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ARM Microcontroller Based Portable Equipment For UV A&B Therapy.

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ABSTRACT

This paper deals with improved technique to cure skin diseases using UV A and UV B light. UV rays is equally essential as it is hazardous to humans. Deficiency of vitamin-D causes skin diseases due to insufficient UV exposure. UV A light and UV B light are used for treating skin diseases due to insufficient UV exposure. Equipment used for treating skin diseases consists of UV A light and UV-B light chambers separately. This is a tiresome process. To overcome this, we develop an equipment which consists of both UV A and UV B light. The proposed work provides portability and a single platform for both the lights and makes the treatment relatively simpler. Furthermore, we design the equipment so as to control the intensity and time duration of the light falling on the body. The results have proved that the timing and intensity of the light falling on the human body can be controlled according to our requirement and are accurate. The scope of this proposed work lies mainly in medical field.

Keywords: UV A and B therapy, Phototherapy, ARM microcontroller, Portable equipment, Intensity control, PUVA therapy.

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INTRODUCTION

Skin disease are most common form of infection seen in people of all ages. Skin disorders due to its irritation, ugliness and related hardships are one of the most difficult ailments to be cured especially when it is located in a sensitive place that is difficult and quite complicated to treat like face, neck etc.

Treatment for skin diseases using light as a source is termed as phototherapy. Personal exposure to UV radiations annually must be 5% to 15% for normal living people and it can reach up to 20% to 30% for people those who work mostly in external environment. Recommendation for our skin: 6 to 10% of body, 1 MED is sufficient to maintain required vitamin-D. But lots of people do not get the recommended amount of UV light. This work focuses on providing required UV exposure by shooting UV light on the patient's body. Normally UV therapy involves a chamber which contains number of similar UV lights of same wavelength. In this case the patient need to expose his/her entire body instead of exposing the particular affected part of the body. And there are two types of treatments in UV therapy classified by the lights used in the therapy. They are UV A and UV B therapy. Separate chambers are used for UV A and UV B therapy respectively [1].

In this proposed work, the person with the disease is made to expose the affected part of their body to UV A or UV B light according to requirement of the particular disease. This process provides the required UV exposure and in turn provides required amount of vitamin D. Various modes are installed for carrying treatment of different kinds of diseases. Each mode has its respective amount of intensity and time period of the light falling on the person's body. A serial printer is interfaced to this setup. The presence of serial printer facilitates the process of obtaining the details and a report of the treatment [2].

MATERIALS AND METHODS

Related Works

Farhad H. Mustafa, Mohamad S. Jaafar, Asaad H. Ismail, and Hend A. A. Houssein demonstrated phototherapy using laser light. 635 nm wavelength lasers are used here. Mostly Red laser is used because red laser transport in biological tissue is mainly scattering dominated than absorption. Dosages and wavelength selection may vary according to the treatment [3].

L.-L. Yang, Y. Tu, X. Zhang, H. Tolner, Y. Jin, P.-P. Zhang and B.-P. Wang proposed a technique called 'Laser Photo Therapy and Immunological Stimulation in Cancer Treatment'. This technique is used for treating cancers related to skin. Here different immunoadjuvants are used in combination with the laser therapy. Immunoadjuvants are those substances used along with the vaccines so as to trigger and improve the immune response [4].

C. Green, J. Ferguson, T. Lakshmipathi and B. E. Johnson developed a method for treating psoriasis using UV B phototherapy. Here UV B light provides sufficient amount of required UV exposure. Mostly UV B light of wavelength 311.2 nm is used since it has advantage of reduction in burning and carcinogenic wavelengths [5].

Hearn, R.M.R., Kerr, A.C., Rahim, J., Ferguson R.S., Dawe R.S. (2008) demonstrated phototherapy using narrow band ultraviolet B light. Typical treatment involves short exposure to UV B rays 3 to 5 times a week and repeated sessions may be required before the results are noticeable. When this treatment is used with psoralen, it turns to PUVA treatment. It consists of a process in which the patient is exposed to the UV A band of ultraviolet light usually delivered from the fluorescent bulb which is specially designed to output the respective frequency of ultraviolet [6].

