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Design and Development of 3D Insect Modeling, Identification, and Dynamic Database Updation

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Abstract— Agriculture is the core component that will directly or indirectly increase the GDP of India. Farmers need to be empowered with the technology to improve their productivity and reduce their losses. In order to overcome the annual losses due to insects and pests, the farmers must correctly identify the insects which are damaging their crops. In this paper an online portal, Agrovaid has been proposed, which will help the farmers in accessing information about crops and insects. The farmers will get detailed information about crops and insects. The increased usage of 3D image data leads to the accumulation of large databases of 3D images. The greater demand for accessing the insect's 3D images justifies the need for more efficient database storage and retrieval. The proposed methodology store images efficiently in a database and automatically update data in the database in increasing or decreasing order of Mahalanobis distance that will improve the efficiency of database.

Keywords— Agrovaid; auto updation of database; efficient storage in database; feature extraction; 3D insect modeling; mahalanobis distance.

I. INTRODUCTION

India's economy mainly depends on agriculture and it is a pillar of Indian economy. Agriculture is the core component that will directly or indirectly increase the GDP of India and reduce poverty. Indian Agriculture contributes to 18.6 per cent of India's GDP, and approximately 59 percent Indians livelihood mainly depends on agricultural sector. Today's Indian agriculture currently faces a lot of challenges due to ever growing population and it is estimated that India's population in 2050 will be as high as 1.65 billion and which 450 million tons of food grains will be required [1]. In order to meet the requirements of large population, there is an urgent need to improve the productivity of agricultural crops. As there is no scope for expansion of land because of limited resources, the emphasis should be on increasing the productivity using available resources properly. In order to improve agriculture productivity, Information Technology is the only way to increase the productivity [2].

IT has changed our life style completely by connecting the world globally. As we know that IT is used in almost every fields and only farmers seems to be far from technology. IT can improve farming and helps in increasing productivity of crops. Government and various Agricultural based companies provide various services through online portals [3-5] and mobile technology with the help of which farmers can access the information about crops and insects [6-8].

Agrovaid is a proposed online portal where farmers will get information about various crops and insects as illustrated in Fig. 1. Farmer can log in, view all crops information, view 3D images of insects and can also give feedback. Admin can access database and update it whenever required. This online portal is designed in such a way that it is simple and easy to use. The farmers will get detailed information about insects which are damaging their crops. The losses incurred by these insects adversely affect agriculture. However, the agricultural sector faces annual losses due to insects and pests. The damage caused by insects greatly reduces the crop production. Although no exact estimates of total crop loss in India due to insects and diseases could be found, it is generally believed that the loss of productivity of farming could range between 10–30%. In terms of monitory value, the losses due to these biotic factors account to near US$12 billion [1]. So it is crucial to prevent this huge amount of loss.

To prevent crop from insects, the first step is to identify the insects correctly. Currently identification methods mainly used 2D images that does not give exact identification of insects and can be time consuming and results in low accuracy. Insects are difficult to distinguish even using detailed 2D images. The appearance of same insect from different angle may vary significantly. The same insect shows different patterns from different viewing angles. Therefore it is quite difficult to correctly identify an insect. In order to solve this problem, we propose 3D modeling of insects.

3D modeling is the process of developing a mathematical representation of any three-dimensional surface of an object. The product is called a 3D model [9]. The main advantage of 3D modeling over 2D method is flexibility, ability to change angles of images with quicker rendering of the change. The working with insects in the 3D images can be much better than the 2D images because it provides virtual reality [10].

With the increased usage of image data and technological progress in acquisition, modeling and processing leads to the accumulation of large databases of 3D images. Consequently, there is a strong need to search and develop technology that supports efficient storage and retrieval of 3D images from databases [11-14]. The 3D images of insect's database must be managed so that information about insects can be accessed at any time with ease. Database management is a continuous process required to keep database update all the time.

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Updation of database can be done automatically based on some similarity distance measure. The database can automatically rearrange images stored in the database using various distance measures like Mahalanobis distance [15-18] or Euclidean distance so that images of same features are stored together that will help in efficient retrieval of 3D images. The auto updation of database can improve performance of databases [19-22].

