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## Personalized Aromatherapy using Artificial Intelligence

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### Abstract

This paper proposes a personalized aromatherapy approach utilizing artificial intelligence and robotics. The methodology involves providing the patient with several types of plant essential oils, as determined by a physician, that possess therapeutic potential for a specific condition. Simultaneously, various polysomnography (PSG) studies are conducted on the patient using multiple sensors integrated into wearable devices. The impact of each essential oil is recorded at different time points and under various conditions. Ultimately, an intelligent system automatically designs a unique fragrance for the patient by combining the essential oils that demonstrated the most significant positive effects on their physiological parameters. This personalized fragrance is then provided to the patient for both its aromatic and therapeutic benefits. This research design aims to acquire various vital signs of patients using a single integrated wearable device instead of multiple diagnostic instruments, and to analyze these signals using a single processor. Furthermore, efforts have been made to optimize the device in terms of weight, size, and energy consumption to enable its portability and use as a wearable companion for the patient.

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**Keywords:** *Aromatherapy, Personalized Medicine, Personalized Pharmacy, Polysomnography (PSG), Artificial Intelligence, Machine Learning, Wearable Device.*

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## **1-Introduction**

The provision of personalized medical services represents a novel paradigm wherein drug prescriptions are tailored based on the genetic profiles of each individual [1]. Artificial intelligence and robotics have exerted a significant positive impact on the pharmaceutical industry, leading to enhanced speed and precision in drug production. Patient information can be extracted from their medical records and compared with the statistical data from clinical trials of other treated patients to design the most effective treatment approach [2].

Personalized medicine generates substantial volumes of data, which can be leveraged using deep learning algorithms to automatically prescribe appropriate treatments for each patient through intelligent systems [3]. Neural networks and data mining techniques can be employed to advance traditional medicines and develop innovative drugs [4].

By harnessing machine learning and artificial intelligence, it is possible to identify medications that are more suitable for a specific patient [5].

Supervised reinforcement learning can facilitate the establishment of a dynamic therapeutic recommendation system for prescribing the most appropriate medication for an individual patient. A patient's physiological parameters, such as blood pressure, body temperature, blood oxygen saturation, respiratory rate, and heart rate, can be fed into a neural network. Based on the weighting previously determined by an expert physician in the intermediate layer of the neural network, the type of disease can be estimated at the network's output [6].

Experiments have demonstrated that industrial products manufactured by robots exhibit higher reliability [7].

In intelligent drug delivery systems, the extent of response to various therapeutic agents is investigated [8].

Personalized medicine can be optimized with the aid of artificial intelligence to automatically determine the appropriate drug and dosage for a specific patient [9].

Based on each patient's response to medications, the optimal dose for each drug can be individually determined [10]. Several factors, including gender,

weight, ethnicity, and renal and hepatic function, can influence drug prescription [11].

Fuzzy logic can provide greater flexibility in determining drug dosages [12].

In aromatherapy, fragrant plants are utilized as therapeutic agents. Essential oils stimulate the olfactory sense, and the olfactory system transmits a signal to the brain. The limbic system, which is the locus of memory, stimulates the hypophysis and hypothalamus glands. This action induces changes in the nervous system and hormone levels [13]. Aromatherapy can improve sleep quality and reduce sleep disorders [14].

Polysomnography studies indicate that the simultaneous stimulation of olfactory and tactile senses in inhalational aromatherapy and aromatherapy administered via massage can prolong therapeutic effects [15]. Aromatherapy has shown superior performance compared to hypnosis in inducing relaxation for sleep and exhibits fewer side effects [16]. Furthermore, aromatherapy can be effective in treating amnesia [17].

In aromatherapy, different plant essential oils exhibit diverse effects. Several examples of the therapeutic properties of aromatherapy are highlighted below.

The most renowned plant in aromatherapy is lavender [18]. Lavender regulates blood pressure [19] and is beneficial in improving concentration [20]. Furthermore, lavender is effective in controlling heart rate [21] and possesses antispasmodic properties [22]. Aromatherapy with peppermint essential oil is beneficial in treating insomnia [23]. Peppermint is also effective in improving respiratory illnesses [24]. Aromatherapy with Damask rose is effective in reducing pain [25]. Rose regulates blood pressure [26]. Aromatherapy with ginger reduces nausea and vomiting [27] and is also beneficial in improving respiratory conditions [28]. Aromatherapy with tuberose essential oil alleviates joint pain [29]. Aromatherapy with Narcissus tazetta essential oil enhances memory [30]. Jasmine essential oil is suitable for pain reduction [31]. Sandalwood essential oil reduces anxiety [32]. Saffron flower essential oil is beneficial in treating depression [33]. Grape seed oil regulates heart rate [34].

