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A Review on Design of Smart Device for UV Radiation Measurement

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ABSTRACT- The sun plays an important role in our health, and too much sun exposure may cause anything from sunburns to skin cancer. Human skin cancer has become a growing health issue. Despite the fact that individuals are aware of the risks, skin damage caused by sunshine has risen in recent decades. The public nowadays relies on weather predictions to learn about UV radiation. For a certain broad region, the author offers rough or average predictions. To minimize the impacts of natural background radiation, this article provides a technique for calculating UV radiance utilizing UV sensors that detect the radiation and operate at a 300 nm wavelength. The sensor provides good detecting results at low and high UV levels, with response and regeneration durations of 22 seconds and 39 seconds, respectively. Using a Raspberry Pi and an LCD display, the author may also monitor and see the preventive steps that need to be performed.

KEYWORDS- LCD Display, Sensor, UV measurement, UV Radiation.

I. INTRODUCTION

Many people have died from skin cancer, as well as other cancers, in the past three decades. Skin cancer has become the most prevalent kind of cancer in the United States, with more than 3.5 million instances reported worldwide. This raises people's awareness of their vulnerability to Ultraviolet light, which really is mainly responsible for the characteristic tumor development. UV light is a natural major greenhouse gas that, at low levels, has a beneficial impact. Skeletal disorders caused by a deficiency of vitamin D, which the body synthesizes with UV, might improve if individuals could avoid all UV exposure. Because there are established links between Ultraviolet rays as well as skin pigmentation, the number of health advantages people may get from UV exposure is dependent on their individual circumstances. The aim is to maintain a safe amount of UV exposure that is not too high to be harmful[1].

UVB rays with shorter wavelengths of 290 nm to 320 nm are more strongly absorbed than long wavelength rays of 320 nm to 400 nm, although UVA and UVB radiations both pass through Earth's atmosphere. Although UVA is more prevalent in the environment, it enters human skin more readily than energetic UV. The startling truth is that one in every five Americans will be diagnosed with skin cancer throughout their lifetime, equating to more than 3.5 million cases each year. Skin cancer is remains the most expensive malignancy to treat, according to a research[2]. For monitoring cumulative UV exposure and preventing UV-related skin cancer, a wearable detector with real-time UV surveillance is greatly sought. On the basis of conductivity or frequencies change, many tests on two major types of wearable UV detectors, UV color shift or UV photo detector, have been performed. Colorimetric UV sensors are simple in terms of features.

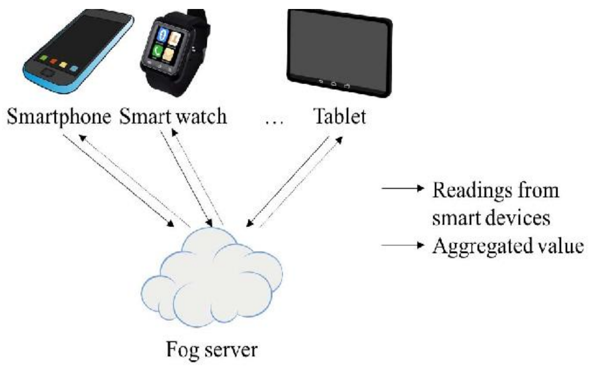

Figure 1: Illustrate the Ultraviolet Radiation Measurement via Smart Devices

But they are limited by the lack of quantitative data and the lack of IoT connection for real-time data collection. Figure 1 showing the UV light measuring device.The following are the objectives and anticipated outcomes:

- Creating a circuit that can accurately detect the strength of certain UV radiation bands.
- Measuring the intensity of UV radiation to determine whether sunscreen is needed.
- Providing information on the strength of UV radiation.
- Keeping track of UV exposure.
- Allowing consumers to track their UV exposure and take necessary measures.

