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ADAPTIVE AND SMART CLOTHING FOR PATIENTS

SCRIPCENCO Alexandr[1], SCRIPCENCO Angela[1],
SCRIPCENCO Alexandr[2]
[1]Technical University of Moldova, Chisinau, Republic of Moldova
[2] Altmühlfranken Weißenburg Hospital, Germany
angela.scripcenco@dtt.utm.md

Conceptual design of hospital clothing is based on a study of the operating conditions, the identification of requirements for products and materials, and then carried out the selection of materials, next is the system analysis of products and functional-structural elements of the product, which ensuring patient comfort. From other hand adding some dispositive for monitoring physiological parameters of the body could increase life conditions to patients who are on long term rehabilitation by observing them in distance giving them possibility of home treatment.

Key words: *clothing for patients, conceptual design, system analysis.*

INTRODUCTION

The problem of ensuring patients' comfort during treatment and medical procedures has become relevant in many countries in recent years. The need for clothing adapted to operating conditions exists especially for patients who are forced to stay in bed during long-term treatment not only in hospitals but also at home. The range of hospital clothing is currently extremely limited, does not meet modern medical requirements, and has a negative impact on the condition of sick people. Modern hospital clothing should not only take into account the characteristics of the course of diseases and the conditions of its use, but also be functional, ergonomic and provide comfort to the patient.

It should be noted that foreign researchers are actively developing both new materials that promote faster recovery and functional hospital clothing that helps treat patients, creating comfortable conditions, this is especially important for patients under the supervision of medical personnel during long-term treatment. In such cases, it is important to provide the patient not only with comfortable clothing, but also to provide the opportunity for medical personnel to monitor from a distance. Modern scientific achievements allow us to consider clothing in a comprehensive manner, on the one hand, as a means of protection from the external environment, on the other hand, as a means of communication that allows you to transmit information about some physiological parameters of the body.

Modern achievements in physics, microelectronics and computer technology have produced a genuine technical revolution in the methods of research and construction of medical equipment for diagnostics and therapy. The methods of recording electrical signals are used to study skin resistance, total tissue resistance, respiratory parameters, arterial pressure, venous pulsation, blood oxygen

saturation, brain condition, mechanical processes in the body and other phenomena.

PURPOSE

The aim of this work is to design adaptive clothing for patients undergoing long-term treatment or rehabilitation. Such clothing should be based on the principle of flexible morphological structure, as well as the development of a portable ECG device for monitoring the patient's condition with an additional condition - the data should be transmitted to a third-party device via wi-fi or Bluetooth protocols, as well as its possible inclusion in a set of hospital clothing.

RESULTS AND DISCUSSION

Our numerous studies [1, 2, 3] show that providing comfort in clothing for patients with limited mobility is possible through the following means: creating a flexible morphological structure of the product (detachable back, “opening” along the side seams, “wrapping” the patient in the product); using complex textile structures in the product and bed linen; using additional elements (massage layers, chest apron, mittens, socks).

The solution to these problems is possible through the use of various design and technological methods that transform everyday clothing into the category of adaptive products for patients [6]. We have developed a set of clothes for bedridden patients after a stroke, consisting of a blouse-tunic and trousers [3]. A distinctive feature of this set is that the process of dressing the patient is transformed into a process of covering or wrapping due to the introduction of various design elements that make it easier to care for the patient when changing clothes. At the same time, patients undergoing long-term rehabilitation feel better at home among their loved ones, so they can be under remote control of medical personnel. In such cases, ensuring objective registration of the patient's physiological parameters is relevant and will reduce the costs of the medical institution for the rehabilitation of such patients. An objective factor for monitoring such patients is ECG.

Electrocardiography is a method of electrophysiological study of heart activity in health and disease, based on recording and analysis of the electrical activity of the myocardium, spreading throughout the heart during the cardiac cycle. Recording is performed using special devices - electrocardiographs. The recorded curve - an electrocardiogram (ECG) - reflects the dynamics during the cardiac cycle of the potential difference at two points of the heart's electrical field, corresponding to the places where two electrodes are applied on the subject's body, one of which is the positive pole, the other - the negative. Electrocardiographs are devices that record changes in the potential difference between two points in the heart's electrical field (for example, on the body surface) during its excitation [4].

