International Journal of Pure and Applied Mathematics
Volume 119 No. 15 2018, 1199-1213
ISSN: 1314-3395 (on-line version)
url: http://www.acadpubl.eu/hub/
Special Issue

http://www.acadpubl.eu/hub/

A SURVEY ON SKIN CANCER DETECTION USING SKIN TEMPERATURE VARIATION ANALYSIS

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ABSTRACT

All over the world, in recent years people were suffering from various types of cancer, the skin cancer becomes emerging in that. In India about 2 in 10 cases people are suffering from Melanoma type of skin cancer. In recent years there is no cancer screening tool available for early diagnosis of skin cancer. The existing method, skin cancer can be detected by the doctors (or) self-examination by the person (or) through certain technique which can capture only images (or) through invasive method like biopsy in the abnormal cell proliferated region. Proposed system is implementation of infrared thermal sensor in a non-contact manner which detects the temperature of the epidermal layer of skin, where the temperature of the skin varies for the subjects if they are suffering from cancer.

KEYWORDS

Arduino, DNA, Infrared Thermal Sensor, Melanoma Skin Cancer, Ultraviolet radiation.

1. INTRODUCTION

Skin cancer is a rare disease in which the abnormal growth of cell arises from the skin surface. These cancer cells are known as malignant cells that are usually occur on the epidermis layer of the skin [1].

These malignant cells have the strength to invade and spread over the surrounding tissues of the body. Skin cancer is mainly caused due to UV exposure in large amount on the human skin surface [2][3].

1.1 TYPES OF SKIN CANCER

Skin cancer is categorized into three types, (a) basal cell skin cancer (b) Squamous skin cancer (c) Malignant skin cancer. The features and the treatment involved in each type of cancers are discussed below.

1.1.1 BASAL CELL SKIN CANCER

Basal cell skin cancers (BCC) pop up like a flesh colored pearl likes a rattle or a pinkish patch of skin [4]. BCC is due to UV exposure especially found in area like face, head, neck, arms, legs and abdomen. BCC has the ability to spread over the body and grows in nerves and bones. BCC is often known as Non Melanoma cancer.

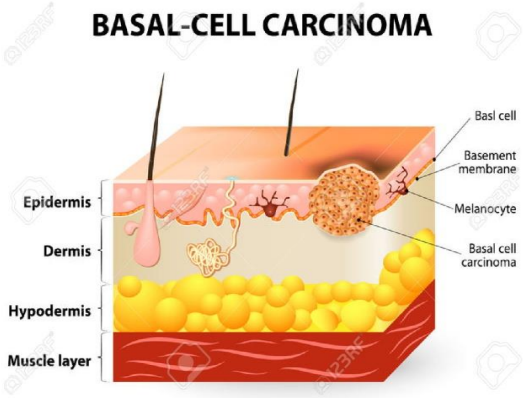

FIGURE 1: BASAL CELL CARCINOMA

(Source: Amp.Ausumed.com)

1.1.2 SQUAMOUS CELL CARCINOMA

Squamous cell carcinoma (SCC) is cancer in which the keratinocyte cells found on outer surface of the skin [5]. It appears like a red firm bumps scaly patches. It is caused due to over sun exposure. It is more commonly found in people who have pale light skin. It is a slow growing cancer cells which doesn't spread over other parts of the body [6][7]. SCC mainly found in the region like ear, face, neck, chest and back. More than 1 million of people were affected due to squamous cell carcinoma and 80,000 people died. In past three decades there are huge increases of squamous cell carcinoma among US. The death rate of SCC is greater than BCC, but comparatively lower than Melanoma. BCC and SCC carry the Ultraviolet radiation and damage the DNA directly. SCC results in Ulceration and ended up with bleeding disorders. It should be treated in earlier stage or else it will grow in dense amount in the body. It can be treated by undergoing a treatment like photodynamic therapy, tropical chemotherapy, and curettage and electro decciation. SCC is the second common cancer in the world. It is not dangerous than that of melanoma [8][9].

