

A Survey on IOMT based Food Recommendation System

Shridevi Soma, PhD

Department of Computer Science and Engineering,
PDA College of Engineering
Aiwan-E-Shahi Road, Kalaburagi Karnataka

Sushmita Dyapur

Department of Computer Science and Engineering,
PDA College of Engineering
Aiwan-E-Shahi Road, Kalaburagi Karnataka

ABSTRACT

Many individuals are affected with numerous ailments and diseases in today's globe. As a general rule, it is quite difficult to recommend a diet rapidly. AI-based medical information systems have potential to extend human life expectancy, prevent additional sickness, as well as enhance general health. Recommendation system for patients monitors a person health in a systematic approach. Considering patient health, monitoring their health conditions and providing the solution instantly are the biggest challenges. Some of the researchers have carried out their work on monitoring a user health by considering users body nutrition values, some of the researchers build a system as per the user preferences. Some of the researchers have considered IOMT data to build a food recommendation system. Using these recommended systems encourage people to maintain good diet and health.

General Terms

IOMT, Deep learning, Food recommendation system, Health monitoring, LSTM, MLP, GRU

Keywords

Sensors, Machine Learning, Deep learning, Blynk cloud, NODE MCU

1. INTRODUCTION

A method for making meal recommendations based on a patient's health which takes systematic approach to recommending the right foods to eat from a wide range of potential options and then produces the outcomes the user wants. Patients are encouraged to consume nutritional supplements and foods that are deemed to be better for their health and taste by recommendation system carefully applied. The most commonly found diseases are chronic diseases, diabetes in people and vitamin deficiencies and food quality. The purpose of this project is to plan food recommended system to improve the health of a person.

Many individuals with illnesses might benefit from the advice of food recommendation services. For improving entire life standard for patient. Also nourishing food which includes minerals, vitamins, protein, antioxidants, and fat, all health care improvement and optimal physical function are a result of these factors. If patient's body is unable to process nutrients because of their illness, it might have an impact. As considered to patient diseases or illness, the main reasons are unhealthy diets, food patterns and not aware of their body conditions and these conditions may lead to further diseases or bigger problems. Voice based food recommendation can help people to monitor their health condition.

1.1 Internet of Medical Things (IOMT)

IOT refers to an interlinked network of physical things or Things that are integrated to share data over the internet. Optimized data interchange & storing upon secure cloud

servers from which connecting computer devices build networking for sharing data and interact all across server are technical details.

There have been a number of "smart" gadget developments using integrated programming which either enhances present functioning of device or allows it to be used for new purposes. In the event of COVID-19 pandemic, it is very important to keep track of the health status of large number of patients at all times, including before and after infection. Remote patient monitoring, screening, and treatment through telehealth, made possible by the Internet of Medical Things (IOMT), are effectively adopted both by health care practitioners and patients. An increasing number of IOMT-based smart gadgets are finding widespread use in wake of worldwide epidemic. Because of sheer scope of problem, IOMT will have its work cut out for it when it comes to healthcare industry.

2. RELATED WORK

Literature survey is used to identify so that we can understand how the proposed system can be design. Literature survey is base for any challenging research work. A thorough study of existing system results to identify the gaps and scope for further work to be carried out. Literature survey includes many existing systems considering IOMT assisted health monitoring, diet recommenders and food recommendation system. Some of the researchers consider the user preferences, some of them only focused on athletes or physically challenged people. Researchers have used machine learning algorithms for the implementation and some of them have used DNN model which includes various algorithm and they have carried out the performance evaluation Following are the recommended papers to understand the existing work in the design of intelligent IOMT assisted food recommendation system.

[1] CELESTINE IWENDI et.al. IoMT-Aided Diet Recommendation System Using Machine Learning Model is expected to be available in 2020, according to the authors of this paper. Deep learning has been proposed as a way to automatically identify that what foods must be provided to which patients based on their illness including different characteristics like age, weight, kcal, nutrients & fat content as well as sodium and fiber and cholesterol levels in the medical dataset on which the deep learning algorithm is built. Multi-Layer Perceptron (MLP), Gated Recurrent Unit (GRU), and Long Short-Term Memory are some of machine and deep learning techniques that they have established a study framework for (LSTM). Before employing deep and machine learning-based methods, IOMT data characteristics had been evaluated & coded moreover. Machine learning & deep learning approaches were tested, and the results show that LSTM performed best than other schemes in terms of consistency, retention, precision, & F1-measures for predicting.

