



DEEP LEARNING-BASED INTELLIGENT MULTICLASS SKIN CANCER DETECTION WITH BLOCKCHAIN SECURITY

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Abstract: Skin cancer is one of the most rapidly increasing and serious health issues globally. Detecting it at an early stage is crucial for successful treatment and saving lives. This paper presents a smart and secure system that uses Deep Learning and Convolutional Neural Networks (CNNs) to analyze digital skin images and classify them as either non-threatening or harmful. The system begins by capturing an image of a skin mark, then processes it to remove background noise, isolates the specific area of concern, and examines its texture, shape, and color. Using advanced AI techniques, the system identifies subtle signs of danger, enhancing diagnostic accuracy and reducing human error and manual work. In addition to AI, the system incorporates Blockchain technology to securely store patient data and diagnostic files in a protected, immutable network, ensuring that medical records remain safe from unauthorized access. Test results indicate that this combined system offers high accuracy, making it a valuable aid for doctors in quick screenings, early detection, and informed decision-making.

Index Terms - Deep Learning, Convolutional Neural Networks (CNN), Skin Cancer Detection, Blockchain Security, Image Preprocessing, Multiclass Classification, Medical Data Privacy, Dermoscopic Images.

I. INTRODUCTION

The number of people diagnosed with skin cancer worldwide is increasing rapidly. This trend is linked to environmental changes, prolonged sun exposure, stress from modern lifestyles, and the use of chemical-laden personal care products. Each year, over one million new cases of skin cancer are reported globally. It is therefore essential to detect and treat skin cancer promptly. Skin cancer typically originates from abnormal skin cells that grow uncontrollably. It mainly occurs in two forms: Basal Cell Carcinoma and Squamous Cell Carcinoma. Basal Cell Carcinoma is a type of skin cancer that tends to grow locally and may damage the surrounding skin if left untreated. Squamous Cell Carcinoma, on the other hand, is more aggressive and can spread to other parts of the body.

Early detection of skin cancer is crucial for improving survival rates and facilitating effective treatment. To this end, doctors are increasingly relying on computers equipped with Artificial Intelligence (AI) and Machine Learning (ML) to analyze images. These computers can quickly process images and identify skin cancer that may be difficult to spot with the naked eye. They can also predict how skin cancer might develop over time.

Using computers in hospitals raises concerns about the security of patient information. Sensitive medical records are sometimes not adequately protected, making them vulnerable to unauthorized access. To address this problem, blockchain technology can be employed. Blockchain functions like a shared ledger that keeps records safe and secure. Once data is added to the ledger, it cannot be altered or deleted. If any

attempt is made to change the data, the system will trigger an alert. This is especially important for individuals undergoing frequent medical check-ups or receiving specialized care for skin cancer.

Combining AI and blockchain technology can enhance the security of medical records while ensuring that patient information remains private. It also supports doctors in delivering high-quality care without compromising patient confidentiality. This approach offers an effective and secure way to manage skin cancer care.

- * We need to find skin cancer and treat it right away.

- * Computers with Artificial Intelligence can help us look at pictures and find skin cancer.

- * Blockchain technology can help us keep records safe.

II. LITERATURE SURVEY

In paper [1], the authors developed an automated medical system that uses Convolutional Neural Networks (CNNs) to examine and classify images of skin lesions. A major accomplishment of this study was showing that deep learning networks can automatically identify and classify visual features such as color variations, cell textures, and irregular borders. The system learned to distinguish between benign moles and malignant melanomas, making it a useful tool for automated screening.

In paper [2], the researchers trained a CNN model using over 100,000 images sourced from institutions worldwide.

Their goal was to determine if an artificial intelligence system could match the expertise of human dermatologists. The results were impressive, as the trained neural network classified skin lesions with accuracy comparable to that of board-certified dermatologists. This study marked a significant milestone, demonstrating that deep learning systems can serve as reliable diagnostic tools for doctors.

