"AUTOMATED DETECTION OF SKIN LESSIONS USING BACK PROPAGATION NEURAL NETWORK"

A Project Report submitted to

JAWAHARLAL NEHRU TECHNOLOGICAL UNVERSITY ANANTAPUR.

In Partial Fulfillment of the Requirements for the Award of the degree of

BACHELOR OF TECHNOLOGY
IN
COMPUTER SCIENCE AND ENGINEERING
BY

C.Sujith **16121A0540**
B.Padmanjali **16121A0519**
D.Hitesh **16121A0551**
D.Srinivas **16121A0553**

Under the Guidance of

Dr. B. Narendra Kumar Rao
Professor and Head
Dept of CSE, SVEC

Department of Computer Science and Engineering

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(Affiliated to JNTUA, Anantapuramu)
Sree Sainath Nagar, Tirupathi – 517 102
2016-2020

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION

VISION

To become a Centre of Excellence in Computer Science and Engineering by imparting high quality education through teaching, training and research.

MISSION

The Department of Computer Science and Engineering is established to provide undergraduate and graduate education in the field of Computer Science and Engineering to students with diverse background in foundations of software and hardware through a broad curriculum and strongly focused on developing advanced knowledge to become future leaders.

Create knowledge of advanced concepts, innovative technologies and develop research aptitude for contributing to the needs of industry and society.

Develop professional and soft skills for improved knowledge and employability of students.

Encourage students to engage in life-long learning to create awareness of the contemporary developments in computer science and engineering to become outstanding professionals.

Develop attitude for ethical and social responsibilities in professional practice at regional, National and International levels.

Program Educational Objectives (PEO's)

1. Pursuing higher studies in Computer Science and Engineering and related disciplines

2. Employed in reputed Computer and I.T organizations and Government or have established startup companies.

3. Able to demonstrate effective communication, engage in team work, exhibit leadership skills, ethical attitude, and achieve professional advancement through continuing education.

Program Specific Outcomes (PSO's)

1. Demonstrate knowledge in Data structures and Algorithms, Operating Systems, Database Systems Software Engineering, Programming Languages, Digital systems, Theoretical Computer Science, and Computer Networks. (PO1)

2. Analyze complex engineering problems and identify algorithms for providing solutions (PO2)

3. Provide solutions for complex engineering problems by analysis, interpretation of data, and development of algorithms to meet the desired needs of industry and society. (PO3, PO4)

4. Select and Apply appropriate techniques and tools to complex engineering problems in the domain of computer software and computer-based systems (PO5)

Program Outcomes (PO’s)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering knowledge**).

2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (**Problem analysis**).

3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (**Design/development of solutions**).

4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions (**Conduct investigations of complex problems**).

5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations (**Modern tool usage**)

6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
(**The engineer and society**)

7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development (**Environment and sustainability**).

8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice (**Ethics**).

9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and team work**).

10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions (**Communication**).

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments (**Project management and finance**).

12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (**Life-long learning**).

Course Outcomes

1. Knowledge on the project topic (PO1)

2. Analytical ability exercised in the project work. (PO2)
3. Design skills applied on the project topic. (PO3)
4. Ability to investigate and solve complex engineering problems faced during the project work. (PO4)

5. Ability to apply tools and techniques to complex engineering activities with an understanding of limitations in the project work. (PO5)
6. Ability to provide solutions as per societal needs with consideration to health, safety, legal and cultural issues considered in the project work. (PO6)

7. Understanding of the impact of the professional engineering solutions in environmental context and need for sustainable development experienced during the project work. (PO7)

8. Ability to apply ethics and norms of the engineering practice as applied in the project work. (PO8)

9. Ability to function effectively as an individual as experienced during the project work. (PO9)

10. Ability to present views cogently and precisely on the project work. (PO10)

11. Project management skills as applied in the project work. (PO11)

12. Ability to engage in life-long leaning as experience during the project work. (PO12)

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	2	3												3		
CO3	1	2	3												3	
CO4		1	2	3											3	
CO5			1	2	3											3
CO6				1	2	3										
CO7							3									
CO8								3								
CO9									3							
CO10										3						
CO11											3					
CO12												3				

(Note: 3-High, 2-Medium, 1-Low)

DECLARATION

We hereby declare that this project report titled **"AUTOMATED DETECTION OF SKIN LESSIONS USING BACK PROPAGATION NEURAL NETWORK"** is a genuine project work carried out by us, in **B.Tech *(Computer Science and Engineering)***degree course of **Jawaharlal Nehru Technological University Anantapur** and has not been submitted to any other course or University for the award of any degree by us.

Signature of the student

1.

2.

3.

4.

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(Affiliated to Jawaharlal Nehru Technological University Anantapur)
Sree Sainath Nagar, A. Rangampet, Tirupati – 517 102, Chittoor Dist., A.P.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Project Work entitled

"AUTOMATED DETECTION OF SKIN LESSIONS USING BACK PROPAGATION NEURAL NETWORK "

is the bonafide work done by

C.Sujith	**16121A0540**
B.Padmanjali	**16121A0519**
D.Hitesh	**16121A0551**
D.Srinivas	**16121a0553**

In the Department of Computer Science and Engineering, Sree Vidyanikethan Engineering College, A. Rangampet. is affiliated to JNTUA, Anantapuramu in partial fulfillment of the requirements for the award of Bachelor of Technology in Computer Science and Engineering during 2016-2020.

This is work has been carried out under my guidance and supervision. The results embodied in this Project report have not been submitted in any University or Organization for the award of any degree or diploma.

Internal Guide and Head

Dr. B. Narendra kumar Rao
Professor & Head
Dept of CSE
Sree Vidyanikethan Engineering College
Tirupathi

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

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ABSTRACT

Skin diseases have a serious impact on people's life and health. One of such serious problems is skin lesions. Preceding works proposes an efficient approach to identify different types of skin lesions. A skin lesion is a part of the skin that has an abnormal growth or appearance compared to the skin around it. There are two categories of skin lesions: primary and secondary skin lesions. Primary skin lesions are abnormal skin conditions present at birth or acquired over a person's lifetime. These include moles, rashes, acne and other types. Secondary skin lesions are the result of irritated primary skin lesions. The most common ones include crust, ulcer, scale and others. It is necessary to develop automatic methods in order to increase the accuracy of diagnosis for these skin diseases. Initially, skin images were pre-processed to remove noise and irrelevant background should be removed by filtering and transformation. Grey-Level Co-occurrence Matrix (GLCM) is planned to segment images of skin disease. The texture and colour features of different skin disease images could be obtained accurately. Finally, by using the Support Vector Machine (SVM) classification method, these skin diseases should be classified. The experimental results should demonstrate the effectiveness and feasibility of the proposed method.

CONTENTS

INTRODUCTION

Skin cancers are cancers that arise from the skin. They are due to the development of abnormal cells that have the ability to invade or spread to other parts of the body. There are three main types of skin cancers: basal-cell skin cancer (BCC), squamous-cell skin cancer (SCC) and melanoma. The first two, along with a number of less common skin cancers, are known as nonmelanoma skin cancer (NMSC). Basal-cell cancer grows slowly and can damage the tissue around it but is unlikely to spread to distant areas or result in death. It often appears as a painless raised area of skin that may be shiny with small blood vessels running over it or may present as a raised area with an ulcer. Squamous-cell skin cancer is more likely to spread. It usually presents as a hard lump with a scaly top but may also form an ulcer. Melanomas are the most aggressive. Signs include a mole that has changed in size, shape, color, has irregular edges, has more than one color, is itchy or bleeds.

More than 90% of cases are caused by exposure to ultraviolet radiation from the Sun This exposure increases the risk of all three main types of skin cancer. Exposure has increased, partly due to a thinner ozone layer.Tanning beds are another common source of ultraviolet radiation. For melanomas and basal-cell cancers, exposure during childhood is particularly harmful. For squamous-cell skin cancers, total exposure, irrespective of when it occurs, is more important. Between 20% and 30% of melanomas develop from moles. People with lighter skin are at higher risk as are those with poor immune function such as from medications or HIV/AIDS. Diagnosis is by biopsy.

Decreasing exposure to ultraviolet radiation and the use of sunscreen appear to be effective methods of preventing melanoma and squamous-cell skin cancer. It is not clear if sunscreen affects the risk of basal-cell cancer. Nonmelanoma skin cancer is usually curable.

Treatment is generally by surgical removal but may, less commonly, involve radiation therapy or topical medications such as fluorouracil. Treatment of melanoma may involve some combination of surgery, chemotherapy, radiation therapy and targeted therapy. In those people whose disease has spread to other areas of the body, palliative care may be used to improve quality of life. Melanoma has one of the higher survival rates among cancers, with over 86% of people in the UK and more than 90% in the United States surviving more than 5 years.

Skin cancer is the most common form of cancer, globally accounting for at least 40% of cancer cases. The most common type is nonmelanoma skin cancer, which occurs in at least 2–3 million people per year. This is a rough estimate, however, as good statistics are not kept. Of nonmelanoma skin cancers, about 80% are basal-cell cancers and 20% squamous-cell skin cancers. Basal-cell and squamous-cell skin cancers rarely result in death. In the United States, they were the cause of less than 0.1% of all cancer deaths. Globally in 2012, melanoma occurred in 232,000 people and resulted in 55,000 deaths. White people in Australia, New Zealand and South Africa have the highest rates of melanoma in the world. The three main types of skin cancer have become more common in the last 20 to 40 years, especially in those areas with mostly White people.

Basal-cell carcinomas are most commonly present on sun-exposed areas of the skin, especially the face. They rarely metastasize and rarely cause death. They are easily treated with surgery or radiation. Squamous-cell skin cancers are also common, but much less common than basal-cell cancers. They metastasize more frequently than BCCs. Even then, the metastasis rate is quite low, with the exception of SCC of the lip, ear, and in people who are immunosuppressed. Melanoma are the least frequent of the three common skin cancers. They rarely cause deaths.

Less common skin cancers include: dermatofibrosarcoma protuberans, Merkel cell carcinoma, Kaposi's sarcoma, keratoacanthoma, spindle cell tumors, sebaceous carcinomas, microcystic adnexal carcinoma, Paget's disease of the breast, atypical fibroxanthoma, leiomyosarcoma, and angiosarcoma.

BCC and SCC often carry a UV-signature mutation indicating that these cancers are caused by UVB radiation via direct DNA damage. However malignant melanoma is predominantly caused by UVA radiation via indirect DNA damage. The indirect DNA damage is caused by free radicals and reactive oxygen species. Research indicates that the absorption of three sunscreen ingredients into the skin, combined with a 60-minute exposure to UV, leads to an increase of free radicals in the skin, if applied in too little quantity and too infrequently.[21] However, the researchers add that newer creams often do not contain these specific compounds, and that the combination of other ingredients tends to retain the compounds on the surface of the skin. They also add that frequent re-application reduces the risk of radical formation.

There are a variety of different skin cancer symptoms. These include changes in the skin that do not heal, ulcering in the skin, discolored skin, and changes in existing moles, such as jagged edges to the mole and enlargement of the mole.

Basal-cell skin cancer (BCC) usually presents as a raised, smooth, pearly bump on the sun-exposed skin of the head, neck, torso or shoulders. Sometimes small blood vessels (called telangiectasia) can be seen within the tumor. Crusting and bleeding in the center of the tumor frequently develops. It is often mistaken for a sore that does not heal. This form of skin cancer is the least deadly, and with proper treatment can be completely eliminated, often without significant scarring.

Squamous-cell skin cancer (SCC) is commonly a red, scaling, thickened patch on sun-exposed skin. Some are firm hard nodules and dome shaped like keratoacanthomas. Ulceration and bleeding may occur. When SCC is not treated, it may develop into a large mass. Squamous-cell is the second most common skin cancer. It is dangerous, but not nearly as dangerous as a melanoma.

Most melanoma consist of various colours from shades of brown to black. A small number of melanomas are pink, red or fleshy in colour; these are called amelanotic melanoma and tend to be more aggressive. Warning signs of malignant melanoma include change in the size, shape, color or elevation of a mole. Other signs are the appearance of a new mole during adulthood or pain, itching, ulceration, redness around the site, or bleeding at the site. An often-used mnemonic is "ABCDE", where A is for "asymmetrical", B for "borders" (irregular: "Coast of Maine sign"), C for "color" (variegated), D for "diameter" (larger than 6 mm – the size of a pencil eraser) and E for "evolving."

Merkel cell carcinomas are most often rapidly growing, non-tender red, purple or skin colored bumps that are not painful or itchy. They may be mistaken for a cyst or another type of cancer.

Ultraviolet radiation from sun exposure is the primary environmental cause of skin cancer. This can occur in professions such as farming. Other risk factors that play a role include:

- Smoking tobacco[26]
- HPV infections increase the risk of squamous-cell skin cancer.
- Some genetic syndromes including congenital melanocytic nevi syndrome which is characterized by the presence of nevi (birthmarks or moles) of varying size which are either present

at birth, or appear within 6 months of birth. Nevi larger than 20 mm (3/4") in size are at higher risk for becoming cancerous.

