

Tea Cultivation that can be Improved by Using Various Aspects of Information Technology

¹B.D.O.I Keerthisinghe, ²Dulsara Nayanajith Mannakkara, ³Ravindu Chathurtha Ranaweera, ⁴Sanvitha Kasthuriarachchi, ⁵E.M.W.C.L Ekanayake, ⁶Dilani Lunugalage

¹⁻⁶Department of Information Technology Sri Lanka Institute of Information Technology, Malabe, Sri Lanka

Abstract - The tea industry is found as a significant partner for over a century in Sri Lanka's economy. The tea industry is our country's forex and source and employment. However, viewing the statistics from some years ago, the tea industry's contribution is claimed to be flawed. Therefore, the problems faced by the tea industry can be solved by using sophisticated technologies. This paper point is to introduce a mobile application which developed using image processing, data science and machine learning techniques to assist farmers to improve knowledge in tea plantation. This system will help to planters to select proper tea clones, visualize growth of the plants, and identify insects and diseases. In distinguishing insects and diseases in tea plantation growers can upload the image to the application. The developed model has 95 percentage accuracy to recognize the disease. After these identification system will give proper chemicals and details about the current disease. Also, Users can get idea about how to grow a tea plants step by step, the time it takes to harvest, yield time of that tea clone and the cost of cultivating the land using this mobile app. Along these this will be useful for tea planters to being successful in their agricultural industry.

Keywords: Machine learning, Data science, Image processing.

I. INTRODUCTION

In this modern world every system is operating using computer-based systems and it is globalizing each and every system in day to day life of us. So, a wide range of operations are being activated through computer-based systems and variety of data is stored in those systems. Tea was planted as an experimental crop in Sri Lanka. From that time several researches were done by different groups to identify the main requirements that are wanted for the cultivation. For production of the high-quality tea needs cool temperature, humidity and the rainfall.

In this research we are going to address the major problems in tea plantation sector in Sri Lanka. In order to do that we develop a mobile application which has some features that are not used in the previously developed apps. This system will help to planters to select proper tea clones,

visualize growth of the plants, and identify insects and diseases.

- i. In selecting proper tea clone's user of the mobile application can upload the image of the leaf to the system will distinguish it is healthy or not. After this process system will give necessary details to cultivate the tea plants in the field.
- ii. By using image processing and data mining techniques system is consisting plant growth monitoring system. It will be visualizing the growth of the plant in the field and the nursery stage. So by using this planter can get an idea the plant is in correct growing procedure.
- iii. The leaves are mainly affected by bacteria, fungi and viruses. These may include a noticeable change in the color, shape, or function of the plant in response to the pathogen. As that, disease identification step must be done accurate way. So, using data mining, machine learning and analyzing techniques prepared a model to identify the harmful diseases to the cultivation. Mobile application identifies the user uploaded images as a healthy or diseased affected image. If the image is diseased affected, system shown the suggested treatments related to each diseased type.
- iv. Many insects do harm to the tea plantation. Some mites, tea scalers, tea aphids etc. Many planters lack the proper knowledge to recognize the variety of insects. So using data mining techniques and analyzing models prepared a database about the harmful insects to the cultivation. When user uploads the image of the insect to the mobile application system will detect the insect and gives proper chemicals that must use to the field.

This mobile application's main motive is to guide the tea planter to use the modern solutions for the problems that are occurs in the cultivation.

II. LITERATURE REVIEW

There is some literature survey on existing applications and systems with nearly capabilities and functionalities prior

to the proposal our research project. Some of the eminent researchers are reviewed here.

A. Crop Medic Mobile Application

Crop Medic is capable of identifying diseases by analyzing the leaf image uploaded by the user. The application will identify the crop type and the stage of the disease in order to suggest possible treatments. The specialty of Crop Medic is its ability to identify the dispersion pattern of the disease and visualize on a GIS based dense map highlighting the areas vulnerable for infection. This mobile application is available in all three languages Sinhala, English and Tamil and is intended to cater farmers engaged in cultivation at a small scale as well as the industrial users and agrarians. [2]

B. Farming Solution Mobile Application

With Farming Solution, farmers can find the information they need to improve their agricultural and management practices in the right format and at the right moment. Farming Solution complements technical assistance, fostering farmers' autonomy to identify, plan improvements and monitor progress over time in their farms. [7] Farmers can:

- Identify challenges through self-assessment
- Plan improvements in their farms
- Learn how to implement adjustments with audio visual resources
- Track progress towards better production
- Keep up-to-date with sector and local news.

