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*Research Paper*

# A SECURE IOT BASED SKIN CANCER DETECTION SCHEME USING SUPPORT VECTOR MACHINE AND PARTICLE SWARM OPTIMIZATION ALGORITHM

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Advances in information and communication technologies have led to the emergence of Internet of Things (IoT). In the modern health care environment, the usage of IoT technologies brings convenience of applied to various medical areas. IoT is a system of interrelated computing devices, mechanical and digital machines, objects or people and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The Internet of Things and information and communication technologies applied in development of health care systems have reached an evolutionary process. In the human health care analysis system, now a days skin cancer causes the deaths of half a million people every year. Due to the costs for dermatologists to monitor every patient, there is a need for an computerized system to evaluate a patient's risk of melanoma. The proposed system involves the detection of skin cancer with high level of accuracy and fast execution time using Support vector machine and Particle swarm optimization algorithm and also creating the Twitter Doctors Community in order to send the patient's health care details to the family members or doctors using Arduino and also Doctor can suggest appropriate treatment for the patient and can Interact with patients with the help of IoT and also enhancing security based healthcare system in which patient's data bases are measured in a secure manner using Anti SQL injection to prevent server data for being hacked.

Keywords: Pre-processing, Segmentation, Melanoma, Support vector machine, Particle swarm optimization

## INTRODUCTION

Internet of Things (IoT) is becoming more and more popular around the world. IoT is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and/or other connected devices.

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Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond IoT environment and covers a variety of protocols, domains, and applications. In Internet of things (IoT), IoT devices are limited to power supply, CPU capacity, memory etc., and have constrained network performance such as bandwidth, wireless channel, throughput, payload etc., the resources of IoT devices however can be shared by other IoT devices. Specially, in IoT healthcare service, the way of management and interoperability of patient-related and device information are very important.

Internet of things was first proposed by Kevin Ashton in 1982. IoT is a combination of hardware and software technologies along with embedded devices which enables to provide services and facilities to any one, anytime, anywhere required using any network. The IoT is a huge network of connected "things". The relationship will be between people-people, people-things, and things-things. Recently, wearable devices, such as smart wristwatch, ring, bracelet and hair lace, are widely applied to offer continuous healthcare, e.g., physiology parameter monitoring for remote healthcare, heart rate record for workout intensity or training, and calorie burn during fitness. These smart watches, health monitors, pedometers, activity trackers and virtual reality headsets are all part of the emerging landscape of wearable technology, which promises to not only change the way we exercise and communicate but also support the emerging healthcare. In the last few years, this field has attracted wide attention from researchers to address the potential of the IoT in the healthcare field by considering various practical challenges.

In the health care environment, Skin Cancer causes death of half a million people every year. Cancer begins when cells in the part of the body starts to grow out of control. A lesion means possibly abnormal change or difference in a tissue or structure such as the skin. Cancer is an uncontrolled growth of abnormal cells. The skin cancer is the uncontrolled growth of skin cells in the body. It develops when an unrepaired DNA damage to the skin cells and mostly caused by ultraviolet radiation of the sun or tanning beds, trigger mutations (genetic defects) which leads to the skin cells multiply rapidly and malignant tumors form. Some skin cancer can spread and cause damage in the nearby tissue cells . Also, in some cases, skin cancer can be on vital organs. Sun is the most common cause of skin cancer. But it fully does not explain that skin cancer usually develop on the skin exposed to sunlight. Also it can be exposed to environmental threats, radiation analysis, and even inheritance could play a role.

The Internet of Things and information and communication technologies applied in development of health care systems have reached an evolutionary process. In the human health care analysis system, now a days skin cancer causes the deaths of half a million people every year. Due to the costs for dermatologists to monitor every patient, there is a need for an computerized system to evaluate a patient's risk of melanoma The proposed system involves the detection of skin cancer with high level of accuracy and fast execution time using Support vector machine and Particle swarm optimization algorithm and also creating the Twitter Doctors Community in order to send the patient's health care details to the family members or doctors using Arduino and also Doctor can suggest appropriate treatment for the patient and can Interact with patients with the help of IoT and also

enhancing security based healthcare system in which patient's data bases are measured in a secure manner using Anti SQL injection to prevent server data for being hacked.