The experimental part of this project consisted of designing and assembling all the necessary components for ECG recording. The connection diagram of the ECG components is shown in Fig. 1. The next step was to develop an application for Android ECG APP for data transfer. The application interface is aimed at ease of use, that is, even an inexperienced smartphone user can handle it. After the application is opened, you should press the CONNECT button and the application will automatically connect to the HC-05 Bluetooth module and the data will start to be displayed on the screen.

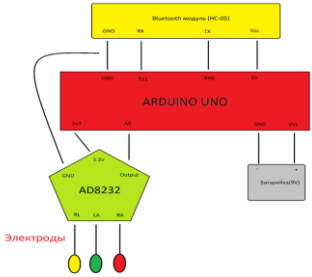


Fig. 1. The connection diagram of the ECG components

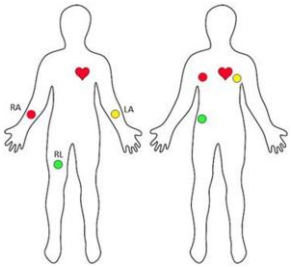
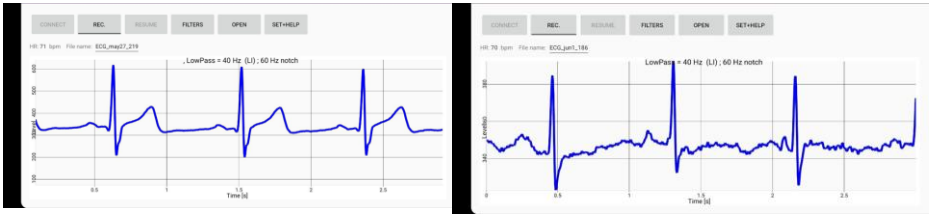


Fig. 2. Position of electrodes on the human body when connecting the device

After connecting our application to bluetooth, you should connect the electrodes to the human body as shown in Figure 2 and almost immediately the data will begin to be displayed on the display, this is possible thanks to the fast recovery circuit organized directly in the AD8232 module.



a b

Fig. 3. Experimental studies and approval of the installation ECG: a – a young man; b – an elderly man.

The registered parameters can be used to evaluate the heart's work: rhythm, state of the cardiac conduction system, contractile function of the myocardium. In particular: arrhythmia, myocardial infarction, flutter and fibrillation of both the atria and ventricles. The electrical axis of the heart, which can change due to external compression of the heart. It is possible to determine increased pressure in the pulmonary artery, pulmonary embolism. The AD8232 board also measures the pulse in parallel with the ECG. In the future, using the ECG recording function in the application, you can send the data to a specialist doctor, cardiologist, therapist, say from a district center to a city or republican hospital, for a better interpretation. You can also save files to track the dynamics of the disease, both positive and negative. But it is also worth considering that the assembled device is still not a medical device and for a better doctor's conclusion, the ECG should be done on a specialized, certified medical device.

CONCLUSIONS

Modern patient clothing is considered as a comprehensive solution of means that affect the quality of medical services, psychological comfort and well-being of

the patient. Designing clothing intended for use by patients during their treatment in hospitals or at home requires a special approach, since such clothing has specific requirements. Integration of electronic components for ECG recording will allow monitoring the patient's condition at a distance, which generally affects the patient's quality of life and optimization of rehabilitation costs.

Theoretical studies have made it possible to solve the problem of recording heart performance indicators, formulate a technical problem and identify means for solving it. Analysis of microelectrical systems has made it possible to develop a basic diagram of the device. Experimental studies have confirmed the hypothesis and allow recording heart performance indicators.

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SCRIPCENCO Al., SCRIPCENCO An., SCRIPCENCO Al.
АДАПТИВНИЙ ТА РОЗУМНИЙ ОДЯГ ДЛЯ ПАЦІЄНТІВ

Концептуальний проєкт лікарняного одягу базується на вивченні умов експлуатації, визначенні вимог до виробів і матеріалів; на основі цього здійснюється підбір матеріалів, проводиться системний аналіз виробів і функціонально-конструкційних елементів виробу, що забезпечують комфорт пацієнта. З іншого боку, додавання деяких диспозитивів для моніторингу фізіологічних параметрів організму забезпечує покращення умов життя пацієнтів, які перебувають на довготривалій реабілітації, спостерігаючи за ними на відстані та надаючи їм можливість домашнього лікування.

Ключові слова: *одяг для пацієнтів, концептуальний дизайн, системний аналіз.*