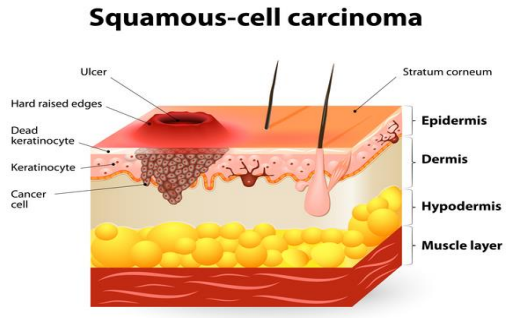

FIGURE 2- SQUAMOUS CELL CARCINOMA

(Source: Genetic home Reference)

1.1.3 MALIGNANT MELANOMA

The rare type of the cancer is malignant melanoma which maximum emerges from moles. Melanoma is usually observed as a dark spot on the epidermal (outer) layer of the skin [10]. It is the fast growing cancer cells that have the ability to spread over the surrounding tissue of the body. The malignant melanoma is caused due to ultraviolet radiation and damage the DNA indirectly [11][12]. The free radical and the reaction oxygen species are the two main causes for DNA damage. Research indicates that intentness of sunscreen components into the skin, conjugate with 60 minutes exposure to UV leads to the increase of free radical in the skin [13]. It is the deadliest form of cancer. Globally in 2012 malignant melanoma occurred in 232,000 people, and 55,000 people were died [14]. Malignant melanoma is the deadliest cancer [15] but it can be cured at early stages of cancer .It is normally treated by chemotherapy, targeted therapy and radiation therapy [16][17].

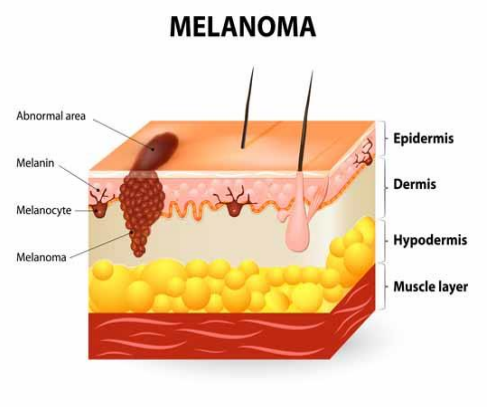

FIGURE 3: SQUAMOUS CELL CARCINOMA

(Source: Genetic home Reference)

2. BACKGROUND SURVEY

Screening and early detection of skin cancer in patients however avoid death by only 45% .It is important to take step to develop to new technology that is superior in both accuracy and patient comfort. Visual differentiation remains a debatable one in the world [18]. Screening of non-melanoma is somewhat accuracy than to the melanoma. In India, may be the reason for poor screening is lack of skin cancer patient. But indirect indications reports from NMSC shows that Skin cancer statistics will rise in India in future. Evidence from research gate survey and from NASA shows that within 2020, the amount of reaching UV rays in India will be drastically progress which is the leading reason in existence of skin cancer. Also the work load of many unemployed individual will be under the shadow of UV rays that kills the DNA strand by mismatching of thymine to pyrimidine. Concerning all these into account, even this period is under urge to make a solution for this [19][20].

Unfortunately, no technique or technology to date has provided definitive evidence to suggest that it improves the sensitivity or specificity of skin cancer screening unlike biopsy. Biopsy is invasive method that makes the tumor region worse in infection after taking the sample from it. Several techniques like spectroscopy, image processing, optical method screening takes more time and the sensitivity of such method proven some negative result on the test reports [21][22].

Beyond this many of them not aware of the disease condition by wrong interpretation on normal and the abnormal extension of mole [23][24]. Microscopy method fails to differentiate the growth of tumor cell ensuring the wrong result also this microscopy measurement takes time and several supporting test which is again an invasive test [25]. One complete way solution is to make use of the time and making evolution of new detection product in India. Hope considering all this study's pros and cons, a new platform to detect skin cancer should be engaged quickly.

The proposed system enable the subject to know the extension of cancer in a non-invasive manner on their own with low cost .

3. MATERIALS AND METHODS

3.1 CONCEPT

The normal temperature of human body 98.6F.Generally the temperature of skin cancer people is greater than that of normal human body temperature due to the disintegration of normal healthy cells.

In melanoma, cancer cells arises from the moles of the skin which causes the inflammation and provide an irregular shape to mole around the epidermal layer which in turn increases the temperature around it.

3.2 DEVICE DESIGN AND SETUP

The proposed system consists of the following unit.

- Sensor unit (Mlx90614 IR thermal sensor),
- Processing unit (Atmega 328) and
- Display unit consists of 16X 2 LCD.