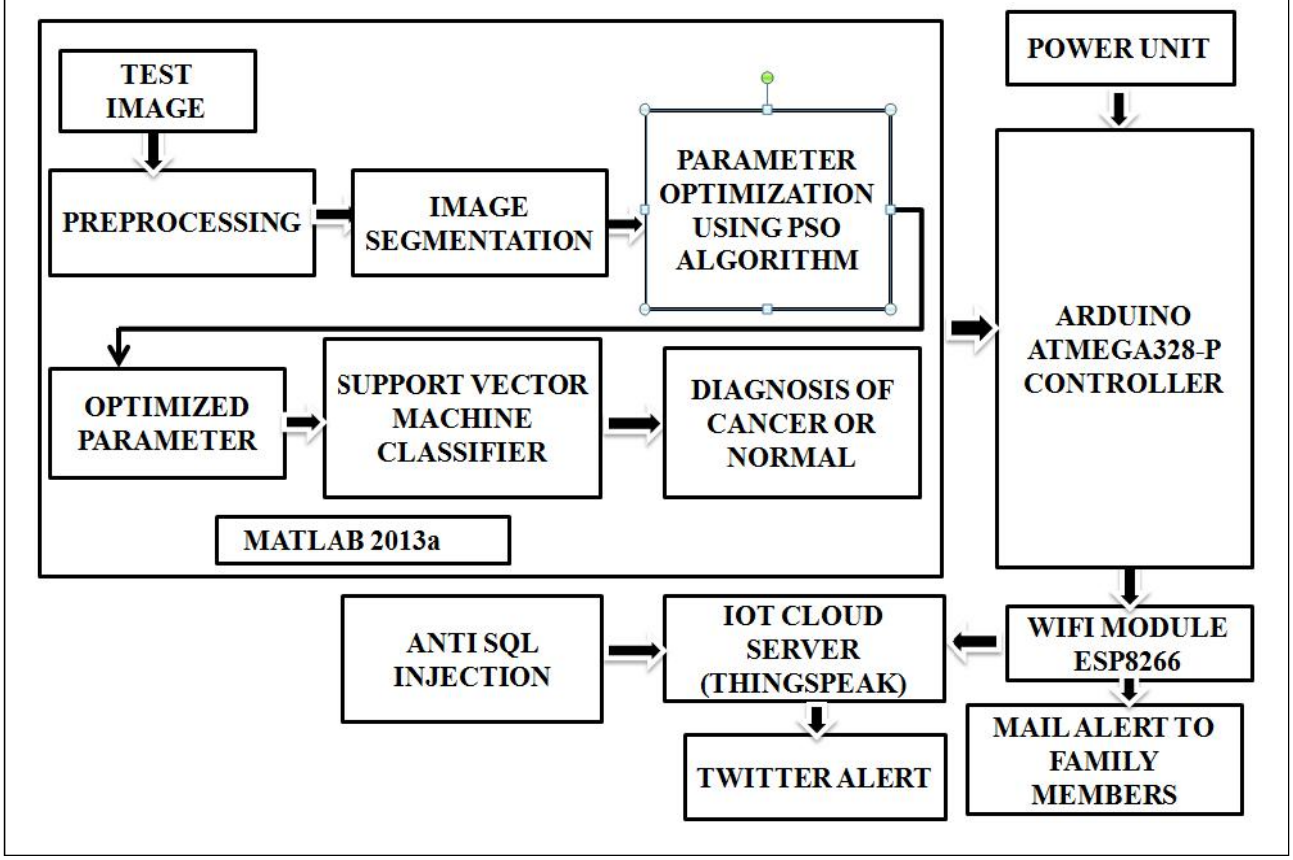
## PROPOSED METHOD

Skin cancer is the most common type of cancer and represents 50% all new cancers detected each year. Due to the costs for dermatologists to monitor every patient, there is a need for an computerized system to evaluate a patient's risk of melanoma using images of their skin lesions captured using a standard digital camera. The proposed system involves the detection of skin cancer with high level of accuracy and fast execution time using Support vector machine and Particle swarm optimization algorithm and also creating the Twitter Doctors Community in order to send the patient's health care details to the family members or doctors using Arduino and also Doctor can suggest appropriate treatment for the patient and can Interact with patients with the help of IoT and also enhancing security based healthcare system in which patient's data bases are measured in a secure manner using Anti SQL injection to prevent server data for being hacked.