## **1-1 Problem Soloution**

In the fragrance industry, various essential oils are combined in different dosages to create a wide array of perfumes. Similarly, by blending therapeutic essential oils, it is possible to formulate a type of fragrance that is beneficial for treating various ailments. This entails creating a unique perfume formulation for each individual, which, in addition to providing a pleasant scent, also serves a therapeutic purpose. To achieve this, it is necessary to investigate the effect of each essential oil on the treatment progress of the patient in question.

One comprehensive approach to examine the functioning of different bodily systems is through a series of Polysomnography tests. Studies on some patients undergoing aromatherapy have shown that they experienced more restful sleep [35].

Polysomnography is a comprehensive test of the body's physiological parameters, including Electroencephalogram (EEG), Electrocardiogram (ECG), Electromyogram (EMG), Electrooculogram (EOG), pulse oximetry, blood pressure measurement, body temperature measurement, and Actigraphy [36].

Actigraphy determines the time taken for the patient to fall asleep and the duration of each sleep stage [37].

To establish personalized aromatherapy with the aid of artificial intelligence, it is essential to expose the patient to different fragrances and evaluate the effect of each. This necessitates the design of a Polysomnography device capable of processing data from all its various tests. Information from each test should be sent separately to a processor. Thus, we will draw inspiration step-by-step from the previous research of other investigators who have worked on constructing each component of a Polysomnography device using an Arduino processor for data processing [38].

An ECG device capable of data processing can be constructed using the AD8232 board and an Arduino processor [39, 40, 41].

An EMG device capable of data processing can be constructed using the SEN-13723 board and an Arduino processor [42, 43].

A blood pressure measuring device capable of data processing can be constructed using the MPX5050DP board and an Arduino processor [44].

An Electrooculography (EOG) device capable of data processing can be constructed using the AD-620 board, an Arduino processor, and a Preamplifier [45].

A pulse oximeter capable of data processing can be constructed using the MAX30100 board and an Arduino processor [46].

A Body Temperature Meter capable of data processing can be constructed using the LM35 sensor and an Arduino processor [47].

An EEG device capable of data processing can be constructed using the Neurosky Brainwave board and an Arduino processor [48, 49].

The patient's respiratory volume can be measured using a Respiratory Belt and an Arduino processor [50].

The patient's snoring level can be measured using a microphone, an amplifier, and an Arduino processor [51, 52].

After constructing the Polysomnography device with the capability to process the measured data, it can be further improved using machine learning algorithms [53].

The next step involves ranking the essential oils based on their impact on the patient. The essential oils that achieve the highest scores will be involved in the process of creating the patient's unique fragrance. The selected essential oils will be combined, and the patient's specific perfume will be formulated. The dosage of each essential oil in the blend will be determined proportionally to the score it obtained. For the automated blending of essential oils, equipment is required that can add each essence to the mixture in precise quantities. An automated liquid bottle filling system can be designed using a conveyor belt, an infrared sensor, and an Arduino processor [54, 55].

The flow rate from the nozzle outlet of each essential oil can also be measured using a Flow Meter [56].

Due to the high sensitivity of this task, a high-precision, programmable syringe infusion pump should be used for injecting the essential oils. Each essential oil requires a separate infusion pump. Constructing such an infusion pump necessitates a Nema 17 stepper motor, a DRV8825 driver, and an Arduino processor to drive a Ball Screw axis [57].

This allows for precise control over the dosage of each essential oil in the patient's personalized fragrance blend. If all the devices employed in the intelligent personalized aromatherapy system are designed and

constructed within a unified setup based on the Arduino processor, it will not only enable online analysis and storage of data received from vital signs sensors but also offer significant improvements in terms of cost, power consumption, and occupied space compared to acquiring each device independently.