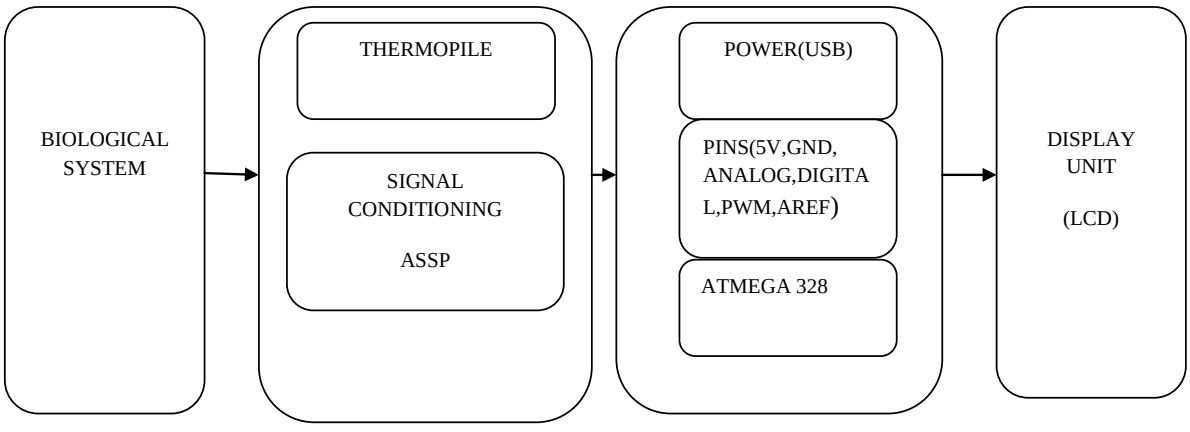

FIGURE 4: BLOCK DIAGRAM OF THE PROPOSED SYSTEM

3.2.1 SENSOR UNIT

The IR Thermal Sensor (Mlx60914) consists of in-built thermopile detector chip and the signal conditioning ASSP. Mlx90614 thermal sensor has the high medical accuracy of 0.5°C and resolution of 0.02°C. It is small in size and easy to integrate with the microcontroller.

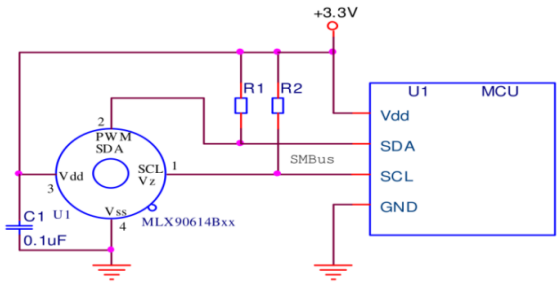

FIGURE 5: CIRCUIT DIAGRAM OF INFRARED THERMAL SENSOR (Mlx90614)

(Source: cds.sparkfun.com)

3.2.2 PROCESSING UNIT

The processor unit consists of Arduino board (Atmega 328). It is a 8 bit AVR RISC based microcontroller combines with 32KB ISP flash memory with read –while-write capabilities, 1KB EEPROM. The device operates between 5 volts.

The power supply to the board is given via USB cable through the PC. It consists of 16 pins. Pin 1 is the input from the IR thermal Sensor. Pin 13 is connected to the display unit.

FIGURE 6 : PROCESSOR UNIT (ATMEGA 328)

(Source:Arduino.cc)

3.3.2.1 POWERSUPPLY

The Arduino UNO board can be powered by using a USB cable from the computer at the operating voltage of 5V supply.

3.3.2.2 PINS (5V, GND, ANALOG, DIGITAL, PWM, AREF)

There are several ground pins on the Arduino that can be used for ground connection of the circuit. There are 6 analog pins in the Arduino Uno board starts from A0 to A5. The main function of analog pins is to read the signal from the sensor unit. Digital pins lies across the analog pins, starts from 0 to 13 on the UNO board which is used for displaying the digital output on the LCD board. PWM pins are responsible

for stimulating the analog output. AREF pins stands for analog reference, it is used to set the external reference voltage.

3.3.2.3 TX RX LEDs

It is responsible for transmission and receiving of signals and it is used to indicate the mode of serial communications.