- Chronic non-healing wounds. These are called Marjolin's ulcers based on their appearance, and can develop into squamous-cell skin cancer.
- Ionizing radiation such as X-rays, environmental carcinogens, artificial UV radiation (e.g. tanning beds), aging, and light skin color. It is believed that tanning beds are the cause of hundreds of thousands of basal and squamous-cell skin cancers. The World Health Organization now places people who use artificial tanning beds in its highest risk category for skin cancer. Alcohol consumption, specifically excessive drinking increases the risk of sunburns.
- The use of many immunosuppressive medications increases the risk of skin cancer. Cyclosporin A, a calcineurin inhibitor for example increases the risk approximately 200 times, and azathioprine about 60 times.

A malignant epithelial tumor that primarily originates in the epidermis, in squamous mucosa or in areas of squamous metaplasia is referred to as a squamous-cell carcinoma.

Macroscopically, the tumor is often elevated, fungating, or may be ulcerated with irregular borders. Microscopically, tumor cells destroy the basement membrane and form sheets or compact masses which invade the subjacent connective tissue (dermis). In well differentiated carcinomas, tumor cells are pleomorphic/atypical, but resembling normal keratinocytes from prickle layer (large, polygonal, with abundant eosinophilic (pink) cytoplasm and central nucleus).

Their disposal tends to be similar to that of normal epidermis: immature/basal cells at the periphery, becoming more mature to the centre of the tumor masses. Tumor cells transform into keratinized squamous cells and form round nodules with concentric, laminated layers, called "cell nests" or "epithelial/keratinous pearls". The surrounding stroma is reduced and contains inflammatory infiltrate (lymphocytes). Poorly differentiated squamous carcinomas contain more pleomorphic cells and no keratinization.

A molecular factor involved in the disease process is mutation in gene PTCH1 that plays an important role in the Sonic hedgehog signaling pathway.

Non-invasive skin cancer detection methods include photography, dermoscopy, sonography, confocal microscopy, Raman spectroscopy, fluorescence spectroscopy, terahertz spectroscopy, optical coherence tomography, the multispectral imaging technique, thermography, electrical bio-impedance, tape stripping and computer-aided analysis.

Computer-assisted diagnosis devices have been developed that analyze images from a dermatoscope or spectroscopy and can be used by a diagnostician to aid in the detection of skin cancer. CAD systems have been found to be highly sensitive in the detection of melanoma, but have a high false-positive rate. There is not yet enough evidence to recommend CAD as compared to traditional diagnostic methods.

Sunscreen is effective and thus recommended to prevent melanoma and squamous-cell carcinoma.There is little evidence that it is effective in preventing basal-cell carcinoma.Other advice to reduce rates of skin cancer includes avoiding sunburning, wearing protective clothing, sunglasses and hats, and attempting to avoid sun exposure or periods of peak exposure. The U.S. Preventive

Services Task Force recommends that people between 9 and 25 years of age be advised to avoid ultraviolet light.

The risk of developing skin cancer can be reduced through a number of measures including decreasing indoor tanning and mid-day sun exposure, increasing the use of sunscreen,and avoiding the use of tobacco products.

There is insufficient evidence either for or against screening for skin cancersVitamin supplements and antioxidant supplements have not been found to have an effect in prevention. Evidence for reducing melanoma risk from dietary measures is tentative, with some supportive epidemiological evidence, but no clinical trials.

Zinc oxide and titanium oxide are often used in sun screen to provide broad protection from UVA and UVB ranges.

Eating certain foods may decrease the risk of sunburns but this is much less than the protection provided by sunscreen.

A meta-analysis of skin cancer prevention in high risk individuals found evidence that topical application of T4N5 liposome lotion reduced the rate of appearance of basal cell carcinomas in people with xeroderma pigmentosum, and that acitretin taken by mouth may have a skin protective benefit in people following kidney transplant.

Treatment is dependent on the specific type of cancer, location of the cancer, age of the person, and whether the cancer is primary or a recurrence. For a small basal-cell cancer in a young person, the treatment with the best cure rate (Mohs surgery or CCPDMA) might be indicated. In the case of an elderly frail man with multiple complicating medical problems, a difficult to excise basal-cell cancer of the nose might warrant radiation therapy (slightly lower cure rate) or no treatment at all. Topical chemotherapy might be indicated for large superficial basal-cell carcinoma for good cosmetic outcome, whereas it might be inadequate for invasive nodular basal-cell carcinoma or invasive squamous-cell carcinomaIn general, melanoma is poorly responsive to radiation or chemotherapy.

For low-risk disease, radiation therapy (external beam radiotherapyor brachytherapy), topical chemotherapy (imiquimod or 5-fluorouracil) and cryotherapy (freezing the cancer off) can provide adequate control of the disease; all of them, however, may have lower overall cure rates than certain type of surgery. Other modalities of treatment such as photodynamic therapy, topical chemotherapy, electrodesiccation and curettage can be found in the discussions of basal-cell carcinoma and squamous-cell carcinoma.

Mohs' micrographic surgery (Mohs surgery) is a technique used to remove the cancer with the least amount of surrounding tissue and the edges are checked immediately to see if tumor is found. This provides the opportunity to remove the least amount of tissue and provide the best cosmetically favorable results. This is especially important for areas where excess skin is limited, such as the face. Cure rates are equivalent to wide excision. Special training is required to perform this technique. An alternative method is CCPDMA and can be performed by a pathologist not familiar with Mohs surgery.

In the case of disease that has spread (metastasized), further surgical procedures or chemotherapy may be required.

Treatments for metastatic melanoma include biologic immunotherapy agents ipilimumab, pembrolizumab, and nivolumab; BRAF inhibitors, such as vemurafenib and dabrafenib; and a MEK inhibitortrametinib.

Currently, surgical excision is the most common form of treatment for skin cancers. The goal of reconstructive surgery is restoration of normal appearance and function. The choice of technique in reconstruction is dictated by the size and location of the defect. Excision and reconstruction of facial skin cancers is generally more challenging due to presence of highly visible and functional anatomic structures in the face.

When skin defects are small in size, most can be repaired with simple repair where skin edges are approximated and closed with sutures. This will result in a linear scar. If the repair is made along a natural skin fold or wrinkle line, the scar will be hardly visible. Larger defects may require repair with a skin graft, local skin flap, pedicled skin flap, or a microvascular free flap. Skin grafts and local skin flaps are by far more common than the other listed choices.

Skin grafting is patching of a defect with skin that is removed from another site in the body. The skin graft is sutured to the edges of the defect, and a bolster dressing is placed atop the graft for seven to ten days, to immobilize the graft as it heals in place. There are two forms of skin grafting: split thickness and full thickness. In a split thickness skin graft, a shaver is used to shave a layer of skin from the abdomen or thigh. The donor site regenerates skin and heals over a period of two weeks. In a full thickness skin graft, a segment of skin is totally removed and the donor site needs to be sutured closed.

Split thickness grafts can be used to repair larger defects, but the grafts are inferior in their cosmetic appearance. Full thickness skin grafts are more acceptable cosmetically. However, full thickness grafts can only be used for small or moderate sized defects.

Local skin flaps are a method of closing defects with tissue that closely matches the defect in color and quality. Skin from the periphery of the defect site is mobilized and repositioned to fill the deficit. Various forms of local flaps can be designed to minimize disruption to surrounding tissues and maximize cosmetic outcome of the reconstruction. Pedicled skin flaps are a method of transferring skin with an intact blood supply from a nearby region of the body. An example of such reconstruction is a pedicled forehead flap for repair of a large nasal skin defect. Once the flap develops a source of blood supply form its new bed, the vascular pedicle can be detached.

The mortality rate of basal-cell and squamous-cell carcinoma is around 0.3%, causing 2000 deaths per year in the US. In comparison, the mortality rate of melanoma is 15–20% and it causes 6500 deaths per year. Even though it is much less common, malignant melanoma is responsible for 75% of all skin cancer-related deaths.

The survival rate for people with melanoma depends upon when they start treatment. The cure rate is very high when melanoma is detected in early stages, when it can easily be removed surgically. The prognosis is less favorable if the melanoma has spread to other parts of the body. As of 2003 the overall five-year cure rate with Mohs' micrographic surgery was around 95 percent for recurrent basal cell carcinoma.

Australia and New Zealand exhibit one of the highest rates of skin cancer incidence in the world, almost four times the rates registered in the United States, the UK and Canada. Around 434,000 people receive treatment for non-melanoma skin cancers and 10,300 are treated for melanoma. Melanoma is the most common type of cancer in people between 15–44 years in both countries. The incidence of skin cancer has been increasing. The incidence of melanoma among Auckland residents of European descent in 1995 was 77.7 cases per 100,000 people per year, and was predicted to increase in the 21st century because of "the effect of local stratospheric ozone depletion and the time lag from sun exposure to melanoma development."

Skin cancers result in 80,000 deaths a year as of 2010, 49,000 of which are due to melanoma and 31,000 of which are due to non-melanoma skin cancers. This is up from 51,000 in 1990.

More than 3.5 million cases of skin cancer are diagnosed annually in the United States, which makes it the most common form of cancer in that country. One in five Americans will develop skin cancer at some point of their lives. The most common form of skin cancer is basal-cell carcinoma, followed by squamous cell carcinoma. Unlike for other cancers, there exists no basal and squamous cell skin cancers registry in the United States.

In the US in 2008, 59,695 people were diagnosed with melanoma, and 8,623 people died from it. In Australia more than 12,500 new cases of melanoma are reported each year, out of which more than 1,500 die from the disease. Australia has the highest per capita incidence of melanoma in the world.

Although the rates of many cancers in the United States is falling, the incidence of melanoma keeps growing, with approximately 68,729 melanomas diagnosed in 2004 according to reports of the National Cancer Institute.

Melanoma is the fifth most common cancer in the UK (around 13,300 people were diagnosed with melanoma in 2011), and the disease accounts for 1% all cancer deaths (around 2,100 people died in 2012).

STATEMENT OF PROBLEM

Automate detection and segmentation analysis on skin lesion using back propagation Neural Network and image processing techniques.

OBJECTIVES

- Automatic segmentation of skin lesions using convolutional nueral networks.
- Detection and classification of skin lesions using Soft-computing techniques.
- To help the professional graders for diagnosis and treatment.

SCOPE

- On implementing of the work, it helps the professional graders for diagnosis and treatment in analysing skin lesion images.
- The accuracy level of the diagnosis can be increased.
- By making further developments this work can be used for all kinds of medical images processing.

APPLICATIONS

Applications of Digital Image Processing

Some of the major fields in which digital image processing is widely used are mentioned below

- Image sharpening and restoration
- Medical field
- Remote sensing
- Transmission and encoding
- Machine/Robot vision
- Colour processing
- Pattern recognition
- Video processing
- Others.

LIMITATIONS

- Just because the computer can read these validated data sets with near-100% accuracy doesn’t mean they can read any image
- The algorithm is only as good as what you have thought it to do
- If you have taught it to diagnose melanoma in skin of color then you are at risk of not being able to do it when the algorithm is complete

LITERATURE SURVEY

Tom Fawcett:

Receiver operating characteristics (ROC) graphs are useful for organizing classifiers and visualizing their performance. ROC graphs are commonly used in medical decision making, and in recent years have been used increasingly in machine learning and data mining research. Although ROC graphs are apparently simple, there are some common misconceptions and pitfalls when using them in practice. The purpose of this article is to serve as an introduction to ROC graphs and as a guide for using them in research.

Mouelhi, M. Sayadi, and F. Fnaiech:

Automated analysis of the quantum dots (QDs) images is very important in the field of material science. In this frame, efficient QDs segmentation is prerequisite. In this paper, we propose an algorithm of automatic detection and segmentation of the QDs, especially the clustered ones. We depend on fuzzy c-means (FCM) method for initial segmentation of the QDs from the substrate background. Then we present a modified watershed algorithm with markers and a novel marking function. The markers are extracted by adaptive H-minima transformation. Then a marking function based on Quasi-Euclidean distance transform is introduced to accurately and rapidly separate the clustered QDs. We demonstrate the comparisons of our method with the existing approaches. The experimental results show that the proposed method is efficient and accurate with very little running time and has a high quality on QDs segmentation.

J.selvakumar, A.Lakshmi, and T.Arivoli:

This paper deals with the implementation of Simple Algorithm for detection of range and shape of tumor in brain MR images. Tumor is an uncontrolled growth of tissues in any part of the body. Tumors are of different types and they have different Characteristics and different treatment. As it is known, brain tumor is inherently serious and life-threatening because of its character in the limited space of the intracranial cavity (space formed inside the skull). Most Research in developed countries show that the number of people who have brain tumors were died due to the fact of inaccurate detection. Generally, CT scan or MRI that is directed into intracranial cavity produces a complete image of brain. This image is visually examined by the physician for detection & diagnosis of brain tumor. However, this method of detection resists the accurate determination of stage & size of tumor. To avoid that, this project uses computer aided method for segmentation (detection) of brain tumor based on the combination of two algorithms. This method allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it also reduces the time for analysis. At the end of the process the tumor is extracted from the MR image and its exact position and the shape also determined. The stage of the tumor is displayed based on the amount of area calculated from the cluster.

