Easy Agro: An Agricultural Consultant Software for Bangladeshi Farmers

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***Abstract*—Bangladesh and the other nations on the Indian subcontinent heavily depend on agriculture. It serves as Bangladesh's economic system's backbone. Bangladeshi citizens have relied on agriculture for their livelihood and productivity since the independence of Bangladesh. It serves as the nation's primary source of national dividend. With more than half of its people living in rural regions and working in agriculture, Bangladesh has a mostly agrarian economy. Agriculture plays a crucial role in Bangladesh's economy, and the sector's continued growth and sustainability are essential for ensuring food security, reducing poverty, and promoting sustainable development in the country. Bangladeshi farmers are still cultivating in typical way. Farmers struggle with issues related to fertility measurement, timely fertilization, disease prevention and treatment, planting process etc. Most of them don't know standard fertilizer measurement. They roughly measure the fertilizer. That's why a lot of fertilizer chemicals are wasted. They don't know standard planting process also. Our research suggests a software called 'Easy Agro' which is designed as an agricultural consultant for Bangladeshi farmers. The software provides features such as fertility measurement, time management of fertilization, medicine suggestion, planting process, disease prediction, and treatment of crop disease. The software is intended to assist Bangladeshi farmers in managing their crops more efficiently and effectively, which in turn can improve their yields and livelihoods.**

***Index Terms*—Easy Agro, Agricultural consultant, Sustainable development, Cultivating, Fertility measurement, Timely fertilization, Disease prevention, Disease treatment, Planting process, Fertilizer wastage**

I. Introduction

Agriculture is the backbone of the Bangladeshi economy, employing over 50 percent of the workforce and contributing to over 15 percent of the country's GDP. However, Bangladeshi farmers face numerous challenges such as land scarcity, lack of access to modern farming techniques, and unpredictable weather patterns. These challenges often result in low yields, which can have a significant impact on the livelihoods of farmers.

To address these challenges, there is a need for technology that can assist farmers in managing their crops more efficiently and effectively. 'Easy Agro' is a software that aims to do just that. The software provides farmers with access to features such as fertility measurement, time management of fertilization, medicine suggestion, planting process, disease prediction, and treatment of crop disease. These features can help farmers to better understand the needs of their crops, manage their time and resources more effectively, and take timely action to prevent or treat crop diseases.

The software is specifically designed for Bangladeshi farmers, taking into account the specific needs and challenges faced by farmers in the country. For example, the software provides information on crops that are commonly grown in Bangladesh, along with specific advice on how to manage these crops. The software is also designed to be user-friendly, with a simple and intuitive interface that can be easily understood by farmers with varying levels of technical expertise.

This software has the potential to make a significant impact on the agricultural sector in Bangladesh. By improving productivity, promoting sustainability, simplifying processes, and promoting digital literacy, 'Easy Agro' can contribute to the growth and development of the agricultural sector in Bangladesh, while also improving the lives and livelihoods of farmers in the country.

The objectives of 'Easy Agro' are to provide farmers in Bangladesh with the tools, information, and guidance they need to improve their farming practices and achieve better outcomes. By helping farmers increase crop yield, reduce crop loss, simplify farming processes, provide access to expert advice, promote sustainability, and improve their livelihoods, this software can make a significant impact on the agricultural sector in Bangladesh.

The primary problem that the ‘Easy Agro’ software aims to solve is the lack of access to modern agricultural practices and technologies among Bangladeshi farmers. This lack of knowledge and resources leads to low crop yields, reduced profitability, and food insecurity. The ‘Easy Agro’ software will provide farmers with the tools and information they need to make decisions, leading to higher crop yields, increased profitability, and better food security for Bangladesh.

The ”Easy Agro” software stands out from other agricultural software solutions because of its focus on providing personalized recommendations for Bangladeshi farmers. the software’s user-friendly interface and accessible language make it easy for farmers with limited technical knowledge to use the software effectively. The software provides step-by-step guidance on how to measure crop fertility, manage fertilization schedules, and apply appropriate medicines, making it a valuable tool for farmers who may not have access to traditional agricultural education or training.

The Easy Agro software also includes a disease prediction feature, which uses historical data and machine learning algorithms to forecast disease outbreaks for specific crop types in a particular location. This proactive approach to disease management enables farmers to take preventative measures to protect their crops, reducing economic losses and increasing food security.

Overall, the software’s unique combination of personalized recommendations, user-friendly interface, and proactive disease management makes it an invaluable tool for Bangladeshi farmers looking to improve crop yields and profitability.

