AI Solutions for Smart Date Agriculture

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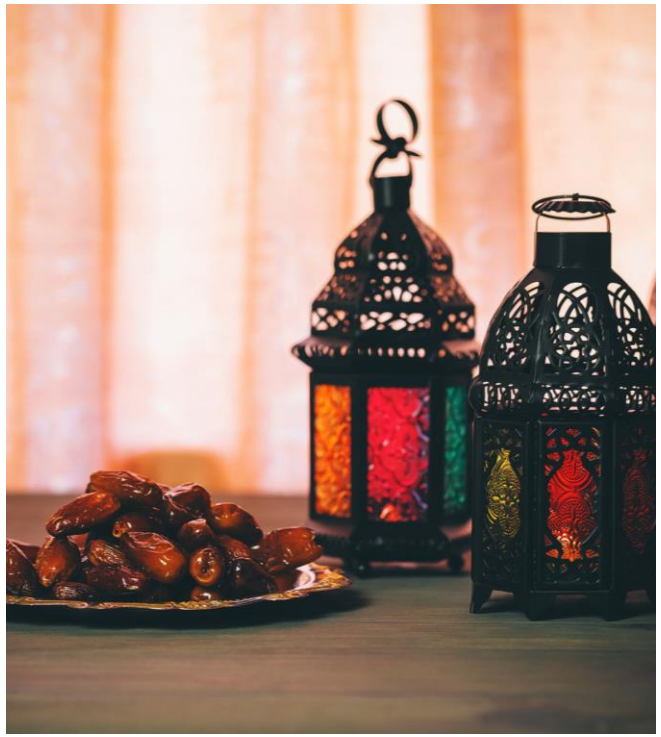
Economic Impact of Date Fruits in Saudi Arabia"

Date fruits are the major fruit in the Middle East and North Africa. Various dates exhibit diverse types, colors, sizes, flavors, and nutritional values. Data from the Ministry of Agriculture in Saudi Arabia indicates that the yearly date production in the country is approximately one million tons, derived from an estimated 2,425 million palm trees. This signifies that 15 percent of worldwide production originates from South Africa .

Source:

https://www.mdpi.com/2079-9292/12/3/665

Economic Impact of Date Fruits in Saudi Arabia"

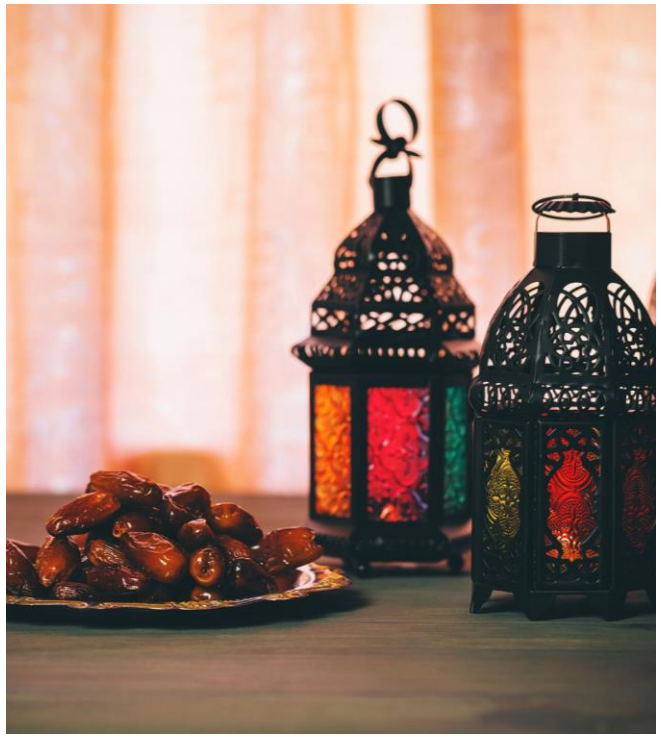


date fruit plays a significant role in the economy of Saudi Arabia. The Kingdom is one of the leading countries in both production and consumption of palm dates. Saudi Arabia is home to an estimated 30 million date palm trees spread over more than 100,000 hectares. There was a dramatic increase in production of approximately 86% between 2000-2010, highlighting the growing importance of the date industry. Date fruits are not only economically significant but also hold cultural importance in Saudi Arabia, with major date festivals being held in regions like Qassim.