Ming-Ni Wu, Chia-Chen Lin, and Chin-Chen Chang:

In this paper, we propose a color-based segmentation method that uses the K-means clustering technique to track tumor objects in magnetic resonance (MR) brain images. The key concept in this color-based segmentation algorithm with K-means is to convert a given gray-level MR image into a color space image and then separate the position of tumor objects from other items of an MR image by using K-means clustering and histogram-clustering. Experiments demonstrate that the method can successfully achieve segmentation for MR brain images to help pathologists distinguish exactly lesion size and region.

EXISTING METHOD

A support vector machine (SVM) is a supervised machine learning model that uses classification algorithms for two-group classification problems. After giving an SVM model sets of labeled training data for either of two categories, they're able to categorize new examples.

So you're working on a text classification problem. You're refining your training data, and maybe you've even tried stuff out using Naive Bayes. But now you're feeling confident in your dataset, and want to take it one step further. Enter Support Vector Machines (SVM): a fast and dependable classification algorithm that performs very well with a limited amount of data.

Perhaps you have dug a bit deeper, and ran into terms like linearly separable, kernel trick and kernel functions. But fear not! The idea behind the SVM algorithm is simple, and applying it to natural language classification doesn't require most of the complicated stuff.

Before continuing, we recommend reading our guide to Naive Bayes classifiers first, since a lot of the things regarding text processing that are said there are relevant here as well.

In machine learning, support-vector machines (SVMs, also support-vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns new examples to one category or the other, making it a nonprobabilisticbinarylinear classifier (although methods such as Platt scaling exist to use SVM in a probabilistic classification setting). An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on the side of the gap on which they fall.

In addition to performing linear classification, SVMs can efficiently perform a non-linear classification using what is called the kernel trick, implicitly mapping their inputs into high-dimensional feature spaces.

When data are unlabeled, supervised learning is not possible, and an unsupervised learning approach is required, which attempts to find natural clustering of the data to groups, and then map new data to these formed groups. The support-vector clustering algorithm, created by Have Siegel Mann and Vladimir Vapnik, applies the statistics of support vectors, developed in the support vector machines algorithm, to categorize unlabeled data, and is one of the most widely used clustering algorithms in industrial applications.

DESIGN

Convolutional neural network

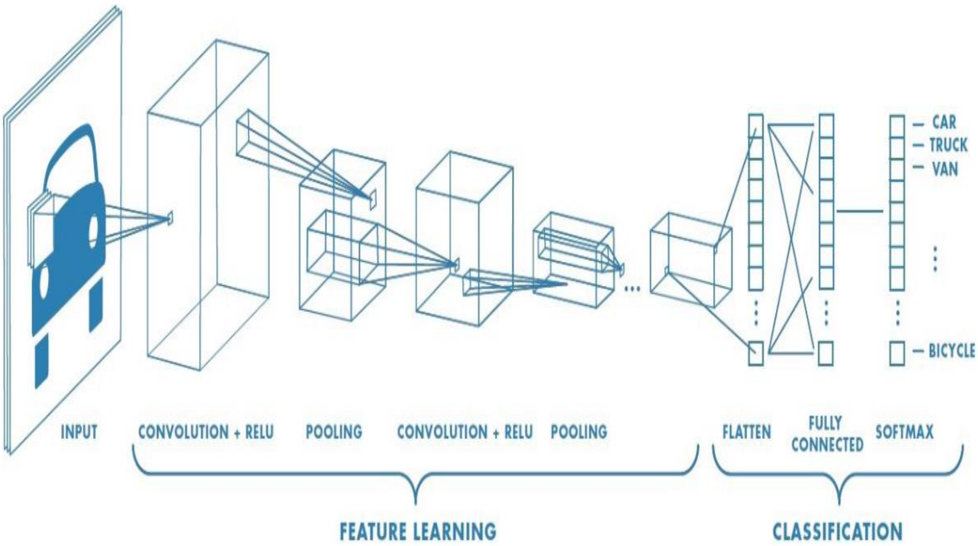


Fig 1. Convolutional neural network

Artificial Intelligence has been witnessing a monumental growth in bridging the gap between the capabilities of humans and machines. Researchers and enthusiasts alike, work on numerous aspects of the field to make amazing things happen. One of many such areas is the domain of Computer Vision. The agenda for this field is to enable machines to view the world as humans do, perceive it in a similar manner and even use the knowledge for a multitude of tasks such as Image & Video recognition, Image Analysis & Classification, Media Recreation, Recommendation Systems, Natural Language Processing, etc. The advancements in Computer Vision with Deep Learning has been constructed and perfected with time, primarily over one particular algorithm — a **Convolutional Neural Network**.

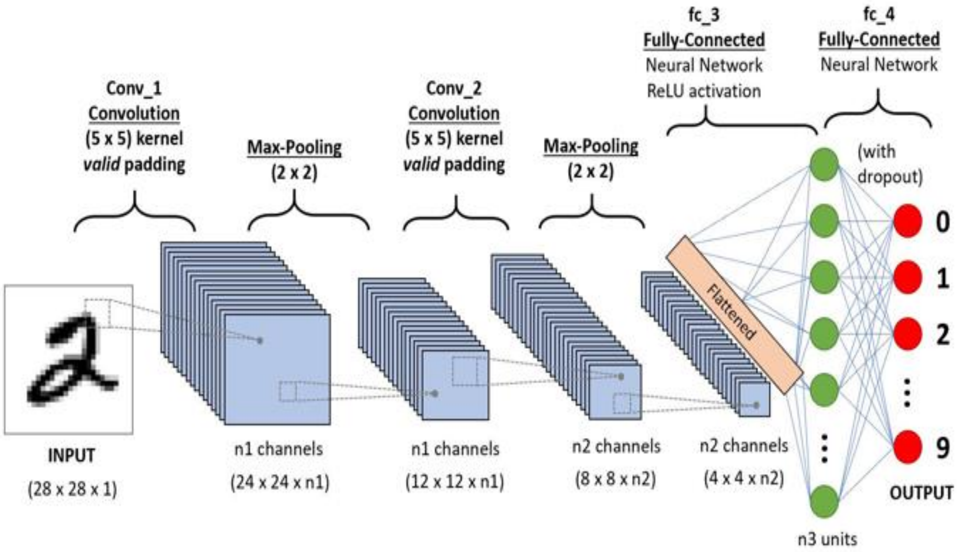


Fig2. A CNN sequence to classify handwritten digits

A Convolutional Neural Network (Convent/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, Convent's have the ability to learn these filters/characteristics.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlaps to cover the entire visual area.

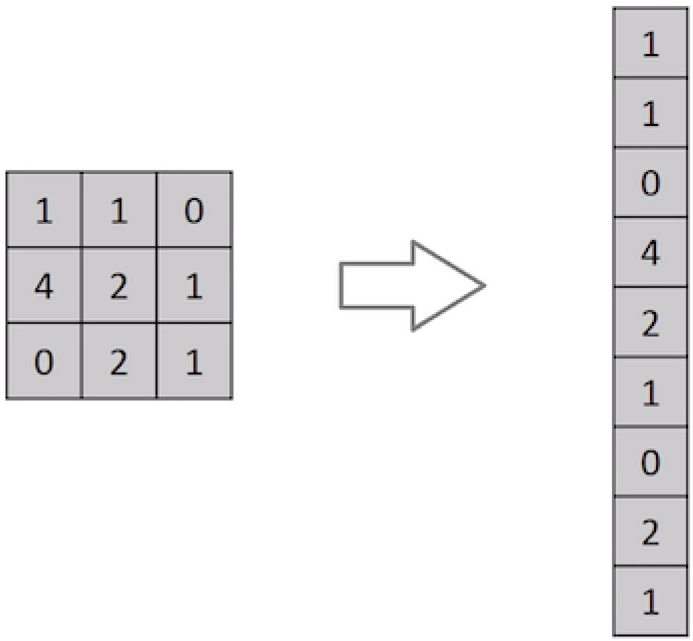


Fig3. Flattening of a 3x3 image matrix into a 9x1 vector

An image is nothing but a matrix of pixel values, right? So why not just flatten the image (e.g. 3x3 image matrix into a 9x1 vector) and feed it to a Multi-Level Perceptron for classification purposes? Uh. not really.

In cases of extremely basic binary images, the method might show an average precision score while performing prediction of classes but would have little to no accuracy when it comes to complex images having pixel dependencies throughout.

A ConvNet is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better.

Input image

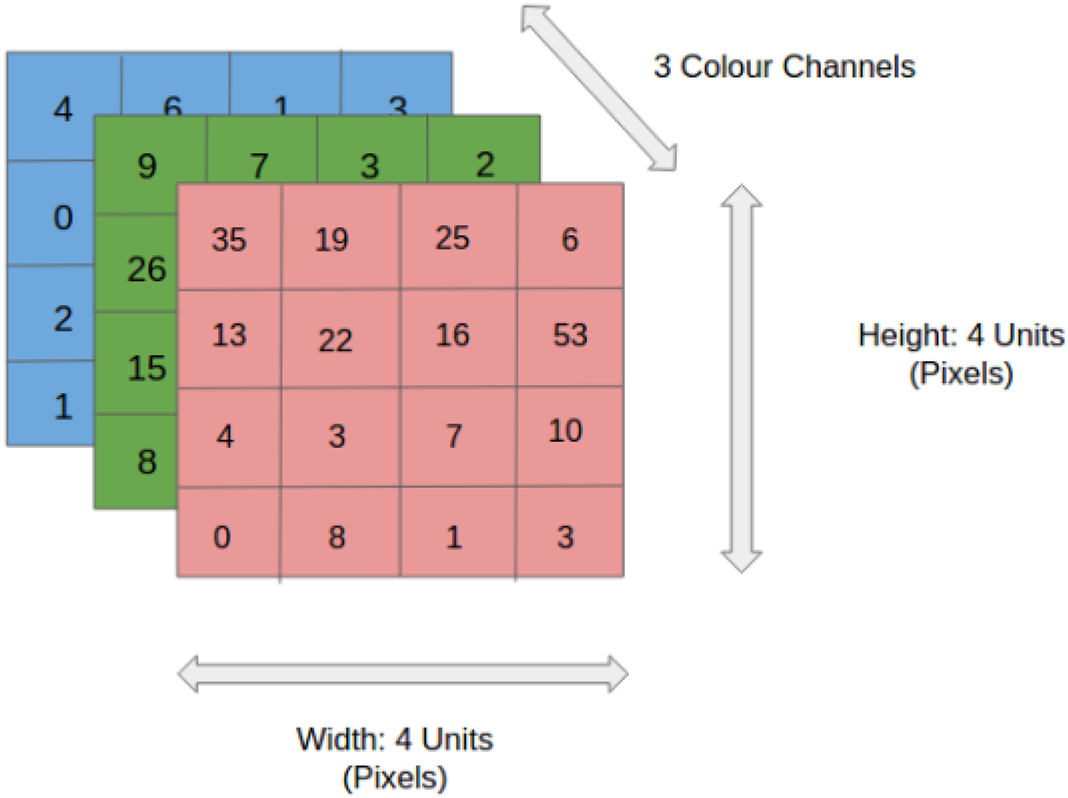


Fig4. 4x4x3 RGB Input Image

In the figure, we have an RGB image which has been separated by its three-color planes — Red, Green, and Blue. There are a number of such color spaces in which images exist — Grayscale, RGB, HSV, CMYK, etc.

You can imagine how computationally intensive things would get once the images reach dimensions, say 8K (7680×4320). The role of the ConvNet is to reduce the images into a form which is easier to process, without losing features which are critical for getting a good prediction. This is important when we are to design an architecture which is not only good at learning features but also is scalable to massive datasets.

