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Digitized Medical and Hospital Facilities using IOT and AI

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***Abstract*—Now, healthcare system is one of the most important things in our society, and a computerized system can help make it work better. With the help of digital infor-mation, creating this system will make it easier for doctors, patients, and medical stores to do their jobs. Machine Learning (ML) and Deep Learning (DL) are two approaches to artificial intelligence that have been successfully used in a number of different technologies, one of which is the disease prognosis. The generation of a classifier framework via the use of ML and DL models has the purpose of providing a significant helping hand in the process of resolving difficulties that are associated with one's health by assisting medical professionals in the early diagnosis and evaluation of diseases. With ML / DL algorithms, it will be fast and easy to find diseases based on their symptoms. Our system will predict and analyses the data, and this data will allow patients to find out if they have a disease without visiting the hospital. This system will also let people know where the closest drug stores are. This system also allows every doctor and medical store to be checked in emergency situation before they sign up. This way, only authorised doctors and medical stores are available. Using this process will make the system stronger and more reliable.**

***Index Terms*— online health care (OHC), scheduler, prediction and analysis, recommendation, minimal distance, machine learning, deep learning.**

I. INTRODUCTION

Everything in the world today is becoming computerised and based on the web. Different organisations have already switched to computerised systems, which have made life easier and faster [1]. The health care sector is one of the most important parts of any country. The Health Care System is the group of people, institutions, and resources that provide health services to meet the medical needs of the general public or any one person. "Digitized medical and hospital facilities using IOT" is the name of a project that helps people. This will help patients find diseases online without the help of a doctor by using machine learning (ML) algorithms. If patients need more information about diseases, they can go to the nearest hospital. This will also help the patient find a nearby medical store, and it will also help them find a nearby hospital where they can get different tests done. Once a patient has signed up, they will be able to see a list of doctors and what they are good at. This site will also tell you about different diseases based on how they make you feel. ML technologies can be used in many different ways to make clinical trial research better. By using advanced predictive analytics on people who want to be in clinical trials, doctors could look at a wider range of data and save money and time on medical tests. ML algorithms can examine imaging data similarly to a highly skilled physician. They can detect diseases such as

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abnormal skin patches, lesions, tumors, and brain bleeding. Because of this, the number of people using these platforms to help predict diseases based on their symptoms is likely to go through the roof.
Most of the time, when a patient goes to the hospital, he or she takes a token number or an appointment to see a doctor. This can cause some manual problems, like if more patients than expected go to the hospital in a day, the doctor may have to change the schedule, or the patient may have to go to multiple pharmacies to buy certain medicines. To avoid this, we've made a system where a patient's disease can be diagnosed online using ML / DL and if he needs to see a doctor right away, he can do so through the website. This will help both the doc-tor and the patient plan their days. This will also help users when they're taking medicine, since they'll already know if the medicine is available with their medicine. The system is more reliable now that we've added functions like verifying doctors, medicals, and hospitals, and the GPS function makes it easier for patients to get to medicals and hospitals. After every checkup, the main function is also to make an online medical report card for each patient, which will make treatment easier in the future. For the next checkup, the next doctor can just look at the patient's medical report card to see what has happened in the past and decide how to treat him.
This document is put together in the following way. In Section 2 (Review of the Literature), it will talk in depth about what other authors have done. In Section 3 (Proposed System), the architecture of the system and the algorithms used for ML are talked about. In Section 4, (Result and Discussion) you show the results of your research and explain what they mean. In Section 5 (Conclusion), we talk about the conclusion.

