FloraBot AI

INTRODUCTION

Aim: To identify image properties and alert the user about certain characteristics, for example, pests and diseases in a farm/garden.

Idea: The idea is to use Artificial Intelligence to identify the semantics of an image and autonomously alert the user when a particular property is found.

Problem: This invention solves the problem of farmers having to spend hours manually checking for diseases and pests. This invention solves this problem, as farmers can, instead, take or upload photos onto the FloraBot AI app to identify plant diseases, pest infestations or intrusions on the farm (foxes, rabbits, etc.).

Originality: Even though the use of AI and robotics are becoming common, this innovation is unique because it isn't restricted to one specific purpose. The invention can alert any characteristic of an image and can be used in a wide variety of industries, not only the agricultural sector. Other use cases of this invention can be in airports to check passengers' luggage or in surveillance to flag specific events.

INSTRUCTIONS

1. Download the FloraBot AI app from https://bit.ly/florabotaiapp on an Android device and sign in. Source code can be downloaded at https://bit.ly/florabotaicode.
2. Click on the three dots on the top-right corner and press 'Alerts'. Add alerts (what you want the app to identify and alert you on) by typing into the text box and pressing 'Add'. Press the back arrow when done.
3. Press the camera button on the bottom-right corner.
4. Photos can be taken using the camera or choosing one from the photo gallery. The camera can be flipped between the front and rear lenses. The camera can re-orient itself no matter how the device is turned, so we would never get an upside-down image, which is critical in a robotic system.
5. Once the required images are taken or selected, press the back arrow to go to the Home Screen, where you can find all the photos.
6. Look for an alert symbol to the right of a photo if there is an alert.
7. You can click on a photo to see its classifications, the percentage confidence that the AI has on these classifications, and the dominant colours of each image.

In our project, we have demonstrated the autonomous use case of the FloraBot AI app on a self-driving robot built using Mindstorms Ev4:

1. Go to the camera screen and place the device on the device holder on the robot and lock it in.
2. Turn on the robot by pressing the centre button of the hub.
3. Place the robot where you want it to start taking photos.
4. Press the centre button to start running the robot to navigate the farm and take photos.
5. Once the robot has taken enough photos, turn the robot off by pressing the centre button on the hub and analyse the photos.

APP DESIGN

We designed four main user interfaces (UI): the main dashboard UI, alert list UI, camera UI and the details analysis UI (please refer to Figure 1). To develop the app, we used Android Studio with Java language. Furthermore, we used Google Vision API from GCP (Google Cloud Platform), an artificial intelligence-based image recognition platform. Finally, we used Google Firebase for the backend infrastructures (Authentication, Real-time Firestore database, Google Cloud Storage and Cloud Functions triggers based on Node.JS).

The main challenge we faced in developing this app is learning Java and Android application development. We also needed to learn how to use Google Vision API. The final challenge we faced is to figure out the authentication mechanism and real-time database implementation. To overcome this challenge, we followed numerous tutorials online to understand these concepts.

The scientific principle implemented here is Artificial Intelligence Deep Neural Networks. This allows Google Vision to recognise characteristics within images to alert the user about them.

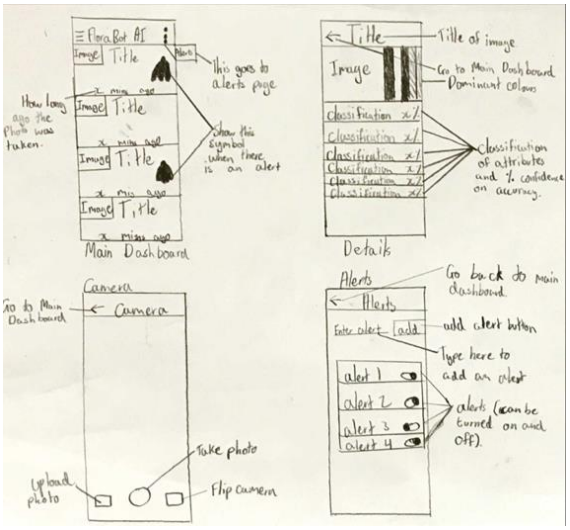

Figure 1. The four main UI in the app.