By utilizing Easy Agro, Bangladeshi farmers will be able to reduce their dependence on expensive agricultural consultants and improve their crop management practices. The software’s accurate and timely recommendations will enable farmers to make informed decisions about their crop management, resulting in better yields, reduced crop loss, and increased profitability.

This agro consultant software aims to enhance crop productivity and provide valuable assistance to farmers in various aspects of agriculture. In comparison to the decision support system (DSS) proposed by [1], the software offers personalized recommendations for crop selection, irrigation, and nutrient management, leveraging machine learning algorithms. The mobile application discussed in [2] demonstrates the software’s ability to accurately identify plant diseases and suggest suitable fertilizers based on image processing techniques. Similarly, the cloud-based autonomic system presented in [3] inspires the scalability and performance of the software, providing timely information, analytics, and decision support. The software also aligns with the principles of agricultural information systems (AIS) outlined in [4], offering potential applications to improve agricultural productivity. Moreover, the software’s design and implementation resonate with the case study of an Agricultural Management Information System (AMIS) in [5], emphasizing user feedback and long-term impacts. The analysis by Lacombe et al. [6] on co-design and stakeholder involvement in agroecological farming systems inspires the software’s approach in engaging farmers and other stakeholders. Additionally, the integration of machine learning techniques, as explored in [7] and [8], enables disease detection, crop yield prediction, and improved decision-making within the software. These studies provide valuable insights and can serve as a reference to further evaluate and enhance the agro consultant software’s capabilities.

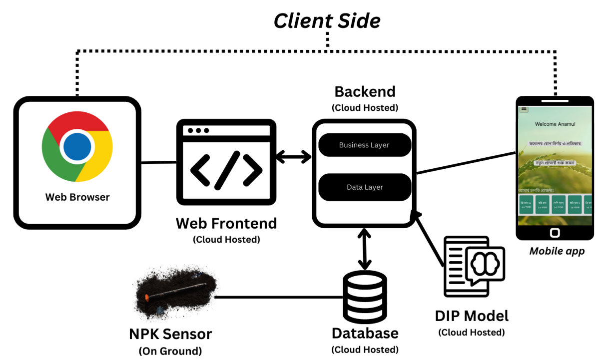

Fig. 1. Overview of Easy Agro

A. Methodology

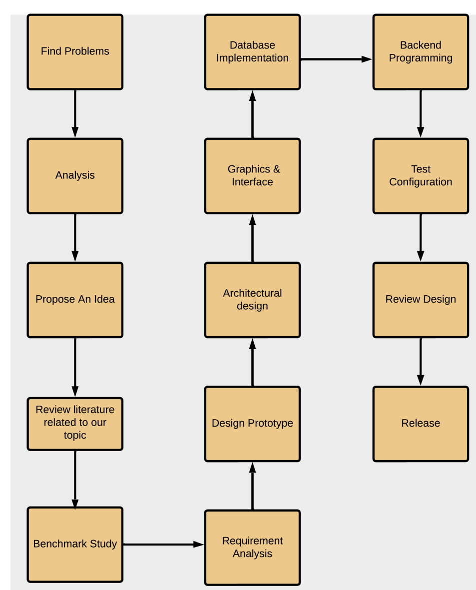

Fig. 2. Methodology

B. *Organization of the report*

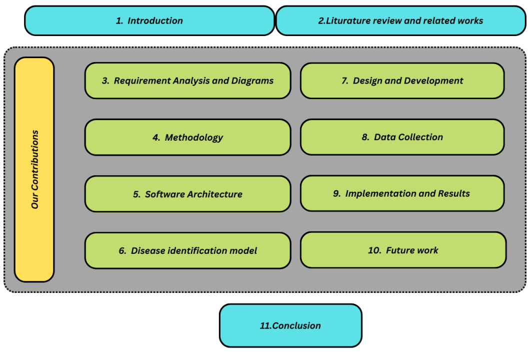

Fig. 3. Organization Of The Paper

II. Literature Review And Related Works

The paper proposes a decision support system (DSS)[1] to assist smallholder farmers in semi-arid agriculture in enhancing crop productivity. The DSS provides personalized recommendations for crop selection, irrigation, and nutrient management based on data from various sources analyzed by machine learning algorithms. The paper presents a case study demonstrating the use of the DSS in practice, which showed positive results. However, the paper does not provide any evaluation of the effectiveness of the DSS beyond the presented case study. The authors conclude that the DSS has the potential to enhance crop productivity and improve the livelihoods of smallholder farmers in semi-arid regions, but further research is needed to assess its impact on a larger scale and in different contexts.

