Bilkent University

Department of Computer Engineering

Senior Design Project

GrapeHealth

Project Specification Report

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1. Introduction

In the last few decades, the integration of agriculture and technology is becoming more substantial due to the economical and sustainability benefits for farmers. Agricultural technology is easing the workload of the farmers and enabling them to produce better quality for harvesting. Turkey is a country of agriculture, therefore, the technological improvements in this sector will advance our economical standing. One option to integrate agriculture and technology is detecting agricultural diseases. Detecting diseases is a challenging concept since there are multiple diseases even for one plant and detecting every one of them is computationally challenging. Therefore, our main focus will be to detect the diseases related with grapes.

Grape is the most produced fruit in Turkey's market share. Turkey has excessively link field for grape production and has great potential for viticulture. Also, Spain, France, Italy and China are the world leaders of grape production. The importance of detecting grape diseases arises in thinking of the worldwide impact. The main purpose of our innovation is to be able to detect five most common grape diseases to change the viticulture experience of the farmers to easily diagnose their grape products.

Farmers solely depend on agriculturalists to diagnose and cure their products, with our mobile application farmers can detect if their grape has disease or not. The potential users are farmers, agricultural engineers, government's agricultural consultants, agricultural groups, grape merchants and drug companies or chemical stores. Our ambition is to help agricultural specialists and groups in being an additional resource to detect diseases. Grape merchants can decide whether or not the product they will buy has any of the common diseases. Farmers and drug companies can communicate more biologically to decide the accurate drug for the grapes. In some circumstances chemical stores and farmers may not have the information to detect the diseases. Integrating the potential users to diagnose diseases will help grape production sector to communicate better. Detecting diseases will improve efficiency and quality by adding value to fresh and healthy grapes.

In this report, first a description of GrapeHealth will be provided, where we explain our mobile application in depth. Then, insight about the constraints regarding GrapeHealth will be listed. Afterwards, the professional and ethical issues will be given. Finally, the functional and non-functional requirements of our project will be included.

Our project webpage: https://brker.github.io/GrapeHealth

1.1. *Description*

GrapeHealth will be a mobile application (Android and iOS) which is designed to serve farmers, agricultural engineers, government's agricultural consultants, agricultural groups, grape merchants and drug companies or chemical stores. The innovative part of GrapeHealth is integrating data, image and agronomy to diagnose grape diseases. The main purpose of the application is recognizing the disease of the grape plants. The application will use two features to recognize diseases. First feature takes photos of the leaf of the grape plant as input and gives probability of five possible diseases that the plant could have. Leafs are the determining factor to detect diseases. Second feature is a Chatbot that asks specific questions to user to get more knowledge about the situation of the plant. A user could just use image recognition or just Chatbot or both for one query. According to a research similar approach to our project gets more than 90% accuracy [1]. By using Chatbot we aim to increase accuracy rate of the application.

We will use some image dataset of both healthy and diseased grape plants to train our application so that the application could recognize the diseases and can apart healthy and diseased grape plants. While we are doing this training, we will use Deep Convolutional Neural Networks approaches based on AlexNet or GoogleNet architecture [2]. The training dataset will be found on web, from Ministry of Agriculture and Forestry data and from data of some contacted agricultural engineers. Also, Chatbot will ask the user some questions and determine disease by using flowchart representation.

1.2.Constraints

1.2.1. Implementation Constraints

- Github platform will be used to work efficiently with group members.
- Deep convolutional neural network in Python will be implemented for designing model.
- AlexNet or GoogLeNet will be used as deep learning architecture.
- React will be used for implementation of mobile application.
- Flowchart representation will be implemented for Chatbot.

1.2.2. Economical Constraints

- Training datasets, deep learning tools, frameworks and libraries will be used with no fee.
- Hosting and domain for our website will be bought.
- Server and database will be rent for image recognition.
- Publishing the application to Google Play Store and Apple Store will have fee cost.

1.2.3. Environmental Constraints

- User will be warned to pay attention to leafs while taking photos.

1.2.4. Social Constraints

- User that uploads irrelevant photos will be blocked, thus; user will be encouraged to obey this obligation.
- Personal privacy will be taking in consideration according to EU privacy laws.

1.2.5. Political Constraints

- None.

1.2.6. Health and Safety Constraints

- Detection of diseases of the grapes enhances public safety and health. Therefore, user will be warned to wear gloves while interacting leafs and taking photos.

1.2.7. Manufacturability Constraints

- None.

1.2.8. Sustainability Constraints

- Application will improve itself by learning from images uploaded by users, thus; it will give more reliable results to user.

1.3. Professional and Ethical Issues

- GrapeHealth will store the information of users such as name, surname, telephone number and location. This private information will not be shared with third parties.
- GrapeHealth will serve as a helping source for agricultural specialists, it will not take their place in this sector.
- Location information of the user will not be taken in the background without user approval.

2. Requirements

2.1. Functional Requirements

- Application requires internet connection and smartphone or tablet.
- Application should store login information on database for both usability and notifications.
- Application should store previous images which are uploaded by user.
- Application should give notifications for potential disease if a contagious is present in nearby locations.
- Application should continue to learn from images uploaded by users.
- Users have to download GrapeHealth from Google Play Store or Apple Store to use application.
- User should give permission to application to use camera and GPS for full functionality.
- User can take several images to upload and select best of them at the end.
- User should upload 3 images from different angles.
- User should upload leaf images to learn the disease of grape.
- User should answer questions through Chatbot to learn the disease of grape.
- User should be able to use both images and Chatbot to find disease of grape.
- Chatbot contains buttons for answers rather than plain text. It is more trustable since user can make spelling mistakes.

2.2.Non-Functional Requirements

2.2.1. Usability

- The user interface should be user-friendly.
- The application should not require any previous knowledge, it should be easy to use.
- Application should be supported most of the Android and iOS versions. Our preliminary examination indicates that Android 4.4 is support %96 of devices and iOS 9 support %98 of devices [3][4].

2.2.2. Reliability

- The accuracy rate of the application should be higher than %80. If accuracy rate is lower than %80, application should give warning to user. %80 and above can be considered as successful [5].
- If application do not find any diseases related to provided photo, it should give warning, instead of highlighted some diseases name.

2.2.3. Efficiency

- The process of finding disease should not be longer than 60 seconds.

2.2.4. Extensibility

- GrapeHealth will be extensible. For now, it will detect diseases on grapes, however, we can increase the range of diseased plants determined by application.
- The application should be extensible to add new functionalities.

2.2.5. Scalability

- The application gives permission for a user to send only one query. The user could not send another query while his/her query still in progress.

2.2.6. Security

- Application should ask for permission for camera and GPS from user when user starts the application.
- Personal data should be secured by the system and images that are received should be used only for train the system.

3. Reference:

[1] Fuentes, A., Yoon, S., Kim, S. C., & Park, D. S. (2017, September). A Robust Deep-Learning-Based Detector for Real-Time Tomato Plant Diseases and Pests Recognition. Retrieved October 14, 2018, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5620500/

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[3] IOS Distribution and iOS Market Share. (n.d.). Retrieved from https://data.apteligent.com/ios/

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[5] Interview with Kerem Erikçi, co-founder of ErikTronik.