Farming Solution can be used by producers of diverse crops and commodities in agriculture and livestock. [7]

C. Agrio Mobile Application

Agrio is an artificial intelligence-based solution that helps user to identify and treat plants diseases and pests in users' field, farm, and garden. This app provides detailed integrated pest management (IPM) protocols to optimize results and lower treatment costs. [3] In addition, Agrio allows field technicians, inspectors and scouters to create digital scouting reports in a very easy and intuitive way. It also does forecast for user and sends user alerts when problems are likely to arrive to users' area. This enables user to protect vegetables, fruits, herbs, flowers, trees, and other plants from damages. When the artificial intelligence algorithms are not confident about the result, we allow user to share images with a team of agronomy experts and agriculture extension specialists who can help user with identification and treatment suggestions for any disease, pest, and nutrient deficiency problem user might have. The automatic answer will be sent to user within seconds if there is a conclusion. If user opts to submit it to the team of experts, they will share their opinion based on the uploaded images and provide user with recommendations to treat the problem. Our premium service, Agrio Shield, is the first artificially intelligent crop disease and pest alert system of

its kind. This smart system warns subscribers after crop diseases, viruses, and pests were detected in nearby areas. These alerts, along with suggested written preventative measures, aids in impeding infestations and reducing yield losses. [3]

D. Plantix mobile application

Plantix and offer user fast and free help. Whether users grow tomatoes, bananas or rice. The only thing user need is an internet-enabled smart phone with a built-in camera. Wherever the problem lies, a smart phone picture is enough and in seconds user will receive a diagnosis and the appropriate treatment tips, especially for the 15 most important crops worldwide. Every disease, pest and deficiency leaves behind a specific pattern, Plantix recognizes these patterns. [4]

In plantix social network user can exchange experiences and information with like-minded people in the immediate area as well as with international experts. This way user will quickly get helpful answers and practical solutions for diseases, pests and deficiency symptoms. [4]

III. METHODOLOGY

In Data Science, methodology is the best way to organize your work better way without losing time.

The data needed to develop this mobile application was collected from the Tea Research Institute. [5] There is also, collected data from kaggle.com

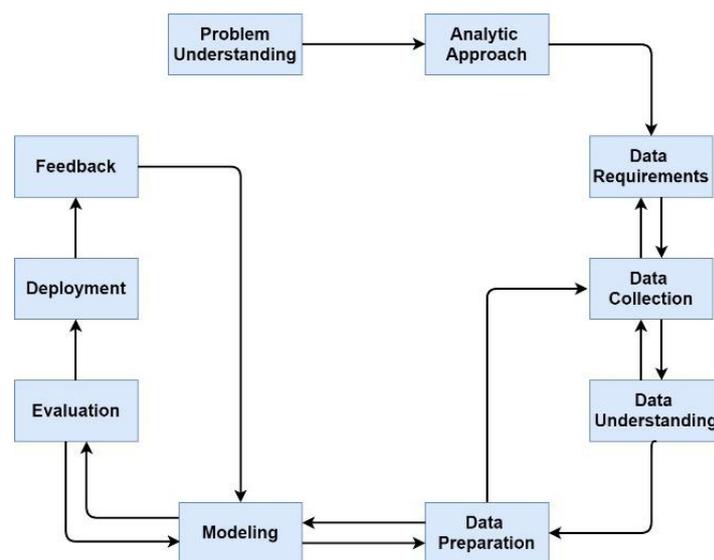


Figure 1: Methodology Diagram

In figure 1 last image, we see that it is highly iterative and never ends because, in a real case study, we have to repeat some steps to improve the model.

