Advances in Melanoma and Other Skin Cancers

SUPTI
Dept of CSE
Daffodil International University
Dhaka, Bangladesh

Abstract

Skin cancer can be of 2 types mainly. They are malignant and non-malignant melanoma. Skin cancer mainly occurs due to exposure of sunlight. Ozone depletion and chemical exposures are other factors involved in precipitating skin cancer. Mutations of p53 gene are involved in UV-induced carcinogenesis. P53 gene acts vital in development of SCC. So, prevention of skin cancer is the main criteria. Regular application of sunscreens could be one of the primary prevention. The purpose of present review is to outline types, pathogenesis, diagnosis, prevention and treatment of skin cancer.
Keywords: Skin cancer, BCC, SCC, melanoma, UV-light.

I. Introduction

Skin cancer the abnormal growth of skin cells-most often develops on skin exposed to the sun. But this common form of the cancer can also occur on areas of your skin not ordinarily exposed to sunlight[1]. There are three major types of skin cancer-basal cell carcinoma, squamous cell carcinoma and melanoma. Melanoma is the most serious form of skin cancer. Melanoma may be cured if caught and treated early, but, if left untreated, the majority of melanomas eventually spread to other parts of the body. Early detection and surgery to remove the melanoma are successful in curing most cases of melanoma; however, it is rarely curable in its later stages[5].In the United States, melanoma accounts for approximately 4% of all newly diagnosed cancers annually. The American cancer society estimates that in 2004, approximately 55,100 new melanomas will be diagnosed and about 7,910 deaths due to melanoma will occur in the United States. Internationally, the incidence of melanoma varies greatly, with the highest incidence occurring in Australia, the United States, Norway, Switzerland, Sweden, Denmark and Israel, and the lowest incidence in Japan, the Philippines, China and India[9]. Melanoma commonly afflicts the young and middle aged; however, people of all ages are at risk. It is the most common cancer in young adults aged 20-30 and is the leading cause of cancer death for women aged 25-30[10-11]. Melanoma is significantly more prevalent among white populations than in blacks and Asians; the incidence of melanoma in blacks is approximately 1/20 than that of whites.There has been a dramatic increase in melanoma incidence over the last century. The lifetime risk of developing melanoma in 1935 was only 1 per 1500 Americans, and the lifetime risk for melanoma in 2004 was 1 in 71 Americans[12]. The lifetime risk is estimated to rise to 1 in 50 Americans by 2010. Fortunately, due to prevention and early detection practices, melanoma mortality rates have not increased as sharply and have remained stable or decreased since the 1990s. fold for basal cell carcinoma (BCC) [3]. Several treatment modalities exist for AK, BCC, and SCC[17]. The mainstay of treatment remains surgery via simple excision or Mohs Micrographic Surgery (MMS) for BCC and SCC. Photodynamic therapy (PDT) provides an alternative that has proven to achieve excellent cosmetic results for AK, BCC, and SCC. Methylaminolevulinate (MAL) and 5-aminolevulinic acid (ALA) are the two agents commonly utilized in clinical practice to perform PDT[25].

II. LITERATURE REVIEW

There are three types of skin cancers, which accounts for almost 100% of diagnosed cases. Each of these three cancers develops in a different type of skin cell and each is named after the name of cell (Gloster and Brodland, 1996). Skin cancers are divided into two categories - non-melanoma skin cancer and melanoma skin cancer. Melanoma is the most dreadful form of skin cancer. Different types of skin cancer are:

Basal cell carcinoma (BCC) BCC is the most common type of cancer that gets develop in most of the human population (Green et al., 1996). BCC comprise about 80% of all the cancers. It may be defined as the cancer that develops in the specified skin cells called the basal cells, which are present in the lowest layer of the skin epidermis. This type of tumor when heals then it may get appear again. Usually it gets red color spots. The most common sites for the appearance of this type of cancer are face and scalp. The rate of growth of these cancers is very slow but they have the ability to get spread in other parts of the body[5-6].