To compare the specifications of these devices, several well-known brands in the medical equipment

market, such as Datex Ohmeda, Nihon Kohden, Siemens, Omron, General Electric, Edan, Riester, Citizen, Micro Life, Beurer, Mindray, B. Braun, Benet, Teda, GSM, and Fresenius, were examined, and the average of the values obtained was used in this paper.

Table 1 shows the cost, power consumption and space occupied by different monitoring devices separately.

Table 1: Cost, power consumption and space occupied by monitoring devices

	Cost(\$)	Power(W)	Volume(ml)
Polysomnography	200	5	400
Electromyography	4000	8	6000
Electroencephalogram	9000	2	4000
Electrocardiography	8000	50	3000
Electrooculography	200	1	100
Actigraphy	1000	1	200
Blood Pressure Monitor	1000	6	1000
Pulse Oximeter	100	0.5	100
Thermometer	100	0.5	100
Respiratory Belt	100	1	2000
Infusion Pump	1000	15	3000

Figure 1 shows the power consumption of each of the monitoring devices.

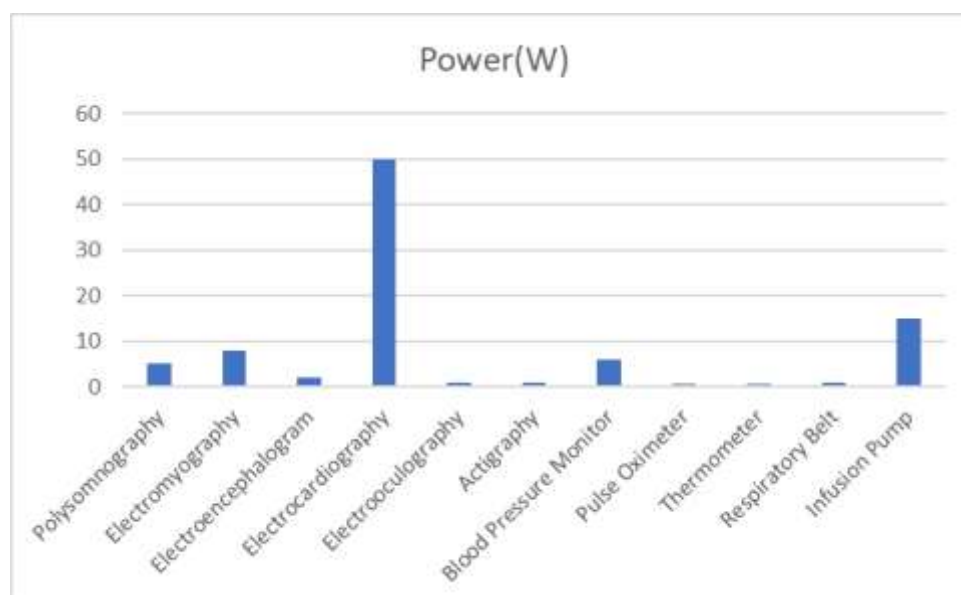


Figure 1: Power consumption of monitoring devices

Figure 2 shows the purchase cost of each of the monitoring devices.