### Image Acquisition

Image acquisition Dermoscopic images are basically digital photographs/images of magnified skin lesion, taken with conventional camera equipped with special lens extension. The lens attached to the dermatoscope acts like a microscope magnifier with its own light source

Figure 1: A Secure IoT Based Skin Cancer Detection Scheme

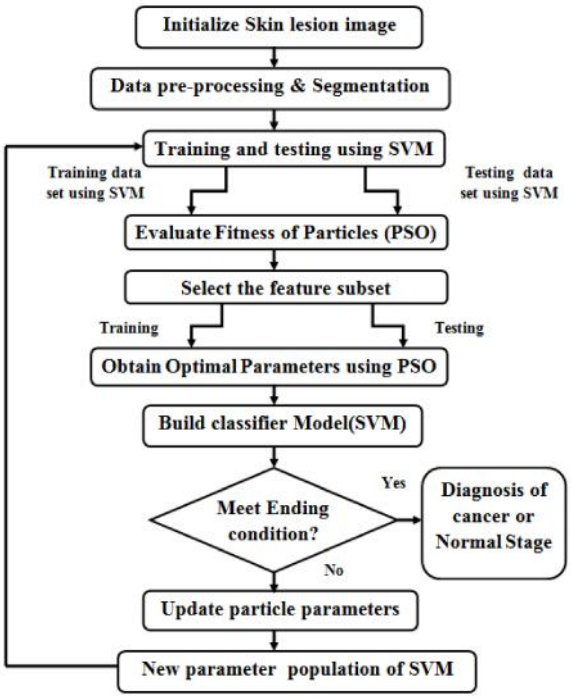


that illuminates the skin surface evenly. Dermatologist can create accurate documentation of gathered images, opening a path for computer analysis, where images are processed in order to extract information that can later used to classify those images.

## Pre-Processing Techniques

Image pre-processing is an essential step of detection in order to remove noises and enhance the quality of original image. It required to be applied to limit the search of abnormalities in the background influence on the result. The main purpose of this step is to improve the quality of melanoma image by removing unrelated and surplus parts in the back ground of image for further processing. Good selection of pre-processing techniques can greatly improve the accuracy of the system. The objective of the pre-processing stage can be achieved through three process stages of image enhancement, image restoration.

Figure 2: Flow Diagram of Skin Cancer Detection System Using SVM_PSO




## Image Enhancement

Image Enhancement is a crucial procedure to improve the visual appearance of the image; it is defined as provider of the “better” transform representation for further automated steps of detection. The image enhancement can be categorized in three categories:

### *Contrast Enhancement*

Contrast enhancement is beneficial step to improve the perception for further processing; it can sharpen the image border and improve the accuracy. Contrast enhancement plays a vital role in increasing the quality of an image.

## Image Post Processing and Restoration

Image Restoration is defined as the procedure to recover the degraded image from a blurred and noisy one. It can restore the degraded images in different ways. The image degradation can happen by various defects such as imperfection of imaging system, bad focusing, motion and, etc., which make an image usually noisy or blur. Since the corrupted images lead to fault detection, hence, it is essential to know about noises present in an image to select the most appropriate de-noising algorithm.

## Segmentation Techniques

Segmentation means to the separation of an image into disjoint regions that are uniform with respect to some property such as color, luminance, and its texture.

### *Thresholding Based Segmentation*

Determining threshold and then the pixels are divided into groups based on that criterion. It include bi-level and multi thresholding.

Thresholding method includes: 1) Histogram, 2) Adaptive thresholding.

### *Region-Based Segmentation*

Splitting the image into smaller components then merging sub images which are adjacent and similar in some sense. It includes Statistical region merging, multi scale region growing, and morphological flooding.

## Feature Extraction Using PSO Algorithm

In automated diagnosis of skin lesions, feature extraction is based on the so-called ABCD-rule of dermatoscopy. The extracted parameter are optimized using Particle Swarm Optimization Algorithm. Particle Swarm Optimization (PSO) is a stochastic global optimization technique developed by Eberhart and Kennedy in 1995 based on social behavior of birds. In PSO a set of particles or solutions traverse the search space with a velocity based on their own experience and the experience of their neighbors. During each round of traversal, the velocity, thereby the position of the particle are updated based on the above two parameters. This process is repeated till an optimal solution is obtained. The original procedure for implementing PSO is as follows:

- Initialize a population of particles with random positions and velocities on dimensions in the problem space.
- For each particle, evaluate the desired optimization fitness function in variables.
- Compare particle's fitness evaluation with its *pbest*. If current value is better than *pbest*, then set *pbest* equal to the,
- Current value, and *Pi* equals to the current location *Xi* in *D*-dimensional space.
- Identify the particle in the neighbourhood with the best success so far, and assign its index to the variable *q*.
- Change the velocity and position of the particle

### *Asymmetry Index*

An important aspect of shape understanding is symmetry, which is very useful in pattern analysis. For a symmetric pattern, one needs only one half of the pattern with the axis of symmetry.

