages (for instance ventilators). As a result, being capable to predict assets consumption (for example, the period of artificial breathing) and patient results is critical (for instance mortality risk). Depending on the kind of result to be predicted, neural networks can be employed in regression and classification tasks (categorical or quantitative). [29]

Lastly, an epidemic's temporal trajectory is characterised by a steady rise in disease information when the number of patients affected rises. Decision support systems should be able to train on dynamic datasets that grow as the amount of data grows; "stochastic" or "on-line" training methods are obtainable for this purpose.The selection of "informative" data is another crucial issue in an epidemic. The latter must be carefully picked to avoid cluttering training algorithms with duplicate data. To alleviate this problem, active learning tactics might be applied.[30]

Application Of Machine Learning

1. Smart Records

This is the first application of the machine learning in healthcare. Current health records is time consuming for maintaining operation.While technology has helped with data entry, the majority of tasks still take a long time to perform.In healthcare, machine learning's main purpose is to simplify operations in order to save effort, time and money.[31]Two instances of document categorization systems that employ vector machines and ML-based OCR recognition techniques which are slowly gaining attention are Google's Cloud Vision API and MATLAB's machine learning-based handwriting recognition technology.MIT is now working on the following generation of intelligent, smart health records, which will contain machine learning depended tolls from the bottom up to aid in diagnosis, clinical treatment recommendations, and other tasks. [32]

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Example:
Quotient:

Location: Denver, Colorado
Machine learning is being used in healthcare in the following software:
Quotient Health is a software for healthcare. This software develop using the machine learning.This programme, developed by Quotient Health, aims to reduce the costs of aiding electronic medical records by improving and standardising the ways through which these systems are established. It is a clear target to enhance the healthcare system while lowering expenses.Quotient sees a world in which healthcare systems reduce healthcare costs and expand access to cutting-edge lifesaving treatment by creating innovative mechanisms for efficiency and interoperability.

CioxHealth :
Location of CIoxHealth: Alpharetta, Georgia
Machine learning is being used in healthcare in the following software:
This is a software for healthcare. This software is the market leader in clinical information sharing in the United States. It helps clinicians and health insurance companies gather, deliver, and reconcile approximately 40 million medical information requests each year in a secure manner. This software a prominent health technology firm, links healthcare decision makers to data and hidden insights in patient medical records in a simple and secure way. Ciox Health's knowledge, relationships, innovation, and capacity, when combined with the industry's most extensive network access to healthcare data, create a variety for healthcare entities and enable enhanced health for patients. This software to helps clients safely and consistently handle the last mile difficulties in healthcare interoperability through its technology platform, which contains solutions for data gathering, release of information, clinical coding, data abstraction, and analytics.This software uses machine learning to enhance "health information management and exchange of health information," with the goal of optimising workflows, making clinical data more accessible, and improving health data accuracy and flow.[33]

2. Medical Imaging and Diagnostics
This is the second application of the machine learning in healthcare.ML is revolutionising the health-care sector by incorporating cognitive technology to unravel a large number of medical records and to do any power diagnostic. Machine learning aids in predicting a user's purpose. By incorporating machine learning into an organization's workflow, it is possible to create a tailored user experience that helps the firm to make better decisions and take better actions that benefit the consumer. As a result, machine learning aids in the storage, collection, and reform of data.[34]
Medical imaging and diagnostics enabled by AI will grow by more than 40% by 2024, topping $2.5 billion, according to Global Market Insights.Machine learning and deep learning models are changing the field of image diagnosis in medicine.MRI scans are the only important use of AI in medical diagnosis. The difficult examination of MRI data has been taken over by AI, which has made the procedure considerably simpler.[35]

Example :
PathAI's:
Location: Cambridge, Massachusetts
Machine learning is being used in healthcare in the following software:
At PathAI, our mission is to improve patient outcomes through AI-powered pathology, and the investment in Poplar allows us to further that mission by enhancing our ability to provide pathologists with PathAI diagnostic products to support patient care," said Andy Beck MD, PhD, co-founder and CEO of PathAI. "Poplar is a top-tier lab with a specialised team that is recognised for its diagnosis accuracy and turnaround speed. Poplar's value offer to clinicians across the United States will be enhanced by PathAI's efforts in digital pathology and artificial intelligence.
PathAI is the world's top provider of AI-powered pathology technology products and services. Using contemporary machine learning methodologies, our platform was created to enable significant increases in diagnostic accuracy and therapy efficacy measurement for complicated disorders.