II. Literature Review

IOT links the real world to the Internet's virtual world. In the physical world, there are things like air purifiers, thermostats, and cars, as well as construction, medical equipment, and the human body [2]. When IoT technologies are used in healthcare, they will help improve people's lives by making it easier to deal with chronic diseases, warn them of danger, and take steps that could save their lives. There are many ways healthcare IoT could be used: (1) Keeping an eye on health. Today's wearable devices can track basic body functions, analyse human behaviour, and check a person's health. Smart wearable devices, like a smart watch, can make patients feel better and save money [3]. This is unlike other delicate medical devices used in hospitals to monitor patients' health. (2) Assistance with health information for patients. Certain IoT devices in healthcare settings may serve as medication reminders for patients. Connecting equipment such as electrocardiograms, blood oxygen monitors, and blood pressure monitors makes it simpler to measure, monitor, and assist patients and caregivers in real time, hence enhancing clinical outcomes [4]. (3) Enhancements to service. IoT enables automobiles to connect to networks. If a vehicle is involved in an accident, the system may determine how severe it was and report the accident's position and direction to the traffic management department and the emergency care center. This will facilitate the prompt delivery of aid to those in need [5]. (4) The aggregation of information resources for big data analytics. The Internet of Things (IoT) in health may generate a great deal of large health data. When analyzed, mined, and used, big health data may aid and accelerate the development of health IoT. The writers of the cited work [6] Examine the development of IoT-based health care technology and the most current network architectures/platforms, applications, and industry trends. In addition, this work proposes an intelligent collaborative security approach to reduce the likelihood of security problems. In addition, it examines the potential medical uses of new technologies such as big data, ambient intelligence, and wearables.
A proposition has been presented for the design of a health care monitoring system that is based on the internet of things, and this is referenced as [7]. The remote health care system is the focus of this study. This system makes use of cutting-edge information technology, recent advances in communications technology, and equipment that measures physiological parameters remotely. A local server stores the data collected from a variety of sensors. This data may then be accessed by individuals, as well as by medical professionals and practitioners, in the event of an emergency. By boosting availability and productivity while simultaneously cutting expenses associated with well-being, the framework has the potential to make people feel more secure and provide them more mental ease.
J.P. Li and others wrote about ML technology in [8]. One of the most interest-ing parts of AI is ML technology, and many companies are trying to use it for their own purposes. More and more people are using ML. It uses algorithms to help people learn from data and can be used in a wide range of situations, from business to healthcare. Because new ideas and technologies are always being made, healthcare is always changing. Some of these new situations could be helped by ML for doctors and nurses.
Reference [9] talks about how ML can help with the structure of healthcare. Fig. 1 shows the many smart and caring parts of the ML culture that help it provide a wide range of services in healthcare. It includes help from smart and digital tools like AI and cloud data performance that are part of healthcare services. Even though it

doesn't cost much, making electronic medical records is a huge help to the healthcare field. Smart reports, digital notes, keeping records, etc., are all areas where ML principles can have a big impact on the quality of services in the healthcare field.

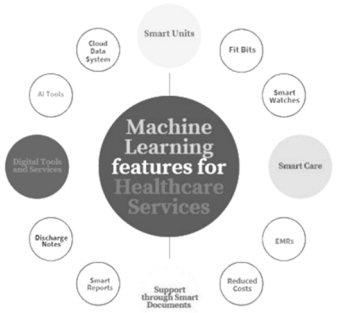

Figure 1. Smart and caring features associated with the ML

Reference [10] talks about the creation of a web application for the people of Bangladesh so that they can store and access their own medical information at any time and from anywhere. A PHP framework called Codeigniter was used to build the system. The server for the database was built with mySQL and XAMPP.

Reference [11] is about making an online appointment with a doctor before going to the hospital, so that the doctor can learn more about the patient and the patient can find out if a specialist doctor is available before going to the hospital. This system was built with ASP.NET.

E-health appointment solution, a web-based approach [12] refers to video appointment solutions that use web technologies. Appointments are made based on the time slots that are open throughout the day. The doctor or someone else in charge decides on these time slots. Video appointments are set up in a web browser, so you don't need any extra software.

In Reference [13] the authors suggested a system for recommending medications based on clinical documents. For extracting medical terms, they have used a unified extraction system with Stanford parser. Then, the diseases are put into groups by the K-means clustering algorithm, and a filtering method is used to find the desired medication.

A method for "instance-based learning," also known as "non-generalizing learning" or "lazy learning," K-Nearest Neighbors, or KNN, is known as "K-Nearest Neighbors." It does not make an effort to construct a comprehensive internal model. Instead, it keeps each individual instance of the training data in a space that has n dimensions. KNN analyzes the data and organizes new data points into groups according to measures of similarity, such as the Euclidean distance function [14]. KNN also considers the existing data points. The classification is determined by selecting the option that receives the most votes from the k nearest neighbors of each point. It is accurate even with noisy training data, but its accuracy is directly proportional to the quality of the training data. The most challenging aspect of KNN is determining how many of a given person's neighbors to examine. The KNN algorithm may be used to categorize data as well as trace its history.