Asymmetry Index is computed with the following equation:

$$AI = (\Delta A/A)*100$$

where, A = Area of the total Image. $\Delta A$ = Area difference between total image and lesion area.

### *Border Irregularity*

In order to calculate border irregularity, there are different measures such as: compactness index, fractal index, edge abruptness, pigment transition.

**Compact Index:** This can be determined by using the following equation:

$$B = [((\text{perimeter})^2/4\pi A]$$

where, A = Area of the Lesion $\pi = 22/7$

### *Diameter*

Melanoma tends to grow larger than common moles, and especially the diameter of 6 mm. Because the wound is often irregular forms, to find the diameter, draw from all the edge pixels to the pixel edges through the midpoint and averaged.

## Classification Using SVM

Support Vector Machines (SVM) are a class of linear learning machines used for classification and regression. In binary classification problems SVM constructs a maximal margin separating hyper plane to separate the input data points into classes. Since it is a binary classification problem

the two classes can be denoted with +1 and -1. We can select two hyper-planes of the margin in a way that there are no points between them and then try to maximize their distance. SVM uses linear model to implement nonlinear class boundaries through some nonlinear mapping the input vectors x into the high-dimensional feature space. A linear model constructed in the new space can represent a nonlinear decision boundary in the original space. In the new space, an optimal separating hyper plane is constructed. Thus, SVM is known as the algorithm that finds a special kind of linear model, the maximum margin hyper plane. The maximum margin hyper plane gives the maximum separation between the decision classes. The training examples that are closest to the maximum margin hyper plane are called support vectors. The original procedure for implementing SVM-PSO Algorithm is as follows:

- Load the data set of n data points
- Perform initial pre-processing and segmentation of skin lesion images
- Training and testing the n data set using Support Vector Machine Algorithm (SVM)
- Evaluate fitness value of each particles
- If fitness > pbest, then set fitness = pbest

  If fitness > gbest, then set fitness = gbest
- Select the extracted feature parameters
- Again Train and test the feature extracted parameters
- To obtain optimal parameter values using Particle Swarm Optimization (PSO)
- If condition is satisfied, then Classification can be done by using SVM Algorithm
- If condition is not satisfied, then update each parameter values.

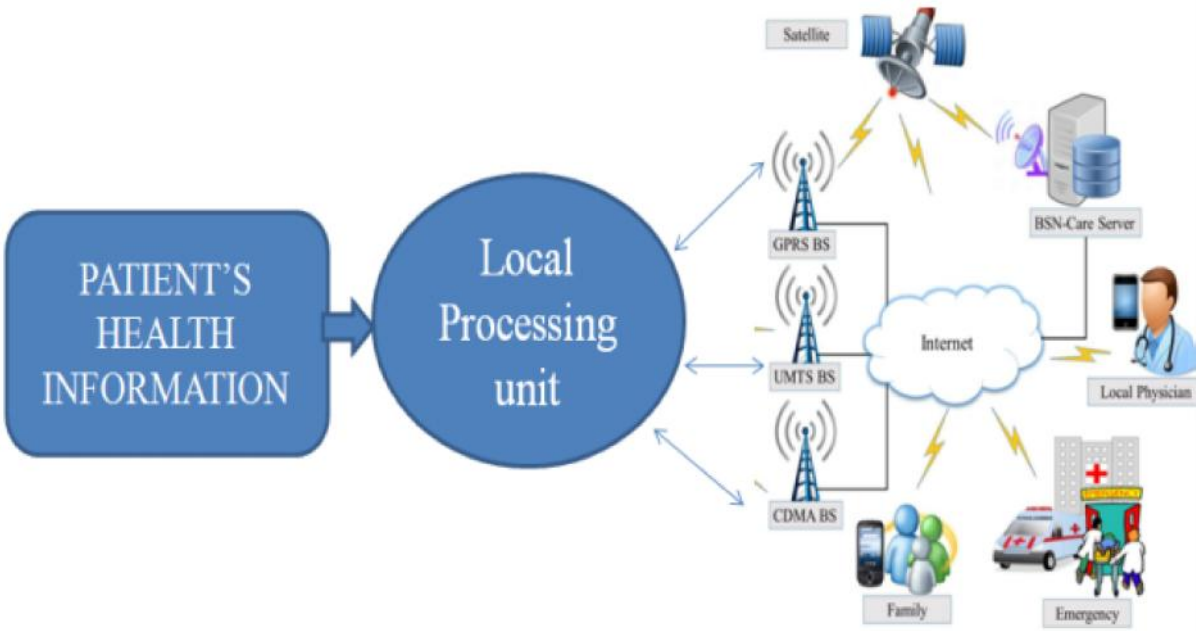
## Secure Internet of Things (Iot) Based Health Care Service

