Study And Forecast of Malaria using High Resolution Satellite Images

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Abstract—*In almost all countries malaria is major health issue specially in under developed countries. It becomes necessary to develop a early warning system for malaria using high resolution satellite images. The environment parameters from satellite images such as temperature, rainfall rate, humidity, precipitation and vegetation are used as tools for measuring malaria risks. Among above mentioned parameters vegetation indices particularly normalized difference vegetation index (NDVI) is the powerful parameter because farming is the one of the major reason that helps malaria transmission. In this paper with NDVI calculation and with all above parameters can find natural habitat of malaria vectors to predict malaria positive cases.*

Keywords: *Resolution, Forecasting, NDVI.*

1. INTRODUCTION

Malaria is an vector borne disease that is transmitted by the anopheles mosquito. The growth of malaria protozoa develops in the mosquito stomach and in a person blood[1].Controlling it not only requires case detection and treatment, but control of mosquito vectors and their development. These protozoal parasite complete their lifecycle in a favourable environmental condition. These factors are temperature, humidity, vegetation and water. The life growth starts when the mosquito bites and swallow human blood during the night time, the mosquito starts reproduction after two to three days. The breeding sites are preferably swamps or slow-flowing water bodies. In the dry and semi dry regions,these water pools can appear after the appearance of heavy raining in the region. Depending on the parasite species and availability of suitable environmental condition ,it takes 8 to 30days for the parasite to grow in the mosquito after which the parasitic will be ready to transmit to human blood[2]. Analyzing satellite-based remotely sensed environmental data in a Geographic Information System (GIS) is one approach that can be utilized to identify large geographic areas of suitable mosquito habitat. The environment factors from satellite images such as temperature , rainfall rate, humidity, precipitation and vegetation are used as tools for measuring malaria risks. The main mosquito species Plasmodium falciparum infections feeds every 2nd day at 25°C,The chance of mosquito existence is low at extreme temperatures i.e. the temperatures below 5°C and temperatures above 40°C (in some reports 35°C) are deadly for the mosquito. In this regard the optimum mosquito survival chance is found at 32°C[3]. for the survival of mature anophelines mosquito more than 60% humidity is required.Rainfall and high humidity as well as water pounds are cause of high reproduction of mosquitoes and protozoa. The time span of rainfall is main than its intensity.Heavy rainfall and flooding can destroy mosquitoes and reproduction sites [2].With the help ofenvironmental factors,noticing of water ponds and greenery areas can find out necessary factorsfor malaria channeling. Of course the valid and accurate data of these elements is difficult to find from satellite data but a relative information of these elements may facilitate the future control policy and may allow the forecasting of epidemicity after environmental changes .The growth of protozoa depend critically upon elements of the weather and land-use all achievable using remote sensing data[4]. Among above mentioned parameters vegetation indices particularly normalized difference vegetation index (NDVI) is the powerful parameter because irrigation is the one of the major reason that helps malaria transmission. Thus, NDVI was one of the most successful of many attempts to simply and quickly identify vegetated areas and their "condition," and it remains the most well-known and used index to detect live green plant canopies in multispectral remote sensing In this paper to summarize this with NDVI calculation and with all above parameters a is favourable for growing malaria outbreaks can find natural habitat of malaria vectors to predict malaria positive cases[2].Remotely sensed images are represented as a two-dimensional array of squares pixels on the computer screen . Pixel data can be related directly to features on the ground using a variety of correlation methods .Unsupervised classification can then be used to advice targeted fieldwork [5].Because of global warming increases growth of malaria protozoa, due to the fact that the channelling is reduce at higher temperatures. For this, an expected 3°C global warming until the year 2100 is estimated which increases cases of malaria in millions.

2. STUDY AREA AND DATASET

In this study a LANDSTAT 7 satellite image is used and elements such as land cover, temp, humidity, water ponds and patches and vegetated area are used. For this study we have selected area of "Egypt'' as shown in Fig. 1 optical image is used here because can achieve a very high resolution(<1m).