In paper [3], Codella et al compared several learning models, including ResNet, VGG16, and Inception, for skin lesion classification. They evaluated each model using the ISIC database and found that deep neural networks outperformed traditional machine learning methods in detecting visual patterns. This research established deep learning as the standard approach for medical image analysis.

In paper [4], the authors introduced digital image processing techniques to improve the accuracy of dermatological diagnoses.

They highlighted that raw clinical images can be distorted due to factors such as skin hairs and body shadows affecting lighting. To address this issue, they developed a preprocessing pipeline that isolates the lesion, removes healthy skin, and produces a clearer image for the CNN to focus on. This results in better feature extraction and fewer false diagnostic outcomes.

In paper [5], the authors aimed to enhance the security of hospital patient data. They implemented blockchain technology to create a system for securely storing patient information. This system acts like a locked box, ensuring that data cannot be altered or accessed by unauthorized individuals. The researchers explained how the system functions and how it prevents cyber attacks. They demonstrated that this approach is highly effective at protecting patient privacy and maintaining data integrity.

In paper [6] the authors came up with a way to combine artificial intelligence with blockchain technology to create a secure medical platform. This platform uses a kind of artificial intelligence called deep learning to look at pictures of skin and figure out what is wrong. The platform then uses blockchain technology to keep the information safe. This means that once a doctor makes a diagnosis the information is locked away and cannot be changed. This is very important for keeping information safe and making sure that doctors and other medical staff are honest.

The people who wrote paper [7] were trying to find a way to make artificial intelligence work better for diagnoses. They used something called transfer learning, which's like teaching a computer to recognize pictures by showing it lots of examples. They took intelligence systems that had already been trained to recognize everyday objects and used them to recognize skin lesions. This made it possible to train the intelligence system much faster and with less power. This is important because it means that doctors can use intelligence to make diagnoses without needing very powerful computers.

In paper [8] the researchers were trying to find a way to share images safely between different hospitals and doctors. They used blockchain technology to create a system that allows doctors to share information securely. This system is like a mailbox that only allows certain people to open it. The system makes sure that only doctors who are supposed to see the information can access it which keeps information private and safe. This is very important, for making sure that patients receive care and that their information is not shared with people who should not have it.

III. SYSTEM REQUIREMENTS AND SPECIFICATIONS

3.1 System Overview & Architecture

The skin cancer detection system we are proposing is built to be an highly secure tool for finding skin cancer early. It brings together two technologies: Deep Learning for smart image scanning and Blockchain for keeping data safe. The main goal of the skin cancer detection system is to look at photos of skin marks accurately sort them to see if they are dangerous and lock that information away where no one can hack or change it.

The whole process of the skin cancer detection system flows through four steps:

1. **Gathering Images:** We collect skin photos from known public medical collections. We split these skin photos into groups used for teaching, checking and testing our Deep Learning AI model for the skin cancer detection system.
2. **Cleaning the Photos:** Before the computer looks at the skin photos we clean them up. This step removes things like lighting or blurry noise resizes the skin photos so they are all uniform and sharpens the images for the skin cancer detection system.
3. **Sorting:** Next we pass the skin photos into a smart AI program called VGG16. This model automatically studies the skin marks color, rough edges and texture for the skin cancer detection system. Based on these features it predicts what kind of skin condition it is for the skin cancer detection system.
4. **Locking the Data:** After the VGG16 AI model gives its diagnosis the patients records and results are turned into code and saved onto a Blockchain. Because a Blockchain is a shared logbook once the data is written it cannot be changed, deleted or messed with by anyone, for the skin cancer detection system.

3.2 System Requirements

To make this software work properly and fast it needs some things. It has to have the hardware, which is the physical computer.

This computer should have an Intel Core i5 processor, least 8GB of RAM to handle the data smoothly and 500GB of hard drive space to store the images. It also needs a color monitor, keyboard and mouse.

The software is also important. The system runs on Windows 10 or 11. We write the code for the software using the Python programming language, inside a program called PyCharm.

