

Smart Health Monitoring System Using Machine Learning

Mrs.P. Ananthy

Research Scholar, Department of Computer Science,
SRMIST Ramapuram Campus, Chennai.

*E-Mail : ananthysganeshan@gmail.com

Dr. J.Dhilipan

Professor & Head, Department of Computer Applications (MCA),
SRMIST, Ramapuram Campus, Chennai.

Email : hod.mca.rmp@srmist.edu.in

ABSTRACT

Machine Learning is a vibrant tool in our everyday life to perform day to day affairs. Machine Learning is prominently adopted to develop algorithms which can learn from the data. Machine Learning is very much used in various fields and especially in health care monitoring. Due to the latest technologies, there is a huge development in health care monitoring over the decades. For monitoring, medical professionals use the machine learning tools and techniques to identify the risks and to provide apt diagnosis and treatment. This paper provides the analysis in terms of smart health monitoring system using different machine learning approaches and techniques.

Keywords: Machine learning, smart health monitoring system.

1 Introduction

Science and Technology has been ruling the world ever since the origin of computers and computer related expertise. One such and the latest in its repertoire is the evolution of Artificial Intelligence. In today's world the advent of Artificial Intelligence has been a boon to various fields. The wide spectrum of applications of Artificial Intelligence has impinged its foot prints on every walk of life. One such field, is the field of Smart Health. Smart Health is an area which grown leaps and bounds and has been the maximum benefactor of artificial intelligence. Smart Health is the hub of two diverse fields, smart cities and Electronic Health (e-Health).

ML plays an important role in s-Health, it can improve the quality of healthcare services by providing accurate medical diagnosis, predicting diseases in early stages and disease analyses thereby facilitating prompt medical attention to the patients who needs the most. Through ML, the complexity of the disease is found early and helps to reduce the casualty and thereby out doing the fatality rate.

This paper is organized as follows: section 2 bestows the components of a smart health

system section 3 gives a comparative study between different machine learning approaches that are applied in s-Health, section 4 talks about the proposed system and section 5 gives the conclusions.

2 Smart Health- A Preamble

S-Health is the latest innovation of healthcare that is the inheritance of e-Health using Electronic Health Records (EHR) that facilitates the improvement of the healthcare. Smart health care monitoring system is a facility that uses the data obtained from various sources and helps to lead a better life by providing emergency response and paging health care workers. It also supports the early detection, diagnosis and treatment of various ailments that deprive normal health.

This mechanism includes data collection and technical aspects like networking, computing technologies, data security, privacy, data processing and data dissemination. We will see each of this in a précis.

The data collection involves collecting data from different sources such as sensor network, Internet of Things (IoT) etc.

The networking and computing technologies are implemented to the data collected and since this data is quite complex, a server is required for the data to be processed.

The data security and privacy play a key role in both s-Health and smart cities as the data should be preserved from theft, manipulation and cloning.

The data processing involves preprocessing to remove unwanted noise and secure the data, feature extraction to find the relevant features, and ML technique to process the data and perform the required task such as classification / clustering etc.

The data dissemination is accountable for getting the output in a prescribed format.

3 ML Approach in Smart Health

This section provides a brief literature survey of different machine learning approaches that are applied in s-Health applications and systems.

¹**Balaji GN, Suryanarayana SV, Sengathir J** introduced an effective Boykov-Kolmogorov Graph Cuts-based image partitioning method that estimates the image data through a synergy cloud model for formulating objective functions. The objective function used in this proposed BKG-CMSIS scheme includes data item and smooth term for boundary preservation in order to determine the deviation of each pixel corresponding to the different regions of the cervical pap smear cells. The experimental results of the proposed BKG-CMSIS scheme are also potent in enhancing the

classification accuracy by 14% which is superior to the benchmarked cervical cancer detection methods considered for investigation.

²**Bhawna Dhruv, Neetu Mittal¹, and Megha Modi** proposed a model to reduce the risk of pancreatic cancer, its detection and diagnosis at an early stage. The work encompasses the processing of CT scans of pancreatic tumor using classical and artificial intelligence based optimized edge detection techniques for optimization and detection of tumor.