ROBOT DESIGN

The FloraBot AI robot aimed to provide a platform for automatic photo taking in the form of a self-driving robot. This robot was built using Lego Mindstorms Ev4 as it was an affordable and easy way to make effective robots. Our original design of the robot was a stationary stand that rotates and takes photos (please refer to Figure 2). However, we thought that it would be more effective to have a self-navigating robot that moves around like a car. Therefore, we redesigned it (please refer to Figure 3).

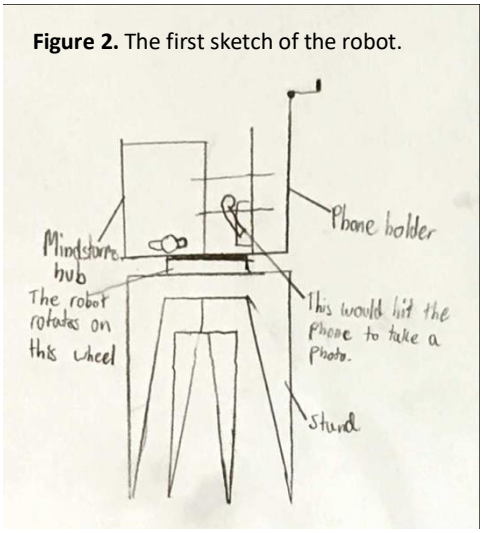

Figure 2. The first sketch of the robot.

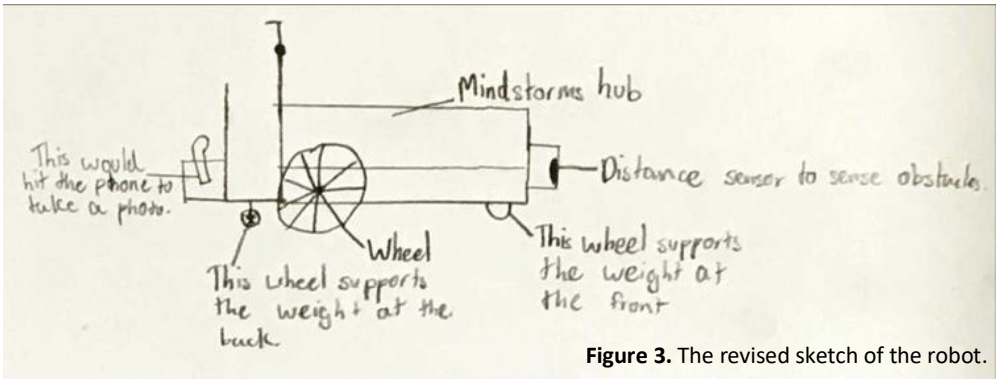

Figure 3. The revised sketch of the robot.

DISCUSSION

This invention solves the problem of farmers having to spend hours on the farm checking their crops for diseases and pests and look out for animal intruders on the farm. The invention does this by a robot automatically navigating the farm and taking photos. The farmer can then see the photos and look for alerts, saving time and effort for the farmer, and making the agricultural industry more efficient.

The scientific principle evident in this invention is Artificial Neural Networks. Neural Networks are composed of several layers. They have an input layer, several hidden layers, and an output layer. In this invention, the input layer takes the photo being sent to the Google Vision API. The Google Vision Neural Network then sends the image to the hidden layers, which matches the image to many different pre-defined datasets. When there is a match found, the hidden layer sends a classification along with the percentage of confidence in the match to the output layer, which then displays that on the app.

However, this invention is limited because the robot does not have a retrieval system, meaning that it cannot return to the place that it started. This means that the farmer would have to search for the robot. A way to improve this is by making a system that can track how long the robot has been moving and which gyro angle it was moving. Using this information, the robot could move back to its original position.

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