The paper[2] presents a mobile application that uses image processing techniques to identify plant diseases and suggest suitable fertilizers based on the plant's nutrient requirement. The system achieved an accuracy rate of 93 percent in identifying diseases in six different crops and was found to be helpful by farmers. However, the paper lacks a detailed description of the image processing techniques and algorithm used for fertilizer suggestion and could benefit from a more thorough discussion of limitations and future work.

The paper[3] describes the design and implementation of Agri-Info, a cloud-based autonomic system for delivering agriculture as a service. The system aims to provide farmers with timely and relevant information about weather patterns, crop management, and market prices, as well as analytics and decision support to improve farming practices and increase agricultural productivity. The paper provides a detailed description of the architecture and key features of Agri-Info, but lacks evaluation or case studies to demonstrate the effectiveness of the system in real-world scenarios.

The paper[4] is a review of various agricultural information systems (AIS) and their potential applications for improving agricultural productivity and promoting rural development. The authors discuss the benefits and challenges of AIS but do not provide a critical evaluation or empirical evidence to support their claims. The paper provides a useful introduction to AIS, but further research is needed to evaluate their effectiveness and best practices for implementation.

The paper[5] presents a case study of the development of an Agricultural Management Information System (AMIS) in Portugal, which was designed to improve crop management and productivity. The authors describe the design and implementation of the AMIS, using open-source solutions, and present an evaluation of the system based on a survey of farmers who used the system. The paper provides useful insights into the development of agricultural management information systems using open-source solutions, although it could benefit from a more detailed evaluation of the long-term impacts of the AMIS and its scalability to other contexts.

The paper[6] analyses the place given to farmers and other stakeholders involved in farming system management in the design of agroecological farming systems. First build an analytical framework based on the literature on design theories concerning co-design. The aim of the framework is to highlight the dimensions of a co-design process that needs to be analysed to qualify the link between transformative goals of co-design and its real effects on the co-designers' work situations. They use this framework to analyse 39 participatory research projects on the design of agroecological farming systems. We characterise different approaches based on how the farmers and other stakeholders are involved in the design process and what effect their involvement has on their own situation of change and learning. Finally, They identify the conditions for a design approach likely to best support agroecological farming system development, and transformation of the place given to farmers in their design.

The paper[7] proposed different machine learning techniques, such as Random Forest, Decision tree, Multi-layer Regressor, Regression algorithms, image processing techniques, Extreme Machine Learning to get better accuracy for system. Here, crop leaf images are taken as input and after processing that image, it will detect whether there is any disease or not. If disease is detected, then it will tell what type of disease it is and will provide solutions such as pesticides or chemicals to cure that disease. It will increase the productivity and economic process. To produce food more sustainably farmers are using new technologies such as temperature and moisture sensors, drones, smart irrigation, self-driving and GPS enabled tractors.

This paper[8] proposed devices that can create a whole computing system from sensors to tools that observe data from agricultural field images and from human actors on the ground and accurately feed the data into the repositories along with the location as GPS coordinates. This idea proposes a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology. It proposes a low cost and efficient wireless sensor network technique to acquire the soil moisture and temperature from various location of farm and as per the need of crop controller to take the decision whether the irrigation is enabled or not.

The paper[9] provides a systematic literature review of the use of machine learning techniques for crop yield prediction. The authors analyzed 68 relevant papers published between 2010 and 2020 and identified several factors that affect the accuracy of crop yield prediction. The authors found that machine learning techniques have been applied to various crops and achieved high accuracy rates in predicting crop yields. However, the reviewed studies have limitations, such as the lack of consideration of weather and environmental factors, limited data availability, and the need for more comprehensive and long-term datasets. The paper provides insights into the application of machine learning techniques in crop yield prediction and identifies gaps in the current research that need to be addressed to improve the accuracy of crop yield prediction models.

The paper[10] is a comprehensive review of the use of machine learning approaches for crop yield prediction, with a specific emphasis on palm oil yield prediction. The authors analyzed 47 studies and found that machine learning techniques have shown promising results in predicting palm oil yield, with accuracy rates ranging from 70 percent to 98 percent. They suggested integrating multiple data sources to improve accuracy and identified the need for more research on the impact of climate change on palm oil yield prediction. The paper could benefit from a more detailed discussion of the limitations of the reviewed studies and suggestions for future research directions. Overall, the paper provides insights into the application of machine learning techniques in crop yield prediction and identifies gaps in the current research.