⁵**Jaya Lakshmi G, Mangesh Ghonge, Ahmed J. Obaid**, proposed a method through cloud-based IoT healthcare sensors to formulate patient monitoring remotely. In combination with the implementation of various inbuilt capabilities, internet-enabled heterogeneous wearable sensors can be used for the collection of biomedical data to transmit patient data directly to cloud to monitor health remotely.

⁶**Jie Li^{*}, Wei Wei Goh, NZ Jhanjhi, Filzah Binti Md Isa, Sumathi Balakrishnan** aspired to identify and measure the ADL that challenges the elderly encounter and improve their quality of life (QoL). The research embarked on semi-structured interviews at 9 geriatric care centers in Malaysia to investigate the ADL challenges by the elderly residents. The thematic analysis approach was employed for data analysis and further discussion. The research findings suggested that the QoL of the elderly is limited by the challenges of geriatric issues, poor living conditions and technology acceptance barriers.

⁷**Leonardo Bertini, Dario Bruneo, Massimo Mecella^{*}, Emilia Reda** recommended to investigate, design, develop and validate a prototype platform, named Assisto eCare 4.0, that provides “well-being” and “safety” services/functionalities to home elderly residents. The platform builds upon biometric technologies and analytics functionalities exploiting AI techniques in order to limit human intervention during emergencies and automatically and immediately deciding actions to be performed immediately by making the operators intervene directly at the user home. The prototype has been validated with a group of 22 users over a period of more than 7 months. The results derived from the final evaluation questionnaire show that the majority of participants rating the service to be excellent.

¹⁰**Md. Milon Islam, Ashikur Rahaman, Md. Rashedul Islam**, proposes a smart health care system in IoT environment that can monitor a patient's basic health signs as well as the room condition where the patients are now in real-time. In this system, five sensors are used to capture the data from hospital environment named heart beat sensor, body temperature sensor, room temperature sensor, CO sensor, and CO2 sensor. The error percentage of the developed scheme is within a certain limit ($< 5\%$) for each case. The condition of the patients is conveyed via a portal to medical staff, where they can

process and analyze the current situation of the patients. The developed prototype is well suited for healthcare monitoring that is proved by the effectiveness of the system.

¹⁵**Sharmila Rengasamy, Chellammal Suria narayanan, Pethuru Raj Chellai** proposed an approach for prediction of heart diseases using Support Vector Algorithm in Spark environment. The proposed approach has been tested with 297 records. In the proposed approach, input data is collected from UCI repository and the data is preprocessed for its completeness and precision. Spark is a distributed big data processing platform which can keep huge data in memory. Spark offers a machine learning library which consists of different machine learning algorithms. In this work, the SVM algorithm in Spark ML Lib is trained with the preprocessed input data. Then the constructed SVM model is evaluated for its performance using accuracy measure. If the accuracy of the model is found sufficient, then the model is put into prediction phase where it predicts the label of any unknown data given as input.

The results obtained finally show that RBF kernel yields highest values of accuracy, precision, recall and F-Score as 84%, 0.89, 0.76 and 0.82 respectively.

¹⁸**Yazeed Zoabi, Shira Deri-Rozov and Noam Shomron**, proposed a machine-learning model that predicts a positive SARS-CoV-2 infection in a RT-PCR test by asking eight basic questions. The model was trained on data of all individuals in Israel tested for SARS-CoV-2 during the first months of the COVID-19 pandemic. This model can be used, among other considerations, to prioritize testing for COVID-19 when testing resources are limited.