Squamous cell carcinoma (SCC) Occurrence of this type of cancer is less as compared to BCC. It may be defined as the type of cancer that gets develop in the squamous cells of the skin (Green et al., 1996). This cancer mostly develops on the dry and rough parts of skin however it can easily be develop on those areas which are mostly exposed to the sun light. It appears in the form of red or blackish yellow spots. Like BCC it can also spread to other parts of the body but various type of treatments have be evolved to prevent its spread to other parts of the body (Kaldor et al., 1993)[5].

Melanoma This type of tumor appears very rarely. It may be defined as the type of cancer that develops in the skin cells called melanocytes (Green et al., 1996). Although it occurs rarely but it is most lethal among all the cancers because it can also spread through the lymphatic system. (Kaldor et al., 1993), (Serrano et al., 1991). It occurs in all age groups but elder people get more affected by this type (Mackie et al., 1998). As this type of cancer can be diagnosed early so can lead towards the effective treatment. Usually melanoma develops in already existing infiltrator or it gives the appearance like an infiltrator[9].

Some other uncommon types of cancer are also seen but are diagnosed in very less cases. Examples include lymphoma. Mortality rates are higher in men than in women. This higher rate may occur because lesions tend to develop in less easily observed areas, such as the back, in men. Mortality is also increased in blacks for this reason, as is the propensity to.[2] develop more aggressive tumors and to be diagnosed at later stages.

III. PROPOSED METHODOLOGY

Skin cancer is one of the most dangerous types of cancers that affect millions of people every year. The detection of skin cancer in the early stages is an expensive and challenging process. In recent studies, machine learning-based methods help dermatologists in classifying medical images. It can affect any area of the human body. It usually appears on the areas exposed to sun rays, such as on the hands, face, neck, lips, etc. Melanoma type of cancers can only be cured if diagnosed early; otherwise, they spread to other body parts and lead to the victim's painful death [5]. There as various types of melanoma skin cancer such as nodular melanoma, superficial spreading melanoma, acral lentiginous, and lentigo maligna

A. Gist of Research

Exposure to sun causes most of the wrinkles and age spots on our faces, and it can lead to much more serious consequences, including skin cancer. Fortunately, when detected and treated early, skin cancer usually can be cured. Although anyone can develop skin cancer, those that are most at risk for skin cancer are people who: Have had an organ transplant,Tan or use tanning beds, Get easily sunburned Have fair or freckled skin, Have a family history of skin cancer, Have blue eyes.

B. Data Collection

We have utilized HAM10000 Dataset [15] for the training and validation in this study. HAM10000 dataset is a benchmark dataset with over 50% of lesions confirmed by pathology.[13] The dataset consists of a total of 10015 dermoscopy images, which includes 6705 Melanocytic nevi images, 1113 Melanoma images, 1099 Benign keratosis images, 514 Basal cell carcinoma images, 327 Actinic keratosis images, 142 Vascular images and 115 Dermatofibroma images with 600X450 pixels resolution[16-17]. Sample images of skin cancer types from HAM10000 are represented in Figure 1.[17-18]

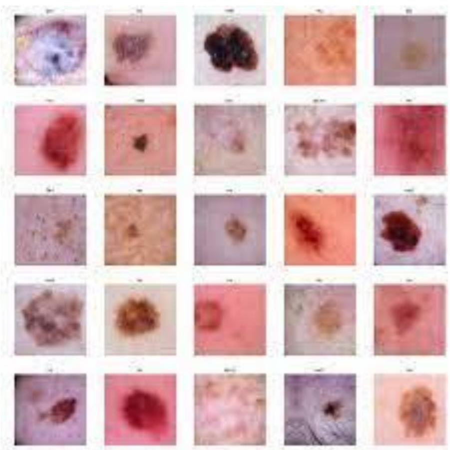


Fig. 1. Sample images from HAM10000 dataset for cancer types (a) Actinic Keratosis (b) Basal Cell Carcinoma (c) Benign Keratosis (d) Dermatofibroma (e) Melanocytic nevi (f) Melanoma (g) Vascular Lesions.