One of the most prominent machine learning (ML) techniques, known as a support vector machine (SVM) [15], may do classification, regression, and other tasks. In a space that may or may not have any dimensions, a support vector machine will construct a hyper-plane or a series of hyper-planes. Since, in general, the higher the margin, the less the generalization error of the classifier, it makes sense that the hyper-plane that is the furthest away from the training data points in any class has a significant separation. It is effective in environments with a large number of dimensions and may behave in a variety of ways, depending on the mathematical function that serves as the kernel. Kernel functions such as linear, polynomial, radial basis function (RBF), sigmoid, and many more are often used in SVM classifiers. Nevertheless, when there is more noise in the data set, such as when target classes overlap, SVM does not function as effectively as it normally would.

An IoT-AIS was suggested for the purpose of improving the safety of healthcare by researchers at [17]. They created WSN with the help of IoT technology and utilized IoT network to bridge the gap between the digital and physical worlds. IoT-AIS was applied by the researchers in order to monitor patient data and encrypt such data. They encrypted the data and put it in the cloud so that remote access to patient data would be possible. The IoT-AIS dashboard offered each patient their own unique user interface, allowing them to independently keep their information while only allowing a single user access to those records. When compared to other methods, the results of their experiments with IoT-AIS showed that it achieved the highest data transmission rate, which was 98.14%, the highest delivery rate, which was 98.90%, a high period of standard responses, which was 93.79%,

less delay estimation, which was 10.76%, improved throughput, which was 98.23%, effective bandwidth monitoring, which was 83.14%, energy usage, which was 8.56%, and the highest performance rate, which was 98.

III. Proposed System

The proposed system involves the integration of various IoT devices and sensors into hospital facilities to collect data on patient health and hospital operations. The data collected will be analyzed using AI algorithms to gain insights into patient health outcomes, improve hospital facility management, and optimize patient care. The project will also focus on improving hospital security and privacy measures to protect patient data. The outcomes of this project will benefit healthcare providers, patients, and hospital administration by providing real-time, accurate data to support medical decision-making, enhance patient care, and optimize hospital operations.

A. System Architecture

Figure 2 shows the proposed system architecture of Digitized Medical and Hospital facilities using loT. The complete system is mainly divided into three parts 1) Hospital Management System 2) Medical Management System and 3) User Sys-tem (Disease Predication and Search Operation).

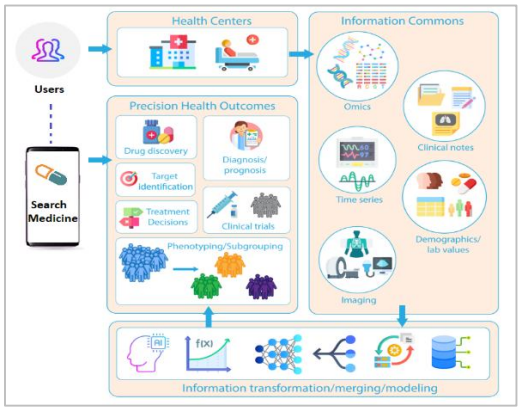

Figure 2. Proposed System Architecture

In Hospital Management System Admin, Doctors and Patient are main entity. In Medical Management System Chemist and Users are main entity and Finally Patient / User can utilise these both systems for getting disease prediction and to search nearest medical for particular prescribed medicine by doctor. Initially system takes user dataset as input which contains user information, symptoms etc. after getting user input admin module process the data. The ML training and testing is performed on data for disease prediction by patient symptoms.

Just by clicking on the appointment with doctor option patient will see the hospi-tals near him with its distance and opening and closing timings. If a patient enters the hospital name and selecting the particular hospital patient can see all the doc-tor connected with that hospital and an appointment form of that hospital, now patient can take the appointment based on hospital or doctor present in that hos-pital. After selecting the doctor either by directly searching in search option or selecting from particular hospital it will always shows the distance and available timing to patient.