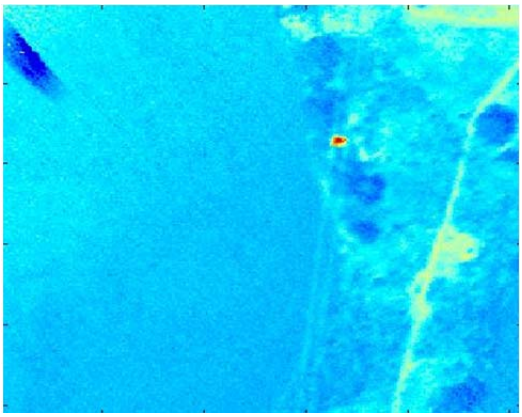
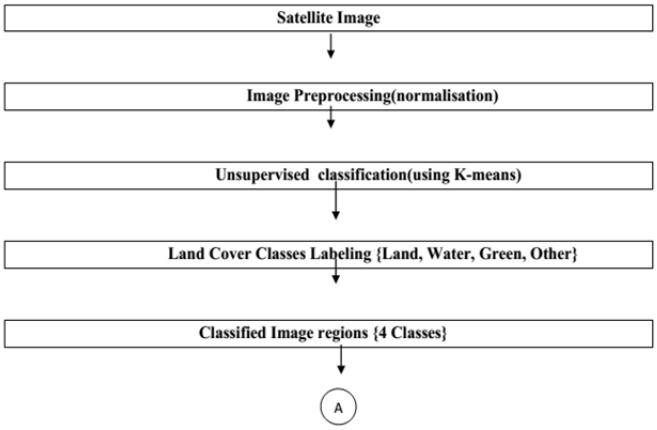


Fig. 1: Landsat Dataset.

3. METHODOLOGY

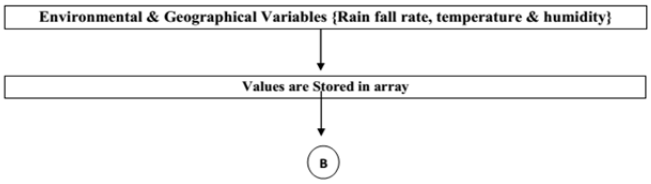
I Satellite Image feature



Description:

1 The satellite image from LANDSTAT data is taken.
2 Image is preprocessed using normalization method.
3 K-means method is applied to obtain different clusters to get different parts of the image.
4 The parts are labeled based on density of colors as Land, Water, Green, Other
5 From this step we will get satellite image description
6 From this step we will get satellite image description

II. The Parameter values related Satellite Images



Description:

1. Temperature values are stored in a array variable[low ,mid and high temperature].
2. Humidity sample values from 0.001% to 0.5% are taken in an array variable.
3. Rain fall rate values are obtained from rain fall rate from ITU equations
4. The values of Rain fall rate, temperature & humidity are taken one by one for calculation.

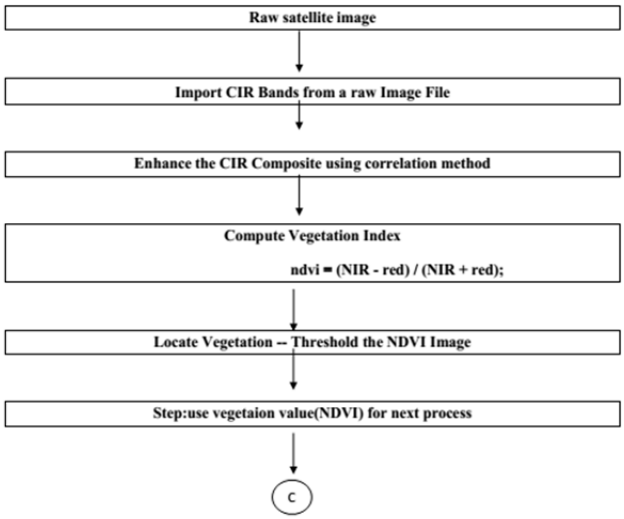
III. NDVI(Normalized Difference Vegetation Index)

NDVI values vary with the absorption of red light by plant chlorophyll and the reflectance of infrared radiation by water filled leaf cells. All visible ranges are captured by satellite cameras in form of bands through which features can be found by NDVI method.[7]:

NDVI = (NIR - CIR) / (NIR + CIR);

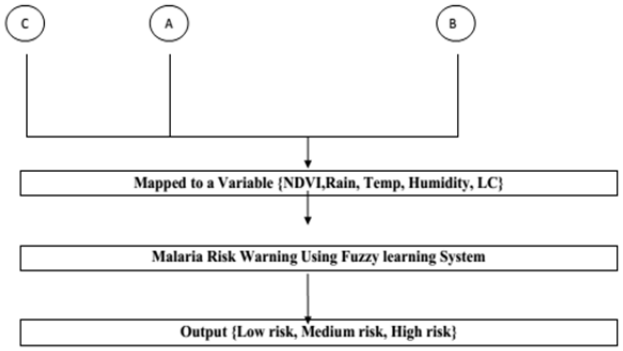
CIR: color-infrared (CIR) composite

NIR: near-infrared (NIR) bands



the NDVI itself thus varies between -1.0 and +1.0.
0.0–0.2 reflects to land,
0.2–0.7 reflects green vegetation and negative values indicate water [7,5].

