

Accurate Monitoring Technology of Core Body Temperature of "yunwentie" Human Body Based on TRIZ Theory

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Abstract. Novel coronavirus pneumonia is a new type of core body temperature measurement product. Methods using TRIZ theory, the problems of existing temperature measurement methods in China were analyzed. Using the corresponding invention principle, solve the relevant problems of thermometer in clinical use, and put forward innovative solutions. Results according to the innovative design idea of TRIZ theory, it was applied to the new human core temperature measurement product. Novel coronavirus pneumonia is difficult to achieve the current core temperature monitoring of new crown pneumonia epidemic. Conclusion the application of TRIZ theory to the research and development of new human core thermometer products defines the improvement direction of thermometer, and puts forward a feasible scheme for the design and development of new human core thermometer products.

Keywords: TRIZ, Accurate core temperature detection, The thermometer, Innovative design.

1 Introduction

At present, there are various thermometers in the domestic market, such as mercury thermometer, electronic thermometer, multifunctional infrared thermometer and so on. Mercury thermometer is the most common one. It is cheap and can be measured at any time without external power supply. It is deeply trusted by people, especially medical workers. However, the traditional mercury thermometer is not environmental friendly, difficult to read and unable to record data, which is inconvenient for patients with acute and serious diseases, the elderly, infants and so on [1]. The electronic thermometer displays the body temperature in digital form by using the determined relationship between the physical parameters of some substances (such as resistance, voltage, current, etc.) and the ambient temperature. The reading is clear and easy to carry. Its disadvantage is that the indication accuracy is affected by factors such as electronic components and battery power supply [2]. The multifunctional infrared thermometer can measure both ear temperature and frontal temperature. The dual function mode can be used in different situations. The defect is that the infrared thermometer is a non-contact thermometer, which is greatly affected by the environment. If there are obstacles such as hair or liquid at the measuring part, the measurement result deviation

is too large [3]. The above existing temperature measurement methods can not quickly and accurately realize the real-time statistics and processing of group body temperature data. Based on the requirements of clinical and health monitoring, the operability and signal characteristics should be considered in the instrument design to simplify the system structure and portable design. The existing conditions can not achieve non-invasive body surface nondestructive measurement of core body temperature. The existing thermometer has large errors, which brings inconvenience to clinical research and disease diagnosis, treatment and nursing.

2 TRIZ theory

In the most popular sense, innovation is the process of creatively discovering and solving problems. The powerful role of TRIZ theory is that it provides systematic theoretical and methodological tools for people to creatively discover and solve problems.

The modern TRIZ theoretical system mainly includes the following aspects:

1. Innovative thinking methods and problem analysis methods
2. Evolution law of technological system
3. Technical contradiction resolution principle
4. Standard solution of innovation problem
5. Invention of problem solving algorithm Ariz
6. Knowledge base based on physics, chemistry, geometry and other engineering principles

After more than half a century of development, TRIZ theory has developed into a mature theory and method system to solve the practical problems of new product development. It has strong practicability and has been tested in practice. Its application field has also expanded from the field of engineering technology to management, society and so on. TRIZ theory has received great attention in western industrial countries, and the research and practice of TRIZ has been popularized and developed rapidly. Now it has achieved significant benefits for many well-known enterprises. Practice has proved that the use of TRIZ theory can greatly speed up the process of people's invention and get high-quality innovative products. It can help us systematically analyze the problem situation, quickly find the essence or contradiction of the problem, accurately determine the problem exploration direction, help us break through the thinking obstacles, break the thinking set, analyze the problem with new vision, carry out systematic thinking, predict the future development trend according to the law of technological evolution, and help us develop competitive new products. This paper will analyze the research and development of new human core temperature measurement products through innovative thinking methods and problem analysis methods, and determine the preliminary idea and final scheme by discovering the core problems and fundamental contradictions [4].

3 Analysis of TRIZ theory

3.1 Problem description

At present, the most common types of thermometers used in clinical diagnostic research and nursing work are mercury thermometer (Fig.1a), electronic thermometer (Fig. 1b), followed by multifunctional infrared thermometer (Fig. 1c).

Mercury thermometer: it is easy to break and may be polluted by mercury; The measurement time is relatively long, which is inconvenient for patients with acute and serious diseases, the elderly, infants and so on. Electronic thermometer: the indication accuracy is affected by factors such as electronic components and battery power supply (Fig. 1 D). Infrared thermometer: non-contact thermometer, which is greatly affected by the environment. If there are obstacles such as hair or liquid at the measuring part, it is easy to affect the measurement results (Fig. 1 E).

