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Dimension Merger in Spatial Domain: A Review on Image Processing

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Abstract

Amount of data generated from remote sensing imagery covers wide applications especially in the area of environment monitoring, agriculture fertilization, object detection and tracing and many more. Yet the amount of data gathered requires direction so that such data can be beneficial along with existing human know sources since 1970's when image based object detection came into light. This paper provides an overview of methods and tools that have made machine learning and IOT based solutions a prime area of research when we talk about imagery and its uses for human life improvement. The main goal of the review is to picturize an Internet of things (IOT) based solution for agriculture improvement in India by surveying plant seed cultivation /recognition or diseased leaf segmentation and various methods implemented in the world from various tools sets being used to algorithms being developed. Survey conduction and probable determination in this area is the first foundation towards our research contribution that is highlighted in this paper.

Keywords; *Segmentation, Clustering, Machine Learning and IOT.*

I. INTRODUCTION

Image processing is a method to perform image analysis in order to perform feature enhancement example image restoration or current trend to extract some useful parameters and provide that as basis to machine learning for reasoning by experience. In the area of machine learning frame works that analyze images could have much benefit in domains like agriculture, image recognition etc., frame works will provide growth of community by providing quality amendment of life/business and many more. Image information extraction, image segmentation and many more tools of image processing when combined with machine learning algorithms provide an improvement to the quality of life making this system created the best fit approach. Hence classifier selection for machine learning model creation in an application domain plays the key role for our research definition.

One of the current research trends have cast their light on plant leaf disease recognition as crop destruction due to unfavorable weather and land fertility is need of the hour when we talk about global destruction because of manmade industrialization and pollution. Plant health monitoring system especially the IOT based solutions have been numerously reported yet their complexity in simplicity comprise of segmentation issues comprising of spot regions and complex background when we talk about image classification and object detection. To overcome these image analysis cracks many algorithms and tools have been proposed [1].

II. PLANT DISEASE DETECTION

A. K-Clustering:

vishnu et al.[2] concise few algorithms in the image processing domain that have helped in plant disease

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recognition like BPNN (called as Back Propagation Neural Network), SVM (called as Support vector Machine), K-means clustering plus many more supervised and unsupervised machine learning classification algorithms. Mostly the research points out that maximum utilization and efficiency has been provided by K-means clustering algorithm when we talk about plant disease detection with the help of machine learning and IOT. K-means clustering revolves around optimization of distance of each pixel with respect to centroid or point of convergence hence the challenge remains the start point and the approach to remove noise when we talk about gray scaling.

B. Super-Pixel:

For color segmentation this K-clustering is modified and know as super-pixel clustering technique [3]. The problem with K-means is centroid detection and with super pixel is that of spot reduction.

Example as shown below from survey:

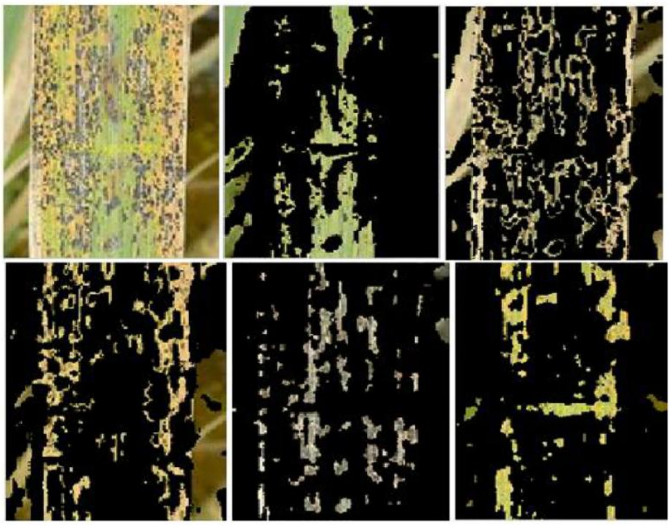

Fig 1: K-Clustering (centroid based image clustering) [7].

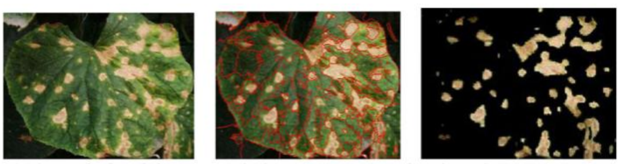

Fig 2: Super Pixel [7]

III. MULTI-SPATIAL IMAGING

Hyperspectral Image processing is an important area which derives its roots from remote sensing. Remote sensing is defined as means of gathering information such that no physical contact is required. Such information generally processed on remote site having numerous applications and usefulness in fields like land surveying for agriculture needs, military intelligence, economic and structure planning or to be generous any humanitarian applications to demand. Remote sensing has always been visional to the use if satellite / airborne based sensors capturing information to classify active or passive objects on earth based on electromagnetic radiation in one or multiple locations simultaneously. The data comprises of multiple resolutions under electromagnetic spectrum like the spatial, spectral, radiometric and temporal. The quality and category based information collected is used for creating maps based on the information collected from sensors or solving tools that extrapolate sensor data in terms of central locus points for example distance with respect to epicenter. The focal point center of an image provides accurate distance but the distortion increases when the reference goes at the edges such error resolution is made possible because of geo-referencing one of the first applications of remote sensing for image processing. [8-9].