In Internet of Things (IoT) environment, IoT devices are limited to power supply, CPU capacity, memory, etc. and have a constrained network performance such as bandwidth, wireless channel, throughput, payload, etc., the resources of IoT devices however can be shared by other IoT devices. Health care applications using IoT are increasing day by day and more because of sensor devices. The IoT has the potential to give rise to many medical applications such as remote health monitoring, physical fitness programs, etc. The IoT healthcare system mainly tries to work on the existing wireless sensor networks, embedded device technologies and ubiquitous computing. IoT systems need to provide the services to any one at anytime and anywhere. The Internet of Things enables health organizations to lift critical data from multiple sources in real-time, and a better decision-making capability. This trend is transforming healthcare sector, increasing its efficiency, lowering costs and providing avenues for better patient care. Specially, in IoT healthcare service, the way of management and interoperability of patient-related and device information are very important. IoT applications in healthcare can be grouped in to following categories based on the functionality.

- Tracking of objects and people
- identification and authentication
- Automatic data collection and sensing.

First, Skin cancer cell can be detected using SVM-PSO Algorithm. Then the Data base details are sent to the Twitter Doctors Community and Patient's Family members mail id through Internet Of things (IoT) and Secure Transmission can be

Figure 2: IoT Based Health Care System




done using Anti SQL injection to prevent server data being hacked.

### WI-FI Module

ESP8266 is the low cost Wi-fi Module Providing Wi-fi functionality to the microcontroller device. ESP requires 3.3 V power Interface with 5 V Arudino Controller.It can be Controlled via AT command. In the ESP module, "Thinker IoT" Operating System can be dumped. The Skin Cancer Data base details are sent to Twitter Doctor Community through "Thingspeak"

- To connect network using ESP8266

  #define SSID "prec"// Network name

  #define PASS "iot12345"// Network password

  #define IP "184.106.153.149"// thingspeak.com

- Link Twitter account to thingspeak account using API

  StringGET="GEThttps://api.thingspeak.com/apps/thingtweet/1/statuses/update?api_key=QQEX756QB6LCS99S&status=";

  Serial.println("Checking if ESP8266 is online...");

  Serial.println("ESP8266 found <module online>...");

  Serial.println("Trying to connect to network...");

### Thingspeak Iot Platform

"Thingspeak" Open source "Internet of Things Platform". It uses Application Interface Key(API) key to store and retrieve data from things using HTTP. It can be integrate with Arduino, Mobile and Web applications, Social Networks, data analytics with MATLAB."Thingtweet"-Connect data to Twitter account and Send alerts to the IoT users. The Stored data send to the Thingspeak using Arduino. Then, Thingspeak sent the data to the Twitter account and user's mail id.