InnerEye :
Location: Redmond, Washington
Machine learning is being used in healthcare in the following software:
This software evolves ml algorithms to enhance and create clinicians more productive in order to meet the growing demand for healthcare; to deliver precision medicine for better patient outcomes; and to better understand how we can

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combine medical imaging features with other kinds of data to change the way we do medicine today, with the aim of empowering personalised medicine.
InnerEye is a research project that develops unique tools for the autonomous, quantitative interpretation of three-dimensional radiological images using cutting-edge machine learning technology. Radiological pictures are converted into measuring devices as part of Project.
This software distinguish uses ML to amongtumours and healthy anatomy in 3D radiological scans, which can help medical professionals with radiation and surgery planning, among other things. In the United Kingdom, InnerEye is utilised to provide 3D imagery that pinpoints the specific position of malignancies and allows for more precisely targeted radiation. In 3D radiological pictures, Project InnerEye advances machine learning algorithms for the automated identification of malignancies and healthy anatomy.

3. Drug Discovery and Development

This is the third application of the machine learning in healthcare.Next-generation sequencing and precision medicine are examples of R&D technologies that can aid in the discovery of therapies for a variety of ailments. Unsupervised learning algorithms, for example, may find patterns in data without making any predictions.
Discovering or developing a novel treatment can be a costly and time-consuming process because various substances are examined and only one result may prove to be useful. Thanks to technology advancements, machine learning may be able to assist in this procedure.
Pfizer:
Location: New York, New York
Machine learning is being used in healthcare in the following software:
With IBM's Watson AI platform, Pfizer uses machine learning for immuno-oncology research, which looks at how the body's immune system could fight cancer.
Real-world evidence (RWE) is being used by Pfizer to discover new or extended uses for their drugs. This involves combining information from electronic health records, registries, and insurance records to provide a more comprehensive picture of how a new treatment may affect patients' lives. Real-world data may aid in the design and execution of clinical research, and in certain situations, it can even answer significant clinical issues without the need to recruit new participants. This is especially crucial when standard trials alone do not yield enough information.
Insitro :
Location: San Francisco, California
Machine learning is being used in healthcare in the following software:
Insitro, a new firm, is using machine learning and data science, as well as modern laboratory technologies, to produce pharmaceuticals with the objective of healing patients more rapidly and at a cheaper cost.

4. Medical Data

This is the fourth application of the machine learning in healthcare.ML is revolutionising the health-care sector by incorporating cognitive methods to unravel a large number of medical records and to do any power diagnostic. ML aids in predicting a user's purpose. By incorporating machine learning into an organization's workflow, it is possible to create a tailored consumer experience that helps the firm to createimproved decisions and take improved actions that benefit the consumer. As a result, machine learning aids in the storage, collection, and reform of data.
Example:
ConcertAI :
Location of ConcertAI: New York, New York
Machine learning is being used in healthcare in the following software:
This software optimises patient care and promotes healing using real-world data and machine learning algorithms. ConcertAI improves cancer therapy by providing on-demand access to real-world data repositories and AI-driven oncology treatments. The business just began working with the FDA to integrate real-world evidence into regulatory decisions.
Orderly Health
Location: Denver, Colorado
Machine learning is being used in healthcare in the following software:
This software bills itself as a "24/7 healthcare concierge" that communicates with customers by email, text, Slack, and video conferencing. The firm's goal is to save time and money for businesses and insurers through providing it easier for customers to understand their benefits and choose the most cost-effective providers. Giving employees or members the information they need to understand their benefits and select the most cost-effective providers.

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5. Treatment and Prediction of Disease

This is the fifth application of the machine learning in healthcare.Machine learning was crucial in predicting medical diseases including heart attacks and diabetes in the early stages. Many AI-based wearables are being created to monitor a person's health and provide any alerts if the gadgets detect something unexpected or implausible. Fitbit and Apple Watch, for example. These gadgets keep track of a person's heart rate, sleep cycle, breathing rate, activity level, blood pressure, and other vital statistics. It maintains track of these metrics 24 hours a day, seven days a week.