Spectral imaging acquires multiple bands of information in electromagnetic spectrum where as image processing of images captured from a normal camera involves capturing just the visible spectrum “RED GREEN & BLUE” components. Spectral imaging involves techniques that have helped human to go ahead of “RGB” with the use of infrared, ultraviolet and X-ray or even combination of two / three techniques along with visible light components possible because of optical filters and illumination. Hyperspectral imaging is another subcategory of spectral imaging, which combines spectroscopy and digital photography. “Hyper” is

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defined as over the above threshold based on quantitative analysis of multiple spectrum wavebands. Such multiple spectrum band information have means to sufficient data that can help us provide solution in identifying many more material parameters. Over a decade research trends have provided development of hyperspectral sensors and tools that analyze such information at ease [4][8].

Hyperspectral sensors analyze the physical properties remotely of an captured scene/image for the purpose of physical/chemical parameter estimation of objects in the environment. Therefore hyperspectral sensor image analysis have increased importance in agriculture, environmental monitoring, urban planning and many more. Hyperspectral imaging provides wonders when combined with analyzing tools revolving around machine learning. Machine learning has become a back bone when we talk about any application that utilizing remote sensing as its front end hence making hyperspectral imaging and machine learning key aspects under review/survey of our paper.

A. Fining: Process by which scene captured can reveal the physical/chemical parameters that multispectral spectrum could not provide is known as fining. This process provides estimation in reference to size, granularity and mass of particles under test. Example in agriculture it is most widely utilized to provide structural texture and roughness of surface know as absorption features that is plant water stress and soil nutrient . Fining as highlighted below from survey [5][7] :

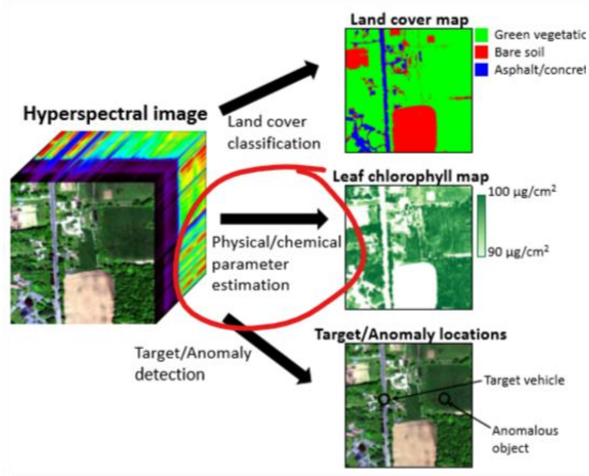

Fig 3: Fining / Physical/chemical parameter extraction (highlighted in red)

IV. MACHINE LEARNING IN HYPER SPECTRAL IMAGING

Machine learning algorithms categorize data to provide a learning model that covers all the variables of the model under test. Machine learning is divided in to two structured groups that are supervised and unsupervised learning; but in order to take also the sub classifications it is further sub divided as per the application category. Supervised learning uses labeled approach of categorizing the data into ordered sets. The complement of supervised learning is unsupervised learning where labelling is not preordered in the training set but rather the training set is created along with system image under test. Active learning is derived from unsupervised learning but the region of interest is restricted to the object to be searched hence making it faster than unsupervised learning. As such algorithms are still a developing domain a sub classification like transfer learning is the one that adapts the solution of one problem to solve another problem and learns with previous as well as current experiences known as domain adaptation under transfer learning. The motto of the survey is to provide Machine learning-based hyperspectral image analysis methods. They are under classification and development where at every step an algorithm is modified according to the application. The categorization of the machine

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learning algorithms is derived from Kevin Murphy's book [19]. All the development in this field is well explained in the book. The main aspect of our literature survey is to find the best method adopted for spatial filtering and what are the possibilities that we can suggest to the research. A excellent literature survey [6] that provides all the methods that are deployed till date for hyperspectral image processing.

V. DIMENSIONALITY MIXING FUTURE SCOPE PROPOSITION

Above sections show that plant detection techniques utilize normal image processing techniques combined with machine learning where as prevention techniques cover machine learning for parameter extraction possible because of hyperspectral imaging. Both solutions are dimension bound wherein the inbound curse of dimensionality has been an important aspect in hyperspectral research for imaging in remote sensing from over a decade. Some of the techniques that have improved over a period of time are dimensionality reduction, spatial information reduction for noise filtering, multitask learning and many more yet the orders of magnitude and possibilities in this domain are infinite and still growing strong. The important aspect that is still left unanswered is the characteristics of intrinsic and virtual dimensionality. That is combining these two techniques on an single IOT platform that utilizes the knowledge of both training sets and provides a more probabilistic and implementable approach. The biggest challenge is not to explore the unexplored yet to provide models that cover maximum applications. Hence statistical modelling that covers or guarantees maxim application coverage is the topic of current research that provides spatial filtering in all domains. Such modelling needs to cover all factors under geotagging of image acquisition like when, how and where. Till now studies have been concentrated to work well on a particular type of imaging and never for multiple complexities that is universal models that label out the unlabeled under different sets of conditions.

CONCLUSION

Some tasks such as dimensional mixing provided not covered by previous solutions are under the region coverage of remote sensing applications. These tasks are the highlighting importance of hyperspectral imaging. Generative multi models or networks are bound to provide a demanding research breakthrough in the future an aspect of hyperspectral imaging left unexplored to its defining capacity. Till date research shows that Gaussian processes have provided a wonderful coverage in terms of classification of physical/ chemical parameters extracted to train the trainer. Yet the most important constraint to our research will be answered only by improving result dimensions of machine learning to make things practical and implementable.

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