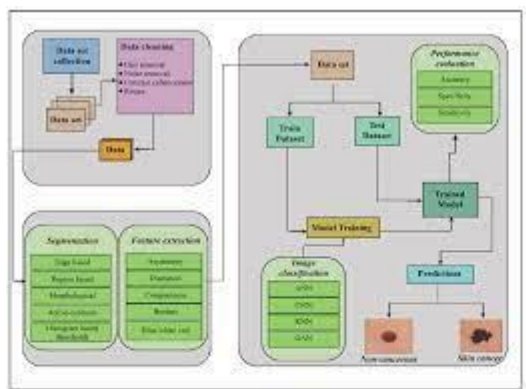
Table 1. Classification Result from NN for melanoma skin cancer

Data type	Feature type	Classification Accuracy %	
		Train Data	Test Data
Melanoma Skin Cancer (Benign & Malignant)	Color Features	100	50
	Shape Features	100	50
	Texture Features	100	50
	Shape & Texture Features	100	95
	Color & Shape Features	100	50
	Color & Texture Features	100	50
	Color, Shape and Texture Features	100	98
Total accuracy from the NN		98%	

Table 1: data table

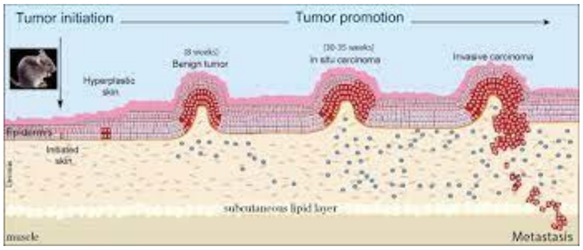
C. Data Preprocessing & Model

Skin is the largest organ of the human body, it protects them from the external environment. However, the number of new skin cancer cases has been going up in the last few years. Fortunately diagnosing skin cancer in earlier stages could increase the probability of treating cancer[9]. Due to machine learning (ML) and deep learning(DL) has achieved great success in dierent elds and has shown an outstanding performance in computer vision applications , lots of ML Applications is concerned in this domain[10]. The main goal of this study is to nd a computer-aided diagnosis system that can be powerful in early detection, which saves time and money[15]. A simple pipeline is used to train dierent types of convolutional neural networks (CNNs), choosing the best four networks and ensemble them together without any prior segmen-tation or repainting. By using the HAM10000 dataset for training and testing, a high-accurate model is achieved which can classify seven kinds of skin lesions very precisely[21-22].



Model 1: classifier

Automatic diagnostics of skin cancer is one of the most challenging problems in medical image processing. It helps physicians to decide whether a skin melanoma is benign or malignant. So,



Model 2: classifier

determining the more efficient methods of detection to reduce the rate of errors is a vital issue among researchers. Preprocessing is the first stage of detection to improve the quality of images, removing the irrelevant noises and unwanted parts in the background of the skin images[27]. The purpose of this paper is to gather the preprocessing approaches can be used in skin cancer images[22]. This paper provides good starting for researchers in their automatic skin cancer detections[23].

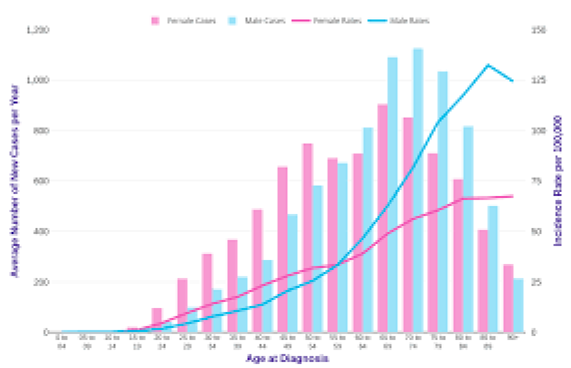


Figure 2: Melanoma skin cancer.