In the beginning, a medical dataset was gathered from the

internet and hospitals, which had 13 characteristics of various illnesses and 1000 goods. Analyzing and encoding the characteristics of IOMT data was accomplished via the use of machine learning methods such as logistic regression. Prior to providing input to the suggested model in research, non-numeric data was transformed into numerical information prior data coding is conducted. The random forest technique was used to do regression and classification tasks. Classifiers such as Gated recurrent unit (GRU), Multilayer Perceptron, Recurrent neural networks, & Long short term memory have been employed in a deep learning model by researchers. Deep learning algorithms have been evaluated for model performance. A favorable outcome was found in terms of accuracy, recall, & F1 metrics for LSTM and GRU) models.

The study shows that existing system was supportive for patient suffering from various kind of illnesses and in proposed system we include new feature like voice based food recommendation to help old age people and physically challenged people so that they make use of the system in affordable way.

[2] XING DONG WU et.al. in the year 2021 have projected an IOT enabled real time health monitor system. In paper researchers focused on real time health monitoring of athletes, to provide a good health for athletes they have presented a deep learning solution to design a program

In order to extract useful information from wearable medical devices, suggested system employs multiple deep learning methods. Sanda athletes have served as case study for this aim. Even if doctors are gone, deep learning algorithms assist physicians accurately diagnose such athletes' ailments and provide the correct prescriptions.

Parts of developed framework are broken down into 3 categories. Wearable sensors, which are connected to athlete's body, gather data on a regular basis. Other components include monitoring equipment as well as wireless communication relay network. Using tinyos data fragment & retransmission, the researchers in this report have developed low-power wireless relay network & refined sensor operating system architecture. Researchers have introduced the DNN model which includes two algorithms Data noise reduction algorithm and model optimization algorithm. Removing unnecessary components and ensuring that the original data's fundamental information isn't lost is critical to data noise reduction algorithms. There are a wide variety of linear & logistic regression apps that can benefit from Gradient Descent algorithm (GD). Step-by-step iteration is used by GD method to obtain minimal value. The method optimizes both speed and stability of training.

As a result, a wireless sensor network that can be worn and walked on is used in this research to monitor wearable sensor device nodes. System raises critical issues, including computation cost, complexity and vanishing gradient. To overcome the issues, we have planned to design a system in a cost effective way and using other DNN algorithms to reduce the complexity.

[3] SANDEEP TEL et.al. in the year 2020 have proposed a system which monitors elderly/Blind patients' health through wearable sensors. They have designed a system to help elderly or physically challenged people to take medicines at proper time by providing reminders to such people regarding their medicines and giving them the instructions on correct time and amount. In the paper a health based on mobile app had been proposed. Doctors and patient caretakers may access the

patient's geolocation & pulse rate status through system. system proposed the access of patients' location and heart rate status by doctors and patient care takers. They have used IR sensor, touch sensor, gas sensors and temperature sensor to collect the data from a patient. APR module is used to store voice which are used to instruct the blind elder person. It is a low-cost high- performance device in which record/replay of the IC occurs. Even after the power supply is removed from the module, the recorded sound is retained.

Researchers have used NextnodeMcu to connect all the devices and sensor through Arduino which is of 16 pins. It is a wi-fi device and includes a firmware that runs on ESP8266 Wi-fi. It is a low cost and an open source device. NodeMCU provides access to General Input/output pins. Telegram is used to send the alert message to the caretaker, Users can interact with the bots by sending messages. In this project, telegram bots are hosted on server and utilize telegraph Bot APIs for connecting to messenger clients. To give strength for keep an eye on the everyday activities for elder person, automated application is suitable.

The system has only focused on reminding people to take tablets in the form of alert messages for elderly or visually impaired people and also helpful for people to control the patient health remotely but system fails to give any other better food recommendations for the betterment of the patient health.