The proposed system consists of a Mobile Phone mostly focused on tea planters and the people in agricultural sector. This application will guide the tea planters to cultivate tea with prior knowledge and better understanding about how to manage the risk that comes to the cultivation.

A. Identification of the clone and give plantation support

When a particular user wants to identify what is the clone that should be applicable to grow in their cultivation area, this functionality can be used for that task. So, by using data mining techniques and modeling techniques predict the gathered data more accurately. And prepare the database by passing that predicted data to the application through a web server API. When user upload the image of the leaf to the mobile application system will detect its healthy or diseased affected leaf with help of the database. [6] [22] after that system gives the details about:

- How to cultivate clones.
- Yield time of that tea clone.
- Overall maintenance of the tea crops.
- Yield depending on the extent of cultivated land.
- The time it takes to harvest.
- The life cycle of the plant.
- The cost of cultivating the land.
- The amount of yield that can be obtained.

B. Identification of the most possible diseases of the tea plants

Many diseases that affected to the tea plantation the leaves are mainly affected by bacteria, fungi and viruses. These may include a noticeable change in the color, shape, or function of the plant in response to the pathogen. As an example black blight, leaf spot, leaf scab, gray spot etc. Many planters do not have the knowledge to recognize these diseases with their naked eyes. As that, disease identification step must be done accurate way. Used a model to predict most accurate and effective result. So, using data mining, machine learning and analyzing techniques prepared a model to identify the harmful diseases to the cultivation. [9]

The admin creates the database by taking pictures in real time with the phone camera or gallery. The user captures the image of the diseases leaf and the image is loaded for further processing. This database contains various types of plant diseases and images are stored in jpeg format. First, define functions for importing libraries and processing data using matplotlib. These images are read using the read command. It is the starting point for the image processing workflow series, so processing can only be done with the help of an image. Use the Image Data Generation function to resize all the images in the dataset. Feature extraction plays an important role in

image classification. [11] Color, texture, and morphological features are considered to diagnose the disease. To identify leaf disease type, used classification technology and machine learning algorithms to train and test the dataset. From the database, 80% is used for training and 20% used for testing. [10]

The created model converted as a flite file for implemented with Android Studio. After done the implementation process, mobile application identifies the user uploaded images as a healthy or diseased affected image. If the image is diseased affected, system shown the suggested treatments related to each diseased type.

C. Determine the growth of the plant

Growth of the plant part focused on the development of a system for the know age of the plant to select stages of the plant. Every Tea plant has 2 stages of their life.

1. Nursery Stage
2. Field stage

Nursery Plant has 4 facts to identify about the plant.

- Age should be below 8 Moths
- Number Tree Leaves should maximum 15 leaves
- Number of branches should be 1 or 2
- Height of the Plant should be about 45cm

Filed stage plant should be more than these measurements. So field visitor must visit the tea plantation and see and mention tea plants of the plantation age ant they are completed satisfactions to go for the field stages. Filed offices must do this job under tea research Intuits guide lines. Field officers doing that process manually.

Every tea planter must do that process with tea research Institute permission for get treatments and every helps for their plantation. In this app field officers and tea planters get tea plant Information through the app and also, field offices can give their permission. By using this app can get these above fact results through app under tea research Institute guide lines.

In currently, selecting the nursery or field plants manually by the proficiency person in that field under tea research institute guide. This requires huge amount of work and also requires excessive processing time. In here, can get also treatment for not grown plants. [18] [21] Using neural network, count the number of tea leaves and height of the plants, age of the tea plant. Use android studio and Implement Joda-Time version 2.9 special dependencies to get current age of tea plant.