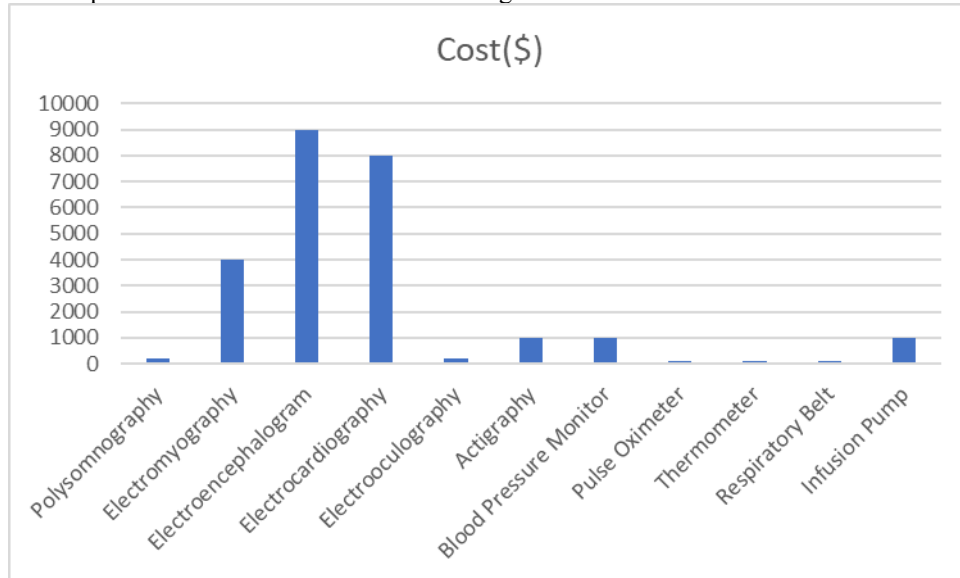


Figure 2: Purchase Cost of Monitoring Devices

Figure 3 shows the amount of space occupied by each of the monitoring devices.

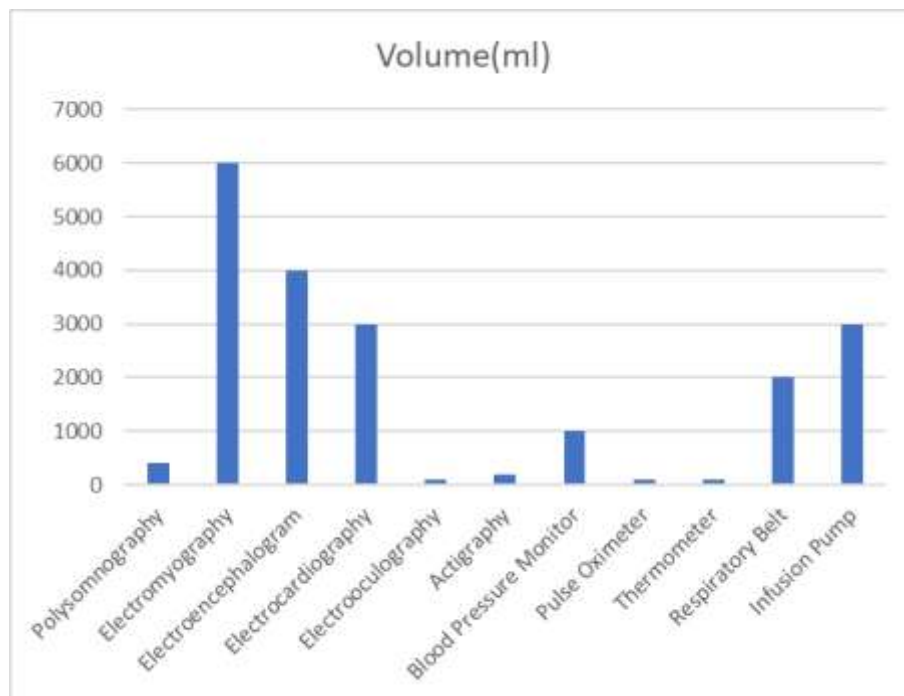


Figure 3: Space occupied by each of the monitoring devices

Table 2 shows the cost, power consumption and space occupied by each of the different modules of the Arduino-based smart personalized aromatherapy system.

Table 2- Cost, power consumption and space occupied by the different modules of the Arduino-based personalized aromatherapy system

	Cost(\$)	Power(w)	volume(ml)
SEN-13723	5	1	50
Neuro Sky Brain wave	200	1	100
AD8232	20	1	50
MPX5050DP	25	1	50
MAX30100	10	1	50
LM35	10	1	20
AD-620	20	1	50
Respiratory Belt (potentiometer)	10	1	100
microphone module	25	1	20
preamplifier	10	1	50
amplifier	10	1	50
linear ball bearing	25	0	100
hard chrome shaft	50	0	100
leadscrew	20	0	100
nema 17 stepper motor	30	5	100
stepper motor driver	30	5	100
power suply 100 w	30	15	300
Arduino mega 2560	30	6	100

Figure 4 shows the cost of purchasing each of the different modules of the personalized aromatherapy system based on the Arduino processor.