IV. EXPERIMENT AND DISCUSSION

Despite efforts toward the earlier detection and prevention of skin cancer, the prevalence of skin cancers continues to increase. Identifying trends in skin cancer burdens among populations can lead to impactful and sustainable interventions. We assessed the global trends in skin cancer from 1990 to 2017 in 195 countries worldwide through the Global Burden of Disease Study (GBD) 2017 database. The rate of change in skin cancers between 1990 to 2017 varied among countries. Squamous cell carcinomas increased by 310% during this time, the highest among any neoplasm tracked by the GBD. Men experienced greater age-specific prevalence rates of keratinocyte carcinoma across all ages ($P < .05$). Women had a greater prevalence of melanoma until approximately age 50 years, after which the trend reversed until age 85 years. Men experienced greater age-specific death rates across all ages. The disability-adjusted life years (DALYs) of melanoma and keratinocyte carcinoma increased exponentially with age ($P < .05$). The incidence, prevalence, and DALYs of skin cancers are increasing disproportionately among different demographic groups. As a worldwide epidemiological assessment, the GBD 2017 provides frequently updated measures of the skin cancer burden, which may help to direct resources and allocate funding to close the gap in global skin cancer disparities.

Figure 3: high risk skin cancer.

B. Experimental Results between different ML classifiers

Malignant melanoma is the deadliest form of skin cancer. Dermoscopy is a noninvasive high-resolution imaging technique that assists physicians for more accurate diagnoses of skin cancers[23]. Melanoma is a fast-growing aggressive type of skin cancer. Due to this feature, malignant melanoma remains one of the fastest growing cancers worldwide. After it metastasizes from its origin into other tissues, the response rate to treatment declines as low as 5%, and its 10-year survival rate is only about 10%. After it metastasizes, there is no surgical removal option available for treatment. Thus, early detection of malignant melanoma is critically important. Among many types of skin cancers, melanoma has the highest false negative ratio[12-13]. Therefore, this thesis proposes three methods for early detection of malignant melanoma. More specifically, this thesis, first, introduces a novel approach of texturebased abrupt cutoff quantification method (abrupt cutoff is one of the critical features for detecting malignant melanoma in its early stages). In current clinical practice, abrupt cutoff evaluation is subjective and errorprone. In our method, we introduce a novel approach to objectively14-15] and quantitatively measure abrupt cutoff. To achieve this, we quantitatively analyzed the texture features of a region within the skin lesion boundary using level set propagation (LSP) method[26]. Then, we built feature vectors of homogeneity, standard deviation of pixel values, and mean of the pixel values of the region of interest between the contracted border and the original border of a skin lesion. These vectors were then classified using neural networks (NN) and support vector machines (SVM) classifiers. Results obtained from these classifiers are also compared. vii Second, to accurately and real-time segment skin lesions in dermoscopic images, we used superpixels approach[21]. More specifically, simple linear iterative clustering (SLIC) superpixel algorithm is used. SLIC adapts kmeans clustering to generate superpixels. After superpixels are created from dermoscopy images, in order to automatically merge meaningful superpixels that fall inside the skin lesion boundary, we first found the mean average value of each superpixel, and second, we calculated the median threshold values for all superpixels. After the merge of superpixels, we were able to accurately segment skin lesion borders[26]. Our results showed that our method provides comparable segmentation results for skin lesions to the physician drawn lesion bordes.