Source :

https://openknowledge.fao.org/server/api/core/bitstreams/0c372c04-8b29-4093-bba6-8674b1d237c7/content

Economic Impact of Date Fruits in Saudi Arabia"



However, like other agricultural products, date palm trees are susceptible to diseases which can negatively impact production. While the paper doesn't provide specific figures on how much palm diseases cost Saudi Arabia, it emphasizes that early detection and intervention of date fruit diseases are vital for saving produce and preventing spread among palm trees. The economic impact of diseases is implied to be potentially substantial, as the paper discusses the need for frequent checks and the challenges of manually inspecting vast date farming lands, which would increase labor costs and ultimately the price of date fruits for consumers if done without technological assistance.

Challenges in Palm Farming

Need for Predictive Solutions

The urgency for predictive analytics arises from the need to forecast potential disease outbreaks accurately. These insights allow farmers to implement preventive measures, reducing economic impact and enhancing sustainable farming practices. Adopting predictive models is crucial for combating the challenges faced in palm farming.

Challenges in Palm Farming

Disease Threats

Palm trees, particularly date palms, face severe threats from diseases that hinder agricultural productivity. Various pathogens can lead to significant yield losses, impacting the economy and food security. Without timely interventions, these diseases can spread rapidly, making management challenging for farmers.

date palm diseases

- Leaf Spot Diseases تبقعات الأوراق

- Black scorch لفحة سوداء

date palm diseases

- Dubas bug حشرة الدوباس

- The red plam weevil سوسة النخيل الحمراء

date palm diseases

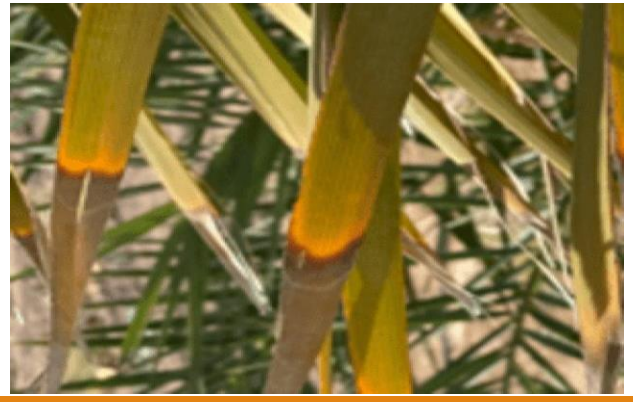
- مرض الذبول الفيوزارميDisease Wilt Fusarium

- Rachis Blight لفحة السعفة

date palm diseases

- White scale = Parlatoria Blanchardi حشرة النخيل القشرية

- Potassium Deficiency نقص البوتاسيوم



date palm diseases

- Manganese Deficiency نقص المنجنيز

- Magnesium Deficiency نقص المغنيسيوم

Date palm disease AI Solution

- استخدام الطائرات وربطها مع نظام مراقبه محلي لا يحتاج لشبكة الانترنت
- النظام يكشف النخيل المصاب ب 9 امراض مختلفة في الوقت الفعلي ويحدد مواقع النخيل لرشه بالمبيدات الزراعية باستخدام الطائرات
- يعرض النظام على شاشة التحكم احصائيات عن النخيل المصاب و اماكنه واستهلاك الماء والمبيدات والاسمدة وذلك باستخدام حساسات مرتبطه بالنظام تم استلهام الفكرة من هنا

