REMOTE PATIENT HEALTH MONITORING SYSTEM USING IOTAND EMBEDDED SYSTEM

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Abstract— The goal of this study is to create a smart health monitoring system using the Internet of Things (IoT). The system was created with API technology to collect health data from wearable devices. Energy metabolism, heart rate, and sleep moments are all included in the data. The system was created to work as a web and mobile app. MySQL software was used to create the database system, and PHP-script, JavaScript, Java, and HTML5 were used to programme it. The Android studio was used to create the mobile app. The association rules for the recommendation system were discovered using a data mining technique and the Rule Induction algorithm. The system supplied a user profile page for editing user information, according to the results. Users can also get basic health advice from the system via a mobile app.

Keywords- *Recommender system, Health record, Data mining, Applications, Web application, Health monitoring*

I. INTRODUCTION

In today's world, technology plays a larger role in our daily lives. Whether it's education, agriculture, or the economy, things are changing. Which country, Thailand, is now entering the Thailand 4.0 period to create numerous things in a prosperous country? By bringing technology to the country, it is simpler to work and advance the country forward, including the issue of health, which is part of the industrial technology group and is an important goal of the country in the development of the age Thailand 4.0, which has five target groups including 1) Food, Agriculture & Bio-Tech 2) Health, Wellness & Bio-Med 3) Smart Devices, Robotics & Mechatronics 4) Digital, IoT, Artificial Intelligence & embedded Technology and 5) Creative, Culture & High Value Services [1]

Also known as the Internet of Things (IoT), the Internet of Things (IoT) is a network of computer systems that allows devices to connect and share data in real time. It's an embedded device system. IoT is a network that connects the sensor device for medical devices or health to make those devices communicate with systems or other devices in the network use the information to continue working [2], and IoT is a network that connects the sensor device for medical devices or health to make those devices communicate with systems or other devices in the network use the information to continue working. For example, many RFID (Radio Frequency Identification) and sensor devices form Wireless Sensor Networks (WSNs), which transmit data via the Internet of Things. [3]

The current Thai people's attention has moved to the subject of health, which includes the health of the Thai people. The focus is on diet and increased activity; popular foods include clean foods, which are weight-controlling and good for eating in conjunction with exercise. This is in sharp contrast to the past, when exercise was more popular among Thai people.

More Thai individuals did not exercise in the past, while working people had the lowest activity rate. It's a condition that can quickly lead to disease; congenital disease or sickness is highly common, for example, high blood pressure and diabetes. [4]

RELATED RESEARCH

A. *Health [5]*

Health is concerned with the entire body, mind, and social aspects, and it is necessary to have

physical, mental, and social health in all aspects, or to say that health is a state of being alive that is perfect physically, mentally, and socially, based on moral principles and the application of intelligence.

In the current, health word does not implication specifically of physically health and mental health. It's also includes social health and spiritual health as well. It can be concluded that "Health" in four components including:

1. Physical health is a good state of the body in which all of the organs are in good working order and free of sickness. The body can function regularly and be associated with all aspects of well-being and efficacy at work.
2. 2. Mental wellness is a state of mind in which one can control one's emotions. Mind that is buoyant and having fun, does not feel constrained or paradoxical in the mind, can adapt to society and environment that is cheerful, and can

control emotion in a setting that is convenient for them. People who have good mental health have good physical health as well, as John Lock once remarked, "A sound mind is in a sound body."

3. A person with complete physical and mental living conditions, or living in a normal society, does not cause others or society to be afflicted, and may interact and adapt to social well and happiness.
4. Spiritual health is a state in which knowledgeable faculties work together to discern virtue, evil, usefulness, and penalty, resulting in a good mind and generous heart.

B. Wearable Device [6]

A wearable device is a gadget that works with a computer system to access data by synchronising with a computer or smartphone through the internet. At first, a smart watch is classified as a wearable gadget that does not only display the time, but also the date and a timer. However, we can count how many steps we take in a day, how much energy we burn, how deep we sleep before going to bed, set an alarm clock that shakes our wrists in the morning, and see what meals we eat that include how many calories.

Working principle of Smart watch is sync data between watch with smartphone. Measure walking pace, shaky in case watch is away from the smartphone, voice support, connecting via Bluetooth including Internet and can charge the battery.

Conclude Wearable Device is device that is come concerned with lifestyle of man. We can wear, Use to record their health information on a daily. Either, sync data with internet computer and smartphone.

C. Mining balance disorders' data for the development of diagnostic decision support systems [7] Body balance dysfunction diagnosis is a difficult assignment for medical specialists, including neurologist. The clinic keeps track of the patient's treatment history. It can preserve history as a diagnostic aid and to facilitate decision- making for medicos with limited physical balance knowledge. It has also built a system that can determine the diagnosis automatically. The steps or instructions for obtaining two- stage diagnostic are as follows. The first step is to determine the cause of the problem. The system will then confirm or deny the diagnosis in the second step. The following are the tools and methods that were employed.