The sensor consists of a parallel condenser sandwiched between conductive electrodes by a flexible dielectric PVDF sheet, with a finely crystalline ZnO thin film covering one of the electrodes. The capacitive sensing performance of the sensor was evaluated in terms of lowest UV detection limit, repeatability, response, and recovery durations. The sensor is a tremendous benefit in terms of efficiency and ease-of-use for the manufacture of inexpensive, portable UV sensors. The flexible substratum was then RF sputtered with a thin zinc oxide layer. The flexible film was decreased due to the high heat[3]. In recent years, the use of cellphones to monitor UV radiation has grown in popularity. The change in total free charges when one of the electrodes is exposed to UV light is the foundation of this capacitive UV sensor. The capacity of the parallel plate is differentiated in the dark by its propensity to retain specific charges for a given voltage divider between its electrodes. The costs at the top and bottom of the plate are similar, however they are on different sides of the plate. It stimulates the melanin pigment that already present in the top skin cells, resulting in a quick-appearing but occasionally transient tan. UVA, on the other hand, excavates deeper skin layers or damages the conjunctive tissue and blood vessels. According to the Health Organization, high UVA penetration causes skin to lose its elasticity or wrinkle (WHO).

Recent research suggests that, although the mechanism for UVA damage is unclear, UVA may also help to prevent skin cancer. UVB rays are more harmful to survival than UVA rays, according to scientists. UVB radiation has been proven to induce DNA damage, which may result in permanent genetic harm. Small cells have self-repair systems that deal with little DNA damage from things like UV light. However, if the damage reaches a specific threshold, the cell's ability to repair itself is compromised, and under normal circumstances, the cell initiates its own death, which scientists refer to as apoptosis. Significant UV dose changes are caused by a variety of factors. UV absorption is reduced at higher altitudes, resulting in increased UV exposure in the atmosphere. The amount of solar UV radiation received outside is affected by daytime and natural circumstances, as well as clouds and dust. The quantity of UV radiation varies approximately fourfold across the globe, and the presence of ozone in the atmosphere, which significantly absorbs UVB, adds to the confusion. At higher latitudes, less ozone is detected in the atmosphere, raising the risk of UVB damage to DNA.

Ultraviolet C is the shortest or most intense component of the UV spectrum (UVC, 100-290 nm). These wavelengths have a lot of energy. Substantial UVC wavelengths are lost mostly via ozone absorption inside the atmosphere, and no significant amounts reach the earth's surface. UVB (290-320 nm) is the most damaging kind of UVR that humans are exposed to. UVB wavelengths are those that are often blocked by heavy clouds, densely woven textiles, and window glass. During the summer, huge amounts of gas are released from the blue sky in the middle of the day. When the sun is low in the sky, as it is in the winter at high latitudes and in the summer in the early mornings and late nights, it is less dangerous. The first is spectroradiometers, which may give very precise findings but are exceedingly costly and difficult to use. Wireless portable UV meters are the second kind. This form comes in a range of shapes and sizes. Others are tiny and portable, but they don't provide reliable readings. Some are smaller and provide more accurate readings, but they are still more expensive for customers. However, one of the most obvious disadvantages is the widespread use of traditional UV measurement equipment, which is neither accurate nor cheap.

The Variable Wavelength UV Detector chooses one wavelength of light to flow into the specimen cell using a monochromatic (slits and grating) system. This Photodiodes Arrays Detectors pass all wavelengths of light through the sample cell and then focus each wavelength on a single sensor plate. The amount of ultraviolet incoming radiation is measured using a UV sensor. The wavelengths of this kind of electromagnetic radiation are shorter than those of visible radiation[4].

A. Feature

- High level of dependability.
- Extremely sensitive.
- A wide variety of responses.
- Power consumption is low.
- UV radiation measurements

A majority of solar radiation studies is focused on collecting data on solar radiation in different places across the globe and at different seasons of the year. According to these research, UV radiation accounts for approximately 3% of total solar radiation.