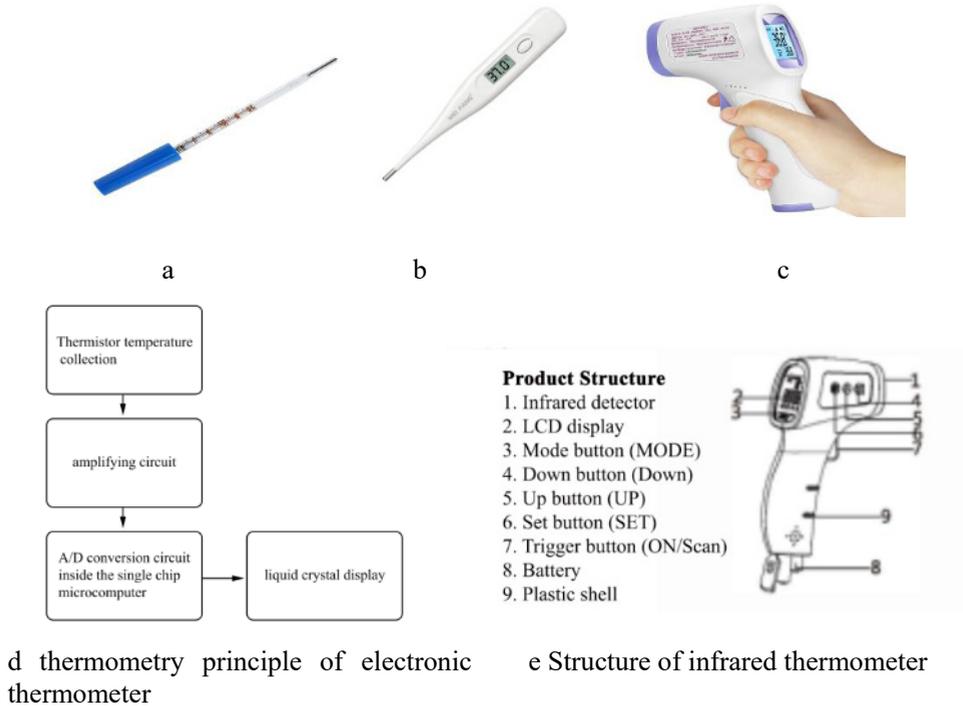


Fig.1a mercury thermometer

Fig.1b electronic thermometer

Fig.1c multifunctional infrared thermometer

Fig1d thermometry principle of electronic thermometer

Fig 1e Structure of infrared thermometer

3.2 Problem analysis method

Problem analysis method is a systematic method to find out the problem and determine the cause of the problem according to the thinking process of solving the problem.

According to the thinking procedure for solving problems, the general steps of problem analysis are:

The first step is to identify the problem;

The second step is to further analyze the problem;

The third step is to explain what is deviation and what is not deviation, and ask questions;

The fourth step is to find out various factors that may lead to deviation;

The fifth step is to confirm what is the real cause of the deviation from the above factors, and check and verify it.

Following the thinking process of solving problems, the first step is to put forward problems; The second step is to clarify the problem stage; The third and fourth steps are the hypothesis stage; The fifth step is the hypothesis testing stage [5]. According to the problem description, the disadvantages of the current common thermometer are analyzed, and the figure shown in Figure 2 is obtained:

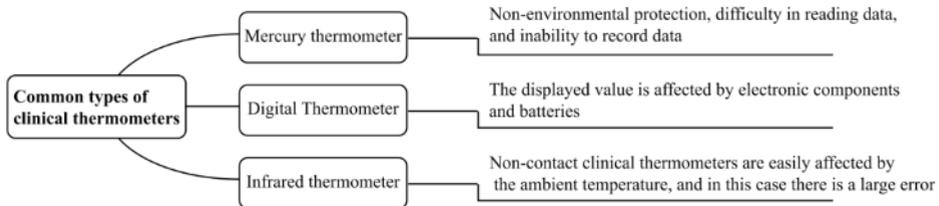


Fig. 2 Analysis of issues.

The problems are analyzed and discussed. ① ~ ③ describe the problems existing in the existing thermometer, which can be solved by using TRIZ theory. As there is no more accurate and systematic temperature measurement method, this product is based on the internet medical background and combined with big data to develop a new human core temperature measurement product - body temperature patch. Therefore, the research and development of this product mainly solves the problems that the existing thermometer is not accurate enough and it is difficult to systematically and dynamically monitor the changes of core body temperature and basic vital signs of the human body, makes up for the shortcomings of the existing temperature measurement methods, simplifies the nursing procedures, and makes the measurement more accurate, efficient and convenient on the premise of safe measurement.

3.3 Analysis of system functional components

The portable "cloud temperature paste" thermometer has obtained the patent certificate and carried out the preliminary sample research and development. The design uses a high-precision medical digital semiconductor temperature sensor for data acquisition, and uses a Bluetooth chip to wirelessly transmit the data to the mobile phone app. The mobile phone app can store and record the body temperature monitoring data, so as to monitor the temperature of the measured personnel within a certain period of time. Through the temperature curve display of mobile app, the temperature change and development trend of the measured object can be observed, so as to monitor the health status of the measured object. Compared with the traditional mercury thermometer, the system has fast temperature measurement speed, the data can be recorded and reproduced, and a health database can be established according to different measured objects to record the body temperature in different time periods. At the same time, the temperature measurement accuracy can reach ± 0.1 °C, meeting the requirements of temperature monitoring accuracy [6], as shown in Figure 3.



