Smart Health Monitoring System – A Comparative Study

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Abstract-Coronary heart disease is the prime cause of death worldwide. In the field of human work, there is a lot of information available, and specialized techniques are used to process this information. One of the methods that is frequently used is handling or processing. The strategy anticipates a range of future events and cardiovascular issues. A previous cardiovascular disease prediction was made using this technique. For manageable IoT, a pulse sensor for observing pulses is used. Sensor readings are transferred into CSV-looking data via IFTTT, which are viewed on Google Sheets. To prepare, and test the treated datasets, facts were used to organize the datasets. The method uses a mechanism for information preparation to evaluate these criteria in stages. Artificial intelligence is used for computation and categorizing tasks. The dataset is initially dissected, examined, and filtered. The input is then analysed using Python programming and machine learning techniques, including KNN algorithms and XG boost outlying classifier approaches. In terms of accuracy, MLP (Multilayer promotion) showed higher results for detecting heart disease. The proposed system then showed its capability to predict past heart issues with high accuracy. Thanks to the suggested hardware and software solution, patients can anticipate cardiac sickness before it becomes serious enough. Because of this, mass screening programs will be more practical in areas lacking hospitals (i.e., rural areas).

Keywords: Health Monitoring System, K-Nearest Neighbour, Multi-Layer Perceptron, A Comparative Study

I. INTRODUCTION

For us to live our daily lives, the healthcare sector is crucial. With the appropriate treatment, healthy diseases can be prevented early and diagonalized. A wide range of diagnostic techniques, including CT, MRI, PET, etc., can promptly locate abnormalities within our bodies or beneath the skin [1]. Additionally, by taking early actions, several common diseases like heart attacks can be easily averted [2].

Due to the unpredictably rapid development of a wide range of degenerative diseases brought on by the massive rise in global population, the contemporary healthcare system is facing challenges. There are now very high financial demands for everything from hospital beds to doctors and nurses. Reducing the strain on the healthcare system is vital to keep the standard and quality of care offered at the highest possible level.

IoT is a choice to lessen the burden on health monitory systems (IoT) [3]. Until recently, diabetic patients with underlying infections, such as those who also had Parkinson's disease, were randomly examined. Researchers employ a variety of techniques [4], such as rehabilitation aids, to continuously monitor the patient's progress to serve a specific purpose for the early treatment of the condition. Due to the vast amount of data currently available [5], data preparation, storage, and analysis should be taken into consideration rather than simply adding it to the system. Several wearable frameworks are recommended to provide reliable telematics transmission.

Clinic administration and IT are both interested in learning more about information executives in security and IoT devices [6]. The study of artificial intelligence may be a subset of artificial reasoning (AI). We shall be able to create a better, superior future thanks to our capacity for reason. The secret to gathering data from references and data without making obvious changes may be AI [7]. Support computations with data and offer data-driven reasoning rather than writing code. AI is being extensively researched in a variety of fields, including web page design, spam filtering, ad targeting, stock trading, and others [8].

While utilising this wealth of knowledge is expected to lead to great improvements in science and design as well as our quality of life, it also creates a rich experience of time.

Internet of Things (IoT), that aims to enable collaboration and remote viewing of real items (things), will develop as a result of artificial intelligence, claims a McKinsey Global Institute analysis [9]. Health-care Environment has recently detailed the scientific and instructional arrangements that rely on wireless sensor hub technology [10].

Due to different interpretations of heart attacks and attacks, patients who do not continue effective therapy at the required time have uncertainty about predictable consequences. This will make it possible to identify friends, family members, motivating professionals, and elderly patients specifically. In order to reach this unexpected pass rate, we want to deploy health of patient that leverages sensor developments and the internet network to contact friends and family in case of emergencies.

Additionally, we observe that ML applications for various IoT applications are continually improving (IoT) [11].

Currently, artificial intelligence is widely used in a range of business applications, such as web-based commerce and others [12]. Information preparation is the act of eliminating data and data collected as information from enormous volumes of raw data. Data mining has significantly improved the ability to find information from a database or continuous information. Information preparation's main goal is to draw out buried information from various databases [13]. By analysing patient datasets and patient information, our goal is to predict coronary artery disease, where we must calculate the chance of developing the condition. One of the uses for this artificial intelligence is prediction.