Example

Tempus :

Location: Chicago, IL

Machine learning is being used in healthcare in the following software:

Tempus aims to make cancer research breakthroughs by collecting enormous volumes of medical and clinical data in order to give individualised therapies tailored to each patient's particular requirements.[1,2]

Prognos :

Location: New York, New York

Machine learning is being used in healthcare in the following software:

This software Registry, according to the business, comprises 19 billion entries for 185 million patients. This software is used to AI platform aids early illness identification, pinpoints therapeutic requirements, exposes potential for clinical trials, indicates gaps in care, and other variables for a variety of ailments with the use of machine learning.[36,37]

II. LITERATURE SURVEY

"K. Shailaja; B. Seetharamulu; M. A. Jabbar" (K. Shailaja, B. Seetharamulu, M. A. Jabbar) A Review of Machine Learning in Healthcare (2018)" Machine Learning has become a significant trend in the market since it is a new and highly complex technical application. Machine Learning is everywhere, and it's employed in a variety of applications. It is crucial in a variety of sectors, including banking, medical science, and security. Machine learning is used to find patterns in medical data and has strong illness prediction skills. We examine a variety of machine learning techniques for generating effective decision assistance for healthcare applications in this research. This work contributes to closing the research gap in the development of effective decision support systems for medical applications.

Ajay Rana, Alka Chaudhary, and Gaurav Parashar AI/Machine Learning in Healthcare: A Systematic Mapping Study and Future Directions (2021) The application of machine learning in healthcare has yielded a number of promising results, instilling trust in the sector. Researchers used ICT and ML to produce solutions for improving the efficacy of previous approaches or procedures. In terms of precision and speed, the sector of healthcare has also benefited greatly from the usage of Big Data, ICT, and AI/machine learning (ML). These technologies have tremendously aided physicians and healthcare workers in their daily job, research, and simulated testing of biomedicine's influence on humans.The physicians keep track of every data about the patient, including clinical notes, prescriptions, medical test results, diagnosis, X-rays, MRI scans, sonographic pictures, and so on. This data becomes a massive repository of information that, if churned, could provide us with better treatment insights, fruitful suggestions and recommendations in diagnosis, the progressive pattern of one disease could be correlated with another disease, and new procedures for treating diseases, among other things. It's possible that a healthcare expert missed a sign that, if not handled promptly, may result in death. As a result, AI/ML tools might aid in the improvement of healthcare services.

With an accuracy rate of 83 percent, Zhai et al. (2017) applied CNN for neuroprotein control utilising data from NinaPro Database (DB) 2&3. With the use of kinematic and EMG data from NinaPro DB, Park et al. (2016) trained CNN for movement intention decoding and concluded that the output was more than 90% accurate. Using data from eight healthy participants, Xia et al. (2017) estimate limb motions with the aid of RNN and argue that the RNN outperforms previous approaches for predicting a 3D trajectory. Allrad et al. (2016) used CNN to guide a robotic arm employing 18 people executing seven gestures with an accuracy of 97.9%. Fraiwan et al. (2017) used an autoencoder to investigate sleep state detection and found an accuracy of 80.4 percent.

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III. CONCLUSION

Natural language processing will be critical in making scientific findings and the outcomes of other machine learning approaches more practical in a healthcare environment. To properly extract the abundance of information into a format that physicians and healthcare workers can use, many specialised systems will need to be connected with one another.Image analysis is becoming more common in many diagnostic procedures, and it will continue to increase radiological diagnosis accuracy. Detecting malignant tumours, as well as validating and verifying current diagnoses, has the potential to enhance patient outcomes while minimising mistakes.

New approaches and technology are constantly being developed to better patient outcomes and the healthcare business. ML is one of these technologies that has showed a lot of promise in the healthcare field. However, in order to attain effective performance, ML often requires human knowledge in its training process and relies on the skill of human designers. Because of this substantial reliance on humans, ML adoption in the healthcare business is limited, despite its immense potential to improve patient outcomes, save time and money, and reduce the burden on the medical system.

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| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 10, Issue 2, February 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1002042 |

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