A. Comparison with other paper

Comparison of this paper with existing 10 papers related to agriculture, smart farming, disease prediction etc.

Study	fertility measurement for different types of crops	Time management for fertilization	medicine suggestion for different types of crops	Planting process by crops type	Disease prediction of crops (One crops for now)	Treatment of diseases
[1]	Yes	Yes	No	Yes	No	No
[3]	Yes	Yes	No	Yes	No	No
[4]	Yes	No	No	Yes	No	No
[5]	Yes	Yes	No	Yes	No	No
[2]	No	No	Yes	No	Yes	Yes
[9]	No	No	No	Yes	Yes	No
[10]	Yes	No	No	Yes	No	No
[8]	Yes	Yes	No	Yes	No	No
[7]	Yes	No	Yes	No	Yes	Yes
[6]	Yes	Yes	No	Yes	No	No
Easy Agro	Yes	Yes	Yes	Yes	Yes	Yes

III. Requirement Analysis and Diagrams

A. Requirement Analysis

1) Functional Requirements:

- Fertility Measurement: The software should have the ability to measure the fertility levels of different crop types accurately like rice, wheat, maize, onion etc.
- Fertilization Time Management: The software should provide schedule of fertilization and notify farmer. ‘
- Pesticide Suggestion: The software should recommend the appropriate pesticide to use for different types of crop
- Planting Process: The software should provide detailed guidance on the planting process of different crop types, including seeding depth, seed spacing, and soil preparation. It should help farmers optimize the planting process and improve crop yields.
- Disease Prediction: The software should be able to predict the likelihood of crop diseases and pest outbreaks accurately.
- Treatment of Crop Diseases: The software should provide guidance on how to treat crop diseases effectively. It should include details on dosage, application method, and timing of treatments.

2) Non-Functional Requirements:

- Usability: The software should have an easy-to-use interface that is intuitive and user-friendly, with clear instructions and feedback for users.
- Reliability: The software should be reliable and accurate, providing consistent results and recommendations to users.
- Performance: The software should be fast and efficient, able to process large amounts of data quickly, and provide results in real-time.
- Compatibility: The software should be compatible with different types of devices and operating systems, making it accessible to a broader range of users.
- Scalability: The software should be scalable, able to handle larger datasets and support the needs of more significant farms or agricultural organizations.

IV. Disease identification model

Our project’s objective was to create a model for diagnosing crop diseases using the Inception v1 convolutional neural network architecture. Initially we created a model for potato disease identification. The model successfully identified three different potato diseases, including healthy, early blight, and late blight, with an accuracy of 97 percent using the ”potato.csv” dataset, which contains picture features. Because our dataset was so small, we decided to use transfer learning with Inception v1, a 27-layer deep neural network. Farmers and agricultural professionals may benefit from the model’s capacity to correctly identify potato illnesses because it will enable early detection and crop damage avoidance. Overall, our disease identification algorithm yields encouraging findings and has the potential to help manage potato crops more effectively.

V. Design and Development

A. User Interface Design

The user interface (UI) design focused on creating a user-friendly and intuitive experience for farmers. A clean and responsive design was implemented, ensuring easy navigation and accessibility across different devices. The UI incorporated interactive elements, such as input forms for capturing user data and image upload functionality for disease identification.

Here are some UI designs:

Fig. 4. Home Page

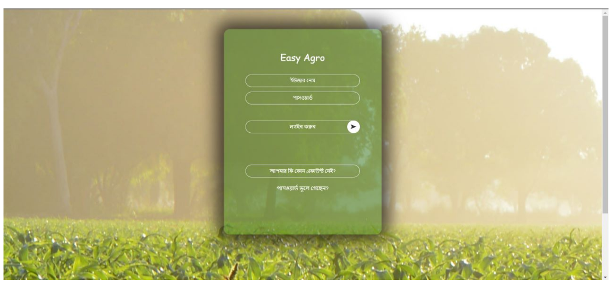

Fig. 5. Login

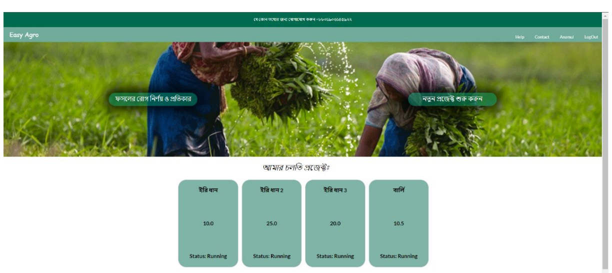

Fig. 6. Dash Board

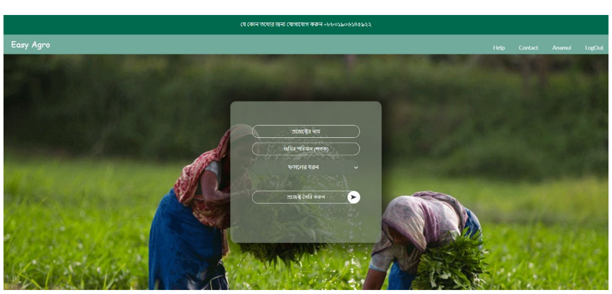

Fig. 7. Project Create Form

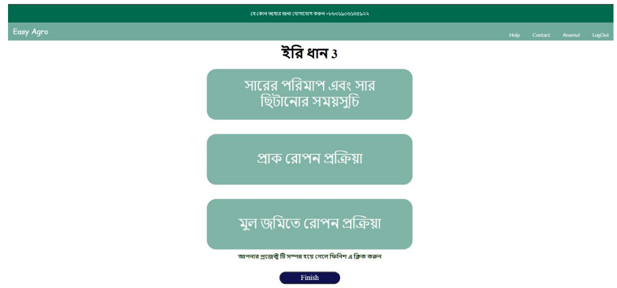

Fig. 8. Project Page

B. Development

The development of the Easy Agro software involved a systematic and iterative process to ensure its functionality and usability. Extensive requirement analysis was conducted by gathering feedback from farmers and stakeholders in the agricultural industry. This helped in identifying the key features, such as fertility measurement, fertilization management, pre and post-planting processes, disease identification, and treatment.

Easy Agro was designed as both a web application and a mobile app to cater to the needs of farmers on different devices. The web app was developed using the Django web framework, providing a user-friendly interface accessible through web browsers. The mobile app, on the other hand, was designed to run on smartphones and tablets, ensuring farmers' convenience in accessing the software on-the-go.

Both the web app and mobile app were connected to the same backend, ensuring seamless data synchronization between the two platforms. The backend, also developed using Django, facilitated efficient data storage and retrieval from the database, optimizing data management for users.

Python was employed for image processing tasks in both the web app and mobile app, enabling disease identification through user-provided images. This feature proved to be especially useful for farmers in identifying and treating crop diseases effectively.

Throughout the development process, an agile methodology was followed, allowing for continuous feedback and refinement. Regular testing and quality assurance procedures were implemented to ensure the software's reliability and robustness. User feedback from both the web app and mobile app was collected during the testing phase to further enhance the software's functionality and user experience.

VI. Data Collection

A. Dataset for Image processing model

For potato leafe disease identification model we collected dataset from a website named Kaggle. The name of dataset is potato.csv. It contains training, test, and validation data. Every part have 3 types of data which are healthy, earky blight, late blight.

B. Fertility needed for different crops(as mg/l or ppm)

We have researched about NPK measurement for defferent types of crops. At first we have goatherd knowledge that how much Nitrogen, phosphorus, potassium needed per hectare or acre(kg/ha and kg/acre) from Fertilizer Recommendation Guide (FRG) 2018 [11]

NPK sensor measure NPK value as mg/kg or mg/l. We have converted needed NPK kg/ha and kg/acre to kkg/l. Mathematical Equation to convert is given below:-

$1kg/ha = (1/depth)mg/l$ and
$1kg/acre = (1/depth)/2.471mg/l$
$(1hectare = 2.471acre)$

Crop Name	Nitrogen(N)	Phosphorus (P)	Potassium(K)
Rice	(123.5/depth) mg/L or ppm	(29.64/depth) mg/L or ppm	(29.64/depth) mg/L or ppm
Wheat	(80/depth) mg/L or ppm	(40/depth) mg/L or ppm	(40/depth) mg/L or ppm
Maize	(135/depth) mg/L or ppm	(65/depth) mg/L or ppm	(50/depth) mg/L or ppm
Onion	(98.8/depth) mg/L or ppm	(49.4/depth) mg/L or ppm	(98.8/depth) mg/L or ppm
Winter Onion	(150/depth) mg/L or ppm	(50/depth) mg/L or ppm	(80/depth) mg/L or ppm
Garlic	(98.8/depth) mg/L or ppm	(49.4/depth) mg/L or ppm	(98.8/depth) mg/L or ppm
Cardamom	(75/depth) mg/L or ppm	(75/depth) mg/L or ppm	(150/depth) mg/L or ppm
Mustard	(25/depth) mg/L or ppm	(60/depth) mg/L or ppm	(20/depth) mg/L or ppm
Cabbage	(90/depth) mg/L or ppm	(90/depth) mg/L or ppm	(90/depth) mg/L or ppm
Cauliflower	(250/depth) mg/L or ppm	(150/depth) mg/L or ppm	(200/depth) mg/L or ppm
Potato	(120/depth) mg/L or ppm	(115/depth) mg/L or ppm	(120/depth) mg/L or ppm
Tomato	(200/depth) mg/L or ppm	(150/depth) mg/L or ppm	(200/depth) mg/L or ppm