II. LITERATURE REVIEW

To gauge patients' health state numerous monitoring systems have been created recently. Checking out some newly published work in this field. The order of hardware partition (or components) that used excess frequently than the other divisor used to classify each system in this assessment. All system consequently split into three major categories [13]:

There are three different kinds of health monitoring devices: sensor-based, smartphone-based, and microcontroller-based. To gauge patients' health state, numerous monitoring systems have been created recently. Checking out some newly published work in this field [14].

Table 1. Table for previous Work:

Predictions in heart disease using techniques of data mining.	Data Discovery by Data Mining or Knowledge Extraction.
Prediction of Heart Disease using Classification Algorithms	Predict the heart attack and to compare the best method of prediction.
Development of Smart Health Screening System for Rural Communities in the Philippines	A program that stores the data automatically in the CSV file.
Smart Health Monitoring System through IOT	Patients with abnormal health conditions can be quickly monitored
Smart Healthcare Monitoring System	Input taken from sensor are processed in raspberry pi and displayed on LCD.
A survey on health monitoring systems for health smart homes	Reduces the cost to provide e-Health Services.
A Smart Health Care Monitor System in IoT Based Human Activities of Daily Living: A Review	Uses existing sensors to predicts the data.

The classification of each system in this assessment is based on the significance of the hardware components.

III. MACHINE LEARNING

There are three types of Machine Learning:

a. Supervised Learning
b. Unsupervised Learning
c. Reinforcement Learning

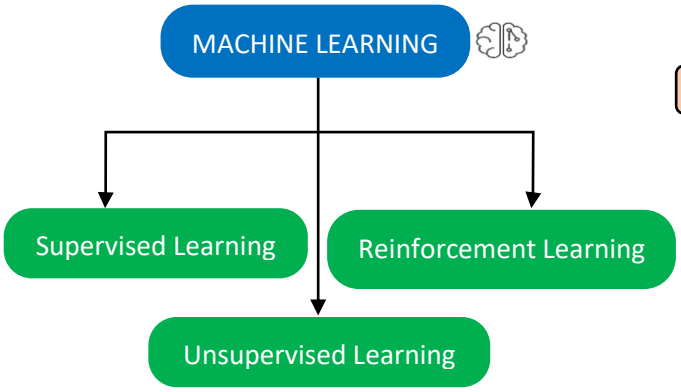


Fig. 1. Types of Machine Learning

Supervised Learning: In this type of learning, a model is trained using a labelled dataset and then learns from various kinds of raw data. After the training process is finished, the model's performance is assessed using test data (a portion of the training set), and an output prediction is made.

Example: Predict House Price

Unsupervised Learning: It is a form of machine learning where the model is not monitored by the training dataset. Instead, the model itself reveals invisible patterns and display insights based on the supplied data. It is comparable to the mental learning that occurs when a person masters a new skill [15].

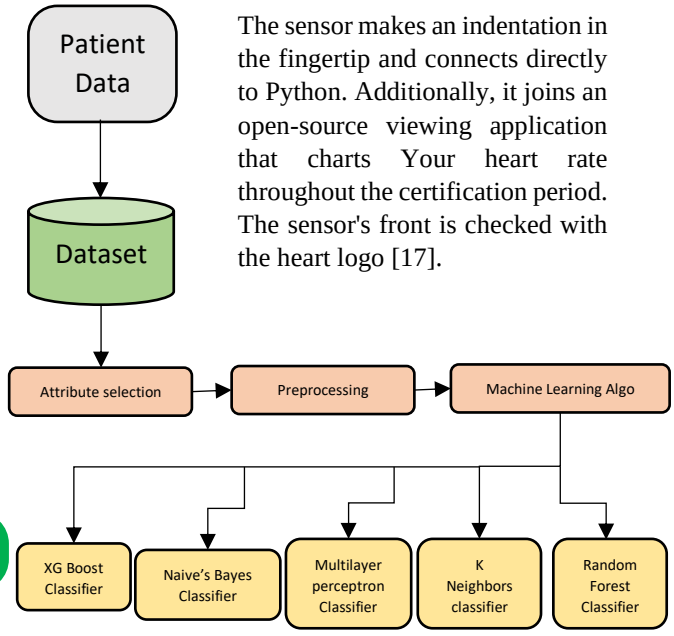
Example: clustering

Reinforcement Learning: It is a method of machine learning that describes how to behave in a certain environment by having it perform actions and track the results. For every good deed the agent does, they get complimented, and for every bad they get criticised or punished.