Patient can also select the doctor by just searching the disease name in search option, for medicine search the app will show all the medical store and as patient types the medicine name in case the returns as medical stores where that particular medicine is available. The main role a admin is to approve all the verification request from the medicals. The admin can also insert, update, delete and display the patient, doctor and medical data, admin can delete articles of doctors.

Following are the task which are carried out by admin / medical store

- The registration will complete after approval of admin.
- The medical store has the facility to add, delete, view and update the price and quantity of the products in his login.
- The medical store can generate bill and requests the sequence number of report card for specific product.
- The doctors can also able to connect with system by registering the online form.

Following are the task which are carried out by doctor / patient /admin

- The registration will complete after approval of admin. After login the doc-tor can update, view, delete his profile.
- Doctor need to generate report card (with specific sequence number) after Every check-up for the patient and send to their login.
- Doctor have the facility to accept, reject or schedule the appointment
- In case of emergency patients, only doctor can view patients report card on basis of: Aadhar-card, Pan-card or Contact number.
- The Patient can also able to connect with system by registering the online form.

B. Algorithms

1. The k-nearest neighbor (KNN) algorithm [16]

KNN is an algorithm for supervised ML that is mostly used to classify things. It has been used a lot to predict diseases. The KNN is a supervised algorithm that uses the features and labels of the training data to predict how unlabeled data will be classified. In general, Classifying datasets is a breeze using the KNN tech-nique, which uses a training model analogous to the testing query and considers the k nearest training data points (neighbours) that are most comparable to the query. In the end, the algorithm employs a majority vote rule to choose the correct classification. The KNN algorithm ranks towards the bottom among ML algorithms in terms of complexity. As a result of its adaptability and simplicity, it is often used for categorization jobs.

2. SVM

The SVM method determines the point at which the lines of each class are closest to one another. These points are referred to as support vectors. The gap between the vectors and the hyperplane is referred to as the margin. The purpose of SVM is to increase this margin as much as feasible. The best hyperplane is the one with the greatest leeway. The training set is now being fitted to the SVM classifier. To build the SVM classifier, we will use the SVC class from the Sklearn.svm package.

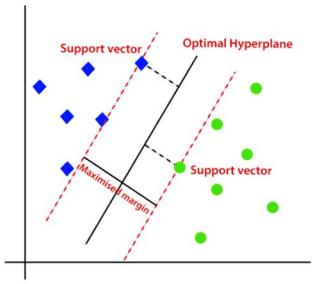

Figure 3. Hyperplane and support vector drawing

3. CNN

Figure 4 shows CNN architecture. CNN includes convolution layer, fully connected layer, pooling layer, flatten and dropout layers. Detail layer description is presented below. Figure 5 shows the CNN layered architecture.

IV. Result and Discussion

A. Dataset Description

We have utilized the data set from Kaggle database (https://www.kaggle.com/datasets/itachi9604/disease-symptom-description-dataset) to validate the performance of the different ML methods.

B. Experimental Setup

All of the tests are conducted on a Windows 10 machine equipped with an Intel i5 processor running at 3.2 GHz, 8 GB of RAM, 1 TB hard drive, and a 512 GB solid-state drive. Anaconda (Jupiter Notebook) IDE is used and Python 3.7 technology is used.

C. Performance Parameters

Four performance assessment indicators are utilized to evaluate the proposed illness prediction model. The confusion matrix is made up of true positives (TP), which is the correct forecast of the target as a patient with chronic disease; true negatives (TN), which is the correct forecast of people who do not have diseases; false positives (FP), which is the incorrect forecast of a healthy person as a diseased person; and false negatives (FN), which is the incorrect forecast of the target as healthy people. The four performance assessment metrics are