[4] K. HARI KISHORE et.al. In 2019, a smart health monitoring warning gadget based on the Internet of Things (IoT) is expected to be introduced to monitor human pulse sensor & warn system. If a person's heartbeat is irregular, a buzzer will sound as well as an emergency message will be sent to person's connections using Global system by Mobile. Wi-Fi-based microcontroller is used to link system to Thing Talk Cloud for data processing.

To keep track of a patient's past medical history, heart rate was employed as primary parameter in health monitoring system, which used IOT. The Arduino Uno microcontroller and the Node MCU ESP8266 are used to operate smart Health Monitoring Gadget to make it easier to use. Heartbeat pulses are used to acquire data in this paper, and that data is transferred to a cloud service called "Thing Talk" for future use like a medical history record.

An irregular heartbeat or other abnormalities in the patient's body causes the system to go into overdrive. The GSM module activates the system and sends the messages to the emergency contacts. As It is critical in medical practice to keep tabs on the patient's pulse. ATMEL's Arduino uno is used in the system design. Pulse sensor delivers the analog output of the heartbeat by putting the finger on the sensor. ESP8266 is Wi-Fi Based Micro controller and is controlled Soc the ICP/IP protocol with 9 GPIO pins. The LED blinks are registering the heartbeat count, and it's functioning well. The sensor is based upon that light modulation in blood that flows through neurological system with each heartbeat. As a GSM modem, it takes a SIM card. By using the GPRS network capability, which connects GSM devices to computers, a network connection may be established on a desktop or laptop computer. The characters of the heart rate are shown on the LCD 16X2 display. An auditory signaling device, the buzzer may be piezoelectric, electromechanical and informs the system in an emergency. It is a warning device. IOT What does the thing say? Thingspeak is an HTTP cloud that is used to submit and retrieve data in cloud using the API (API) Existing system has only focused on patients

with heart diseases and provide the solution in the form of alert messages. The system is useful for people who are able to understand the technology.

[5] HONEY PANDEY et.al. in the year 2020 have proposed IOT based health monitor system. To reduce coronary illness and handle the patient health researchers have proposed a machine learning solution for the IOT sensor data, by work of AI classifying & calculations. To analyze the information, researchers used machine learning methods such as the decision tree algorithm and the random backwoods classifier algorithm, which were applied using IFTTT readings from a sensor in a Google Sheet. The heart rate was measured by means of a heartbeat sensor. It's a great sensor for Arduino since it's easy to install and fit. The sensor is attached to fingertip then expands directly into Arduino board. The open-source monitoring tool it joins also shows your pulse in verified time on a graphic representation of it. SVM, Nave Bayes, Decision trees, and KNN algorithms were among the machine learning classifiers used by the system. Patients' data was gathered and utilized in machine learning methods for 40 samples. With the aid of an arduino and a pulse rate sensor, the system uses the internet of things to capture real-time patient data. People's heart disease was predicted using machine learning techniques.

Support vector machine methods provide best accuracy & prediction based on patient data. The KNN technique has precision of 78%, SVM has an precision of 86%, the random forest classifier has an accuracy of 83%, the decision tree has an accuracy of 74%, and the nave bayes algorithm has an accuracy of 83%. As a result, when compared to all other methods, support vector machine (SVM) has the best accuracy. In the early stages of cardiac disease, the suggested hardware and software solution assists patients to forecast. It will be useful for mass screening in rural areas where there's no medical amenities. To make the predictions more accurate, the proposed system makes use of the deep learning model to achieve the better accuracy results.

[6]. PRATIKSHA ASHOK.NAIK in the year 2020 have proposed an Intelligent Food Recommendation System. The consumer's purchasing habits are influenced by product's recommendations. Product reviews and rankings may be used to make recommendations. Deficiency in any of these nutrients may lead to serious health issues, therefore it's important to eat a well-balanced diet. Researchers in this work presented a recommendation system that is trained upon that suggestions obtained by customers who have previously tried the product. Using data from other customers who have purchased and used a similar product, software makes a recommendation to the customer. Deep learning and genetic algorithms are used in the suggested recommendation approach to get most accurate results.