Example: Robotics

This project we are using and implementing this project using Supervised Learning [16].

IV. PROPOSED METHODOLOGY



The sensor makes an indentation in the fingertip and connects directly to Python. Additionally, it joins an open-source viewing application that charts Your heart rate throughout the certification period. The sensor's front is checked with the heart logo [17].

Fig. 2. Division of particular work

This is typically the side that comes into contact with skin. There is a tiny, circular hole on the front where the Light Emitting Diode shines through from the back. A tiny, almost noticeable square region is also present beneath the Light Emitting Diode. After the Light Emitting Diode shines light into the fingertip, ear ligament, or other thin tissue, the sensor closely monitors the amount of light that reflected back. Inexactly in that manner does it pick up the beat. On the other side of the sensor are the remaining parts dataset an informational index contains a lot of data (or dataset).

An illustration is a particular informational column. It originates from the viewpoint of the area. When employing AI techniques, we frequently need a few datasets for a variety of tasks. A dataset is a collection of examples. The data is then prepared and put to the test using AI algorithms [18]. Two datasets are used in this study: one to test the accuracy of our model but not to develop it, and the other to feed data into our AI calculation to build our model. B.

Pre-processing of the information: Pre-processing suggests steps before incorporating our data into the graph. Pre-processing is a method for converting faulty data into perfect academic records. Illegal characteristics must be handled from largely unpleasant educational records in order to conduct frivolous backcountry checks on them. Some established AI models want information in

predetermined areas; for example, random forest computations do not promote incorrect features. According to a different viewpoint, the goal of heuristic classification as an organisational approach should be to evaluate many machine learning and deep learning estimates on a single instructional record and choose the best one [19].

V. EXPERIMENTATION

Machine Learning Classifier:

To analyse cardiac patients and healthy persons, AI permutation calculations were used. Some of the well-known representational computations that will now be briefly reviewed are used in machine learning:

Logistic regression is the name of this representational calculation. For the combined acquisition task to foresee the estimation of the insightful variable y where y belongs to [0, 1], 0 is the negative class and 1 is the definite or sure class. Similar to visualising an estimate of y when y -> [0, 1, 2, 3], it uses multi-classification. To describe the two classes 0 and 1, a theoretical h (θ) = θ T X will be constructed, and the edge classifier's yield is hθ(x) at 0.5. If h θ (x) is estimated to be 0.5, it predicts that y = 0, signifying that the subject is in good health, and if h θ (x) is inferred to be 0.5, it predicts that y = 1, signifying that the subject has coronary artery disease [20]. Under the restriction of 0<=hθ(x)<=1, the anticipation of policy recurrence is now complete. Typical examples of deliberately repeated sigmoid volumes are:

$$h\theta(x) = g(\theta TX),$$

where, $g(z) = 1 / (1 + (x-z))$ and,

$$h\theta(x) = 1 / (1 + (x-z)). \qquad \text{eq..(1)}$$

Naive Bayes: It is a collectively controlled learning algorithm. It depends on the constrained likelihood assumption to decide the class of another component vector. It uses a pre-set dataset to find restriction likelihoods for vectors belonging to a particular class. The importance of the resulting vector class depends on how the wake handles the likelihood limit estimations for each vector. The use of NB is made in content where a problem is depicted [21].

A decision tree classifier makes advantage of supervised AI (AI). A decision tree shape is, to put it simply, a tree with each handle acting as the decision or leaf centre point. When using decision trees, the decision-making process is straightforward and reasonable. Decision trees with internal and external foci can have relationships.

$$P(W/Q) = \frac{(P(Q/W)\ P(W))}{P(Q)}$$

$$P(W)/P(Q) = \frac{P(Q/W)\ P(W)}{(P(Q/W)\ P(W) + P(Q/M)\ P(M))}$$

$$P\ (A\ /\ B) = \frac{P\ (B\ /\ A)\ P\ (A)}{P\ (B)} \qquad \text{eq..(2)}$$

Using K-Nearest Neighbour KNN is a method of computing the game plan for supervised learning. Using fresh commitments, KNN evaluates the source's agreement with the data in its preparation set; KNN estimates predict the class name of additional data. if the new data is consistent with the permutation set's model [22].