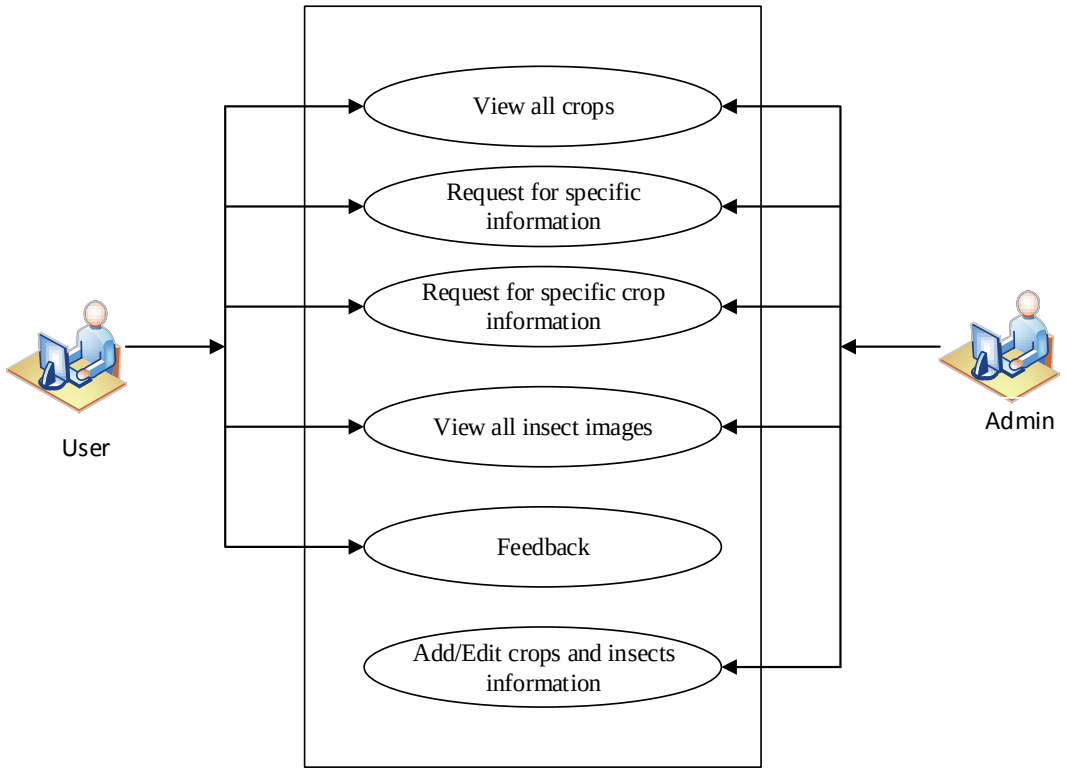

Fig. 1. Overall interaction between user and admin.

An efficient Database Should:

- *Eliminate data redundancy*: the same piece of data shall not be stored in more than one place. This is because duplicate data not only waste storage spaces but also easily lead to inconsistencies.
- *Ensure data integrity and accuracy*: Data integrity implies that the data should be accurate, relevant, complete and timely accessible for the users it is intended for.

II. PROPOSED METHODOLOGY

Database can be defined as a structured collection of data that is stored in a computer so that a user can consult it to answer queries. The records retrieved in answer to queries become information that can be used to make decisions. The computer program used to manage and query a database is known as a database management system (DBMS). Fig. 2 illustrates the steps followed while designing, development and auto updation of image database.

1. *Collect images to be store in the database* - collect all types of 3D images to be store in the database. The images of insects are taken from different angles such as from top, from front side, from left side and from right side. These different views help in correctly identification of insects.
2. *Identify and extract features* - identify the features of insects and then by applying feature extraction techniques, extract features such as average intensity of image, average intensity of red, average intensity of green, average intensity of blue, length of insect, width of insect and color of insect. All these features provide detailed information about insects. The features may be required to be invariant with respect to changes in rotation, translation and scaling.
3. *Store images in the database* - store insect's images along with the features in the database. For new image to be store in the database, find the similarity measure between new image and all the images stored in the database using Mahalanobis Distance. Mahalanobis distance finds the correlation between new image and all the images stored in the database. The new image will store closer to the image in the database having similar features to that of new image.
4. *Automatic updation of database* - the focus of 3D image database not only concerns the efficient storage and retrieval of 3D images but also the auto updation of database using Mahalanobis distance. The database automatically rearranges images either in ascending or descending order of Mahalanobis distance so that images of same features are stored together that will improve database searching time.