4. MALARIA RISK MAPPING



Description:

Now we have image classifiers and environmental features.

Now using fuzzy logics rules are defined based on malaria analysis.

Here based on inputs e.g. as high rain rate,low temp ,less humidity and region class; malaria disease risk factor like low ,mid and high are mentioned

5. EXPERIMENTAL RESULTS

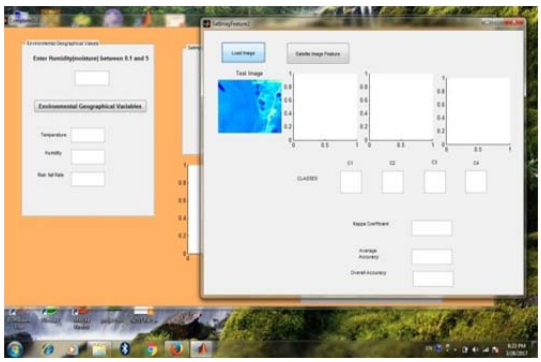


Fig. 2: In this window image is loaded.

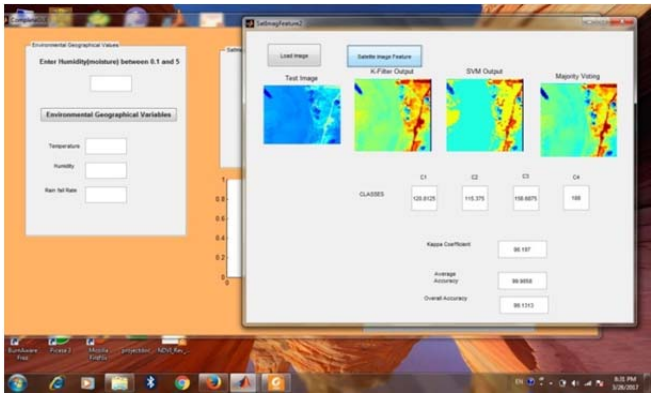


Fig. 3: Satellite image is processed.

Satellite Image is pre-processed using normalisation method and the unsupervised classification is done and we get 3 outputs k-filter output,SVM output and majority voting accordingly we get 4 classes depending upon the density of colours as land (C1), water(C2),green(C3) and others(C4).

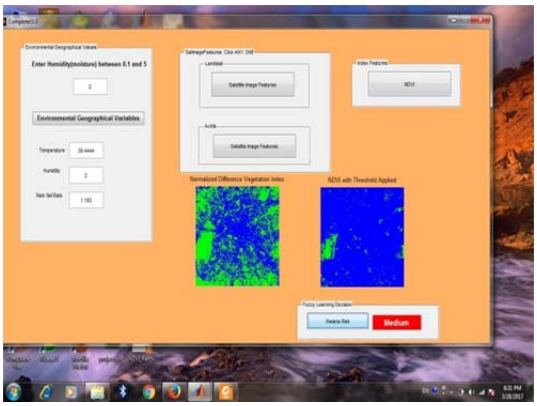


Fig. 4: NDVI&NDVI threshold applied.

Now we have image classifiers and environmental features.

Now using fuzzy logics rules are defined based on malaria analysis.

Here based on inputs e.g. as high rain rate,low temp ,less humidity and region class; malaria disease risk factor like low ,mid and high are mentioned.

6. CONCLUSION

It is found that one can predict malaria outbreak by extracting environmental parameters necessary for mosquito's parasite life cycle. These parameters are temperature, humidity, rainfall, stagnant water and vegetation covers. Any intrinsic uncertainties in the extraction of these parameters from satellite images due to their resolutions and interfering atmospheric condition can affect the results . These weighted four parameters showed acceptable agreements with the collected data. There are some problems present with the parameters which calls for further research. There are other elements such as shadows, manmade ponds, heavy rainfall and many other elements that can affect the outbreaks. The satellite ability in the detection of high risk region may provide non-expensive information on regular interval not only in malaria but for other epidemics as well..

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