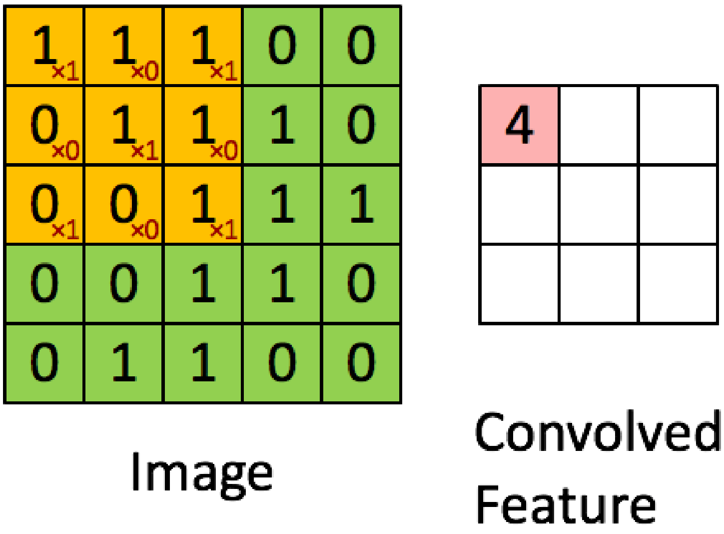


Fig5. Convolutional kernel

Convoluting a 5x5x1 image with a 3x3x1 kernel to get a 3x3x1 convolved feature

Image Dimensions = 5 (Height) x 5 (Breadth) x 1 (Number of channels, eg. RGB)

In the above demonstration, the green section resembles our 5x5x1 input image, I. The element involved in carrying out the convolution operation in the first part of a Convolutional Layer is called the Kernel/Filter, K, represented in the color yellow. We have selected K as a 3x3x1 matrix.

The Kernel shifts 9 times because of Stride Length = 1 (Non-Stride), every time performing a matrix multiplication operation between K and the portion P of the image over which the kernel is hovering.

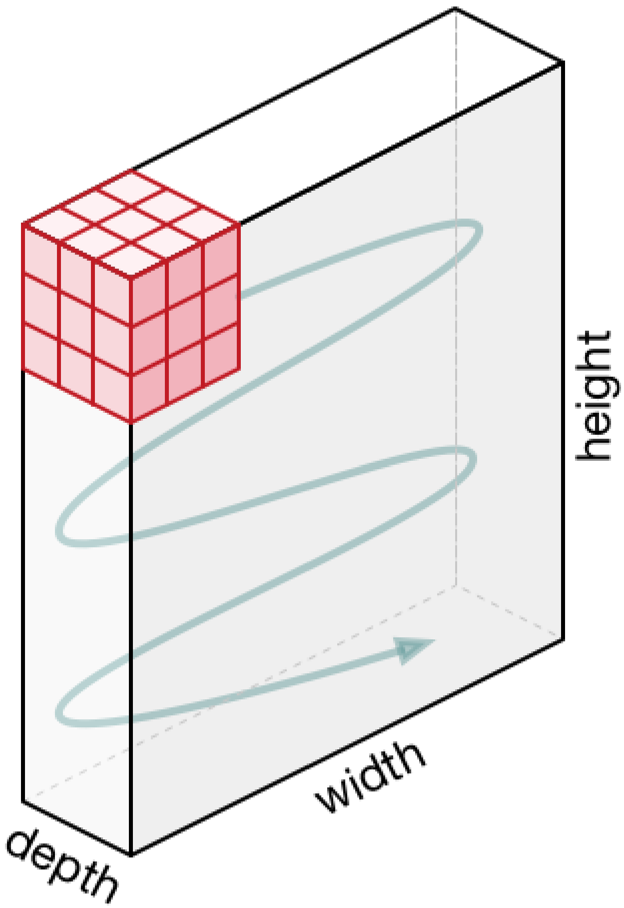


Fig6. Movement of the Kernel

The filter moves to the right with a certain Stride Value till it parses the complete width. Moving on, it hops down to the beginning (left) of the image with the same Stride Value and repeats the process until the entire image is traversed.

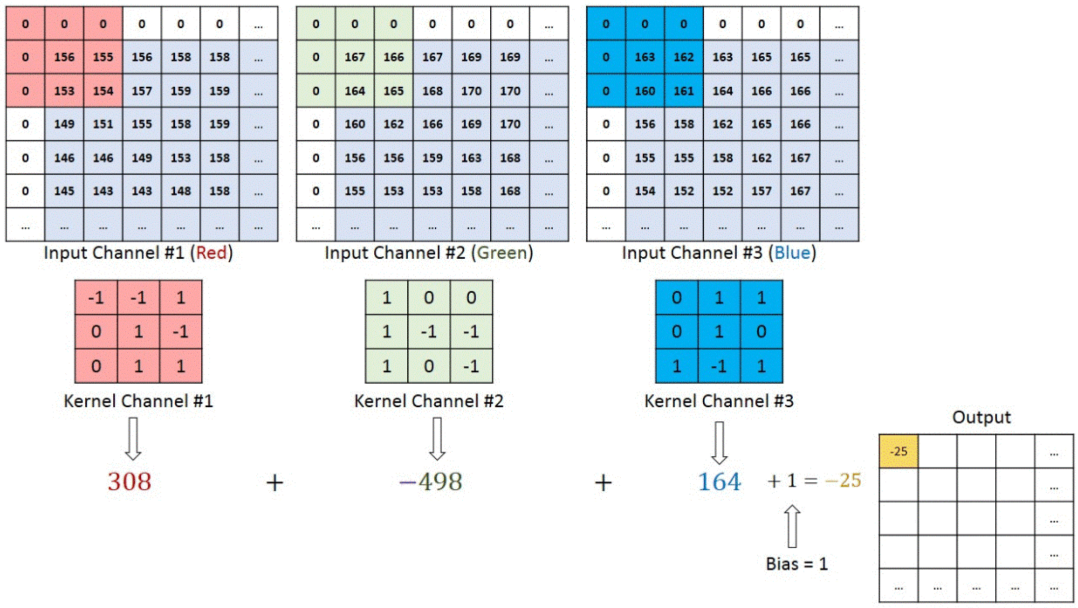


Fig7. Convolution operation on a MxNx3 image matrix with a 3x3x3 Kernel

In the case of images with multiple channels (e.g. RGB), the Kernel has the same depth as that of the input image. Matrix Multiplication is performed between Kn and in stack ([K1, I1]; [K2, I2]; [K3, I3]) and all the results are summed with the bias to give us a squashed one-depth channel Convoluted Feature Output.

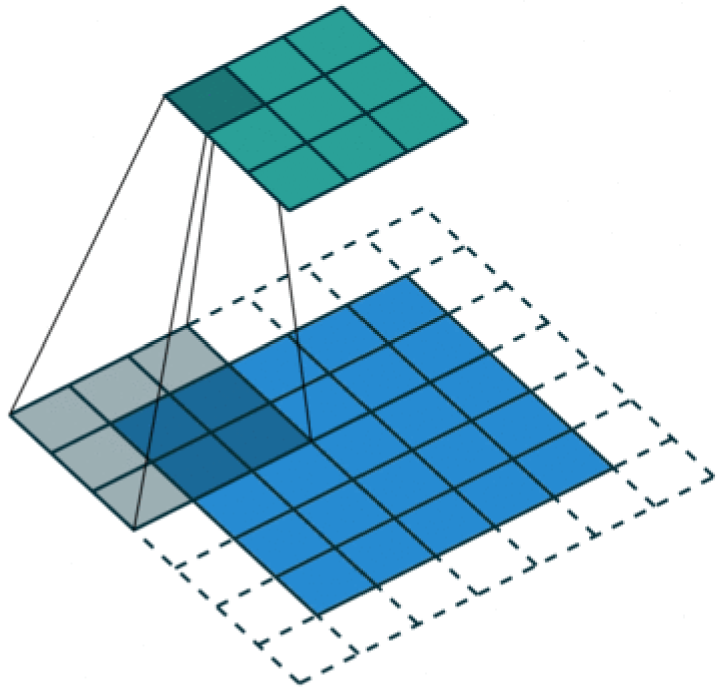


Fig8. Convolution Operation with Stride Length = 2

The objective of the Convolution Operation is to extract the high-level features such as edges, from the input image. Convent's need not be limited to only one Convolutional Layer. Conventionally, the first ConvLayer is responsible for capturing the Low-Level features such as edges, color, gradient orientation, etc. With added layers, the architecture adapts to the High-Level features as well, giving us a network, which has the wholesome understanding of images in the dataset, similar to how we would.

There are two types of results to the operation — one in which the convolved feature is reduced in dimensionality as compared to the input, and the other in which the dimensionality is either increased or remains the same. This is done by applying Valid Padding in case of the former, or Same Padding in the case of the latter.

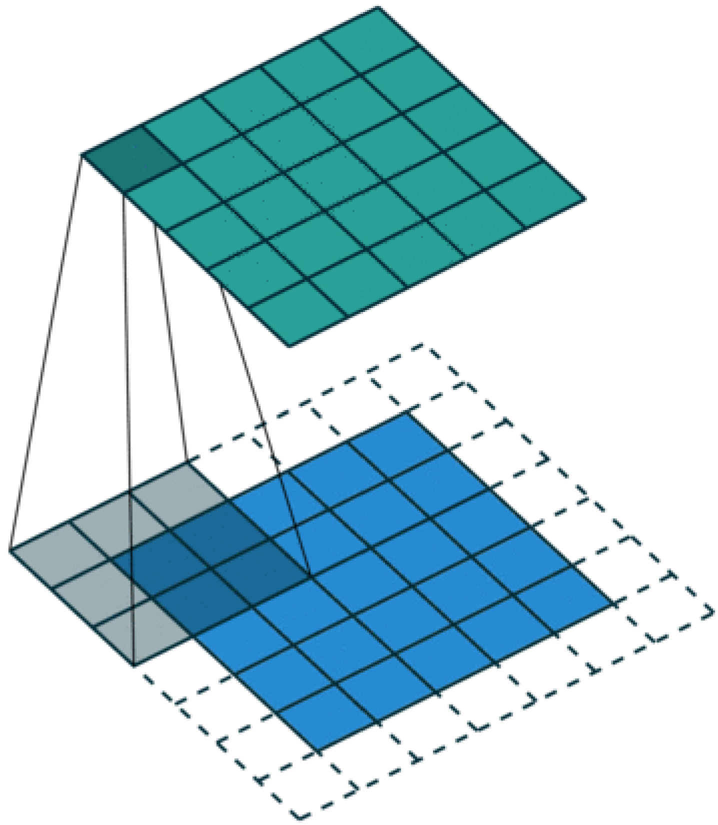


Fig9. SAME padding: 5x5x1 image is padded with 0s to create a 6x6x1 image

When we augment the 5x5x1 image into a 6x6x1 image and then apply the 3x3x1 kernel over it, we find that the convolved matrix turns out to be of dimensions 5x5x1. Hence the name — Same Padding.

On the other hand, if we perform the same operation without padding, we are presented with a matrix which has dimensions of the Kernel (3x3x1) itself — Valid Padding.

Pooling layer

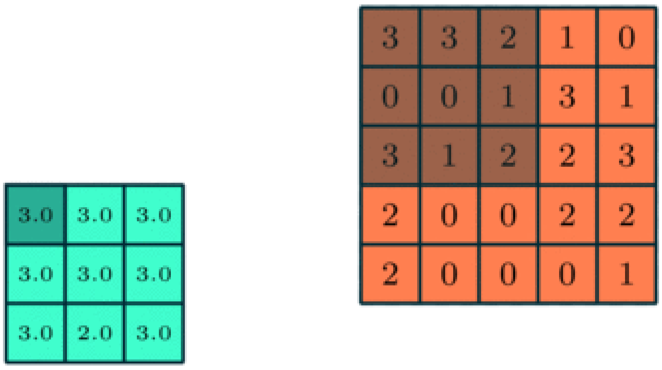


Fig10. 3x3 pooling over 5x5 convolved feature

Similar to the Convolutional Layer, the Pooling layer is responsible for reducing the spatial size of the Convolved Feature. This is to **decrease the computational power required to process the data** through dimensionality reduction. Furthermore, it is useful for **extracting dominant features** which are rotational and positional invariant, thus maintaining the process of effectively training of the model.

There are two types of Pooling: Max Pooling and Average Pooling. **Max Pooling** returns the **maximum value** from the portion of the image covered by the Kernel. On the other hand, **Average Pooling** returns the **average of all the values** from the portion of the image covered by the Kernel.

Max Pooling also performs as a **Noise Suppressant**. It discards the noisy activations altogether and also performs de-noising along with dimensionality reduction. On the other hand, Average Pooling simply performs dimensionality reduction as a noise suppressing mechanism. Hence, we can say that **Max Pooling performs a lot better than Average Pooling**.