VI. RESULTS

Therefore, the number of health conditions that result in death globally can be decreased with appropriate treatment and early detection. With the use of a pulse rate sensor, real-time patient data may be recorded as part of this project. As a result, human cardiac disease is predicted using machine learning algorithms.

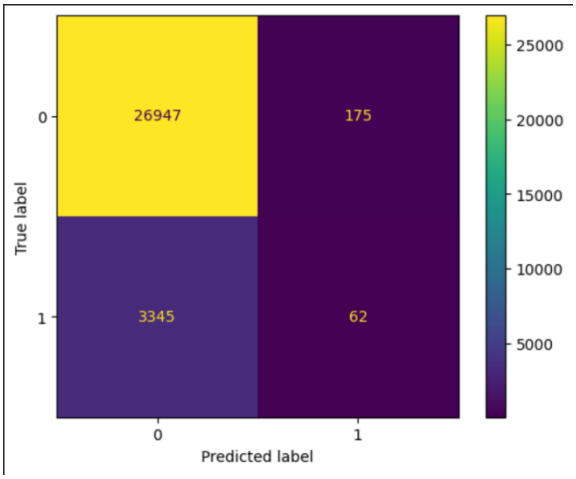


Fig. 3. True label and predictable label graph

As a result, machine learning algorithms were trained using 40 samples of patient data. Among the algorithms I have focused on most are K-Nearest Neighbour (KNN) classifier, decision tree random forest and SVM (support vector diagram). after a real-time comparison of all algorithms. after comparing all algorithms in real-time. Pulse rate and waveform are consequently ways for the body to

communicate. Figures 3 and 4 display the graph and related accuracy [23].

MLP Classifier: The KNN and MPL method supposedly enables better accuracy and prophecy, according to patient data observations. The results of the following algorithm are displayed in Fig. 4 below.

	Model	Accuracy score	Precision Score
1	XGBoost	0.531462	0.152408
2	RandomForest	0.613155	0.163530
3	K Nearest Neighbor (KNN)	0.884700	0.261603
4	Multi Layer Perception (MLP)	0.887025	0.309091

Fig. 4. Comparison of all Algorithms

KNN algorithm – 0.88

XG Boost – 0.53

Random Forest: 0.61

Multi-layer Perception: 0.88

	encounter_id	patient_nbr	race	gender	age	weight
count	1.017660e+05	1.017660e+05	101766	101766	101766	101766
unique	NaN	NaN	6	3	10	10
top	NaN	NaN	Caucasian	Female	[70-80)	?
freq	NaN	NaN	76099	54708	26068	98569
mean	1.652016e+08	5.433040e+07	NaN	NaN	NaN	NaN
std	1.026403e+08	3.869636e+07	NaN	NaN	NaN	NaN

Fig. 5. Data Obtained from CSV-File

MLP and KNN have the highest accuracy and prediction rate when compared to other algorithms as a consequence.

VII. CONCLUSION AND FUTURE WORK

Given that coronary heart disease is the world's greatest killer, In the field of human services, there is a lot of information, and specialised techniques are used to process this information. One of the methods that is most frequently used is handling or processing. The focus of this essay is on using real-time data for IoT and machine learning to provide more precise forecasts and estimates.

These data are accessible through Google Sheets, where they are later used in automated procedures. So, I discovered that when all the algorithms are compared to one another, I found that the KNN algorithm is 88% accurate, the MLP algorithm is 88% accurate, the random forest classifier is 61% accurate, and the XG boost algorithm produces an accuracy of 53% when all algorithms are compared to one another. KNN and MLP classifier has the highest accuracy out of all approaches as a consequence. Thanks to the suggested hardware and software solution, patients can anticipate cardiac sickness before it becomes serious. It will be simpler to establish a mass screening programme in places lacking hospitals as a result (i.e., rural areas).

Smart health monitoring systems customized to an individual's unique health needs in future, taking into account factors like age, gender, medical history, and lifestyle. This could lead to more accurate and personalized health recommendations. In future, all these parameters are stored and fetch the health condition of human and related solution provided by the doctors also included. Therefore, with appropriate care and early diagnosis, the number of illnesses that result in death globally can be reduced. To collect real-time patient data, this project makes use of the internet of things.

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