For the purpose of making recommendations, the TESCO dataset was culled by the team. It is possible to get particular terms from a collection of reviews by using methods such as data cleansing, tokenization, frequency calculation, and product feature frequency, all of which can be found on well-known websites like Amazon, MouthShut.com, and Flipkart. As a result, the data we need for our project comes from these methods. To classify the user's nutrition gainers, like salt,

protein, sugar, fat, etc., the user is presented with a series of questions at the user logged-in page. The user receives a rating based on the options selected, with the greatest ratings going to one or more nutrient gainers. Thus, the product is suggested to buyer's liking based on this information. Genetic algorithms, a deep learning method, was employed to filter the data. The categorization data is sent into a genetic algorithm. Cleansing, tokenization, and periodicity calculations are all performed by the method. The association between product and the customer is established by the Genetic Algorithm.

For the time being, the system makes food recommendations to users based on their genetic risk for heart disease, diabetes, and hypertension. for making this system as real-time as possible, the proposed system makes use of IOT sensors and a deep learning model to make these food recommendations to users.

[7]. ABHAYKUMAR SAHOO et.al. A deep learning-based health recommendation system has been suggested for the year 2019 Big data analytics with recommender systems play an essential part in patient health decision-making processes in the healthcare industry. This study proposes an intelligent system combining Restricted Boltzmann Machine (RBM)-Convolutional Neural Network (CNN) deep learning, which offers an insight into how big data analytics may be utilized for the creation of an effective health recommender engine, and demonstrates an opportunity for the health care sector to move from a typical scenario to a more customized paradigm in a tele-health setting.

For example, the patient's interests, ratings and selections, or the item's behavior may be dynamically collected and filtered by the filtering-based system. A patient's profile or an item's profile may be used to build this system. An item-based collaborative filtering-based health recommender system is described in this research, which offers useful information to patients based on the item's profile. Numerous social media and digital forums are now available on the internet, allowing individuals to share their thoughts and viewpoints on a wide range of items and services. Recommender systems use patient ratings to make recommendations for patients who haven't given any ratings for any product. It has been hypothesized that In order to make predictions, the content-based filtering approach evaluates things based on their characteristics and qualities. A patient profile is used to provide a suggestion based on the various features of products and the patient's past purchasing history. Positive, negative, or neutral ratings are given by patients in order to express their preferences. Using this method, patients are given recommendations for products with high patient satisfaction ratings. A patient-item grid of preferences or likes for items created by patients is used in collaborative filtering to forecast unknown outcomes.

By analyzing and comparing all the approaches with proposed RBM-CNN method, the proposed method gives better accuracy considering two error measures such as RMSE and MAE. The integration of an RBM with CNN in a deep learning environment provides a better recommendation quality for choosing a hospital for a particular patient.

Table.1: Methodology and Accuracy Results

Sl.no	Methodology Used	Description	Percentage of Accuracy	References
1	SVM	The SVM is an AI characterization calculation which has been for the most part is utilized for arrangement issues.	86%	[1] , [5]
2	Naive Bayes	The Naïve's Bayes is a grouping regulated learning calculation.It utilizes the preparation dataset to discover the restrictive likelihood esteem of vectors for a given class. NB is utilized for content concerned issue characterization.	83%	[1] , [5]
3	KNN	K-NN is an overseen learning game plan computation. K-NN estimation predicts the class name of another data.	76%	[5]
4	MLP	This is a feed forward neural network which has many hidden layers in which perceptron uses the arbitrary activation function. The auto-encoder is a model based on unsupervised learning which attempts to regenerate its input data in the output.	92%	[1],[7]
5	LSTM	The long short term memory (LSTM) is an architecture or model which performs a memory extension for the RNN. 3 layers LSTM with batch size 32 and sigmoid function is used for activation. For optimization adam function is used.	97%	[1]
6	GRU	It performs more efficiently and unlike the LSTM, it trains models faster. The model is can be easily manipulated and modifications are easily done on the model.	96%	[1]

The system only focused on people choices and preferences through social media platform. It did not consider the current health condition of a patient or person, to overcome these issues proposed system designed to integrate IOT and deep learning model to help in a best possible way.