The artificial intelligence part of the software is built using tools called TensorFlow and Keras. We keep the data in an SQLite3 database. This way the software runs smoothly and quickly without needing a supercomputer..

3.3 Software Development Environment

The Python Programming Language, we picked Python for this project because lots of people use it for intelligence and medical research. Python reads code one line at a time. This makes it easy to try out ideas and fix mistakes quickly.

The code in Python is very simple to understand, like reading normal English. This simplicity helps us build software that's well organized. The best part is that Python is free to use. It works on Windows, Mac and Linux computers. So our skin cancer tool will work on any computer.

3.4 Core Libraries and Frameworks

1. Deep Learning Tools (TensorFlow & Keras)

TensorFlow is a tool that Google made to do the complicated math that is needed to look at digital images. Keras is like a cover that goes on top of TensorFlow making it easy for people to use. When we use TensorFlow and Keras together we can easily. Train our VGG16 AI model. This means the system can look at our skin cancer photos and see how well it is doing.

2. Image Processing & Data Management (OpenCV, NumPy, & Pandas)

Before our AI model can look at a photo we need to get the photo ready. OpenCV is a tool that helps us look at pictures. It removes things in the background that we do not need, like hair or shadows. OpenCV works with NumPy, which changes the photo into a grid of numbers that the computer can understand. Then Pandas helps us keep all the information and photos organized, like a computer spreadsheet.

3. Graph Tools (Matplotlib & Seaborn)

We use Matplotlib and Seaborn to show how well our AI model is doing. These tools take the data we get from testing. Turn it into simple charts, line graphs and maps that are easy to read. This helps doctors and researchers see how accurate the system is and how it is getting better over time. They can look at the charts and graphs. Understand the data from our Deep Learning Tools like TensorFlow and Keras and the work we do, with Image Processing and Data Management using OpenCV, NumPy and Pandas.

3.5 Database Architecture (SQLite3)

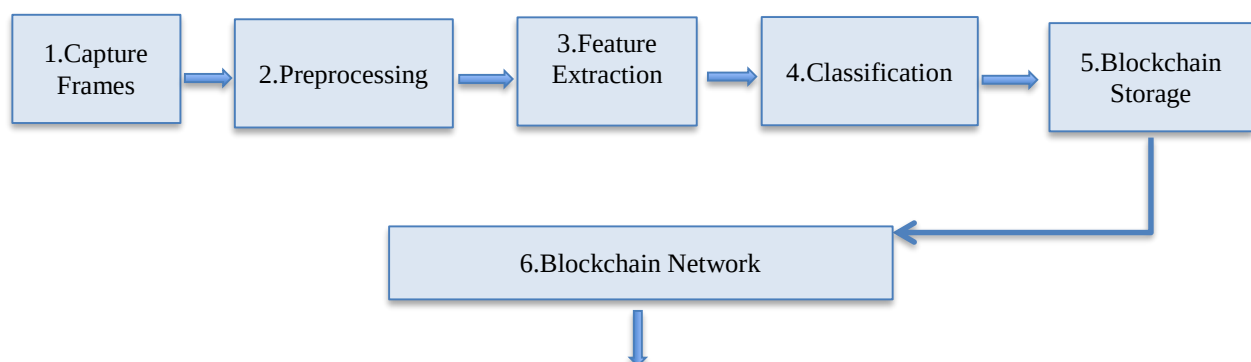
Local patient details, login passwords and diagnostic files are managed using SQLite3. I think of SQLite3 as a simple digital filing cabinet that is part of Python. It is not like those corporate databases that need their own servers and a team of IT professionals to run them. SQLite3 stores everything in one file on the computers drive. This makes it very fast, easy to use and perfect for handling data right away before it gets logged onto the blockchain.

History and Features

SQLite was made in the year 2000 by a developer named D. Richard Hipp. He wanted a database engine that could fit into other small applications. Now SQLite is source and completely free. It is used in billions of devices including smartphones and web browsers.