D. Identify the possible risks that comes after the cultivation

Many insects do harm to the tea plantation. Some mites, tea scalers, tea aphids etc. [19] Many planters lack the proper knowledge to recognize the variety of insects. So, using data mining, machine learning, object detection techniques and analyzing models prepare a database about the harmful insects to the cultivation. As that, insect identification step must be done accurate way. Used a model to predict most accurate and effective result. [14] [16]

When user upload the image of the insect to the mobile application system will detect the insect. The database contains various types of insects and images are stored in jpeg format. First, define functions for importing libraries and processing data using matplotlib. [19] These images are read using the read command. It is the starting point for the image processing workflow series, so processing can only be done with the help of an image. Image segmentation is the separation or division of an image into different parts. There are various methods of image segmentation, from simple openings to high-color image segmentation methods. Computers have no intelligent detection of objects, and various methods for image segmentation have been developed. The segmentation process is based on various features found in the image. [15] This might be color information, boundaries or segment of an image. From the database, 80% is used for training and 20% used for testing. [17]

The created model converted as a tflite file for implemented with Android Studio. After done the implementation process, use Genetic algorithm for color image segmentation. Image processing techniques such as Grayscale, threshold, median filters, and binary images are used for this process to give accurate outcome. If the recognize insect is harmful, system shown the insecticides which protect the cultivation from those insects. [20]

IV. RESULTS AND DISCUSSION

The complete system is designed using Jupiter notebook, Matlab and android operating system. User uploads images in real time with the phone camera or gallery. Then user can click disease identification button to view the result.

As shown in the figure 2 the user can upload the image through the database or real time using the android phone application. Import tensor flow and keras libraries and processing data using matplotlib to create a machine learning model to identify diseases that can be affected to tea plantation. In model training step, from the database trained 80% images and tested 20% images. The test set for prediction of leaf as healthy or Unhealthy.

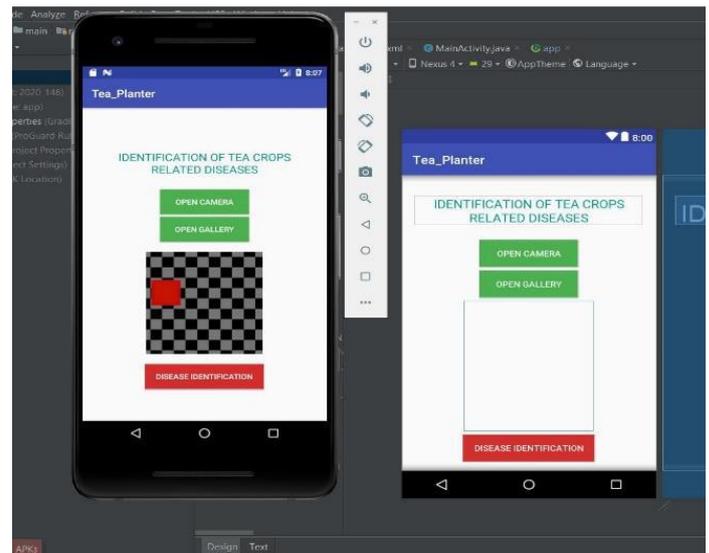


Figure 2: Image Uploading Interface



Figure 3: Disease Identification through the model

The above figure 3 represents the predicted result using created model.

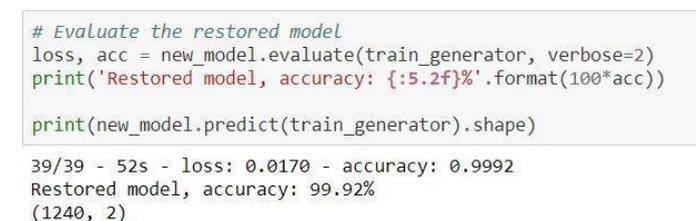


Figure 4: Model Accuracy

The above figure 4 shows the accuracy of the result produced by the model. Therefore, this model is suitable for identifying diseases in tea plantations using tea leaf.

Tea plants are growing as a nursery plant or field plant. Users can get idea about how to grow a tea plants using this mobile app. For that first, user input details about the tea plants. As well as user must input image of tea plants.



Figure 5: Original Image

As shown in the figure 5 uploads the image of the plant by using mobile app.

Then scan the uploaded image by using Math lab natural network and image.



Figure 6: Scan Image

Above figure 6 shows the scan image. Converted scan image into threshold image using matlab.