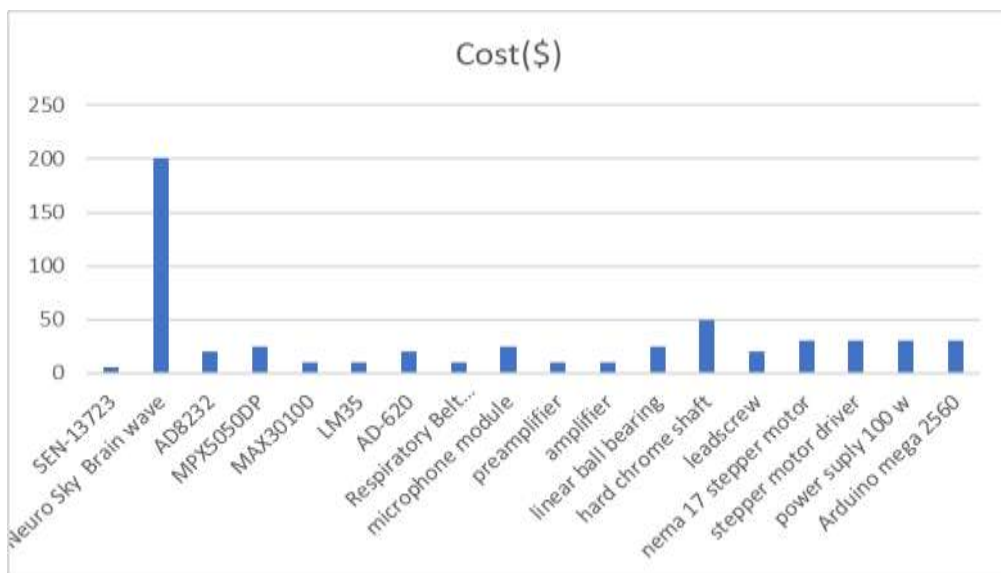


Figure 4: The cost of purchasing each of the different modules of the personalized aromatherapy system based on the Arduino processor

Figure 5 shows the space occupied by each of the different modules of the Arduino-based personalized aromatherapy system.

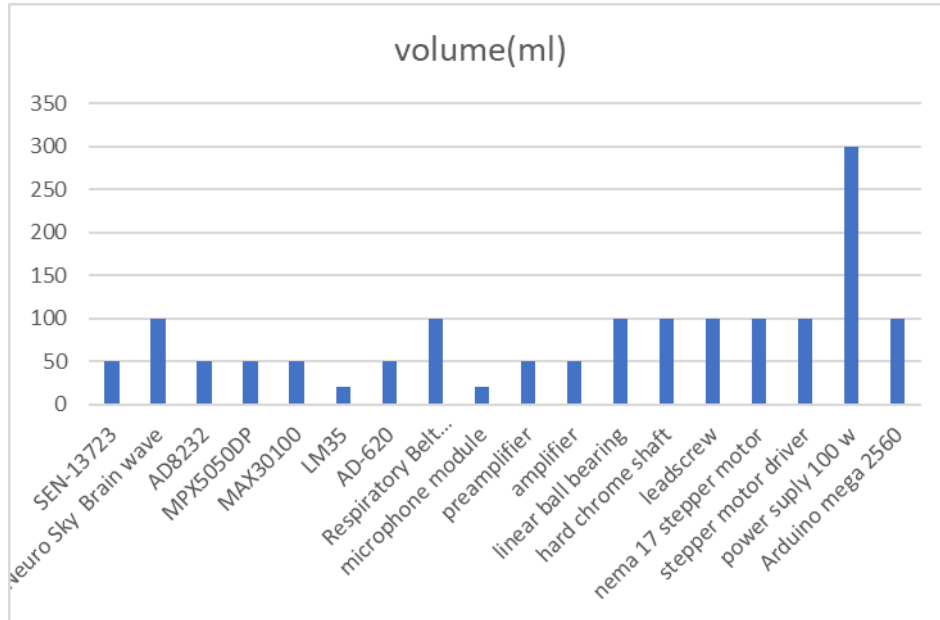


Figure 5- Space occupied by each of the different modules of the Arduino-based personalized aromatherapy system

Figure 6 shows the power consumption of each of the different modules of the personalized aromatherapy system based on the Arduino processor.