Conclution:

B. Experimental Results between different ML classifiers: Malignant melanoma is the deadliest form of skin cancer. Dermoscopy is a noninvasive high-resolution imaging technique that assists physicians for more accurate diagnoses of skin cancers[23]. Melanoma is a fast-growing aggressive type of skin cancer. Due to this feature, malignant melanoma remains one of the fastest growing cancers worldwide. After it metastasizes from its origin into other tissues, the response rate to treatment declines as low as 5%, and its 10-year survival rate is only about 10%. After it metastasizes, there is no surgical removal option available for treatment. Thus, early detection of malignant melanoma is critically important. Among many types of skin cancers, melanoma has the highest false negative ratio[12-13]. Therefore, this thesis proposes three methods for early detection of malignant melanoma. More specifically, this thesis, first, introduces a novel approach of texturebased abrupt cutoff quantification method (abrupt cutoff is one of the critical features for detecting malignant melanoma in its early stages). In current clinical practice, abrupt cutoff evaluation is subjective and errorprone. In our method, we introduce a novel approach to objectively14-15] and quantitatively measure abrupt cutoff. To achieve this, we quantitatively analyzed the texture features of a region within the skin lesion boundary using level set propagation (LSP) method[26]. Then, we built feature vectors of homogeneity, standard deviation of pixel values, and mean of the pixel values of the region of interest between the contracted border and the original border of a skin lesion. These vectors were then classified using neural networks (NN) and support vector machines (SVM) classifiers. Results obtained from these classifiers are also compared. vii Second, to accurately and real-time segment skin lesions in dermoscopic images, we used superpixels approach[21]. More specifically, simple linear iterative clustering (SLIC) superpixel algorithm is used. SLIC adapts kmeans clustering to generate superpixels. After superpixels are created from dermoscopy images, in order to automatically merge meaningful superpixels that fall inside the skin lesion

boundary, we first found the mean average value of each superpixel, and second, we calculated the median threshold values for all superpixels. After the merge of superpixels, we were able to accurately segment skin lesion borders[26]. Our results showed that our method provides comparable segmentation results for skin lesions to the physician drawn lesion bordes.

REFERENCES

[1] Franceschi, S., Levi, F., Randimbison, L., & La Vecchia, C. (1996). Site distribution of different types of skin cancer: new aetiological clues. *International journal of cancer*, *67*(1), 24-28.

[2] Franceschi, S., Levi, F., Randimbison, L. and La Vecchia, C., 1996. Site distribution of different types of skin cancer: new aetiological clues. *International journal of cancer*, *67*(1), pp.24-28.

[3] De Gruijl, F. R. (1999). Skin cancer and solar UV radiation. *European Journal of Cancer*, *35*(14), 2003-2009.

[4] Franceschi, Silvia, Fabio Levi, Lalao Randimbison, and Carlo La Vecchia. "Site distribution of different types of skin cancer: new aetiological clues." *International journal of cancer* 67, no. 1 (1996): 24-28.

[5] Jensen, P., Hansen, S., Møller, B., Leivestad, T., Pfeffer, P., Geiran, O., ... & Simonsen, S. (1999). Skin cancer in kidney and heart transplant recipients and different long-term immunosuppressive therapy regimens. *Journal of the American Academy of Dermatology*, *40*(2), 177-186.

[6] Qadir, Muhammad Imran. "Skin cancer: Etiology and management." *Pakistan journal of pharmaceutical sciences* 29.3 (2016).

[7] De Gruijl, F.R., 1999. Skin cancer and solar UV radiation. *European Journal of Cancer*, *35*(14), pp.2003-2009.