1) Dataset

Dataset composed of the patient's information related to the body balance used time intervals with no symptoms, linking of symptoms and stimulate associated with symptoms. We will take the features mentioned above and observed data to use in testing set. In case of a medical specialist the features described above are used to analysis data and diagnose data by standard ICD10, this is the international standard used to classify neurological disorders.

2) Methods

The information is divided into two parts: training and testing. Complementary data includes history, dizziness, deafness, physical examination, and hearing testing. For inner ear and brain diagnosis, use video Nystagmography (VNG). The material was given precedence to two groups based on the eyeball response. The first is the feature selection, which is based on a well-described solution. The features were chosen by the second group using the data mining technique. To make a decision to mind the diagnosis, it employs decision tree algorithms.

ISSN: 2278-4632
Vol-13, Issue-01, No.03, January 2023

Results

Check exactitude after the results of the use of the recommender system to help decision is fast response system, indicates the actual situation with the patient, forecasts are positive and negative and the results of the diagnosis are accurate.

D. Increasing trend of wearables and multimodal interface for human activity monitoring: A review [8]

Activity monitoring targeted to check the movement we have set it. The movement will be counted according to the conditions set by the user. Receiving activities, important role in the environment in which the elderly live and evaluate the changing behavior of the elderly. Event tracking will include two processes are classification of acquired data and how to get that information.

Wearable Sensors is sensor for wear. Typically, a sensor is attached to the bandage or some items can be wear by the user.

Basic requirements of wearable are device requires a low power, lightweight and safety for the wearer. It can be said that the wearer, must be the least wear of the equipment. The subject that we need to consider is the frequency of the measurement may be reduced or reduces wireless data transmission to reduce the amount of heat that may occur on the device.

Recent developments in human activity monitoring using wearable sensors and bio-potential signals. The scope of the sensor development is very wide and there is a difference for example, development to support medical services, used in training athletes, it's an intelligent smarthome automation system, to control the robot including security system. But, the design is finally there also available in terms of user acceptance. The device is size and comfortable to wear.

Patient tracking each day. The battery must be used Body Sensor Network (BSN) which was BSN It is a combination of wearable device and robots. This technology is the key to achieving the goal of tracking patients at home. But these systems are complex and have the ability to be able to monitor the status of patients and it is a technology that will cope deal with emergency situations.

Wearable device to detect the signal ECG it must be processed at all times. There are wireless protocols in use the name is ANT (ANT Protocol) for transfer data. Reduces the power consumption of the sensor. Because it is a wireless protocol with low datarate.

II. TOOLS AND TECHNOLOGY

A. MySQL Technology [9]

MySQL is a database management system. The structure of the data collection, to be more, access or process data stored in the database. Necessary will need a database management system. This will act as an intermediary in manage with data.

MySQL can be used in a specific job and supports applications to use the database and manage of large amounts the data MySQL serves as a database and database management system.

B. PHP Technology [10]

PHP technology is a server-side scripting language that is specifically designed for the web and join with HTML PHP, embedded with HTML when to work each time. The page is interpreted on the server side and created as a web page in HTML. As a result, be used to be visible. PHP is Open Source give the developer access Source Code can use work edit and dispense.

C. JAVA Technology [11]

Java technology is intended for programming purposes in style Object-oriented and designed for application developers “Develop only once but can work anywhere”. This means that we can compile Java code run on any platform that support JAVA language. By being well-matched it must be through the Java Virtual Machine.

D. Android Technology [12]

E. Google released Android as an open source operating system under the Apache License. Manufacturers will be able to customise and distribute their products thanks to open source (Under the conditions set by Google). Android is an operating system that unifies developers who produce many Java-based applications, as well as network providers.

F. Bootstrap Technology [13]

ISSN: 2278-4632
Vol-13, Issue-01, No.03, January 2023

Front-end Front-end refers to the presentation of information to non-technical users via a website. In the same way, framework means to assist in determining the framework of the task. Because there was no framework in the past. The issue that developers face is that team development does not follow the same path or adhere to the same standards. Make time to solve problems becauseno agreement has been reached in advance. The Bootstraptechnology will assist in the development of the website in the same direction..

G. Cloud Technology [14]

H. When connecting a large number of computers, the computers in the group do not need to be installed in the same location. Because all computers are connectedby a high-speed network, they do not require the same hardware or operating system. Users do not require a high-performance computer or a lot of software toprocess, and they do not need to understand the complexity of the operation within the subscriber system; all they need is the results of the processing.