VII. Implementation and Evaluation

A. Implementation

The Easy Agro software, an agricultural consultant system, was developed using the Django web framework for web application development. Django provided a robust and scalable foundation for building the software. The front-end of the application was created using HTML, CSS, and JavaScript, with Django's template engine enabling dynamic content rendering. The back-end logic was implemented using Python, integrating various functionalities.

For the fertility measurement feature, the software integrated an NPK sensor to measure the nutrient levels in the soil. The sensor readings were collected and processed using Python libraries and algorithms. The implementation involved configuring the sensor and establishing the communication between the sensor and the software. The software then calculated the required fertility levels based on the crop type and the land area.

To calculate the required fertilizer amount, the software utilized the collected sensor data, crop-specific fertility requirements, and the land area. The implementation involved developing algorithms that considered the nutrient levels detected by the sensor, the nutrient requirements of the specific crop, and the size of the field. The software provided accurate recommendations on the amount of fertilizer needed to achieve optimal fertility levels.

The time management of fertilization feature was designed to assist users in determining the optimal timing for fertilizer application based on crop.

The pre and post-planting processes, specific to each crop type, were implemented by incorporating crop-specific guidelines and best practices. The software provided step-by-step instructions for preparing the soil, selecting appropriate seeds or seedlings, and carrying out the planting process. The implementation involved gathering comprehensive information on various crops and their specific requirements, which was then integrated into the software.

For disease identification, the software incorporated an image processing model developed using Python. Users were able to upload images of crop leaves or affected areas, and the software employed image analysis techniques to identify the diseases present. Python libraries such as OpenCV and TensorFlow were used to preprocess the images, extract relevant features, and classify the diseases using machine learning algorithms. The image processing model was trained on a diverse dataset of crop disease images to ensure accurate identification.

The software utilized the SQLite database to store and manage data. The database schema was designed to store information related to sensor readings, fertility calculations, fertilization schedules, crop-specific guidelines, and disease identification results. The SQLite database provided a lightweight and efficient solution for data storage and retrieval within the software.

B. Evaluation

Easy Agro software demonstrated its effectiveness in providing agricultural consultation services. The successful implementation of all modules ensured accurate fertility measurements, optimized fertilization timing, proper pre and post-planting processes, and reliable disease identification. Users, including farmers and agricultural experts, expressed satisfaction with the software's functionality, usability, and the valuable insights it provided for informed decision-making in agriculture.

The results of this software highlight its potential to enhance farming practices, improve crop productivity, and contribute to sustainable agriculture in Bangladesh.

VIII. Future work

The future work for the Easy Agro software includes expanding the crop database, integrating additional sensors, enhancing disease prediction accuracy, incorporating pest management strategies, developing a mobile application, conducting long-term impact assessments, and gathering user feedback for iterative development. These improvements will enhance the software's relevance, accessibility, accuracy, and overall effectiveness in supporting farmers and improving agricultural practices in Bangladesh.

IX. Conclusion

In conclusion, the Easy Agro software is an agricultural consultant tool that has been successfully developed and evaluated for its effectiveness in supporting farmers in Bangladesh. The software incorporates modules for fertility measurement, time management of fertilization, pre and post-planting processes, and disease identification. It provides accurate fertility measurements using an NPK sensor and calculates the required fertilizer quantities based on crop-specific needs and land area. The software offers precise recommendations for fertilizer application timing. It also provides tailored guidelines for soil preparation, seed selection, and planting techniques to ensure proper crop establishment. The disease identification module utilizes an image processing model to accurately identify crop diseases based on user-provided images. This software demonstrates its potential to improve farming practices, increase crop productivity, and empower farmers with valuable insights and practical recommendations. Continued research and development can further enhance the software's capabilities, contributing to the overall development of the agricultural sector in Bangladesh.

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