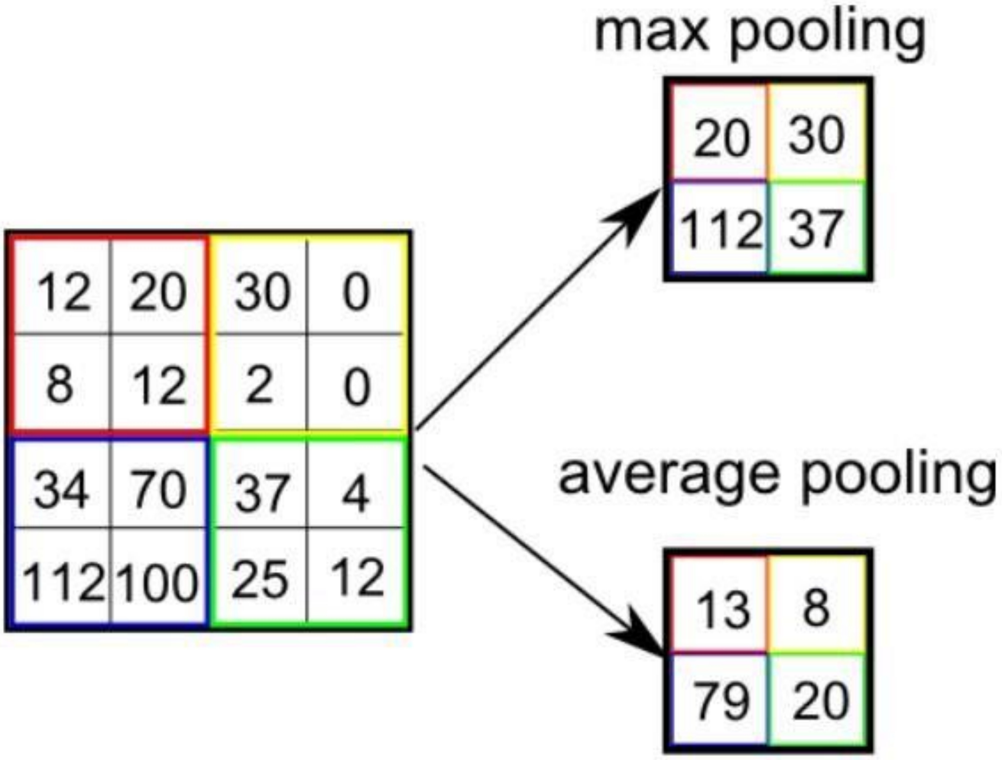


Fig11. Types of Pooling

The Convolutional Layer and the Pooling Layer, together form the i-th layer of a Convolutional Neural Network. Depending on the complexities in the images, the number of such layers may be increased for capturing low-levels details even further, but at the cost of more computational power. After going through the above process, we have successfully enabled the model to understand the features. Moving on, we are going to flatten the final output and feed it to a regular Neural Network for classification purposes.

Fully connected layer

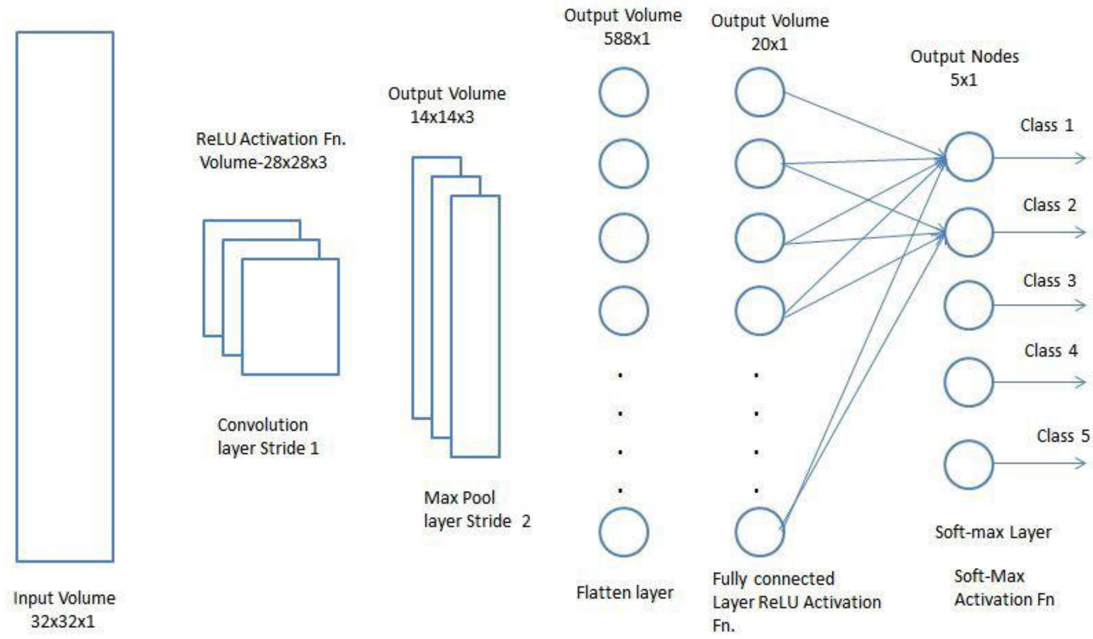


Fig12. Fully connected layer

Adding a Fully-Connected layer is a (usually) cheap way of learning non-linear combinations of the high-level features as represented by the output of the convolutional layer. The Fully-Connected layer is learning a possibly non-linear function in that space.

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. According to Wikipedia, morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to greyscale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest.

Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels. Some operations test whether the element "fits" within the neighbourhood, while others test whether its "hits" or intersects the neighbourhood:

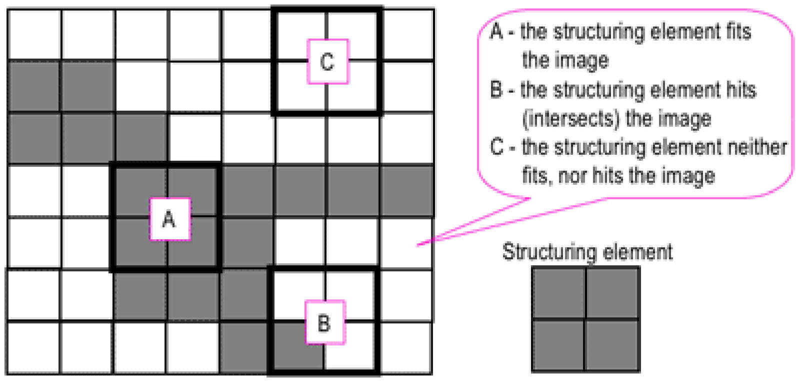


Fig13. Probing of an image

Probing of an image with a structuring element (white and grey pixels have zero and non-zero values, respectively).

A morphological operation on a binary image creates a new binary image in which the pixel has a non-zero value only if the test is successful at that location in the input image.

The structuring element is a small binary image, i.e. a small matrix of pixels, each with a value of zero or one:

- The matrix dimensions specify the size of the structuring element.
- The pattern of ones and zeros specifies the shape of the structuring element.
- An origin of the structuring element is usually one of its pixels, although generally the origin can be outside the structuring element.

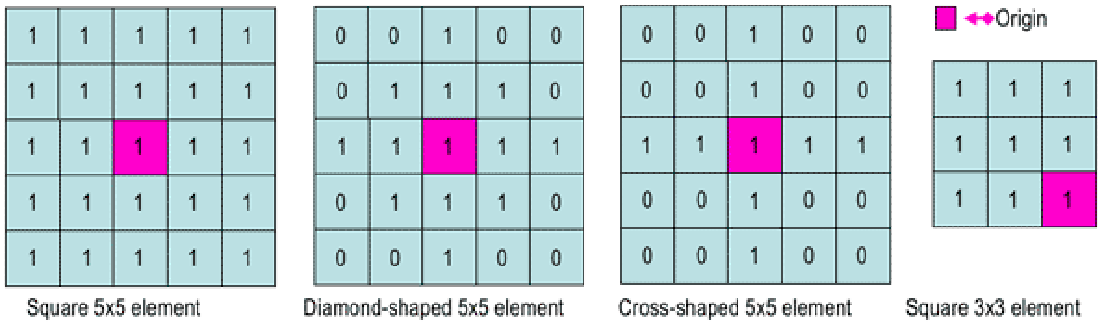
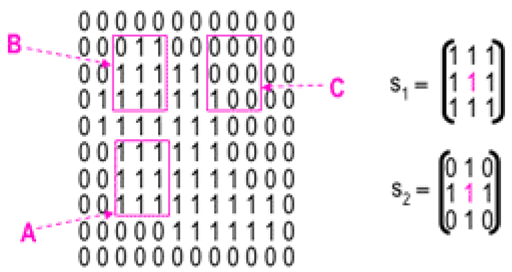


Fig14. Examples of simple structuring elements.

A common practice is to have odd dimensions of the structuring matrix and the origin defined as the centre of the matrix. Stucturing elements play in moprphological image processing the same role as convolution kernels in linear image filtering.

When a structuring element is placed in a binary image, each of its pixels is associated with the corresponding pixel of the neighbourhood under the structuring element. The structuring element is said to fit the image if, for each of its pixels set to 1, the corresponding image pixel is also 1. Similarly, a structuring element is said to hit, or intersect, an image if, at least for one of its pixels set to 1 the corresponding image pixel is also 1.



		A	B	C
fit	s_1	yes	no	no
	s_2	yes	yes	no
hit	s_1	yes	yes	yes
	s_2	yes	yes	no

Fig16. Fitting and hitting of a binary image with structuring elements s_1 and s_2.

Zero-valued pixels of the structuring element are ignored, i.e. indicate points where the corresponding image value is irrelevant.

Fundamental operations

More formal descriptions and examples of how basic morphological operations work are given in the Hypermedia Image Processing Reference (HIPR) developed by Dr. R. Fisher et al. at the Department of Artificial Intelligence in the University of Edinburgh, Scotland, UK.

Erosion and dilation

The erosion of a binary image f by a structuring element s (denoted f $\ominus$s) produces a new binary image g = f $\ominus$s with ones in all locations (x,y) of a structuring element's origin at which that structuring element s fits the input image f, i.e. g(x,y) = 1 is s fits f and 0 otherwise, repeating for all pixel coordinates (x,y).

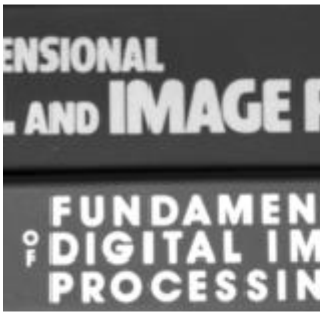
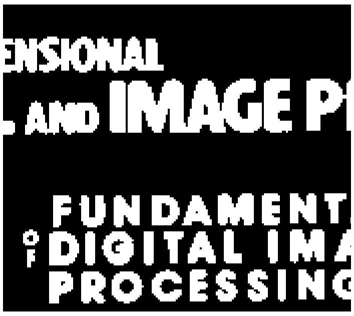


Fig17.Greyscale image



Binary image by thresholding

Erosion: a 2×2 square structuring element

http://documents.wolfram.com/applications/digitalimage/UsersGuide/Morphology/ImageProcessing6.3.html

Erosion with small (e.g. 2×2 - 5×5) square structuring elements shrinks an image by stripping away a layer of pixels from both the inner and outer boundaries of regions. The holes and gaps between different regions become larger, and small details are eliminated:

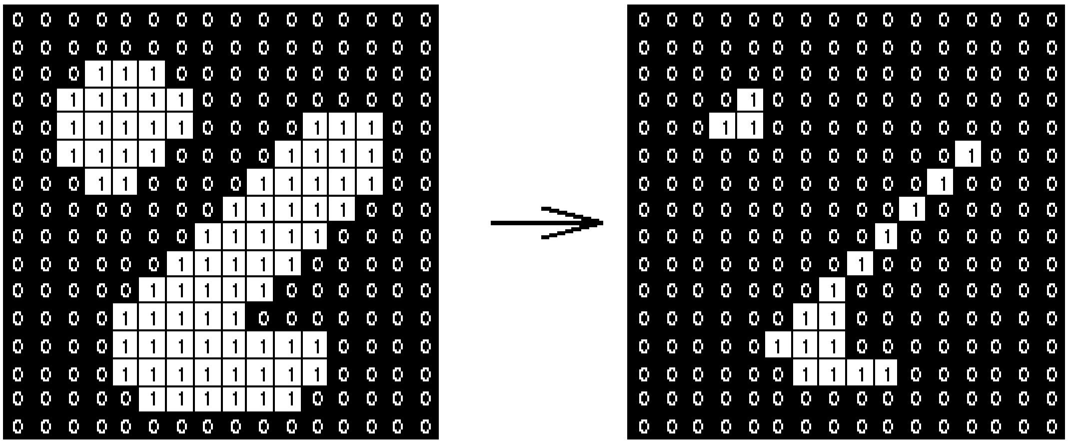


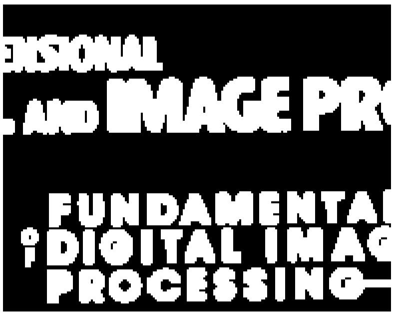
Fig19. Erosion: a 3×3 square structuring element (www.cs.princeton.edu/~pshilane/class/mosaic/).

Larger structuring elements have a more pronounced effect, the result of erosion with a large structuring element being similar to the result obtained by iterated erosion using a smaller structuring element of the same shape. If s_1 and s_2 are a pair of structuring elements identical in shape, with s_2 twice the size of s_1, then
$f \ominus s_2 \approx (f \ominus s_1) \ominus s_1$.