Proposed Work

To cure the diseases occurring due to deficiency of vitamin D, we need to treat the part of the person's body using UV light. The treatment using UV light to cure skin diseases is termed as PUVA therapy. PUVA is an ultraviolet light therapy treatment for psoriasis, vitiligo, eczema, mycosis fungoides, cutaneous T-cell lymphoma, graft-versus-host disease and large-plaque parapsoriasis using the sensitizing effects of the drug psoralen. The psoralen is taken orally or applied to the skin, then the skin is exposed to UV A [7].

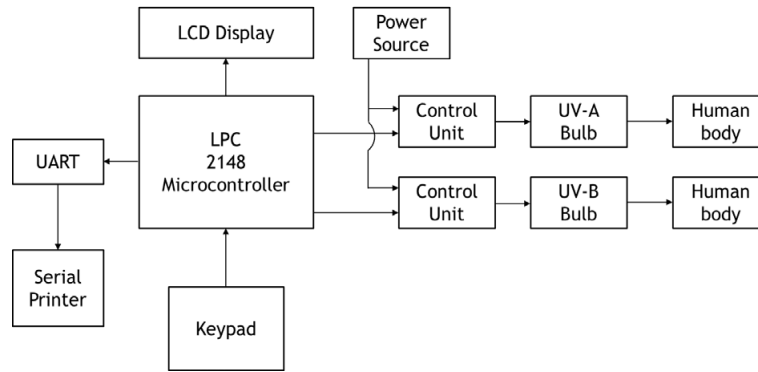


Figure 1: Block diagram of UV A&B Therapy

The aim of this paper is to reduce the complexity of PUVA therapy and make it portable. As mentioned earlier, UV-A and UV-B therapies comes in different chambers for treatment. We develop an equipment which consists of both UV-A and UV-B light. This provides portability and a single platform for both the lights for easy treatment of diseases.

Furthermore, we design the equipment so as to control the intensity and time duration of the light falling on the body. Since the use of UART gives the possibility to interface serial printer and presence of two 32-bit timer where one is used to timer PWM waveform which in turn is used to control the intensity of bulbs, we make use of ARM microcontroller which is the heart of the device [8].

As discussed earlier, modes used here are classified into basic and pre-set modes. In basic modes we can feed the values of timing and intensity according to our need. The basic modes are,

- Single mode
- Continuous mode
- Repetitive mode
- Super mode

In pre-set modes there are certain fixed default values which are used for common treatment [9].

How PWM waveform is generated?

LPC 2148 microcontroller consists of Timer Counter (TC) and set of PWM registers which are used to generate PWM waveform. PWM Prescale Register (PR) comes under the set of PWM registers. The formula used for finding the delay is

$$Delay = \frac{Y}{X * 10^6} \text{ Seconds}$$

Where Y = PR+1; Clock cycles of PCLK (Peripheral Clock Cycles) X ->frequency of PCLK

For an instance, if we consider PR=59 i.e., Y=60 and PCLK is running at 60MHz then X=60, then we get a delay of 1 micro-second exactly.

$$Delay = \frac{59 + 1}{60 * 10^6} \text{ Seconds} = 1 \text{ micro - second}$$

The delay obtained using PR is the respective delay required for TC to get incremented by 1 [10].

RESULT AND DISCUSSIONS

The coding for ARM microcontroller is developed using KEIL embedded development tool which includes the generation of PWM waveform code, which in turn is used to control the intensity of UV light. The output of the PWM waveform is shown below.



Figure 2: PWM output for 10% on time and 90% off time



Figure 3: PWM output for 30% on time and 60% off time



Figure 4: PWM output for 50% on time and 50% off time



Figure 5: PWM output for 90% on time and 10% off time

CONCLUSION

This paper has presented the improved technique for UV A&B therapy using LPC 2148 ARM microcontroller. The proposed work and its results shows that this work provides portability to the equipment and enhances the efficiency by shooting UV light with the required amount of intensity and time period. Various modes used in this work makes the treatment easier and effective. The serial printer interfaced is used to generate the report which can be used to analyze the data of treatment. This work finds its use in medical field where skin diseases are often observed and treated.

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