الفكرة تم تنفيذها بالهند وامريكا ولكن غير منفذه بالمملكة

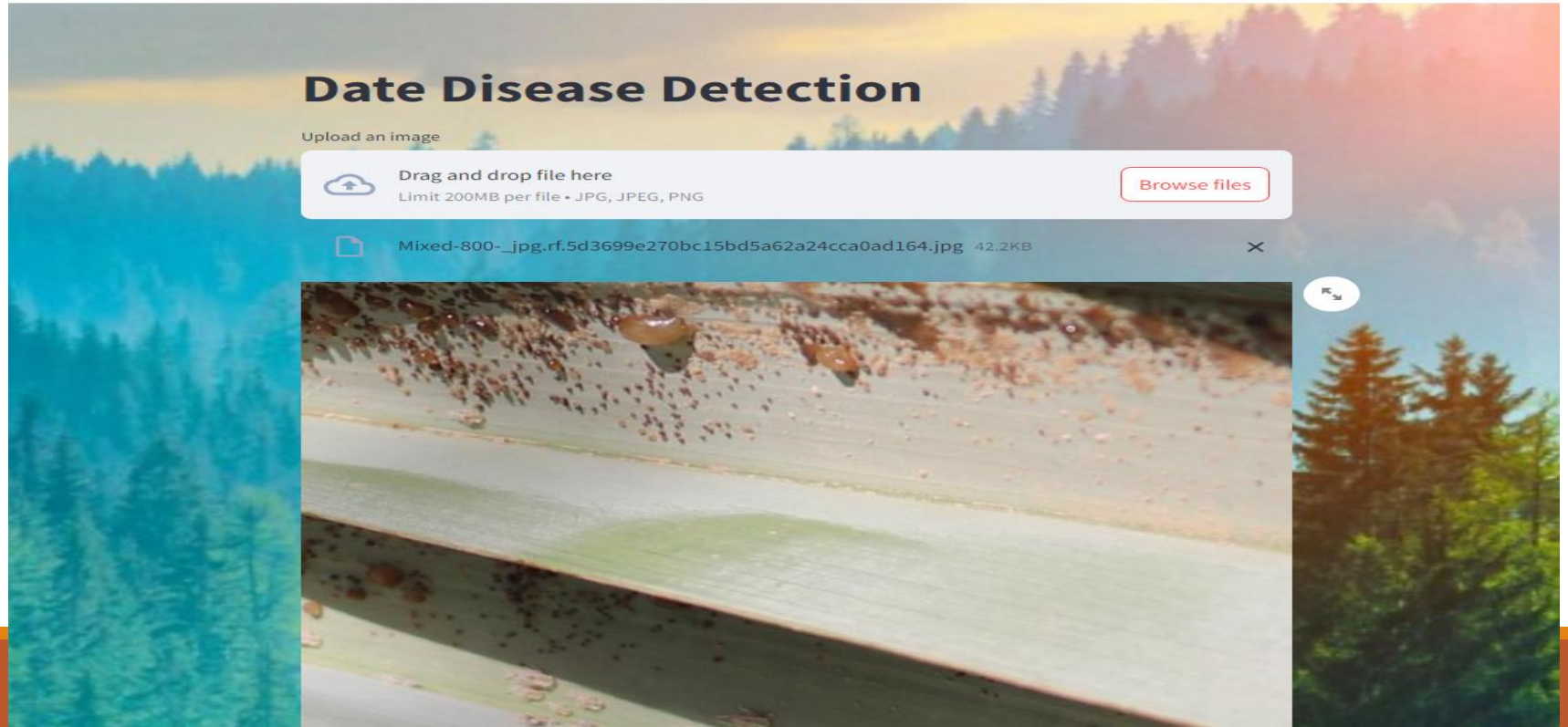
الحلول التقنية المقدمة للهاكثون من تنفيذ فريقنا فقط

- استخدام جهاز الموجات الصوتيه للكشف المبكر عن سوسة النخيل الحمراء
- متوفر الجهاز من عدة شركات ويمكن استيراده
- مصدر الفكرة هنا

Date palm disease AI Solution

مراحل النظام

1- انشاء نظام ذكاء اصطناعي للتعرف على الامراض من خلال الصور تمت بالفعل



Date palm disease AI Solution

مراحل النظام

2 –استخدام الطائرات الدرونز للتصوير وربطها مع نظام مراقبه متكامل ستتم في حالة الحصول على تمويل

3- شراء أجهزة الكشف المبكر عن سوسة النخيل الحمراء ستتم في حالة الحصول على تمويل

Datasets

First dataset

https://data.mendeley.com/datasets/g684ghfxvg/1

Second dataset

https://www.kaggle.com/datasets/hadjerhamaidi/date-palm-data/data

Third dataset

https://data.mendeley.com/datasets/2nh364p2bc/2

Description of the first Dataset

a description of the Dataset of infected date palm leaves for palm tree disease detection based on the information provided in the paper:

This dataset contains images of infected date palm leaves to aid in the early detection and classification of date palm diseases. Key features of the dataset include:

Coverage: The dataset covers 8 main types of disorders affecting date palm leaves:

- 3 physiological disorders (potassium deficiency, manganese deficiency, magnesium deficiency)
- 4 fungal diseases (black scorch, leaf spots, fusarium wilt, rachis blight)
- 1 pest-caused disorder (parlatoria blanchardi)
- Additionally includes a baseline of healthy palm leaves

Size:

- 608 raw images
- 3089 processed/augmented images
- Total of 3697 images

Description of the first Dataset

1. Image Collection:
    1. Captured over 3 months during autumn and spring seasons
    2. From 10 real date farms in the Madinah region of Saudi Arabia
    3. Using smartphones and an SLR camera
    4. Focused mainly on infected leaves and leaflets
2. Image Processing:
    1. Raw images were filtered and cropped to focus on specific leaf pathologies
    2. Processed images were resized to 300x300 pixels
    3. Data augmentation techniques like rotation and flipping were applied

Description of the firstDataset

1. Potential Uses:
    1. Training deep learning models for classification of infected date palm leaves
    2. Early detection and prevention of palm tree diseases
    3. Comparison with other palm tree datasets for identifying infection patterns
    4. Development of automated palm leaf disease detection systems

This dataset aims to address the scarcity of public data on infected palm leaves and support research in agriculture, plant pathology, and machine learning applications for smart date farming.

Description of the second Dataset

Contains 3 categories

1. Healthy
2. White scale
3. Browne spots

Total 2,631 Images

Description of the third Dataset

Contains 3 categories

1. Honey
2. Dubas
3. bug
4. Healthy

We combine 1 ,2, and 3 in one folder because these are all folders for one bug named DUBAS

Total 3,000 Images

Used dataset

We combine the previous 3 datasets then we apply data augmentation using roboflow website

https://roboflow.com/

Dataset description:

The dataset includes **22,001** images.

Date are annotated in folder format.The following pre-processing was applied to each image:

* Auto-orientation of pixel data (with EXIF-orientation stripping)

* Resize to 640x640 (Stretch)The following augmentation was applied to create 3 versions of each source image:

* 50% probability of horizontal flip

* 50% probability of vertical flip

* Equal probability of one of the following 90-degree rotations: none, clockwise, counter-clockwise

* Random rotation of between -15 and +15 degrees

* Random brigthness adjustment of between -15 and +15 percent

* Random exposure adjustment of between -10 and +10 percent

Disease Prediction Models

We split the dataset to

92% training

4% validation

4% testing

There are 2 models used

1- Not open source model using roboflow API()

https://docs.roboflow.com/api-reference/introduction

2-Open source model (YOLO V8)