Erosion removes small-scale details from a binary image but simultaneously reduces the size of regions of interest, too. By subtracting the eroded image from the original image, boundaries of each region can be found: $b = f - (f \ominus s)$ where f is an image of the regions, s is a 3×3 structuring element, and b is an image of the region boundaries.

The dilation of an image f by a structuring element s (denoted $f \oplus s$) produces a new binary image $g = f \oplus s$ with ones in all locations (x,y) of a structuring element's orogin at which that structuring element s hits the the input image f, i.e. g(x,y) = 1 if s hits f and 0 otherwise, repeating for all pixel coordinates (x,y). Dilation has the opposite effect to erosion -- it adds a layer of pixels to both the inner and outer boundaries of regions.

Fig20. Binary image



Dilation: a 2×2 square structuring element

http://documents.wolfram.com/applications/digitalimage/UsersGuide/Morphology/ImageProcessing6.3.html

The holes enclosed by a single region and gaps between different regions become smaller, and small intrusions into boundaries of a region are filled in:

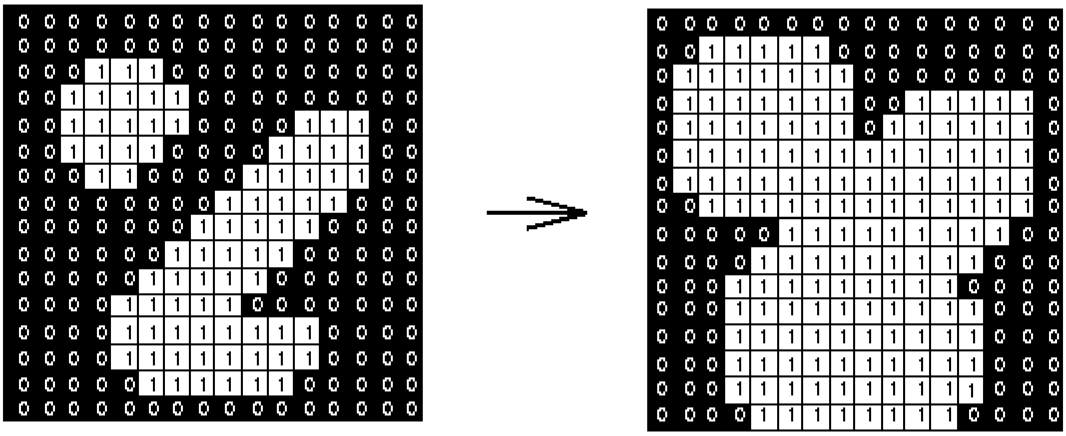


Fig21. Dilation: a 3×3 square structuring element (www.cs.princeton.edu/~pshilane/class/mosaic/).

Results of dilation or erosion are influenced both by the size and shape of a structuring element. Dilation and erosion are dual operations in that they have opposite effects. Let f^c denote the complement of an image f, i.e., the image produced by replacing 1 with 0 and vice versa. Formally, the duality is written as

$f \oplus s = f^c \ominus s_{rot}$

where s_{rot} is the structuring element s rotated by 180°. If a structuring element is symmetrical with respect to rotation, then s_{rot} does not differ from s. If a binary image is considered to be a collection of connected regions of pixels set to 1 on a background of pixels set to 0, then erosion is the fitting of a structuring element to these regions and dilation is the fitting of a structuring element (rotated if necessary) into the background, followed by inversion of the result.

Compound operations

Many morphological operations are represented as combinations of erosion, dilation, and simple set-theoretic operations such as the complement of a binary image:

$f^c(x,y) = 1$ if $f(x,y) = 0$, and $f^c(x,y) = 0$ if $f(x,y) = 1$,

the intersection $h = f \cap g$ of two binary images f and g:
$h(x,y) = 1$ if $f(x,y) = 1$ and $g(x,y) = 1$, and $h(x,y) = 0$ otherwise,

and the union $h = f \cup g$ of two binary images f and g:
$h(x,y) = 1$ if $f(x,y) = 1$ or $g(x,y) = 1$, and $h(x,y) = 0$ otherwise:

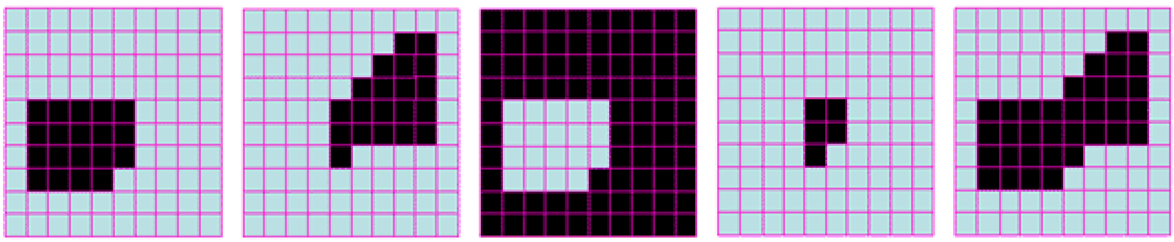


Fig22. Set operations on binary images: from left to right: a binary image f,a binary image g, the complement f^coff, the intersection $f \cap g$, and the union $f \cup g$.

The opening of an image f by a structuring element s (denoted by $f \circ s$) is an erosion followed by a dilation:

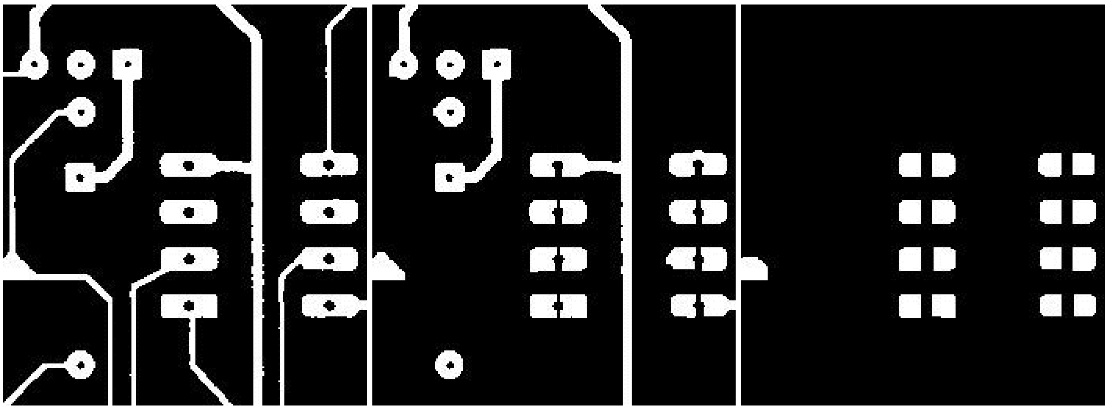
$f \circ s = (f \ominus s) \oplus s$

Fig 23. Binary image

Opening: a 2×2 square structuring element

http://documents.wolfram.com/applications/digitalimage/UsersGuide/Morphology/ImageProcessing6.3.html

Opening is so called because it can open up a gap between objects connected by a thin bridge of pixels. Any regions that have survived the erosion are restored to their original size by the dilation:



Binary image f $\quad$ $f \circ s$ (5×5 square) $\quad$ $f \circ s$ (9×9 square)

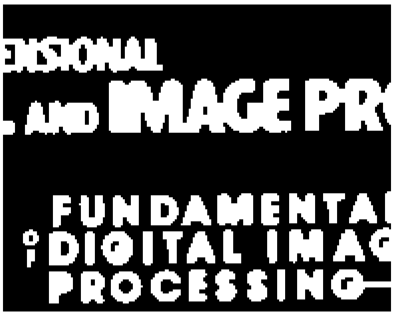
Fig24. Results of opening with a square structuring element (www.mmorph.com/html/morph/mmopen.html/).

Opening is an idempotent operation: once an image has been opened, subsequent openings with the same structuring element have no further effect on that image:

$(f \circ s) \circ s) = f \circ s.$

The closing of an image f by a structuring element s (denoted by f • s) is a dilation followed by an erosion: $f \bullet s = (f \oplus s_{rot}) \ominus s_{rot}$

Fig 25. Binary image



Closing: a 2×2 square structuring element

http://documents.wolfram.com/applications/digitalimage/UsersGuide/Morphology/ImageProcessing6.3.html

In this case, the dilation and erosion should be performed with a rotated by 180 ∘ structuring element. Typically, the latter is symmetrical, so that the rotated and initial versions of it do not differ.

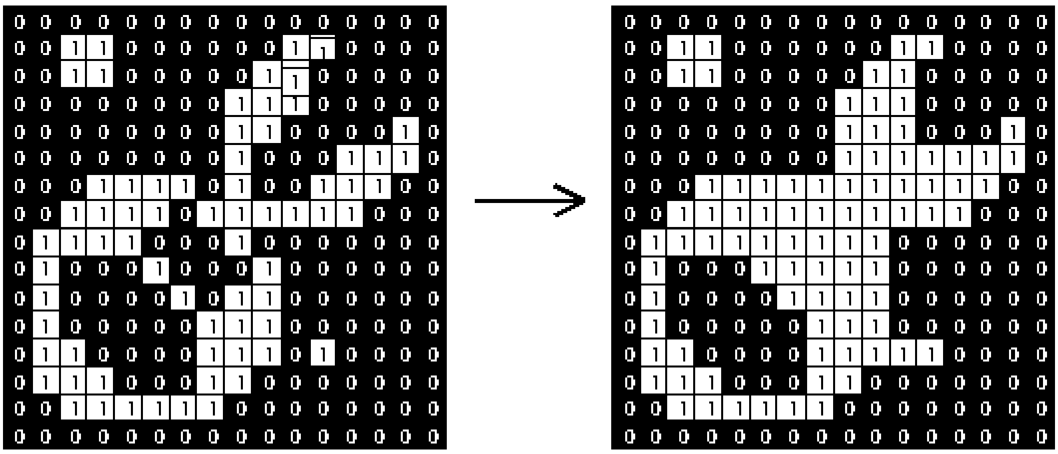


Fig26. Closing with a 3×3 square structuring element (www.cs.princeton.edu/~pshilane/class/mosaic/).

Closing is so called because it can fill holes in the regions while keeping the initial region sizes. Like opening, closing is idempotent: $(f \bullet s) \bullet s = f \bullet s$, and it is dual operation of opening (just as opening is the dual operation of closing):

$f \bullet s = (f^c \circ s)^c$; $f \circ s = (f^c \bullet s)^c$.

In other words, closing (opening) of a binary image can be performed by taking the complement of that image, opening (closing) with the structuring element, and taking the complement of the result.

The hit and miss transform (see also HIPS2 web page) allows to derive information on how objects in a binary image are related to their surroundings. The operation requires a matched pair of structuring elements, $\{s_1, s_2\}$, that probe the inside and outside, respectively, of objects in the image:

$f \circledast \{s_1, s_2\} = (f \ominus s_1) \cap (f^c \ominus s_2)$.

http://documents.wolfram.com/applications/digitalimage/UsersGuide/Morphology/ImageProcessing6.3.html

A pixel belonging to an object is preserved by the hit and miss transform if and only if s_1 translated to that pixel fits inside the object AND s_2 translated to that pixel fits outside the object. It is assumed that s_1 and s_2 do not intersect, otherwise it would be impossible for both fits to occur simultaneously.

It is easier to describe it by considering s_1 and s_2 as a single structuring element with 1s for pixels of s_1 and 0s for pixels of s_2; in this case the hit-and-miss transform assigns 1 to an output pixel only if the object (with the value of 1) and background (with the value of 0) pixels in the structuring element exactly match object

(1) and background (0) pixels in the input image. Oterwise that pixel is set to the background value (0).

The hit and miss transform can be used for detecting specific shapes (spatial arrangements of object and background pixel values) if the two structuring elements present the desired shape, as well as for thinning or thickening of object linear elements.

Morphological filtering

of a binary image is conducted by considering compound operations like opening and closing as filters. They may act as filters of shape. For example, opening with a disc structuring element smooths corners from the inside, and closing with a disc smooths corners from the outside. But also, these operations can filter out from an image any details that are smaller in size than the structuring element, e.g. opening is filtering the binary image at a scale defined by the size of the structuring element. Only those portions of the image that fit the structuring element are passed by the filter; smaller structures are blocked and excluded from the output image. The size of the structuring element is most important to eliminate noisy details but not to damage objects of interest.

UML diagrams for skin lesion detection

- There are five entities in the skin lesion detection. They are User, System Application, Camera, Image database, Training neural network. Here, System application used is MATLAB.
- User interacts with System application or matlab. Whatever action that is needed for user, user gives the command and system will give result.
- System application need not to be matlab, it may also be other one. Here,we used matlab for the requirement.
- Here, Camera is used for capturing images of skin lesion and those will be used for the further processes.
- Images captured or gathered will be taken into database. Those images can contain different types of skin lesions. Grouping of these images is called dataset.
- This image dataset will be used for training. For identifying this kind of images, training neural network is for recognizing this type of patterns.
- By training neural network, skin lesion features will be predicted and system application will differentiate different kinds of skin lesion.
- Images in the dataset will be tested for predicted patterns in the training neural network.