Even though SQLite3 is small it is very strong. It follows rules called ACID properties. This means that if the hospital computer suddenly freezes or crashes in the middle of a scan the patients data will be safe. SQLite3 can handle a lot of data up to a terabyte in size. This makes it a reliable tool for storing patient data on the local computer. SQLite3 is a choice, for this project because it is simple and reliable. The patient details and diagnostic files stored in SQLite3 are safe and easy to manage.

IV. SYSYTEM DESIGN AND DEVELOPMENT



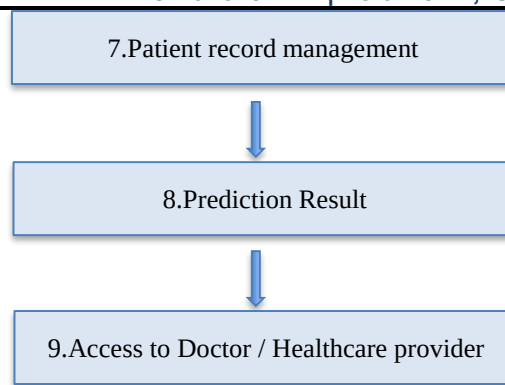


Fig:4.1 System Architecture

4.1 System Process Flow

The system works in a steps to process data smoothly. It starts with a raw skin photo, the photo goes through cleanup steps.

These steps include making the photo smaller making the photo look normal and removing parts to make the photo look better.

Now cleaned photo is then sent to the VGG16 CNN model. This model finds details in the photo like texture, color and shape.

The VGG16 CNN model is really good, at finding these details. The system uses these details to classify the skin mark, it decides if the skin mark is harmless or dangerous. The system uses the skin mark classification to help doctors.

The patients records the diagnosis and medical history are then secured. Blockchain technology is used for this. It locks all the information into a digital record. Approved doctors and healthcare providers can view this record. The blockchain technology keeps the patients information safe. The patients records are locked with blockchain.

4.2 System Design Overview

The main goal of the design phase is to figure out a solution to the problems we talked about earlier. It helps us get from understanding what the system needs to do to building the system. We start with our needs and the design stage explains exactly how to build the software parts the deep learning classification engine, the blockchain network and the user interface.

To draw a picture of how the system works developers use two types of mapping tools: UML Diagrams and Data Flow Diagrams.

1. Unified Modeling Language Diagrams

The Unified Modeling Language is a way to draw the look and behavior of software. In this project Unified Modeling Language diagrams are used to draw a picture of every step. Including how a user uploads a picture how the system cleans and cuts the file how the Convolutional Neural Network finds features and how the final report gets saved into the blockchain. This picture makes it easy for developers and doctors to talk about and understand how the app works behind the scenes.

2. Data Flow Diagrams

A Data Flow Diagram is a picture that shows how information moves through a system. It shows where information comes from how it changes as it moves through software parts, where it gets saved and where it ends up.

For our project the Data Flow Diagram shows what happens to a skin photo from the moment a user uploads it through the cleanup phase into the VGG16 feature finder through the classification and straight into the secure blockchain database before showing the final answer, on the users screen. The design phase uses the learning classification engine and the blockchain network to make sure everything works together smoothly. The user interface is also a part of the design phase and it is what the user interacts with when they upload a picture and get the final answer.

The good things about Data Flow Diagrams

Using Data Flow Diagrams gives the project a lot of things when we are building it:

* **Clear Visual Mapping:** Data Flow Diagrams make it easy to understand software pathways. They do this by breaking them down into charts that are easy to read. This helps the people making the software and the medical professionals see how the information moves. They do not get confused by the technical code.

Data Flow Diagrams help us find mistakes early. We make a map of how the data will flow before we start writing the software. This way we can see if there are problems with the design or if something is missing. We can also see if there are any security problems. This means the system is less likely to fail on.

* **Better Requirement Tracking:** A good Data Flow Diagram shows us where the data is processed and where it is stored. This makes it easy to set up databases like SQLite3 and files like Blockchain, in the places. We can put them where they are needed most. This is highly beneficial for creating Data Flow Diagrams (DFDs). Data Flow Diagrams are very useful, for this.