Figure 3: Thingspeak to Link Twitter Account

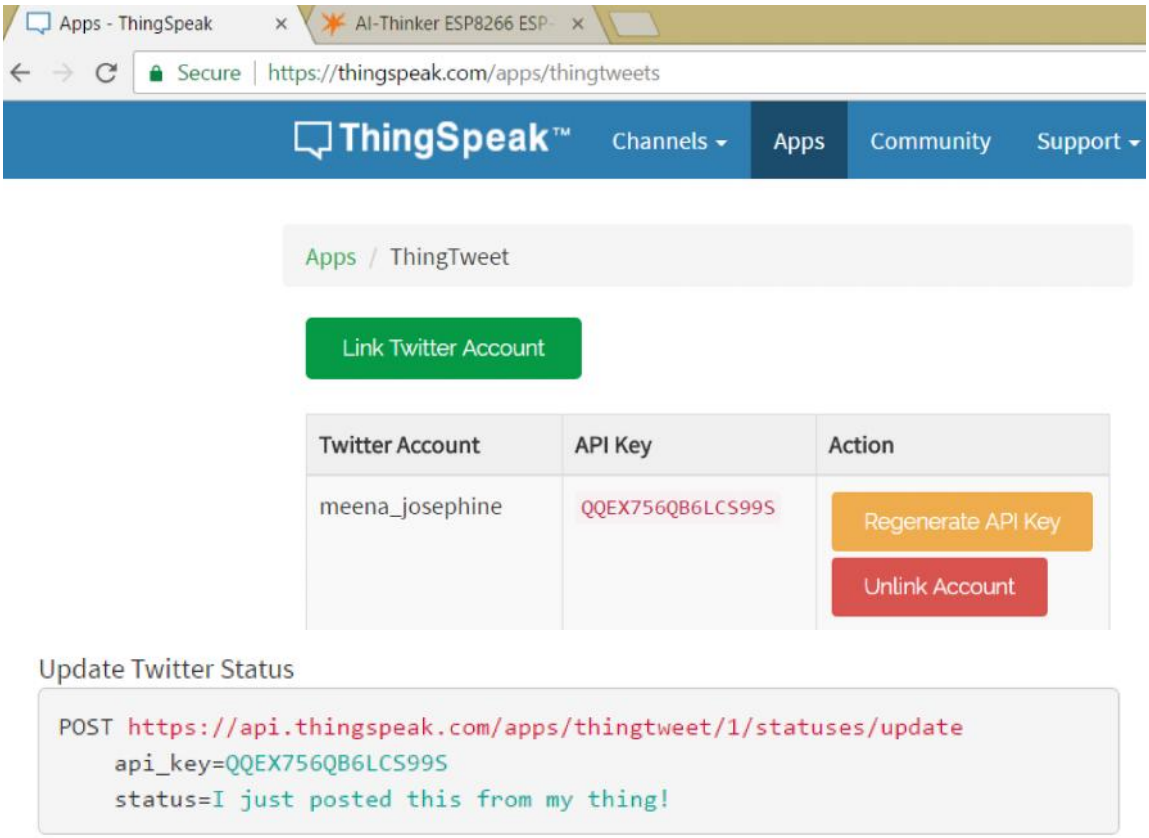



Figure 4: Normal Skin Image After Image Processing

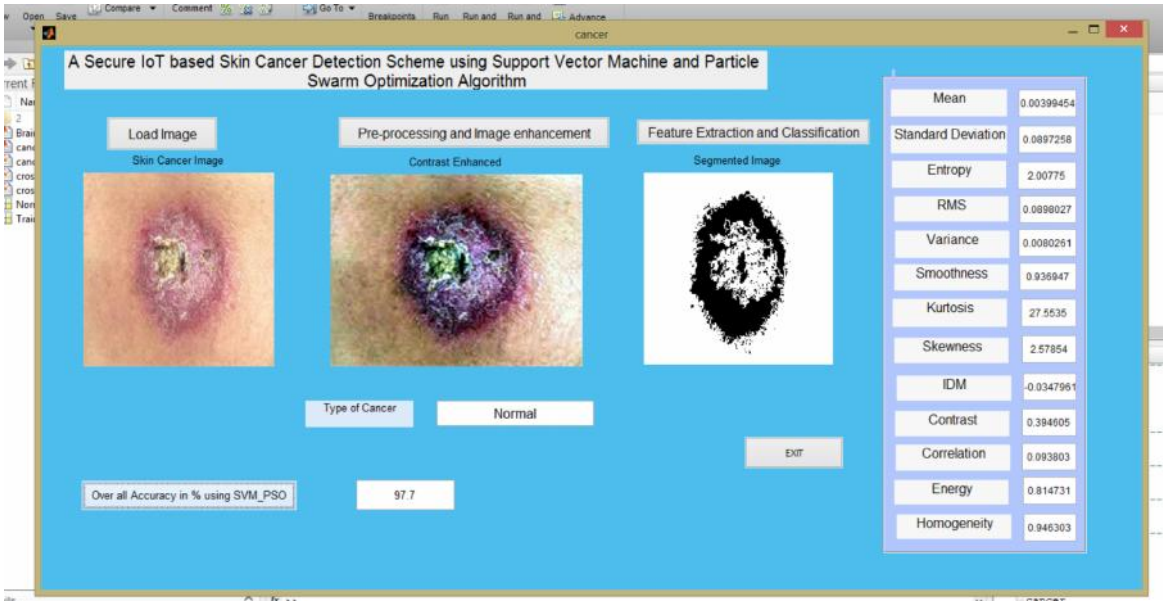