Summary of a survey includes some of the existing systems related to IOMT based health monitoring system [1] which uses sensed medical data and product features to recommend a good diet for patient by implementing deep learning methods like LSTM, MLP, GRU achieved a good accuracy rate for LSTM and GRU with 94% of accuracy. IOT based health monitoring system [5] to reduce the coronary illness of a patient using machine learning techniques like SVM with 78% of accuracy, random forest classifier has an accuracy of 83%, naïve bayes has an accuracy of 83%. A deep learning based health monitoring system [7] use big data analytics with recommender system, the study includes Restricted boltzman machine RBM and CNN focusing on people choices and their preferences on social media platform.

Researchers have developed a health monitoring system [2] for athletes using wearable sensors and deep learning methods like Gradient Descent algorithm, as per the study system

raises some critical issues including computation cost and complexity. An Intelligent food recommendation system [6] using product reviews and rankings gives a good product recommendation for the user. A voice based health monitoring system [4] to monitor patient health and consider heart rate as a primary parameter. System alerts user using Thing talkcloud if any irregularity in the heart rate. Some of the researchers designed a system to help elderly/blind patient's health through wearable sensors and system will remind patients caretakers to follow the medications suggested by the doctors using telegram bot, to store the voice message have used APR module to instruct the blind patient.

Reviewing various existing papers regarding food recommendation and health monitoring, proposed contents of the paper can be helpful for people by giving the solution in

real time. A proposed system includes IOMT and deep learning methods to produce the result in the form of voice.

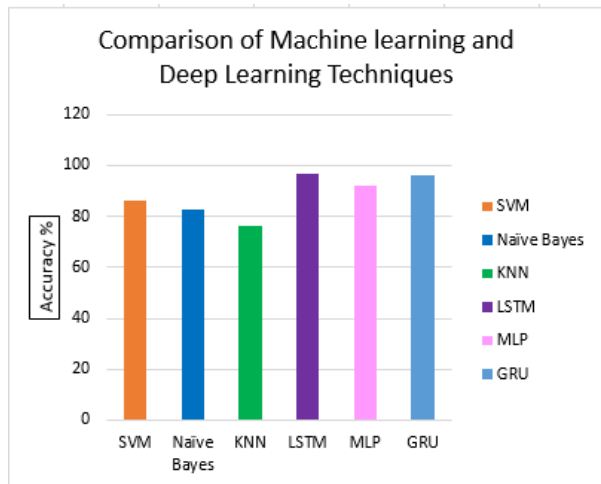


Figure:1 Comparison of techniques based on their Accuracy

By referring to the above Figure 1 and Table 1 and relevant work it is concluded that the Deep Learning algorithms achieved a good accuracy than the machine learning algorithms.

3. CONCLUSION

An automated IOMT assisted system could grow endurance, protection against sickness in future, also enhance living standards. It evaluates the performance of the various deep learning classifiers. It provides the best solution for the problem. It also monitors patient health conditions continuously to give the better health. A voice based recommendation system will fulfill the people health needs in a better way. Initially this Literature survey includes various research papers related to IoT assisted healthcare system and some of the papers include the survey on deep learning models, machine learning model and various algorithms and methodologies. In the survey we have gone through many existing systems include food recommendation, diet recommendation systems for patients, menu planning system for adults, IOMT assisted health monitoring systems and food recommendation systems for individuals suffering with chronic illnesses, diabetes & they are implemented by deep Learning Models & Machine Learning models. An existing system is in the study they have used machine learning model and deep learning model to implement system. As considered to patient diseases or illness, the main reasons are unhealthy diets, food patterns and not aware of their body conditions and these conditions may lead to further diseases or bigger problems in order overcome these issues our proposed system come up with a solution which integrate the IOMT and deep learning model in one system to recommend the correct food,

to monitor patients body condition and voice based recommendation.

In order to fill the gap in the existing system, The research incorporates the new features in to the system to provide features like voice based recommendation, continuous monitoring of patient health condition and also medicine suggestions of Ayurveda which are currently not present in the existing system.

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