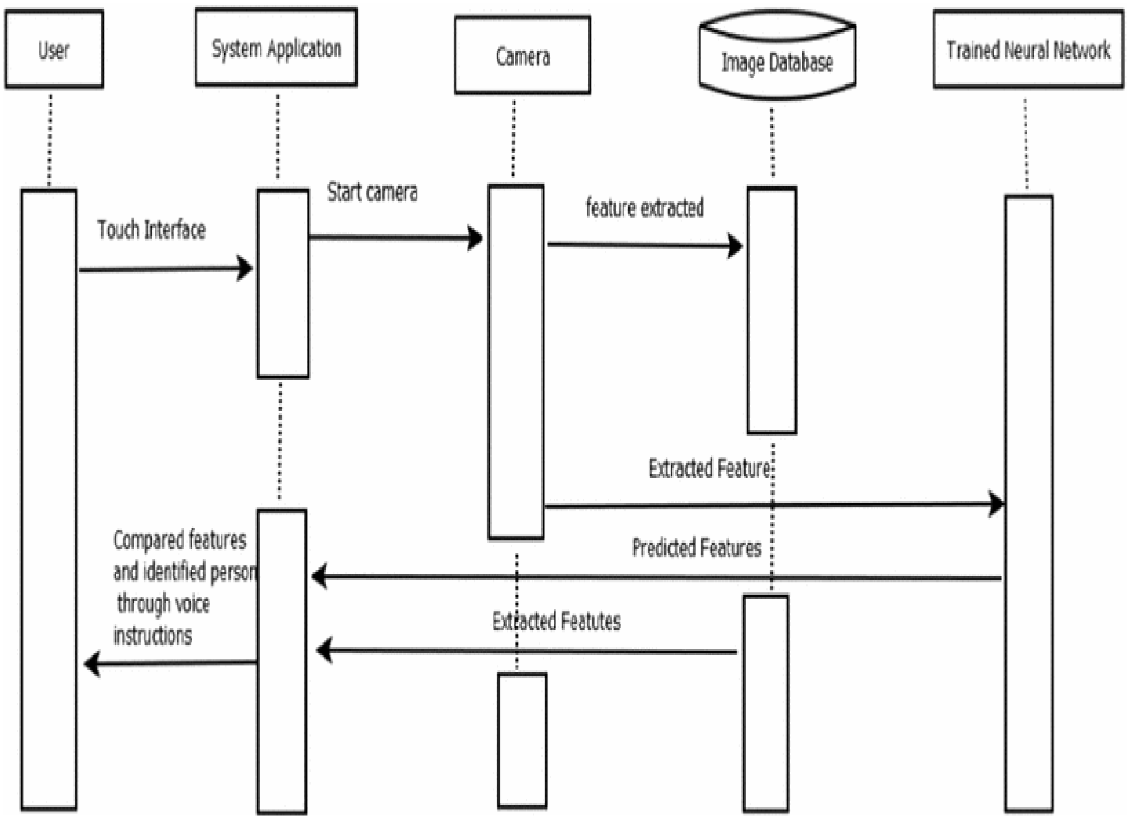


Fig 27. Skin lesion detection UML diagram

IMPLEMENTATION

Requirements:

Software Requirements:

- MATLAB R2018a or above
- OS: Windows 10

Hardware Requirements:

- A system with at-least 8 GB RAM.

IMPLEMENTATION

To implement automated skin lesion detection, convolution neural network algorithm is used. Here, we need to train the neural network for skin lesion patterns.

OBJECT EVALUATION

Here, object evaluation is to find out what is the object lies in the image. For that, clustering object evaluation is used. It is used to cluster the input data, stored as valid clustering algorithm name or function handle. It will cluster the pixels of near intensity values in the image. If this is done correctly, then the pattern of the object will be identified.

IMAGE SEGMENTATION

Image segmentation is splitting the image into various segments, so that required segment will be selected to identify the object in the image. Method used for image segmentation is OTSU segmentation. Among all thesegmentation methods, Otsu method is one of the most successful methods for image thresholding because of its simple calculation. Otsu is an automatic threshold selection region based segmentation method.

OBJECT EVALUATION CODE: MathWorks MATLAB R2018a x64.zip

```
%

default_fields = {'u_tag', 'u_extention', 'back_shift_for_u', 'back_shift_for_gt', 'gt_tag_and_ext', 'skl_gt_tag_and_ext', 'gt_meddir', 'meddir', 'text_region_flag', 'No_dibco'};

fortemp_label = 1:2:(nargin-3)

parameter_name = varargin{temp_label};

parameter_val = varargin{temp_label + 1};

matched_field = strmatch(lower(parameter_name), default_fields);

ifisempty(matched_field)

error('ERROR: ', 'Unknown parameter name: %s.\n', parameter_name);

elseif (length(matched_field) > 1)

error('ERROR: ', 'Ambiguous parameter name: %s.\n', parameter_name);

else

switch(matched_field)

case 1  % u_tag

u_tag = parameter_val;

case 2  % u_extention

u_extention = parameter_val;

case 3  % back_shift_for_u

back_shift_for_u = parameter_val;

case 4  % back_shift_for_GT

back_shift_for_GT = parameter_val;

case 5  % GT_tag_and_ext

GT_tag_and_ext = parameter_val;

case 6  % SKL_GT_tag_and_ext

SKL_GT_tag_and_ext = parameter_val;

case 7  % GT_meddir

GT_meddir = parameter_val;

case 8  % meddir
```

```
meddir = parameter_val;
case 9  % text_region_flag
text_region_flag = parameter_val;
case 10 % No_DIBCO
No_DIBCO = parameter_val;
end
end
end
%
if not(iscell(u_extention))
u_extention = {u_extention};
end
%
if not(iscell(GT_tag_and_ext))
GT_tag_and_ext = {GT_tag_and_ext};
end
%
ifstrcmpi(GT_meddir, '')
GT_meddir = meddir;
end
% check SKL_GT_tag_and_ext
SKL_GT_flag = true;
try
SKL_GT_tag_and_ext;
if (strcmpi(SKL_GT_tag_and_ext, ''))
SKL_GT_flag = false;
end
catch ME
SKL_GT_flag = false;
end
end%
```

FINAL CODE (Finalcode2run.m)

```
clc
clear all
close all
close all hidden;
[file1,path1]=uigetfile('*.*');
img1=imread([path1,file1]);
figure,imshow(img1);title('Input image');

matlabroot = 'Z:\code analysis\Final code';
digitDatasetPath = fullfile(matlabroot,'Dataset');
imds =
imageDatastore(digitDatasetPath,'IncludeSubfolders',true,'LabelSource','f
oldernames');

layers = [
    imageInputLayer([300 300 3])
    convolution2dLayer(3,32,'Stride',1,'Padding','same','Name','conv_1')
    batchNormalizationLayer
    reluLayer
    maxPooling2dLayer(2,'Stride',2,'Name','maxpool_1')

    convolution2dLayer(3,64,'Stride',1,'Padding','same','Name','conv_2')
    batchNormalizationLayer
    reluLayer
    maxPooling2dLayer(2,'Stride',2,'Name','maxpool_2')

    convolution2dLayer(3,128,'Stride',1,'Padding','same','Name','conv_3')
    batchNormalizationLayer
    reluLayer
    maxPooling2dLayer(2,'Stride',2,'Name','maxpool_3')

    fullyConnectedLayer(2)
    softmaxLayer
    classificationLayer];

options = trainingOptions('sgdm','Plots','training-
progress','MaxEpochs',30,'initialLearnRate',0.001);
convnet = trainNetwork(imds,layers,options);
YPred = classify(convnet,img1);
output=char(YPred);


if output=='1'
    msgbox('No tumor is detected;It is a mole')
else
    msgbox('Tumor is detected')
     rgb=img1;
I = rgb2gray(rgb);
os = otsu(rgb,50);
```

```
 gmag = imgradient(I);
L = watershed(gmag);
Lrgb = label2rgb(L);
se = strel('disk',25);
Io = imopen(I,se);
Ie = imerode(I,se);
Iobr = imreconstruct(Ie,I);
Ioc = imclose(Io,se);
Iobrd = imdilate(Iobr,se);
Iobrcbr = imreconstruct(imcomplement(Iobrd),imcomplement(Iobr));
Iobrcbr = imcomplement(Iobrcbr);
fgm = imregionalmax(Iobrcbr);
I2 = labeloverlay(I,fgm);
bw = imbinarize(Iobrcbr);
bw=imcomplement(bw);
figure;imshow(bw);
title('segmented image');


end

a=img1;
a=im2bw(a);
aa=imresize(a,[256 256]);
u_bw_filename = aa;

b=bw;
% b=im2bw(b);

 bb=imresize(b,[256 256]);
u_GT_filename = (bb);

u_GT = [((u_GT_filename)) > 0 ];
u_bw = [((u_bw_filename)) > 0 ];

temp_obj_eval = objective_evaluation_core(u_bw, u_GT);

disp('Accuracy--');
disp(temp_obj_eval.Accuracy);
```

Execution Procedure

MATLAB is an intuitive framework whose important records thing is an exhibit that doesn't require dimensioning. This allows you to address several specialized processing issues, specifically people with framework and vector data, in a small quantity of the time it might take to compose a program in a scalar non intuitive dialect, as an instance, C or FORTRAN.

The name MATLAB stays for grid studies facility. MATLAB modified into to start with composed to offer simple access to framework programming created thru the LINPACK and EISPACK ventures. Today, MATLAB vehicles fuse the LAPACK and BLAS libraries, putting the cutting element in programming for network calculation.

MATLAB has advanced over a time of years with contribution from several customers. In college situations, it's miles the same old educational system for early on and propelled courses in arithmetic, designing, and technological know-how. In industry, MATLAB is the tool of selection for high-profitability research, development, and exam.

MATLAB highlights a collection of extra utility-precise preparations called device booths. Important to most clients of MATLAB, tool kits allow you to examine and practice particular innovation. Tool compartments are exhaustive accumulations of MATLAB capacities (M-records) that extend out the MATLAB situation to take care of precise instructions of problems. Territories in which device stash are reachable incorporate flag dealing with, manage frameworks, neural systems, fluffy purpose, wavelets, recreation, and several others.

The MATLAB System:

The MATLAB machine includes five predominant parts.

Development Environment:

This is the set of tools and facilities that assist you use MATLAB functions and files. Many of those system are graphical consumer interfaces. It includes the MATLAB computing device and Command Window, a command history, an editor and debugger, and browsers for viewing help, the workspace, files, and the hunt direction.

The MATLAB Mathematical Function:

This is a wonderful collection of computational algorithms starting from essential features like sum, sine, cosine, and complex mathematics, to extra sophisticated features like matrix inverse, matrix eigen values, Bessel competencies, and fast Fourier transforms.

The MATLAB Language:

This is an excessive-degree matrix/array language with manipulate go with the go with the flow statements, competencies, statistics systems, input/output, and object-oriented programming talents. It permits every programming in the small to hastily create quick and dirty throw-away programs, and programming in the big to create entire massive and complicated software applications.

Graphics:

MATLAB has huge facilities for showing vectors and matrices as graphs, further to annotating and printing those graphs. It consists of immoderate-degree capabilities for two-dimensional and three-dimensional facts visualization, image processing, animation, and presentation images. It additionally includes low-stage functions that allow you to completely customize the appearance of image graphs further to assemble whole graphical consumer interfaces on your MATLAB packages.

The MATLAB Application Program Interface (API):

his is a library that lets in you to write C and Fortran packages that engage with MATLAB. It includes centers for calling workout routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for analyzing and writing MAT-documents.

5.2 MATLAB WORKING ENVIRONMENT:

MATLAB DESKTOP:

Matlab Desktop is the precept Matlab utility window. The computing device consists of five sub windows, the summon window, the workspace software, the prevailing catalog window, the order records window, and at the least one figure home windows, which are confirmed simply whilst the patron indicates a realistic.

The order window is the vicinity the consumer types MATLAB orders and expressions on the provoke (>>) and where the yield of these costs is shown. MATLAB characterizes the workspace because the association of factors that the purchaser makes in a work consultation. The workspace application demonstrates these elements and a few information approximately them. Double tapping on a variable in the workspace software dispatches the Array Editor, which can be applied to get statistics and wage instances regulate certain homes of the variable.

The gift Directory tab over the workspace tab demonstrates the substance of the prevailing registry, whose way is seemed within the gift index window. 1For case, in the home windows working framework the manner may be as consistent with the subsequent: C:MATLABWork, demonstrating that registry work is a subdirectory of the number one catalog MATLAB, that's added in force C. Tapping on the bolt inside the gift index window demonstrates a rundown of as of late utilized approaches. Tapping at the capture to at least one aspect of the window allows the customer to exchange the prevailing catalog.