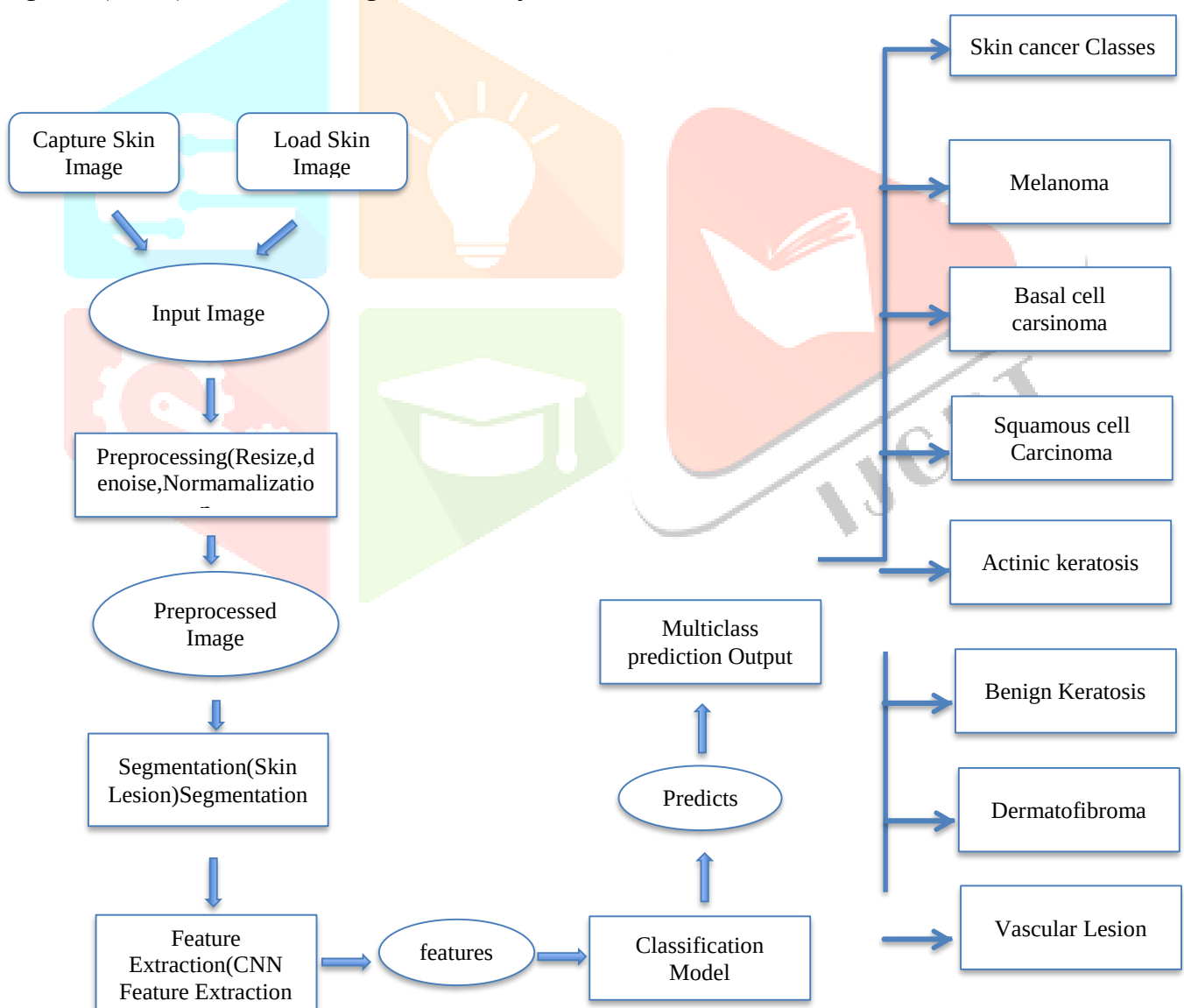


Fig4.2:Data Flow Diagram

V. SYSYTEM IMPELMANTATION

5.1 Methodology

Convolutional Neural Networks and blockchain technology, this system is supposed to be really good at managing skin cancer data. It can do this because the Convolutional Neural Networks part of the system looks at pictures and figures out what is going on with the skin. It can tell if someone has melanoma or basal cell carcinoma or some other kind of skin problem like keratosis or nevus. The blockchain part of the system makes sure that all the information, about the skin cancer is safe. This means that the final diagnosis cannot be changed or seen by people who are not supposed to see it. The skin cancer data is kept safe by the blockchain technology. Image analysis is performed using Convolutional Neural Networks (CNNs).

5.2 The CNN Step-by-Step Processing Pipeline

1. Input and Convolutional Layers

The system starts with skin photos. It resizes them to a size and makes sure the pixels are all the same. Then these photos go through convolutional layers. In these layers small filters look at the photo to find things like edges and skin texture and colors. The system uses something called ReLU to help it understand pictures. We can use existing systems like VGG16 or ResNet or MobileNet to make it work well.

2. Pooling Layers

After the layers the pooling layers make the data smaller. They use something called Max Pooling to pick the important things and get rid of the rest. This improves the system's efficiency, reduces memory usage, and helps prevent the model from overfitting to the training images.

3. Feature Extraction

Old computer programs needed people to tell them what to look for.. A CNN can figure it out by itself. During training, the model learns to identify features such as asymmetrical spots and irregular or blurred edges. It looks at the colors and the texture of the spot.

4. Connected and Output Layers

When the system has all the information it puts it into a long list of numbers. This list goes through connected layers that connect the information to actual diagnoses. To make sure it works well with photos some parts of the system are turned off during training. This is called dropout layers. Finally a Softmax layer gives a score for each disease type and the one with the score is the answer. The Convolutional Neural Network or CNN uses skin photos and convolutional layers and pooling layers and feature extraction and fully connected layers to make a diagnosis. The system is really good, at looking at dermoscopic skin photos and finding skin problems.