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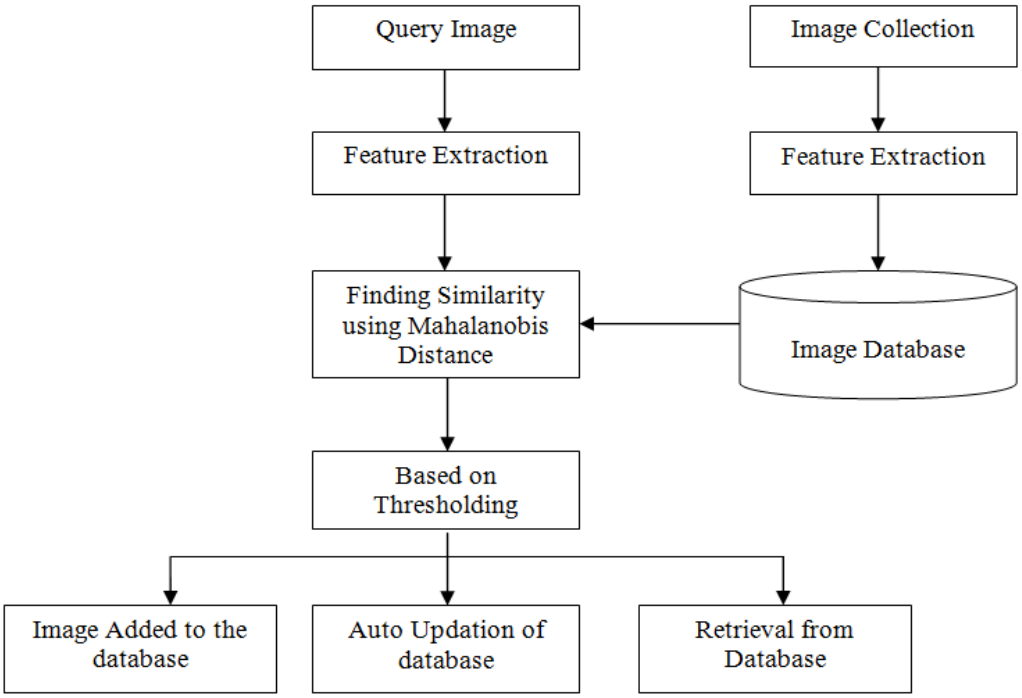

Fig. 2. Proposed methodology.

III. Significance

The findings of the study will redound to the benefits of farmers considering that Agrovaid, an online portal, will help the farmers in accessing information about crops and insects. The farmers will get detailed information about insects which damage their crops. The greater demand for accessing the insect's 3D images justifies the need for more efficient database storage and retrieval. The proposed method store images efficiently in a database and automatically update data in the database in increasing or decreasing order of Mahalanobis distance that will improve efficiency of database.

IV. Conclusion

Indian Economy largely depends on agriculture. The average annual growth rate of agriculture must be maintained to fulfill the needs of ever growing population. This can occur only by introducing new technologies and farmers who seem to be far from technologies must know the benefit of these technologies. In this paper an online portal, Agrovaid, has been proposed which will be very helpful for farmers. It is very user friendly portal where farmers will get detailed information about crops and insects. Indian agriculture suffers annual loss due to insects. In order to overcome the annual losses due to insects and pests, the farmers must correctly identify the insects. The increased usage of 3D image data leads to the accumulation of large databases of 3D images. The greater demand for accessing the insect's 3D images justifies the need for more efficient database storage and retrieval. The proposed methodology store images efficiently in a database on the basis of Mahalanobis distance so that images of same features are stored together. By using Mahalanobis distance, 3D image database automatically rearrange images in increasing or decreasing order of their distances in database that will improve efficiency of database.

Acknowledgment

This Research work involves auto updation of 3D image databases based on Mahalanobis feature detection and comparison. This work shall be integrated with the required hardware by B.Tech. students (M.B.S College, Jammu) as per the idea originally proposed by Dr. Parveen Lehana.

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