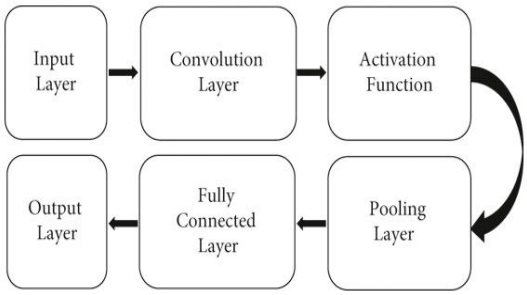

Figure 4. Hyperplane and support vector drawing

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_9 (Conv1D)            (None, 187, 32)           128
_________________________________________________________________
conv1d_10 (Conv1D)           (None, 187, 64)           6208
_________________________________________________________________
conv1d_11 (Conv1D)           (None, 187, 128)          24704
_________________________________________________________________
max_pooling1d_3 (MaxPooling1 (None, 94, 128)           0
_________________________________________________________________
dropout_3 (Dropout)          (None, 94, 128)           0
_________________________________________________________________
flatten_3 (Flatten)          (None, 12032)             0
_________________________________________________________________
dense_9 (Dense)              (None, 256)               3080448
_________________________________________________________________
dense_10 (Dense)             (None, 512)               131584
_________________________________________________________________
dense_11 (Dense)             (None, 5)                 2565
=================================================================
Total params: 3,245,637
Trainable params: 3,245,637
Non-trainable params: 0
```

Figure 5. CNN Layered Architecture

described in detail below. Three performance measures: accuracy, precision, and recall are used to calculate performance of proposed system. The accuracy measure is found by dividing all of the correct predictions by all of the correct predictions and all of the other predictions.

$$\text{Accuracy} = TP+TN / TP+TN+FP+FN$$

To figure out the precision measure, you divide the number of true positives by the number of both true and false positives.

$$\text{Precision} = TP/ TP+FP$$

Like the precision measure, the recall measure is calculated by dividing the true positive values by the true positive values and the false negative values.

$$\text{Recall} = TP / TP+FN$$

These three performance measures will be used to assess the classification results.

D. Result Analysis

Table 1 shows that CNN Classifier outperforms the other algorithms in terms of disease prediction accuracy (98%), hence this method should be used.

TABLE I. PERFORMANCE PARAMETERS COMPARISON

Algorithm	Precision	Recall
SVM	94	96
KNN	96	97
CNN	99	97

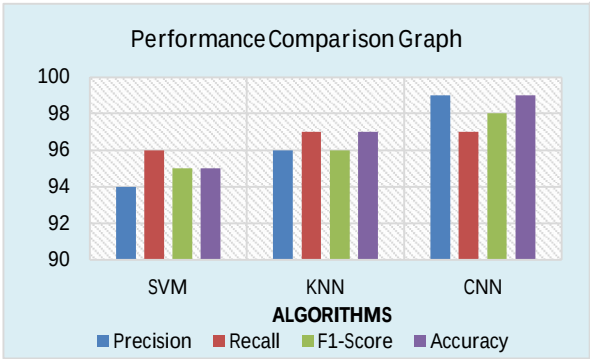

Figure 6. Performance Comparison Graph

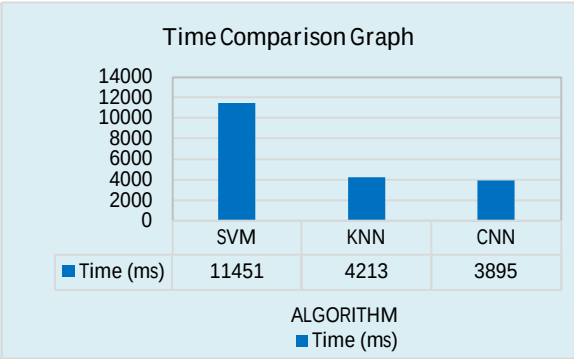

Figure 7. Time Comparison Graph

Figure 6 shows the prediction results for different types of ML methods. Figure 7 shows the time comparison graph of CNN, SVM and KNN for disease prediction using patient's symptoms. From graph we can see that CNN required less time compare to KNN and SVM classifier for disease prediction. Figure 8 shows (a) training and validation accuracy graph and (b) training and validation loss comparison graph of CNN for 50 epochs.

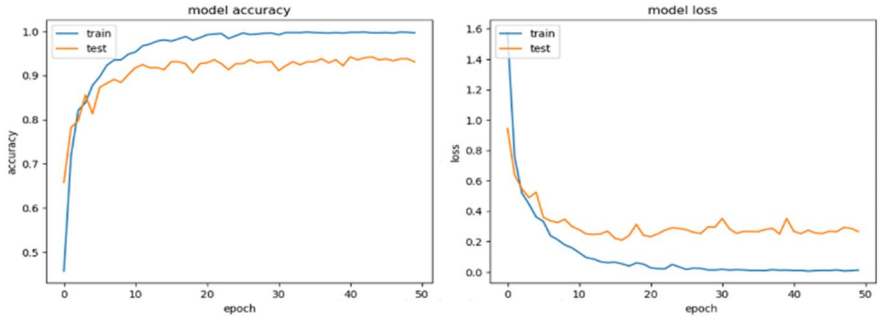

Figure 8. Accuracy and Loss Comparison Graph of CNN

III. CONCLUSIONS