https://docs.ultralytics.com/models/yolov8/

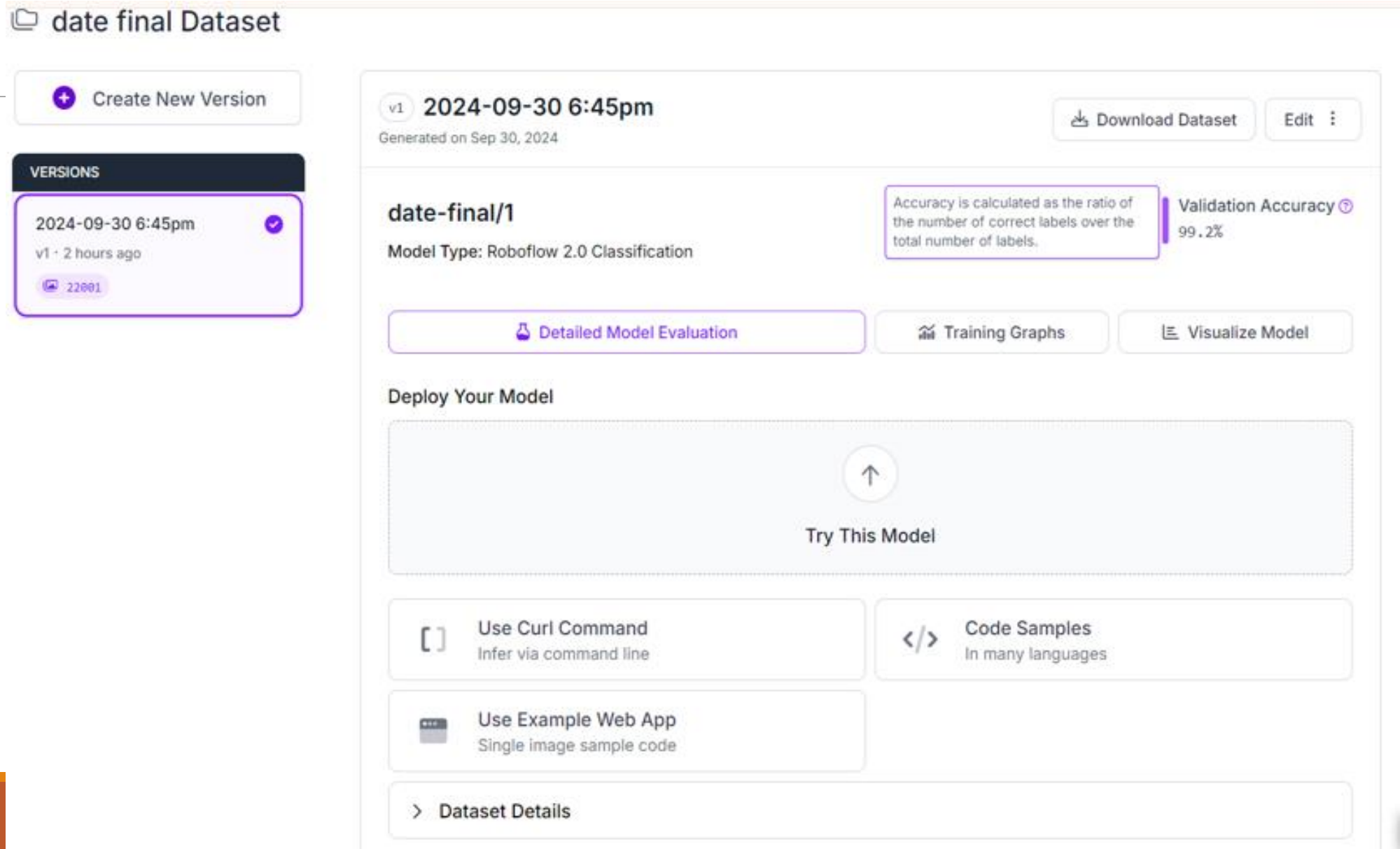
Disease Prediction Models

Model 1:

Roboflow :

Validation Accuracy

99.2%



Disease Prediction Models

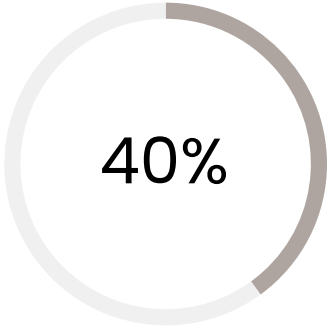
Model 2:

YOLO

Yolo top1 accuracy **%97.86**

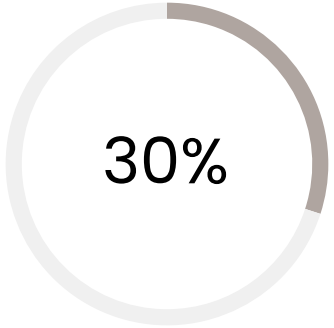
Top 5 accuracy %**99.8**

Benefits of Predictive Analytics



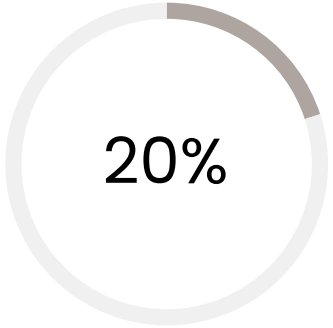
Early Disease Detection

Predictive analytics facilitates early disease detection, allowing farmers to take preventive actions. Swift intervention can substantially reduce crop losses and maintain palm tree health.