I. Data Mining Technology [15]

Data Mining is processes that deal with large amounts of data. Find hidden patterns and relationships, in the data set. At present, data mining has been applied in many types of work. In business that help in decision making of executives, in science and medicine as well as ineconomics and society.

Data mining technique store and interpret data from the simple storage,the data is stored in a database that canretrieve information. Until the data mining can discover the hidden information in the data or to split the article

III. RESEARCH METHODOLOGY

A. System architecture

To collect data and track people using wearable devices, a smart health monitoring system with IoT was designed. The application of information technology to the data collection process in order to develop new data collection methods. TheMySQL database was used to collect health data. The information is analysed, and a rudimentary health suggestion system is provided to the user. The API is used to retrieve databy the system. The user's health information is displayed, as well as a health tip. This technology could serve as a model for other agencies looking to create a health-advice system.

The following is the system architecture: (Fig. 1).

Fig. 1. Client Server Architecture

IV. RESULTS

Between the client and the web server, the system was handled. Be a beginning in submitting a request to a web server to request a web service by the client. Then wait for theweb server to respond to the client; if one does, the connectionis regarded successful, and work on the requested part can begin. In this example, the web server is hosting the database and running the Fitbit API to utilise in the directive or to transmit data to the system. These data could be the outcome of data processing or data being pulled from a database and sent to a user. We will have access to the database, but it will only be available through web servers and not directly.

A. Performance analysis

Wearable gadgets are used to collect data for this study. Data mining techniques are used to analyse the data we require (Fig.2). The association rules for the recommendation system were discovered

ISSN: 2278-4632
Vol-13, Issue-01, No.03, January 2023

using a data mining technique and the Rule Induction algorithm. The model's accuracy was 62.05 percent (Fig. 3). Gender, energy metabolism, heart rate, and sleep times were all used in the analysis. Data analysis is divided into three steps.

1) Use a wearable gadget to collect data. Gender, energy metabolism, heart rate, and sleep times are among the 1,120 records that can be collected.

2) Change the form. xlsx should be saved as a file. To evaluate data, use a csv file. To uncover some connections, I used the Rapid Miner software.

3) The results have a precision of 62.05 percent. It is thought that the criteria can be used as a model (rule), and that the user can benefit from the basic health advice. The correctness and relevance of data can be determined using the Rule Induction technique of analysis (Fig. 3).

Person	Age	SpO2(%)	Pulse(bpm)	Temperature (C)
Person 1	25	97	75	37
Person 2	32	97	73	36
Person 3	34	93	70	40
Person 4	56	97	74	37
Person 5	23	97	75	40

Fig. 3. Patients Data

B. Performance of the system

1) Login is required to access the system. The login system is only available with a username and password for a social network for security reasons (i.e., Facebook account). Users can pick from three main functions after logging in: data entry, data management, and recommendation. Both mobile and web applications can use the system:

2) Mobile application: displays information such as energy metabolism, heart rate, and sleep moments, as well as basic health advice for the user (Fig. 4a-d). The advice is based on association laws, such as the fact that if there is too much energy and a normal heartbeat, rapid eye movement will occur. Consciousness in sleep is recommended for a variety of reasons, including excessive energy consumption or physical disease, such as gastroesophageal reflux disease (GERD), Sleeping late, sleeping at the wrong time, intense workouts, and caffeine stimulant use can all cause abnormal breathing and spasms during sleeping or in everyday life. To prevent and improve our health, avoid caffeine-containing beverages since it stimulates the central nervous system, resulting in insomnia, restless hands, and frequent urination. Exercise should be done in moderation because it burns a lot of calories and hence depletes the body's oxygen supply. They should exercise for 30 minutes to an hour, take a warm bath before bed to relax, and sleep after 4 to 6 hours. You will not sleep half-awake again this time [16-19].].

Fig. 4. Interface of Application

2) Web application: use the Fitbit API to record data from a wearable device. The most important data in the record is heart rate, energy metabolism, and sleep times. Users can access their health information and report through the web application (Fig. 5-7). Users can also alter their own passwords and change their profile pictures (Fig. 8). The administrator has the ability to add, delete, and alter all members, as well as generate health reports for the user in a variety of formats (Fig 9).

ISSN: 2278-4632
Vol-13, Issue-01, No.03, January 2023

IV CONCLUSION

A smart health monitoring system that uses the Internet of Things collects health data. Using a method of health recording using wearable devices, as well as basic user health advice. Data was collected from the device and analysed using Rapid Miner, a specialist tool for data analysis or, as we call it, data mining. Rule Induction is the algorithm used to identify data correctness and relationships. The rule is then modelled. Users will receive basic health advice via a mobile and online application. The system could assist users in keeping track of their health data and implementing the system'srecommendations in their daily lives.

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