Figure 5: Cancer Skin Image at Squamous Cell Carcinoma Stage

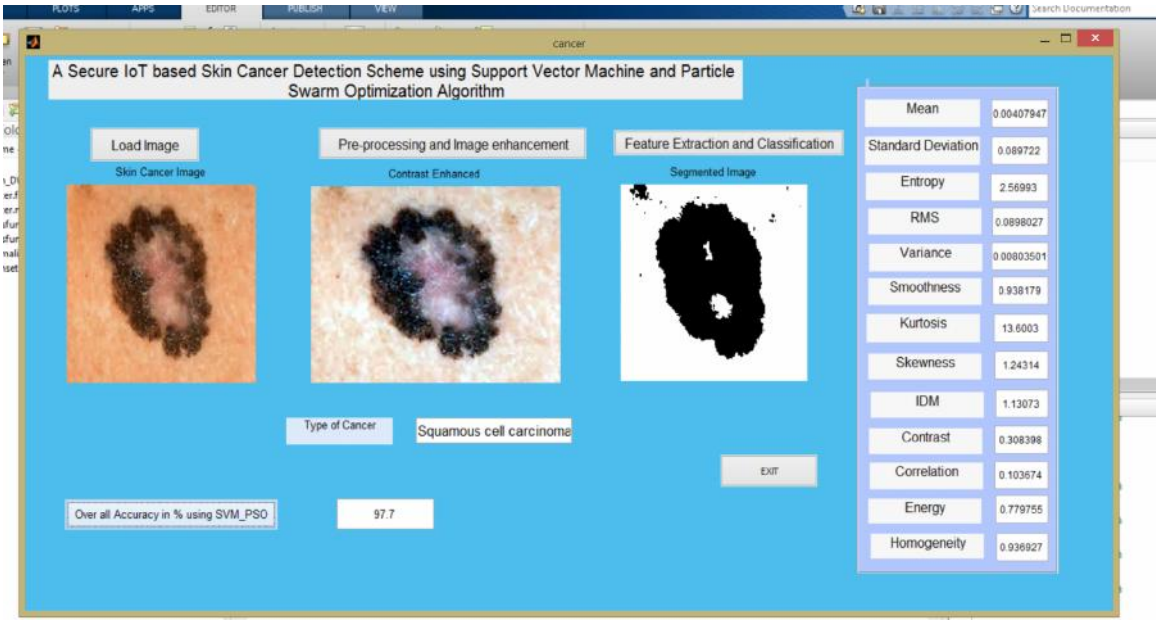
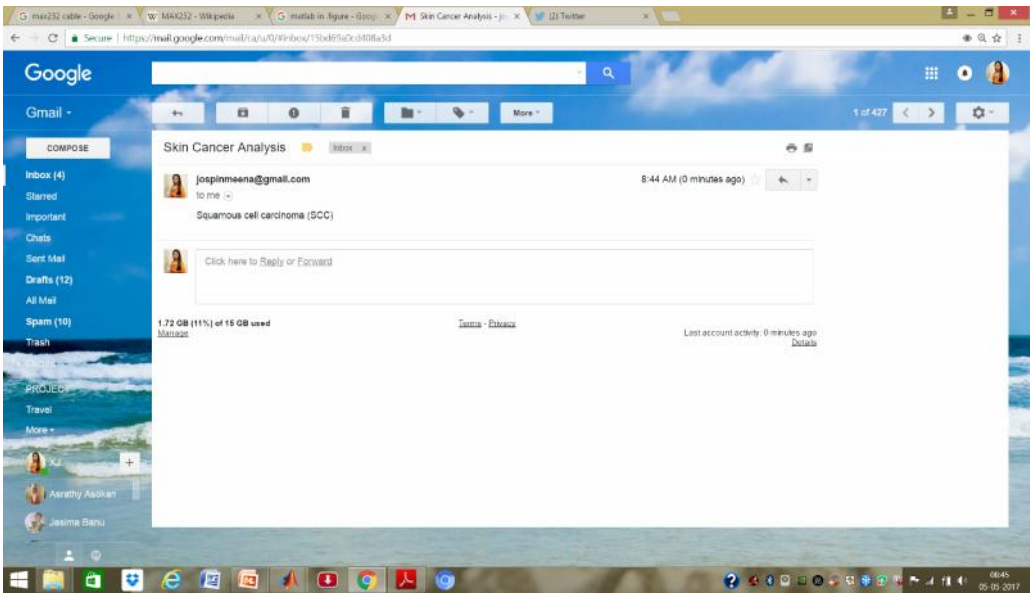