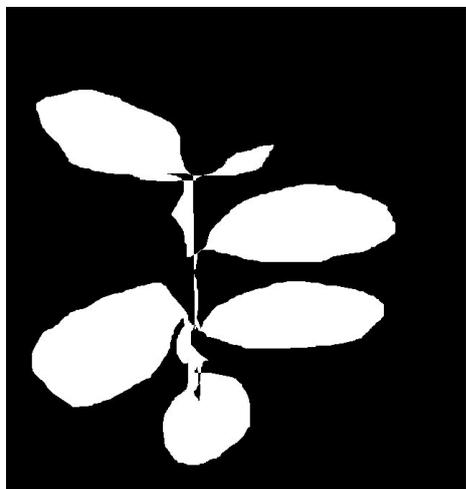


Figure 7: Threshold Image

Above figure 7 shows the threshold image.

Summary								
File Edit Font								
File	Count	Total Area	Average Size	%Area	Mean	Major	Minor	Angle
rascale Image.tif	6	90500	16433	100	126.595	NaN	NaN	NaN

Figure 8: Result

The above figure 8 shows the final result produced by the growth calculation process. Therefore, this process is suitable for determine the growth of the plant.

This research explored the literature about detecting diseases of the tea plants, measuring the growth of a tea plant, and also giving the information about the basic requirements for the plantation support. The findings show that great work has been done in the previous research efforts. This problem has not been completely addressed in the previous works. Some of the components have been addressed partially. However, Tea Planter mobile app would be a very helpful guidance to the tea planters in Sri Lanka.

V. CONCLUSION

In this research work a mobile app was developed as guidance for the tea plantation. This app is developed as a tool that can easy for use for everyone has the capability to use a mobile app. In this modern world in the agriculture sector also using the updated technologies to do the cultivation. So this app would be very helpful for the farmers to gain their profit as they expected.

Following future aspects can be considered for further research.

- Online solutions related to plants diseases can be provided by using web portals.
- It is also required to increase the number of data for training and testing purposes to achieve better accuracy.
- Existing work can also be extended to achieve high speed and accuracy by developing the advanced algorithms.

ACKNOWLEDGMENT

This research was supported by the authority of Sri Lanka Institute of Information Technology (SLIIT) and we would like to express our gratitude towards them.