MATLAB utilizes an inquiry way to discover M-information and other MATLAB associated documents, which might be kind out in catalogs within the PC report framework. Any report hold going for walks in MATLAB must reside in the ebb and go with the flow registry or in an index this is on are looking for manner. Of course, the facts provided with MATLAB and math works device kits are integrated into the inquiry manner. The least traumatic approach to look which indexes are at the inquiry manner. The best method to peer which catalogs are quickly the search way, or to consist of or adjust an inquiry manner, is to pick out set way from the File menu the computing device, and after that utilization the set way change container. It is extremely good exercise to feature any normally applied catalogs to the pursuit manner to preserve a strategic distance from again and again having the exchange the existing index.

The Command History Window incorporates a file of the orders a customer has entered in the rate window, together with each gift and beyond MATLAB classes. Already entered MATLAB orders may be selected and re-done from the fee history window by using right tapping on a sum on or association of orders. This interest dispatches a menu from which to choose exclusive picks however executing the orders. This is helpful to pick special choices notwithstanding executing the summons. This is a precious element even as attempting different things with distinct orders in a work consultation.

Using the MATLAB Editor to create M-Files: The MATLAB manager is both a word processor specific for making M-information and a graphical MATLAB debugger. The proofreader can display up in a window without everybody else, or it could be a sub window inside the desktop. M-statistics are supposed by means of the growth .M, as in pixelup.m. The MATLAB editorial manager window has diverse draw down menus for errands, as an example, sparing, seeing, and troubleshooting files. Since it plays out some primary tests and furthermore makes use of shading to separate among exceptional components of code, this content material device is suggested because the apparatus of choice for composing and changing M-capacities. To open the proofreader, sort adjust at the incite opens the M-report filename. In a supervisor window, organized for changing. As referred to before, the file has to be within the momentum catalog, or in an index inside the pursuit way.

Getting Help:

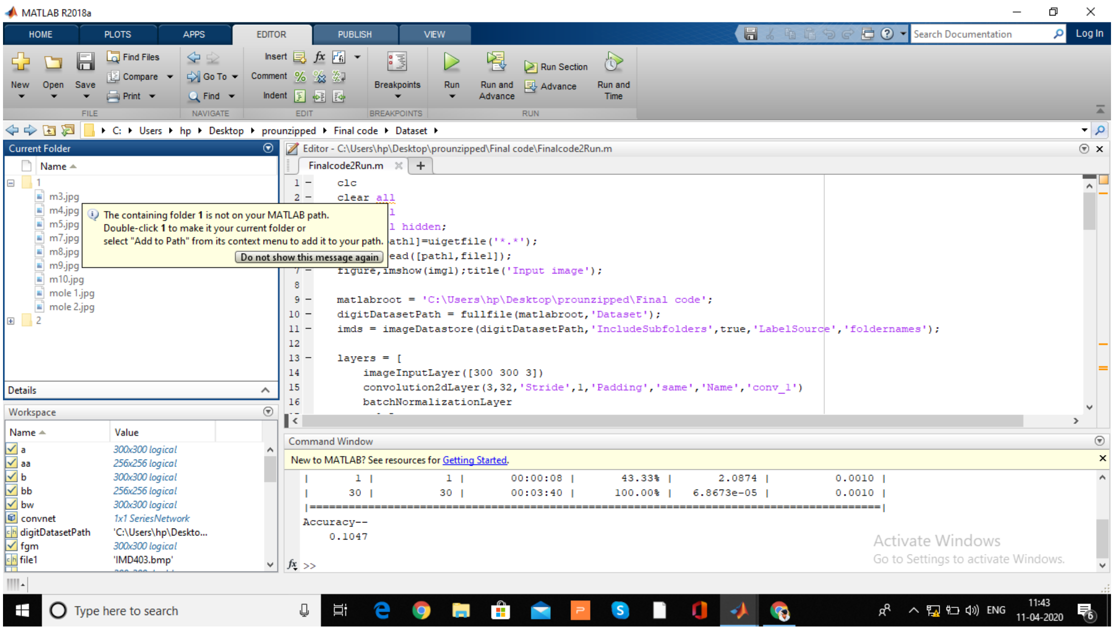
The important approach to get help online is to utilize the MATLAB help program, opened as a different window either by tapping on the question mark image (?) on the desktop toolbar, or by writing help program at the provoke in the order window. The assistance Browser is a web program coordinated into the MATLAB desktop that shows a Hypertext Markup Language (HTML) records. The Help Browser comprises of two sheets, the assistance pilot sheet, used to discover data, and the show sheet, used to see the data.

STEPS OF EXECUTING PROCESS:

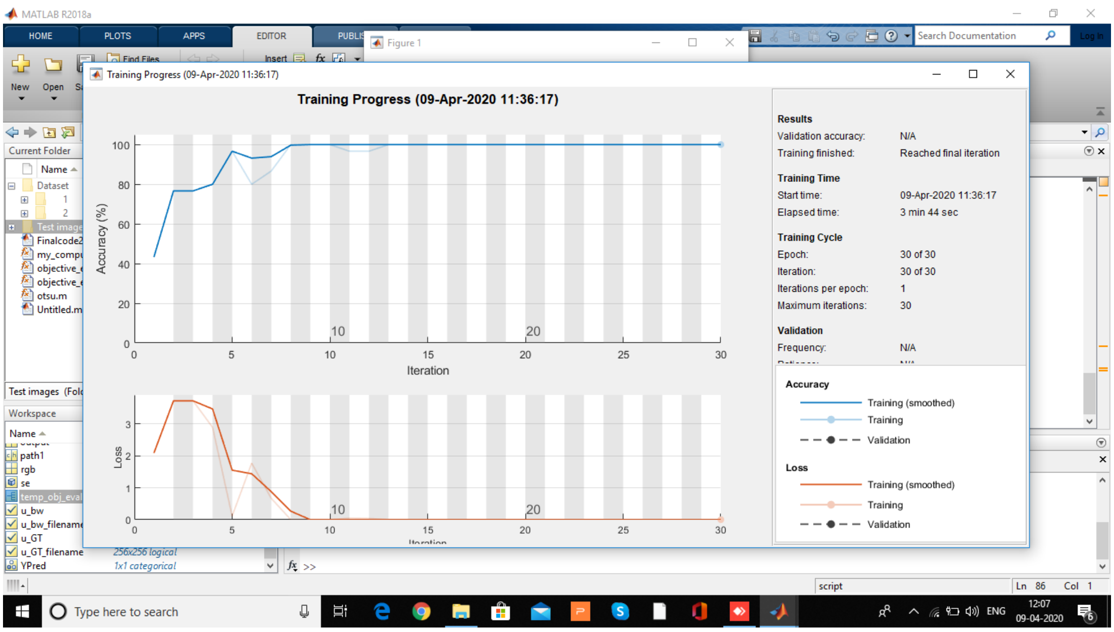
- Install MATLAB 2018 or above version.
- Open MATLAB and click on folder which consists of data set input images.
- Open folder containing final code programs on MATLAB console screen.
- Set the root path of the program.
- Run this program on MATLAB.
- Input the image that wanted to be tested.
- After analysis, this shows Training progress of the picture.
- Next step of execution is, it displays segmented image of input image.
- Final step is from segmented image displays whether the cancer is detected or not.
- Accuracy of the results are displayed on the command window.

Results and Output

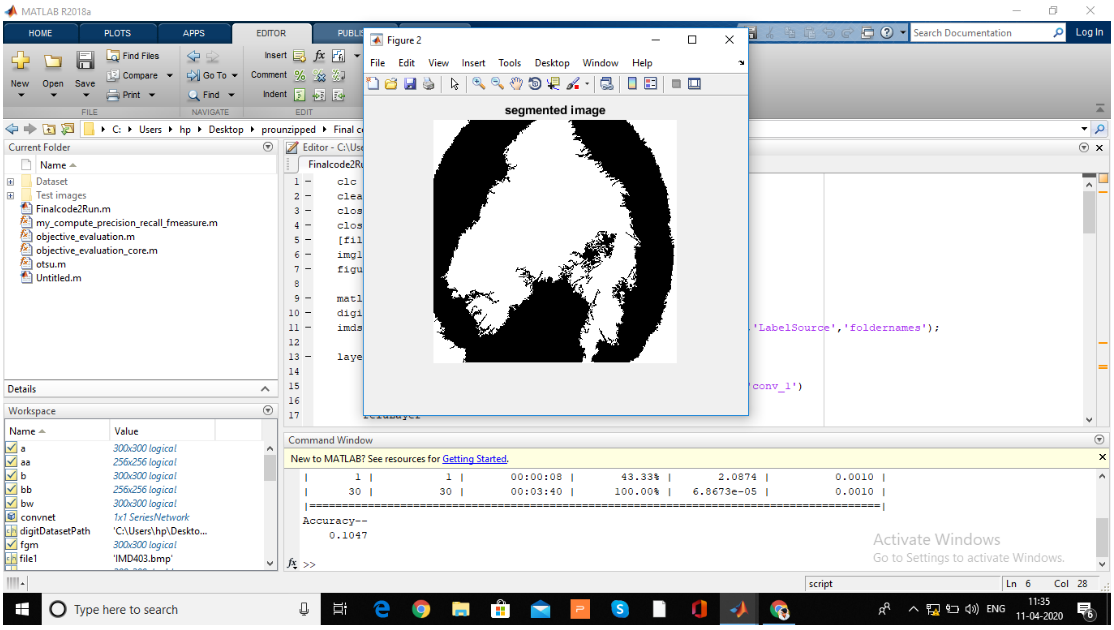
Software Used:



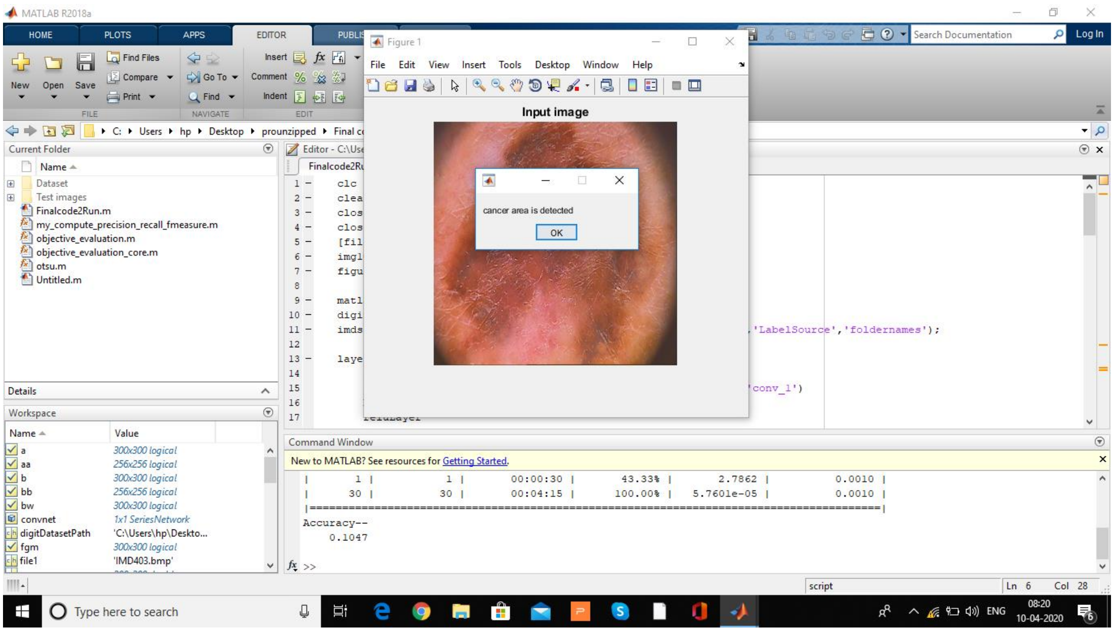
Training progress:



Segmented Image:



Result:



CONCLUSION AND FUTURE WORK

In this work, a computerized skin diagnosis method is introduced. The proposed approach is to measure the skin disease surface and control its evolution. This method is divided into two steps: image segmentation and edge detection based on active contour.

The goals of this technique are to make the dermatologist's work easy to reduce the measurement-time and to improve the precision of the caregivers' intervention.

In this paper, a novel proposed criterion, called EAC, was used to find out the most suitable segmentation technique for our case. In this work, several experiments are made to show the performance of the proposed measure technique of the skin surface and its ability to control the skin disease.

Although, the proposed method is applied on the skin disease image. As future work, the application of this method will be extended for other medical image analysis.

Program Listing

List of Abbreviations

1.GLCM	- Grey-Level Co-occurrence Matrix
2. BCC	- Basal-cell skin cancer
3. SCC	- squamous-cell skin cancer
4. SVM	- Support Vector Machine
5. NMSC	- nonmelanoma skin cancer
6. HIPR	- Hypermedia Image Processing Reference
7. HTML	- Hyper Text Markup Language
8. CNN	- Convolutional Neural Network

List of figures

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