B. Survey

As stated in the introduction, the number of instances of skin cancer has steadily increased in recent years, and the majority of non-melanoma malignancies are caused by UV radiation exposure. According to a study conducted in New Zealand, 17.8% of skin cancer cases may be related to sun exposure in one way or another. Since the publication of various studies, 60 percent of people have been at danger from sunburns, and 94.4 percent are aware that sunburns increase the risk of skin cancer. Sunburn affects about two-thirds of respondents at least once a year, and nearly all (96%) have previously been burnt.

C. Raspberry

The detector is linked to a Raspberry Pi single board device. The Raspberry Pi is a low-cost credit card that links to a computer screen, television, or mobile phone. This is a portable device that enables children of all ages to learn about computers. It is linked to a smart gadget that measures UV rays. It is utilized to manage a large portion of the process. This section is in charge of resource management. The data gathered by the microcontroller will also be sent to a computer through Bluetooth, allowing the user to see the data on a display. This is also where the signal that controls the feedback originates. The microprocessor is in charge of integrating all other modules into the circuit, while the memory stores measured and computed data for extended periods of time. The UV radiation will be monitored using the sensor circuit's incoming signals. The UV index, sunscreen application time, total exposure, or feedback power will all be monitored on the microprocessor. These values will be saved in memory for calculating purposes. As additional sunscreen is applied, this will also send a signal to the feedback circuit. The Bluetooth communication with a computer will also be regulated by this block. It receives and transmits all of the necessary data from its connected computer[5]. These displays are short, around 1 diagonal, due to the strong contrast of OLED monitor, but they can still be read. This panel has 128x32 single white OLED pixels, and there is no need for a backlight since the display generates light. As a result, the OLED requires less electricity to operate, and the presentation contrasts so dramatically. Only the I2C pins are used by the OLED, but there are plenty of GPIO connections for switches, LEDs, sensors, and other devices. It's also small and light, so it'll work in any situation.

D. Electricity

Power must be distributed to all system components via the power supply. A DC jack converter, charging circuit, and two 3.6V LIR 2450 rechargeable batteries will be included in this package. For the functioning of all components controlled by the microcontroller, the input voltage to the microcontroller should be at least 6V. The minimum stress requirements will be met by two sets of 3.6V LIR batteries. These two batteries are connected to a charging circuit with a DC jack adapter as the input source. Two batteries are charged by connecting the DC jack converter to a wall adapter that delivers 9V at 1A.

E. Batteries

All of the device's components will be powered by two 3.6V rechargeable Lithium-ion batteries with an 11mAh capacity. The batteries are expected to last 12 hours and can be fully charged in 2.5 hours.

F. Circuit for Charging

This is the charging station for the two batteries. In this arrangement, two coin-cell battery holders are connected to the safety circuit and the female DC power connector. The DC power jack ensures that the device's batteries are strong and safe.

G. The user interface (UI)

The gadget is controlled by the user via an app on his or her smartphone. At the start, a menu will display, asking the user whether he or she wishes to alter the operating mode or system settings.

H. Optional mode selection

The user may choose the system's operating mode from this menu. "Modus check" is the first mode. The software can capture a quick sample of UV radiation and also accept user feedback. A computer signal will notify the customer of the intensity of UV radiation and whether or not sunscreen is required. The cumulative mode is the second. This setting allows the device to track the quantity of UV exposure.

II. LITERATURE REVIEW

Li, Ruinian et al. studied about UV radiation has a significant effect on human health. Currently, most people learn about UV radiation using weather forecasts that can only offer a general and average estimate for a given geographical region. Smartphones have the potential to be the perfect tool for measuring UV radiation since CMOS sensors in smartphone cameras are extremely sensitive to it. At the same time, using fog computing, result optimization may be done in real time since fog servers can collect UV radiation data or calculate the results in local regions. This article went through in detail a new method for measuring UV radiation using smartphone cameras, as well as how to use fog computing to enhance UV measurement accuracy. An Android app named UV meter was created to carry out the process. Experiments were carried out on both smartphones and smart watches, using the app to verify and assess the procedure's correctness or precision. The suggested method achieved an average of 95 percent accuracy of a typical professional digital UV meter, or it could be readily applied on smart devices, according to the findings[6].