3.4 WORKING OF PROPOSED SYSTEM

The sensor unit picks up the temperature from the subject and converts it to the electrical signal by the combination of the integrated circuit (thermopile and signal conditioning ASSP). These electrical signals are fed into the Arduino board for processing and it compares the obtained temperature range with the threshold value which has been already programmed in Arduino IDE. The threshold value is fixed based upon the hyperpyrexia condition (<45 degree Celsius). Hyperpyrexia is the condition usually occurs in skin cancer subject where hypothalamus of the body fails to maintain the normal temperature due to the indirect mutation in DNA of the skin that occurs due to the exposure of UV rays. The processed data will be displayed in the Liquid crystal displaying unit. It is noticeable that, when severity increases, there will be the changes in temperature at each stage of melanoma skin cancer. If the acquired temperature range exceeds the normal template temperature range, then the subjects have to look after their health immediately.

At last the subject can have the knowledge about the level of cancer on their own. Thus they can learn by themselves about the extension of disease and further review can be done by the experts.

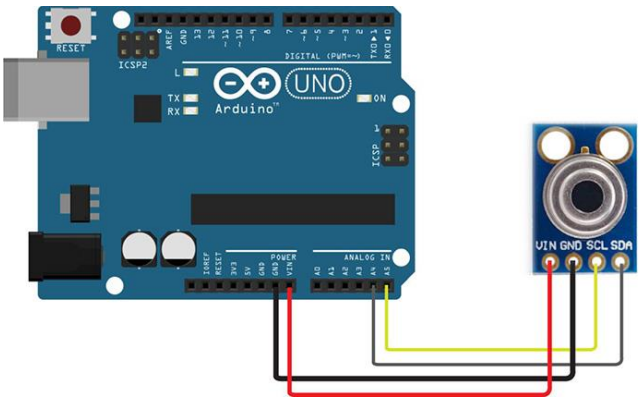

FIGURE 7: INTEGRATION OF MLX90614 IR THERMAL SENSOR WITH ARDUINO UNO (ATMEGA 328) BOARD

(Source:Arduino.cc)

4. EXPECTED OUTCOME

This technique enables the subject to know about the extension of the cancer in their body from one stage to next stage through the display system from the obtained temperature value. When the cancer subject is proceeding to the next level, the subject is indicated to be in alkaline medium that controls the growth of cancerous cell and to check their health level with the physician. From this output we can infer the subject health status and the extension of cancer cells grown within the body.

REFERENCES

[1] Kanavy H E and Gerstenblith M R (2011). "Ultraviolet radiation and melanoma". Semin Cutan Med Surg, Volume :30, Issues (4), Pages: 222–228.

[2] Bichakjian C K, Halpern A C, Johnson T M, Foote Hood A ,Grichnik J M, Swetter S M, Tsao H, Barbosa, VH Chuang, TY Duvic, M Ho, VC Sober, AJ Beutner, KR Bhushan and Smith Begolka R(2011), "Guidelines of care for the management of primary cutaneous melanoma. American Academy of Dermatology". Journal of the American Academy of Dermatology, Volume65, Issue(5), Pages: 1032–47.

[3] Gallagher R P, Lee T K, Bajdik C D, Borugian M (2010),"Ultraviolet radiation". Chronic diseases in Canada. Voulme 29, Issues:(1), Pages: 51–68.

[4] Gandhi S A and Kampp, J (2015)."Skin Cancer Epidemiology, Detection, and Management",The Medical clinics of North America, Volume 99,Issues (6), Pages: 1323–35.

[5] Cakir B Ö, Adamson P and Cingi, C (2012). "Epidemiology and economic burden of nonmelanoma skin cancer". Facial plastic surgery clinics of North America,Volume 20, Issues (4),Pages: 419–22.

[6] Freedberg, et al. (2003). Fitzpatrick's Dermatology in General Medicine. (6th ed.). McGraw-Hill.

[7] James, William D and Berger, Timothy G. (2006). Andrews' Diseases of the Skin: clinical Dermatology. Saunders Elsevier

[8] Cessari G and Girolomoni G. Nonmelanoma(2012),” skin cancer in solid organ transplant recipients: update on epidemiology, risk factors, and management”,Dermatol Surg. Volume:38,Issue(10),Pages:1622-30.

[9] Jennings C (2010), "Management of High-Risk Cutaneous Squamous Cell Carcinoma". Journal of Clinical and Aesthetic Dermatology, Volume 61,Pages:282–285.