[8] Qadir, Muhammad Imran. "Skin cancer: Etiology and management." *Pakistan journal of pharmaceutical sciences* 29, no. 3 (2016).
[9] Jensen, P., Hansen, S., Møller, B., Leivestad, T., Pfeffer, P., Geiran, O., Fauchald, P. and Simonsen, S., 1999. Skin cancer in kidney and heart transplant recipients and different long-term immunosuppressive therapy regimens. *Journal of the American Academy of Dermatology*, *40*(2), pp.177-186.
[10] Qadir MI. Skin cancer: Etiology and management. Pakistan journal of pharmaceutical sciences. 2016 May 1;29(3).
[11] Glanz, Karen, et al. "Development and reliability of a brief skin cancer risk assessment tool." *Cancer detection and prevention* 27.4 (2003): 311-315.
[12] Glanz, K., Schoenfeld, E., Weinstock, M. A., Layi, G., Kidd, J., & Shigaki, D. M. (2003). Development and reliability of a brief skin cancer risk assessment tool. *Cancer detection and prevention*, *27*(4), 311-315.
[13] Glanz, Karen, Elinor Schoenfeld, Martin A. Weinstock, Gabriela Layi, Jeanne Kidd, and Dorothy M. Shigaki. "Development and reliability of a brief skin cancer risk assessment tool." *Cancer detection and prevention* 27, no. 4 (2003): 311-315.
[14] Glanz, K., Schoenfeld, E., Weinstock, M.A., Layi, G., Kidd, J. and Shigaki, D.M., 2003. Development and reliability of a brief skin cancer risk assessment tool. *Cancer detection and prevention*, *27*(4), pp.311-315.
[15] Allegra, Alessandro, et al. "Oxidative stress and photodynamic therapy of skin cancers: Mechanisms, challenges and promising developments." *Antioxidants* 9.5 (2020): 448.
[16] Allegra, A., Pioggia, G., Tonacci, A., Musolino, C., & Gangemi, S. (2020). Oxidative stress and photodynamic therapy of skin cancers: Mechanisms, challenges and promising developments. *Antioxidants*, *9*(5), 448.
[17] Allegra, Alessandro, Giovanni Pioggia, Alessandro Tonacci, Caterina Musolino, and Sebastiano Gangemi. "Oxidative stress and photodynamic therapy of skin cancers: Mechanisms, challenges and promising developments." *Antioxidants* 9, no. 5 (2020): 448.
[18] Allegra, A., Pioggia, G., Tonacci, A., Musolino, C. and Gangemi, S., 2020. Oxidative stress and photodynamic therapy of skin cancers: Mechanisms, challenges and promising developments. *Antioxidants*, *9*(5), p.448.
[19] Allegra A, Pioggia G, Tonacci A, Musolino C, Gangemi S. Oxidative stress and photodynamic therapy of skin cancers: Mechanisms, challenges and promising developments. Antioxidants. 2020 May;9(5):448.
[20] Boukamp, P. (2005). Non-melanoma skin cancer: what drives tumor development and progression?. *Carcinogenesis*, *26*(10), 1657-1667.
[21] Boukamp, P., 2005. Non-melanoma skin cancer: what drives tumor development and progression?. *Carcinogenesis*, *26*(10), pp.1657-1667.
[22] Szeimies, R. M. M. C., Morton, C. A., Sidoroff, A., & Braathen, L. R. (2005). Photodynamic therapy for non-melanoma skin cancer. *ACTA DERMATOVENEREOLOGICA-STOCKHOLM-*, *85*(6), 483.
[23] Szeimies, R.M.M.C., Morton, C.A., Sidoroff, A. and Braathen, L.R., 2005. Photodynamic therapy for non-melanoma skin cancer. *ACTA DERMATOVENEREOLOGICA-STOCKHOLM-*, *85*(6), p.483.
[24] Orthaber, K., Pristovnik, M., Skok, K., Perić, B., & Maver, U. (2017). Skin cancer and its treatment: novel treatment approaches with emphasis on nanotechnology. *Journal of nanomaterials*, *2017*.
[[25] Orthaber, K., Pristovnik, M., Skok, K., Perić, B. and Maver, U., 2017. Skin cancer and its treatment: novel treatment approaches with emphasis on nanotechnology. *Journal of nanomaterials*, *2017*.
[26] Markova, A., & Weinstock, M. A. (2013). Risk of skin cancer associated with the use of UV nail lamp. *The Journal of investigative dermatology*, *133*(4), 1097.
[27] Markova, A. and Weinstock, M.A., 2013. Risk of skin cancer associated with the use of UV nail lamp. *The Journal of investigative dermatology*, *133*(4), p.1097.