AgriGuard Project

Problem We trying to Solve:

Farmers are using too much fertilizer and pesticides, and it's not helping. It's making the soil worse, lowering crop yields, and it's bad for people's health. The solution? Use exactly what's needed, no more. This way, we improve the soil, grow more food, and need fewer farmers to get it done. Simple, right? Work smarter, not harder.

Project Goals:

1. Improving agriculture and achieving sustainability.
2. Reclaiming agricultural land.
3. Increasing soil fertility.
4. Enhancing production and saving foreign currency.

Used Models:

Name	Type
Identifying the suitable crop for the land.	Classification Model
Determining the required nutrients to make the soil fertile.	Regression Model
Plants Diseases Detection using CNN.	Classification Model
Specifying the appropriate amount of pesticides.	Reinforcement Model
Using Media pipe's Object detection model for identifying obstacles and facilitating navigation.	Object Detection Model

Links to Found Models and Data Sets:

Brief Description Notebook	Link
Fertilizer Prediction using Decision Tree	https://www.kaggle.com/code/karthikreddy77/fertilizer-prediction/notebook
End-to-End Crop Recommendation	https://www.kaggle.com/code/sushilyeotiwad/crop-recommendation-end-to-end-lr-accurecy-97-58/input?select=Crop_Recommendation.csv
Plant-Diseases-Detection-using-CNN	https://github.com/mohamedhaitham22/Plant-Diseases-Detection-using-CNN
Crop Recommendation	https://www.kaggle.com/code/atharvaingle/what-crop-to-grow/input

Egypt Vision 2030 Goals

الهدف الثالث :اقتصاد قوى

مصر عايزة تبني اقتصاد متنوع وقوي، وتعتمد على المعرفة والتكنولوجيا .كمان عايزة تزود فرص الشغل، تحسن بيئة الأعمال، وتدعم ريادة الأعمال .الشمول المالي برضه جزء من الخطة مع الاهتمام بالجوانب البيئية والاجتماعية.

الهدف الرابع :معرفة وابتكار

مصر شايفة إن المعرفة والابتكار هما الأساس للتنمية .عشان كده بتركز على تطوير الناس، تشجيع الإبداع، ودعم البحث العلمي وربطه بالتعليم والتنمية.

الهدف الخامس :استدامة بيئية

مصر بتحاول تحافظ على البيئة مع التنمية، من خلال الاستخدام الذكي للموارد، ومواجهة التغيرات المناخية .كمان بتركز على الطاقة المتجددة وأنماط الإنتاج والاستهلاك المستدامة عشان الأجيال الجاية تعيش في بيئة آمنة.

Targeted Soil Types

1. Sandy Soil

2. Clay Soil

Crops Targeted by the Image Classification

1. Blueberry - التوت الأزرق
2. Apple – التفاح
3. Corn (maize) – الذرة
4. Cherry (including sour) – الكرز بما في ذلك الحامض
5. Orange – البرتقال
6. Grape – العنب
7. Pepper (bell) – الفلفل الحلو
8. Peach - الخوخ
9. Raspberry - التوت الأحمر
10. Potato - البطاطس
11. Squash – القرع
12. Soybean - فول الصويا
13. Tomato - الطماطم
14. Strawberry - الفراولة

Crops Targeted by the Fertilizer Prediction Model

1. Sugarcane - قصب السكر
2. Maize – الذرة
3. Tobacco – التبغ
4. Cotton – القطن
5. Barley – الشعير
6. Paddy (Rice) – الأرز
7. Millets – الدخن
8. Wheat – القمح
9. Pulses – البقوليات
10. Oil seeds - بذور الزيت
11. Ground Nuts - الفول السوداني

Crops Targeted by the Crop Recommendation Model

1. Rice
2. Maize

Measured Parameters from Soil

1. Nitrogen
2. Phosphorous
3. Potassium
4. Ph
5. Soil Temperature
6. Humidity
7. Salinity

Primary and Secondary Processing Units

1. **Primary Processing Unit:** This going to be controlling the robotic arms in robots responsible for spraying pesticides and fertilizers.

    a. Jetson Nano 4G Development Kit (Not final decision yet)

2. **Secondary Processing Unit:** Responsible for handling all sensors data and controls the one-axis arm of which all sensors are mounted on it.

    a. ESP32 Board.

Why ESP32 not ESP8266 ,atmega32 or mega?

Features	ESP32	ESP8266	Atmeg32	ATmega2560 (Arduino Mega)
Number of GPIO Pins	34	17	32	54
Communication Protocols	4xSPI, 2xI2C, 2xI2S, 3xUART, CAN, Ethernet	1xI2C, SPI, 2xUART	1xSPI, 1xTWI, UART	SPI, I2C, 4xUART
Speed (MHz)	240Mhz	160Mhz	16 Mhz	16 Mhz
Does it offers Wifi/Bluetooth	Offers both wifi and Bluetooth 4.2	Only offers wifi	NO	No
Operating Voltage	2.5-3.6v	2.2-3.6v	5v	5v
ADC Resolution	12-bit SAR ADC up to 18 Channels	10-bit ADC on 1 channel	10 bit	10-bit
Flash Memory	4 Mb	Usually 512Kb to 1Mb	32 Kb	256 Kb
SRAM	520 kb	64 kb	2 Kb	8 Kb
Power Consumption	Active: ~160 mA, Sleep: ~6-10 µA	Active: 70-80mA	1.5-15 mA (Highly depended on operating clock (1Mhz – 16Mhz))	~20 mA

List of all used sensors and modules in robot

Sensor Name	Measured Qualities
485 Soil Comprehensive Sensor	Nitrogen, Phosphorous, Potassium, Ph, Soil Temperature, Soil Conductivity.
Soil Humidity Moisture Sensor	Soil Moisture (Humidity)
Water and Soil EC-Moiture-Salinity Temperature Sensor	Conductivity for both soil and water, Moisture for both water and soil, salinity, Temperature for both soil and water.
NEO7M GPS Module	Exact Location
VL53L1X Time of Flight Sensor (4m Precision Distance Measurements)	Distance

Overview of Software Architecture

1. The autonomous movement and control of the spraying robotic arms, along with the handling of ML models, will be managed by middleware deployed in the Primary Processing Unit using ROS2 Foxy FitzRoy, the latest version of ROS2.

2. Initially, the Arduino framework will be used on the Secondary Processing Unit for easier deployment and repetitive testing. In the final stage, the Arduino framework will be replaced, and the entire program will be rewritten using ESP-IDF to maximize the board's performance. ESP-IDF will be utilized only if the Secondary Processing Unit remains with Espressif Systems.

3. Flutter will be used to build a user-friendly interface, allowing users to view real-time sensor readings and easily set up the robot's internet connection, if available. Note: The robot does not rely on the internet to operate, but it needs an internet connection for users to receive updates. The robot will upload cached readings once it reconnects to the internet.

4. “Firewire – Platform” will serve as an easily deployable platform for the main company to release regular updates to all robots. It will also facilitate monitoring the Primary Processing Unit by providing SSH access (when active) and visualizing active pins. This system will be built using the Flask framework.