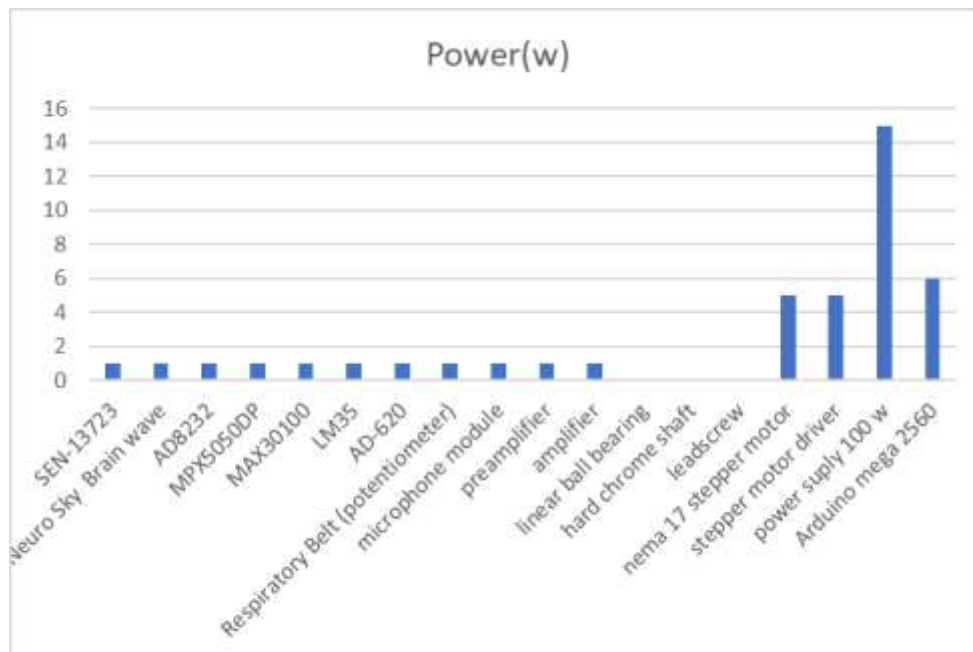


Figure 6: Power consumption of each of the different modules of the personalized aromatherapy system based on the Arduino process

Table 3 provides a concise comparison between traditional monitoring methods using standalone devices and the proposed wearable Arduino-based aromatherapy system.

Table 3- Cost, Power Consumption, and Space Requirements: Traditional Monitoring Devices vs. Arduino-Based Wearable Aromatherapy System

Feature	Separate Devices	Arduino-Based Integrated System
Total Cost (\$)	~ \$30,000	~ \$600
Total Power Consumption (W)	~ 150 W	~ 30 W
Total Volume (ml)	~ 25,000 ml (25 L)	~ 1,500 ml (1.5 L)
Wearable Capability	No	Yes
Data Analysis	Separate	Real-time & Unified
Database Storage	Not Available	Available

## 2-Conclusion

Administering medication to patients is often a difficult task, undertaken out of necessity, whereas most people are inclined to use perfume. If Personalized Aromatherapy is implemented with the aid of artificial intelligence and robotics, many patients could enthusiastically use their unique medication. To investigate personalized treatment for each patient and the effects of different essential oils on each individual across various times and conditions, it is necessary to create circumstances where a patient's vital signs and signals can be monitored without requiring hospitalization. The proposed design in this paper allows for the use of monitoring devices as wearable tools, occupying less weight and volume, and being portable by patients. Wearable gadgets have many advantages, Wearable technology has enhanced the quality of personalized medicine[58], Wearable sensors are a non-invasive way to continuously analyse vital signs[59], Recently, the use of smart sensors in medicine has gained popularity[60], Wearable devices have enabled more accurate monitoring of healthcare[61]. It is recommended that future studies explore the use of nanotechnology to enhance intelligent aromatherapy approaches. Nanofibers containing plant extracts prepared by electrospinning have a high specific surface area and small pores, which increases the possibility of drug absorption[62]. Electrospun nanofibers can be

effectively utilized for the enhanced delivery of personalized therapeutic fragrances. Due to their high specific surface area and the presence of controlled micro-pores, these nanofibers provide a greater capacity for the absorption and sustained release of plant-based aromatic compounds in the target environment. These characteristics significantly improve the bioavailability of active fragrance components while reducing their rapid evaporation. As a result, electrospun nanofibers can function as an intelligent fragrance delivery system, substantially enhancing the efficacy of personalized aromatherapy approaches. All monitoring devices can be integrated into a single device with a unified processor. This approach not only significantly reduces the power consumption of the devices but also enables real-time analysis of all vital patient data, along with the creation of a database for recording and analysing the big data received from the sensors.

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