Table1 ML Approaches in s-Health

S.NO	AUTHORS	TITLE	MACHINE LEARNING TECHNIQUE
1	Balaji G N, Suryanarayana S V, Sengathir J	Enhanced Boykov's Graph cuts based segmentation for cervical cancer Detection.	BKGC-CMSIS scheme Cloud model
2	Bhawna Dhruv, Neetu Mittal, and Megha Modi	Early and Precise Detection of Pancreatic Tumor by Hybrid Approach with Edge Detection and Artificial Intelligence Techniques	Optimized edge detection techniques
3	Jaya Lakshmi G, Mangesh Ghonge, Ahmed J. Obaid	Cloud based IoT Smart Healthcare System for Remote Patient Monitoring	Cloud-based IoT
4	JieLi, Wei Wei Goh, NZ Jhanjhi, Filzah Binti Md Isa, Sumathi Balakrishnan	An Empirical Study on Challenges Faced by the Elderly in Care Centers	Thematic analysis
5	Leonardo Bertini, Dario Bruneo, Massimo Mecella, Emilia Reda	Assisto eCARE 4.0 – An IoT- and AI-based	Assisto eCare 4.0

		architecture for assisted active aging	
6	Md. Milon Islam, Ashikur Rahaman, Md. Rashedul Islam	Development of Smart Healthcare Monitoring System in IoT Environment.	Sensors
7	Sharmila Rengasamy, Chellammal Surianarayanan, Pethuru Raj Chellai.	Machine Learning based method for Prediction of Heart Disease in Big Data Environment	Support Vector Algorithm in Spark environment
8	Yazeed Zoabi, Shira Deri-Rozov and Noam Shomron	Machine learning-based prediction of COVID-19 diagnosis based on symptoms	Gradient-boosting machine model

4 PROPOSED SYSTEM:

a) Objectives of the System:

- The main objective of the proposed system is to enhance the health care by making use of Machine learning and IoT to monitor the patient in an effortless and cost-effective manner.
- To better understand the health of the patients and to give better guidance and support without human interference.

The health care monitoring system of patients are based on their Food Habits and vital parameters such as Pulse rate, Heart Beat rate and Body Temperature will be taken as input for Raspberry pi. The data to be received from the Raspberry pi will be transferred and stored in cloud for processing. A model will be designed in the cloud and the collected data will be processed using k means algorithm. The processed data and the proposed diagnosis will be stored in the cloud for further reference.

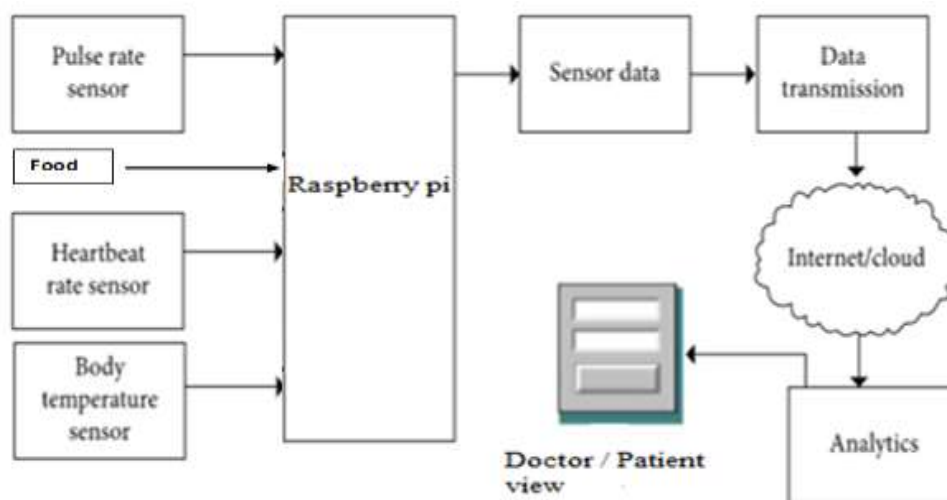
Proposed Model:

Figure-1: Proposed Model

5 CONCLUSIONS

Smart health is one of the fast emerging and extraordinary research field having significant effect on the healthcare industry. In this article an overview of the challenges and techniques that behest smart health is attempted and elucidated on various methodologies from data collection to data dissemination keeping in mind the data security and privacy and various other technological aspects.

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