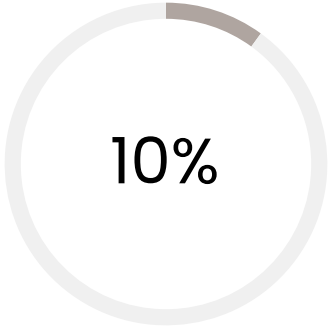
Optimized Resource Use

By predicting disease outbreaks, farmers can optimize their use of pesticides and water, leading to more sustainable farming practices and cost savings.



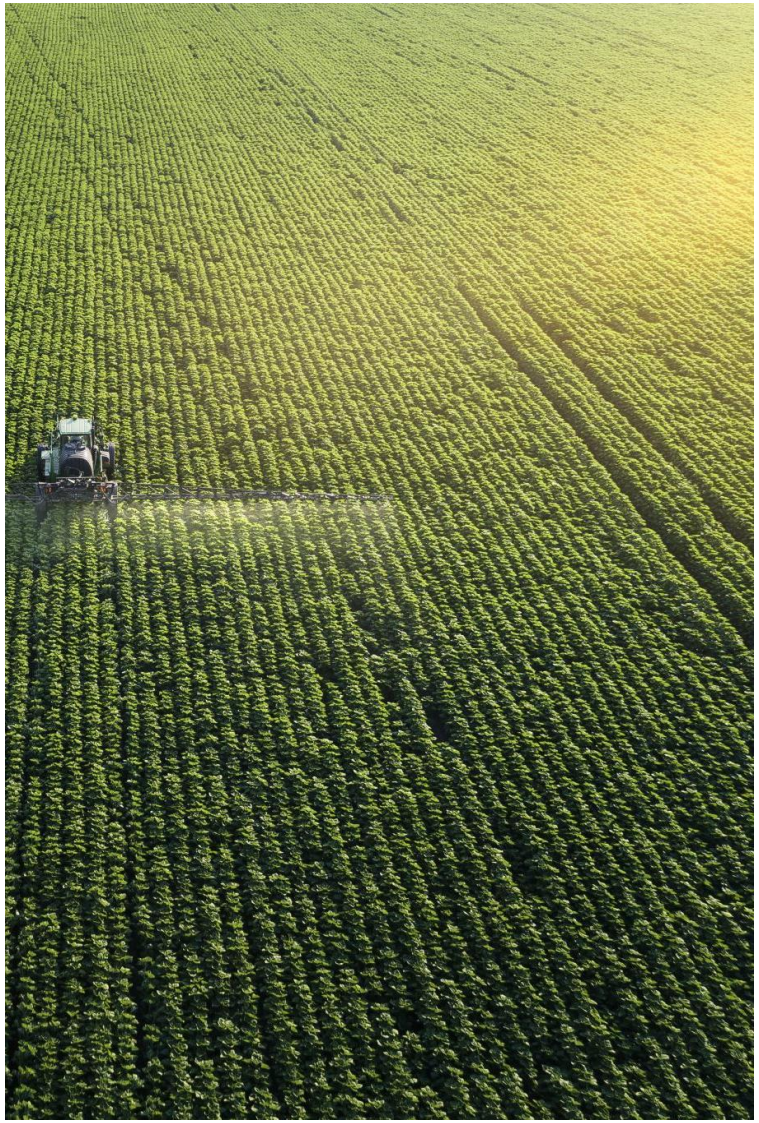
Increased Crop Yields

Healthier crops result in enhanced yields, driving greater profitability for farmers. Predictive analytics enables more informed decision-making to maximize production.



Sustainable Practices

Implementing data-driven approaches promotes sustainable agricultural practices. This contributes to environmental conservation and long-term soil health.



Integration of AI and IoT

Our contribution is predictive analytics in agriculture lies in the integration of AI and IoT technologies. This combination enables real-time monitoring of palm trees and surrounding environments. Using smart sensors, farmers can gather precise data on tree conditions, weather, and soil health, enhancing decision-making capabilities. Such advancements promise to revolutionize palm tree management by providing actionable insights and improving overall productivity.

Source:

https://www.mdpi.com/2079-9292/12/3/665