Fig.3.

4 TRIZ theory to solve the problem

4.1 Product introduction

The "cloud temperature patch" is a circular patch, which can separate or connect different external shapes. It is equipped with a shell protection to protect the internal technology chip of the product from damage. Combined with the developed big data platform, patients can measure themselves with only one patch. The measurement location is in the body surface projection area of pulmonary artery catheter. The monitoring is 24-hour continuous monitoring. Through the cloud platform, the data can be connected to mobile phones, community hospitals, doctors, etc., as shown in Figure 4.



Fig.4.

4.2 Application of inventive principles

(1) It is easy to observe at any time. If the temperature changes, it will cause color changes. Measures can be taken immediately to avoid aggravation of the disease and prevent it from happening;

(2) The product is light, easy to carry and easy to install.

(3) Compared with other temperature measuring tools, it is more economical to measure the same number of temperature measuring points.

(4) Avoid scraping, scratching, folding or high temperature during use and storage. If you are not skilled in stripping, you can tear it gently from the edge. Don't pick it randomly to avoid damage. The temperature measuring part pasted shall be relatively clean and can be cleaned or wiped with alcohol or other solvents, so as to paste firmly [7].

4.3 Product instructions

- ① Separate the patch at the bottom of the product and place it on the chest of the human body for data measurement. After about 3-5 minutes, remove the patch;
- ② Paste the patch back to the bottom of the product, and directly read the body temperature on the electronic display screen of the product in real time;
- ③ Connect the product with Bluetooth devices such as mobile phones to obtain more real-time monitoring data;
- ④ After multiple measurements, the system will obtain the change curve of the measured data and the analysis and comparison results. When the body temperature is too low or too high, the alarm will be triggered.

4.4 Determination of innovation scheme

The achievement of the new precise monitoring technology of human core temperature is called "cloud temperature paste", as shown in Figure 5.

The trend of novel coronavirus pneumonia is accelerating. The vital signs such as body temperature, respiration and pulse are of great importance for epidemic prevention and control, case selection, timely diagnosis and timely isolation treatment. In the physiological range of fever, the accuracy of peripheral thermometer is uncertain. The existing temperature measurement methods can not quickly and accurately realize the real-time statistics and processing of group temperature data. In order to solve this problem, the research and development of "cloud temperature paste" provides a more convenient and efficient service means for temperature monitoring of susceptible people. Dynamically monitor the changes of vital signs and inflammatory indicators of suspected cases, and accurate temperature measurement will guide the diagnosis and management of high-risk groups. Clinical diagnosis should learn from the core temperature of human body, so as to solve the problem of screening epidemic patients from the perspective of accurate nursing technology and timely diagnosis and treatment.

The novel coronavirus pneumonia is a novel coronavirus pneumonia portable intelligent early warning device developed by combining the large data platform developed by the enterprise with the most vulnerable and vulnerable groups. It is a new portable intelligent early warning device for rapid detection of suspected cases. It can quickly and accurately monitor the vital signs and inflammatory markers of suspected cases, and screen, diagnose, and diagnose new crown pneumonia patients. The evaluation of treatment effect in the process of treatment after diagnosis plays an important role in clinical guidance.

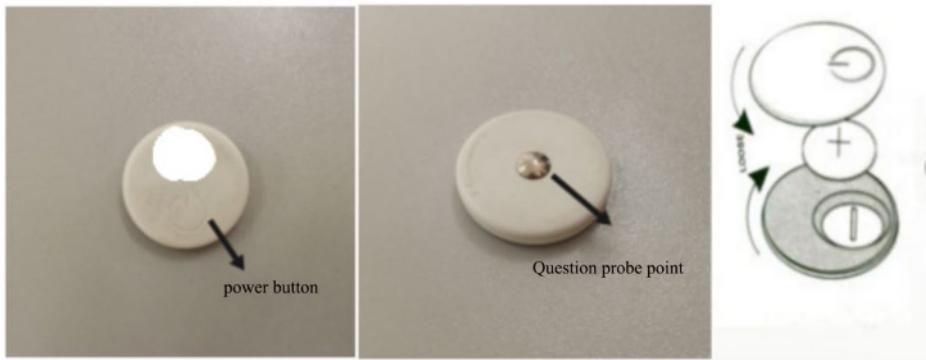


Fig. 5.

5. Discussion

TRIZ theory provides a series of innovative principles and methods to solve problems, and provides important ideas for the innovative design of body temperature paste. The innovative scheme solves the problems that the existing temperature measurement methods in China are insufficient in accuracy and safety, and can not meet the needs of clinical treatment and nursing. At the same time, it also improves the selectivity of temperature monitoring. It is suitable for various situations with simple and convenient operation and low complexity. It provides more accurate vital sign data and judgment factors for medical care, and reduces a series of diseases caused by the difference of body temperature. The patch does not use toxic chemicals such as mercury, which reduces the risk of mercury pollution. The innovative invention scheme has applied for a national invention patent.

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