5.3 End-to-End Network Training

The network fixes its mistakes through a training process that uses backpropagation and optimization tools like the Adam optimizer or Stochastic Gradient Descent. This process is really important for the network to learn from the skin cancer images.

To make sure the network learns correctly we use a combination of skin cancer images in each training round.

We also make changes to the images, such, as rotating, zooming, flipping and scaling them so the network can recognize a tumor from any angle. The skin cancer images are divided into three groups: one group to teach the network one group to check how well the network is doing and one group to see how well the network works in the world. When the network makes a diagnosis it sends the information to the blockchain ledger right away. The patients information, the date and time and the diagnosis results are stored safely across a network that many computers are connected to. This ledger is very secure because it cannot be changed. If someone tries to alter the patients information it will be clear that something is wrong and the patients records will stay safe and trustworthy.

The blockchain ledger is a way to keep the patients records safe and it helps us trust the networks diagnosis of skin cancer.

The network and the blockchain ledger work together to make sure the patients information is safe and the diagnosis of skin cancer is accurate.

5.4 Functional System Modules

The core application is made up of six parts that work together to handle the data from start to finish.

* **Dataset Collection:** This part gets the pictures of skin from websites that are open to everyone. These pictures already have labels on them that say what kind of skin condition they are. This is very important for training and checking the application.

The pictures are cleaned up. Made to be the same size in the Preprocessing part. This part also makes sure the light in the pictures is the same and adds some changes to the pictures to make the application work better.

* **Image Segmentation:** This tool takes the skin problem out of the picture. It removes unnecessary information that is not relevant to the problem. It uses math to get rid of things like hair and shadows that're in the way. This makes the picture of the skin problem very clear.

The Feature Extraction part looks at the picture of the skin problem. Finds out what it looks like. It looks at the shape and the colors. Turns these things into numbers that the application can understand.