Figure 6: Send Type of Cancer to Family Members MAIL ID

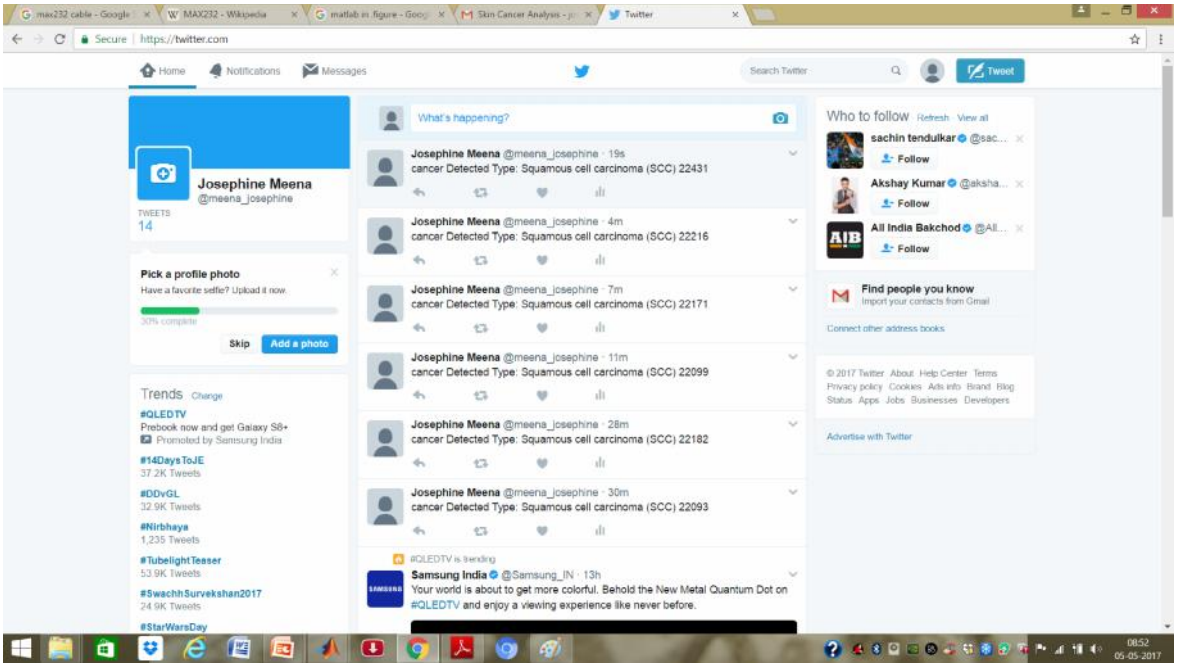



## RESULTS AND DISCUSSION

The Computer Aided Diagnosis system performance detection is based on the Feature Extraction. The experimental results are conducted using Matlab 2013a. Image processing techniques can be done by using SVM-PSO algorithm with high level of accuracy.

Skin cancer data base details sent to the IoT platform through Wi-fi module. Also Skin cancer data base details are sent to the Twitter

Figure 7: Cancer Types are Send to the Twitter Community




Community and user mail id through Thingspeak IoT platform.

## CONCLUSION

A Secure IoT based skin cancer detection System is proposed. It proved to be a better diagnosis method than the conventional Bioscopy method. The diagnosing methodology uses Digital Image Processing Techniques Combined with Support Vector Machine and Particle Swarm optimization Algorithm for the classification of the image from Normal Skin image. The cancerous region is separated from healthy skin by using SVM_PSO Algorithm. The results showed 97% accuracy. The data base details sent to the IOT platform through ESP8266 Wi-fi module. Skin cancer data base details are sent to the Twitter Doctors Community and USER mail id through Thingspeak IoT platform. Secure transmission can also be done using MYSQL quires along with Application User Interface (API) key.

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