[10] Goldstein B G and Goldstein A O (2001). "Diagnosis and management of malignant melanoma". American Family Physician, Volume 63 , Issue(7), Pages: 1359–68

[11] Rünger T M, Farahvash B, Hatvani Z and Rees A (2012). "Comparison of DNA damage responses following equimutagenic doses of UVA and UVB: a less effective cell cycle arrest with UVA may render UVA-induced pyrimidine dimers more mutagenic than UVB-induced ones". Photochem. Photobiology science, Volume 11, Issue (1), Pages: 207–15.

[12] Leslie M C and Bar-Eli M (2005). "Regulation of gene expression in melanoma: new approaches for treatment". J. Cell. Biochemistry, Volume: 94,Issue (1), Pages: 25–38.

[13] Greene M H (1998). "The genetics of hereditary melanoma and nevi". Cancer, Volume:86, Issue (11), Pages: 2464–77

[14] Rhodes A, Weinstock M, Fitzpatrick T, Mihm M and Sober A (1987). "Risk factors for cutaneous melanoma. A practical method of recognizing predisposed individuals". JAMA, Volume: 258, Issue (21), Pages: 3146–54.

[15] Johnson T M, Headington J T, Baker SR and Lowe L (1997). "Usefulness of the staged excision for lentigo maligna and lentigo maligna melanoma: the "square" procedure". J. Am. Acad. Dermatol, Volume: **37**, Issue:(5), Pages: 758–64.

[16] Bastiaannet E, Beukema J and Hoekstra H (2005). "Radiation therapy following lymph node dissection in melanoma patients: treatment, outcome and complications". Cancer Treat Rev,Volume: 31, Issue (1),Pages: 18–26.

[17] Bertrand Bessoud, Nathalie Lassau, Serge Koscielny, Christine Longvert, Marie-Francoise Avril, Pierre Duvillard, Valérie, Rouffiac Jerôme and Leclère Alain Roche (2003), "High-frequency sonography and color Doppler in the management of pigmented skin lesions", Ultrasound in Medicine and Biology, Volume 29, Issue 6, Pages 875–879.

[18] Susan K. Parsons,Jeffery A. Chan, Winifred W. Yu, R.D. Ndidiamaka Obadan, Sara J. Ratichek,Jounghee Lee and Srila Sen, Editor Stanley Ip (2011), "Noninvasive Diagnostic Techniques for the Detection of Skin Cancers", AHRQ Publication No. 11-EHC085-EF.

[19] Sung J, Koh D, Siong W C, Choo T B (2009),"Skin cancer trends among Asians living in Singapore from 1968 to 2006".

[20] Sigurdsson S, Philipsen P A, Hansen L K, Larsen J, Gniadeeka M and Wulf H C(2004),"Detection of Skin Cancer by Classification of Raman Spectra",IEEE Transaction on Biomedical Engineering, Volume:51,Issue 10, Pages:1784-1793.

[21] Rajab M I, Woolfson M S, Morgan S P(2004), "Application of region-based segmentation and neural network edge detection to skin lesions", Elsevier Volume 28,Issue (1,2) Pages: 61-68.

[22] Ammara Masood ,Adel Ali Al-Jumaily (2013), "Computer Aided Diagnostic Support System for Skin Cancer: A Review of Techniques and Algorithms", International Journal of Biomedical Imaging, Volume 2013, Pages-22.

[23] Joel A. Wolf, Jacqueline F. Moreau, Oleg Akilov, "Diagnostic Inaccuracy of Smartphone Applications for Melanoma Detection", JAMA Dermatol. Volume 149, Issure (4),Pages:422-426.

[24] Giuseppe Argenziano , .Peter Soye Hr , Sergio Chimenti , Renato Talamini , Rosamaria Corona , Francesco Sera , Michael Binder ,Lorenzo Cerroni , Gaetano De Rosa , Gerardo Ferrara , Rainer Hofmann-Wellenhof (2003) , " Dermoscopy of pigmented skin lesions: Results of a consensus meeting via the Internet",JADD, Volume 48, Issue(5),Pages:679-693.

[25] Chad A. Lieber ,Shovan K. Majumder , Darrel L. Ellis ,D. Dean Billheimer ,Anita Mahadevan-Jansen(2008) , "Invivo nonmelanoma skin cancer diagnosis using Raman micro spectroscopy", Lasers In Surgery and Medicine,Volume 40, Issue 7 , Pages :461–467.