REFERENCES

- [1] A.Patel and B.Joshi, 2017. [Online]Available: https://www.researchgate.net/publication/317858111_A_Survey_on_the_Plant_Leaf_Disease_Detection_Techniques [Accessed: 22- Feb- 2020].
- [2] "Crop Medic - Apps on Google Play," Google. [Online]. Available: https://play.google.com/store/apps/details?id=com.crop.android.cropmedic&hl=en_US. [Accessed: 20-Feb-2020].
- [3] "Agrio - Protect your crops. Harvest more! - Apps on Google Play," Google. [Online]. Available: https://play.google.com/store/apps/details?id=com.agrio&hl=en_US. [Accessed: 20-Feb-2020].
- [4] "Plantix - your crop doctor - Apps on Google Play," Google. [Online]. Available: https://play.google.com/store/apps/details?id=com.pepat.GartenBank&hl=en_US. [Accessed: 20-Feb-2020].
- [5] "Tea production in Sri Lanka - Wikipedia". [Online]. Available: https://en.wikipedia.org/wiki/Tea_production_in_Sri_Lanka. [Accessed: 25-Feb.-2020].
- [6] "Seeds vs. Clones of Tea Plants – Tsubaki Tea". [Online]. Available: <https://tsubakitea.com/archives/varietal-selections-of-tea/273>. [Accessed: 25-Feb.-2020].
- [7] "Farming Solution - App Store - Apple". [Online]. Available: <https://apps.apple.com/us/app/farming-solution/id1328105273>. [Accessed: 25-Feb.2020].
- [8] "Crop Farmers App - Apps on Google Play," Google. [Online]. Available: https://play.google.com/store/apps/details?id=com.bivatec.cropfarmersguide&hl=en_US. [Accessed: 20-Feb-2020].
- [9] G. Sun, X. Jia and T. Geng, "Plant Diseases Recognition Based on Image Processing Technology", *Journal of Electrical and Computer Engineering*, vol. 2018, pp. 1-7, 2018. Available: <https://www.hindawi.com/journals/jece/2018/6070129/>. [Accessed 15 February 2020].
- [10] V. Singh and A. Misra, "Detection of plant leaf diseases using image segmentation and soft computing techniques", *Information Processing in Agriculture*, vol. 4, no. 1, pp. 41-49, 2017. Available: <http://Detection of Plant Leaf Diseases Using Image Segmentation and Soft Computing Techniques>. [Accessed 18 February 2020].
- [11] G. Dhingra, V. Kumar and H. Joshi, "Study of digital image processing techniques for leaf disease detection and classification", *Multimedia Tools and Applications*, vol. 77, no. 15, pp. 19951-20000, 2017. Available: https://www.researchgate.net/publication/321365372_Study_of_digital_image_processing_techniques_for_leaf_disease_detection_and_classification. [Accessed 21 February 2020]
- [12] "Ceylon Tea Products Export Performance - EDB", Srilankabusiness.com, 2020. [Online]. Available: <https://www.srilankabusiness.com/tea/about-tea/exportperformance.html>. [Accessed: 21- Feb-2020].
- [13] Export development authority Sri Lanka, export performance, February 2019, 2017. [Online]. Available: <https://www.srilankabusiness.com/tea/about-tea/exportperformance.html> [Accessed: 19th February 2020].
- [14] Huddar, S. R., Gowri, S., Keerthana, K., Vasanthi, S., & Rupanagudi, S. R. "Novel algorithm for segmentation and automatic identification of pests on plants using image processing". *2012 Third International Conference on Computing, Communication and Networking Technologies (ICCCNT'12)*. doi:10.1109/icccnt.2012.6396012 [Accessed: 19th February 2020].
- [15] K. S. Srinivas, B.S. Usha, S. Sandya, and Sudhir R. Rupanagudi, "Modelling of Edge Detection and Segmentation Algorithm for Pest Control in Plants", *International Conference in Emerging Trends in Engineering*, pp. 293-295, May 2011. [Accessed: 17th February 2020].
- [16] X. Li, Y. Deng, and L. Ding, "Study on precision agriculture monitoring framework based on WSN," *International Conference on Anti-counterfeiting, Security and identification*, vol. 2, pp. 182 - 185, August 2008. [Accessed: 17th February 2020].
- [17] Johnny L. Miranda, Bobby D. Gerardo, and Bartolome T. Tanguilig, "Pest Detection and Extraction Using Image Processing Techniques", *International Journal of Computer and Communication Engineering*, Vol. 3, No. 3, May 2014, [Accessed: 14th February 2020].
- [18] A.Phinyomark, C. Limsakul, and P. Phukpattaranont, "A novel feature extraction for robust EMG pattern recognition," *Journal of Computing*, vol. 1, pp. 71-80, Dec. 2009. [Accessed: 14th February 2020].
- [19] Mayukh Sarker, "Use of Image Processing Techniques for Detection of Tea Pests from Darjeeling foothills", India, Volume 6, Issue 1, March 2019, [Accessed: 23th February 2020].
- [20] Miranda, J.L., Gerardo, B.D. and Bartolome, T.T. 2014. Pest detection and extraction using image processing techniques, *International Journal of Computer and Communication Engineering*, Vol.3 No.3, 189-192, [Accessed: 22th February 2020].

[21] Pratik Srichandan, Ashis Kumar Mishra, Harkishen Singh, Data Science and Analytic Technology in Agriculture, *International Journal of Computer Applications*, Volume 179 – No.37, April 2018, [Accessed: 21th February 2020].

[22] Pratibha Gangurde#1, Manisha Bhende, “A Review on Precision agriculture using Wireless Sensor Networks” *International Journal of Engineering Trends and Technology (IJETT)* – Volume 23 Number 9- May 2015, [Accessed: 22th February 2020].

Citation of this Article:

B.D.O.I Keerthisinghe, Dulsara Nayanajith Mannakkara, Ravindu Chathurtha Ranaweera, Sanvitha Kasthuriarachchi, E.M.W.C.L Ekanayake, Dilani Lunugalage, “Tea Cultivation that can be Improved by Using Various Aspects of Information Technology” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 1, pp 1-7, January 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.501001>