Benson et al studied about in the field of biomaterials research, radiation is often utilized for surface modification, sterilizing, and improving bulk characteristics. Radiation is also utilized to create biochips and photopolymerizable bio adhesives in situ. High-energy electrons, gamma radiation, ultraviolet (UV), or visible light are the most frequent energy sources utilized to irradiate biomaterials. Surface modification include chemical processes that put certain chemical moieties on a material's surface to enhance bio interaction for cell adhesion or proliferation, hem compatibility, and water absorption. When a polymer is exposed to radiation, particularly ionizing radiation, chain scission or crosslinking may occur, resulting in changes in bulk and surface characteristics. Irradiation sterilization is intended to render most microorganisms inactive on the surface of biomedical equipment. The use of gamma and UV radiation to enhance surface tissue compatibility, bulk and surface characteristics for wear resistance, hydrogel generation, and curing dental sealants and bone adhesives is discussed. The surface modulus and hardness of gamma and vacuum ultraviolet (VUV) treated ultrahigh molecular weight polyethylene (UHMWPE) improve. Surface modulus and hardness of UHMWPE were found to be affected by the kind of radiation, dose, and processing. The hydrophobicity of VUV surface modified e-PTFE vascular grafts rises, as does their ability to adhere to fibrin glue[7].

Gniotek et al. conducted research on the difficulties of a new field of science known as 'tectonics' are discussed in this article. This concept refers to a new multidisciplinary, cross-disciplinary scientific branch formed by the synergy of the three disciplines of textile science, electronics, and computer science. Fibrous sensor examples are given against the backdrop of difficulties associated with signal processing. In the context of developing textile automated control systems, the importance of construction weight and the use of fibrous actuators is emphasized. The three most common methods for attaching electrical components to textiles are described[8].

Kwon et al. studied about a semitransparent photovoltaic cell with a photographic liquid crystal layer is used to show an optically controlled energy-harvesting smart window. Depending on the input solar radiation, the LC layer may transition between a translucent (day mode) as well as an opaque (night mode) state. This window, when combined with a solar cell, serves as a model for future smart window systems[9].

III. DISCUSSION

The sun plays an important role in our health, and far too much sun exposure may cause anything from sun damage to skin cancer. Human skin cancer has become a growing health issue. Despite the fact that individuals are aware of the risks, skin damage caused by sunshine has risen in recent decades. The public nowadays relies on weather predictions to learn about UV radiation. For a certain broad region, the author offers rough and average predictions. It's essential to keep in mind that this article has certain flaws. In this article, just the general proportion of UV radiation against total solar radiation was utilized. Because the percentages vary somewhat for different locations on Earth, seasons, and times of the day, future study may focus on how to utilize the backdrop of UV rates to generate a comparable proportion for a location at different times of the day and year. Second, the light in the scene had a significant impact on accuracy, according to this study. The author will need to conduct further tests to determine the connections between the light as well as the measured effects.

IV. CONCLUSION

In this paper, the author suggested a method that could use UV sensors to validly quantify UV radiation at a specific site.The technique used sensor readings directly for real-time computation, meaning it can be used on almost all the smart devices on the market. Furthermore, the author implemented how to make use of Raspberry Pi to boost the accuracy of the test in real-time. Additionally, the UV meter device built was lightweight, fast and efficient. Overall, the results of rigorous tests showed that the proposed technique could achieve an average accuracy of 94.4 percent of a standard qualified digital UV meter and much better accuracy than using the existing UV sensors.

It's important to note that there are some drawbacks to this article. Next, the general percentage of UV radiation versus total solar radiation was only used in this article. Since the percentages for various places on Earth, various seasons and different times of the day are slightly different, future research may concentrate on how to use the background of UV rates to produce a similar percentage for a location at different times of a day and a year. Second, this paper showed that the scene's light had a significant effect on accuracy. To know the relationships between the light and the measured effects, the author must perform further experiments.

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