* **CNN Classification Framework:** This is the part of the application. It uses these numbers to figure out what kind of skin condition it is. It does this fast and is very good at it.

The Blockchain Integration Module is like a safe where the application stores the results. It keeps the results safe by using a kind of math that makes it impossible to change them. This is better, than storing the results on a computer because it is more secure and everyone can see what is going on.

The core application has these six parts: Dataset Collection, Preprocessing, Image Segmentation, Feature Extraction, CNN Classification Framework and Blockchain Integration Module. These parts work together to make the core application work.

VI. RESULTS



Fig 6.1: Main webpage



Fig 6.2: Real image

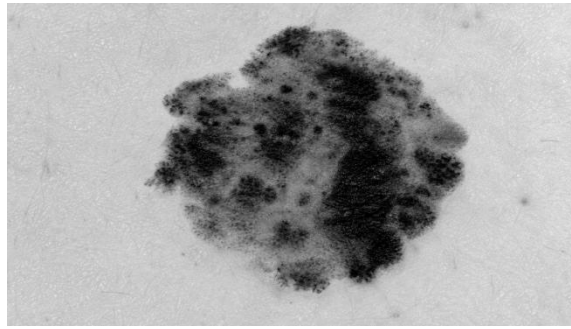


Fig 6.3: Preprocessing

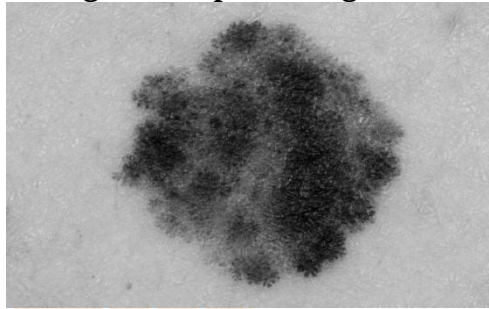


Fig 6.4: Gray-scale image



Fig 6.5: Threshold image

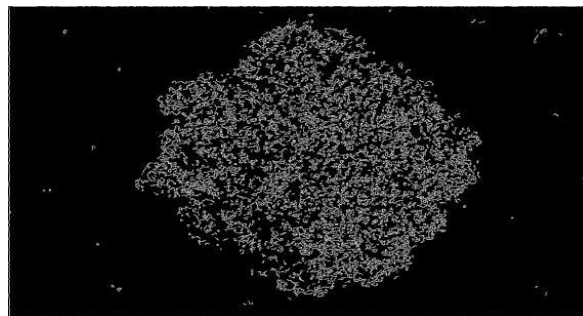


Fig 6.6: Segmented Image

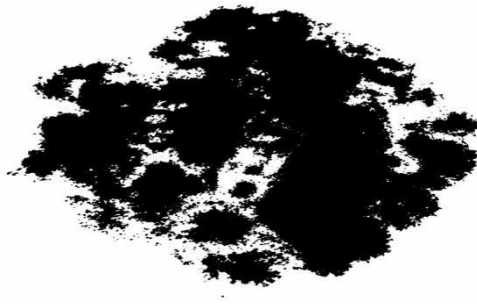


Fig 6.7: Feature Extraction



Fig 6.8: Identification skin cancer

VII. CONCLUSION

The system developed in this research provides a highly capable and secure approach for finding skin cancer early by pairing deep learning with decentralized networks. By using the VGG16 CNN layout, the software can study clinical photographs of skin markings and successfully separate various types of skin diseases without needing manual guidance. Incorporating thorough image cleanup and automatic feature analysis significantly increases the software's overall accuracy and real-world performance.

In practice, this automated platform reduces the heavy paperwork and manual labor typically required in clinical tracking, drastically accelerates the speed of preliminary diagnoses, and supports early medical intervention. Ultimately, this tool serves as a reliable assistant for doctors and skin specialists, enabling them to deliver higher-quality care. It is especially valuable for monitoring elderly patients and vulnerable groups who need consistent, long-term observation and quick medical answers to ensure successful treatment.

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