An "AI and IOT base digitized medical and Hospital Facilities" system is devel-oped. This system provides a smooth platform for patient, doctors and medicals. The digitization in system reduces the extra efforts and time for all of them. The mobile application facility that we have introduce here makes easier to patient to search nearest medical where particular medicine is available on single click. In addition, we have also used several ML algorithms for disease prediction and find out which algorithm works best for predicting a particular disease based on patient symptoms. As ML / DL methods are effective to detect disease the results show that CNN outperform other methods.

REFERENCES

[1] Islam S. R., Kwak D, "The internet of things for health care: a compressive Survey. IEEE access, 2015.
[2] Greengard S. The internet of things: MIT press; 2015
[3] Abawajy JH, Hassan MM. Federated internet of things and cloud computing pervasive patient health monitoring system. IEEE Commun Mag. 2017;55(1):48–53.
[4] Fernandes CO, De Lucena CJP. A software framework for remote patient monitoring by using multi-agent systems support. JMIR Med Inform. 2017;5(1), Article PubMed PubMed
[5] Liang C, Gu D, Tao F, et al. Influence of mechanism of patient-accessible hospital info. sys implementation on doctor–patient relationships: a service fairness perspective. 2017.
[6] Mahdavinejad MS, Rezvan M, Barekatain M, Adibi P, Barnaghi P, Sheth AP. Machine learning for internet of things data analysis: a survey. Digit Commun Netw. 2018;4(3).
[7] Abdulameer T.H, Ibrahim A.A. and Mohammed, A.H., 2020, October. Design of health Care Monitoring System Based on Internet of Thing (IOT). In 2020 (ISMSIT). IEEE.
[8] J.P. Li, A.U. Haq, S.U. Din, J. Khan, A. Khan, A. Saboor, Heart disease identification method using machine learning classification in e-healthcare IEEE Access, 8 (2020).
[9] P.H.C. Chen, Y. Liu, L. Peng, how to develop machine learning models for healthcare Nat. Mater., 18 (5) (2019), pp. 410-414
[10] Anjum, F., Shoaib, A. S. M., Hossain, A. I., & Khan, M. M. (2018). Online health care. 2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC)
[11] Hang, B., 2010, June. Web based long-distance appointment registered system. In 2010 International Conference on Computer and Communication Technologies in Agriculture Engineering (Vol. 3, pp. 232-235). IEEE.
[12] Cola, C. and Valean, H., 2015, November. E-health appointment solution, a web based approach. In 2015 E-Health and Bioengineering Conference (EHB) (pp.1-4). IEEE.
[13] John, A. and Vasudevan, V. Medication recommendation system based on clinical documents. In 2016 (ICIS) (pp. 180-184). IEEE.
[14] Pedregosa F, Varoquaux G, Gramfort A, Michel V, Thirion B, Grisel O, Blondel M, Prettenhofer P, Weiss R, Dubourg V, et al. Scikit-learn: ML in python. J Mach Res. 2011; 12:2825–30.
[15] Keerthi SS, Shevade SK, Bhattacharyya C, Radha Krishna MK. Improvements to platt's smo algorithm for svm classifier design. Neural Comput. 2001;13(3):637–49.
[16] Uddin, S., Haque, I., Lu, H. et al. Comparative performance analysis of K-nearest neigh-bour (KNN) algorithm and its different variants for disease prediction. Sci Rep 12, 6256 (2022).
[17] Ghazal, Taher. (2021). Internet of Things with Artificial Intelligence for Health Care Security. Arabian Journal for Science and Engineering. 48. 10.1007/s13369-021-06083-8.