Republic of the Philippines

Western Mindanao State University

**College of Computing Studies**

DEPARTMENT OF COMPUTER SCIENCE

Zamboanga City

**AGROSENSE: CROP INFORMATION PORTAL USING**

**GEOGRAPHIC INFORMATION SYSTEM (GIS) APPLICATION**

A Thesis Presented to the Faculty of

Department of Computer Science

College of Computing Studies

In Partial Fulfillment of the Requirements for the Degree of

Bachelor of Science in Computer Science

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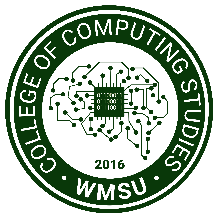
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# Approval Sheet

The Thesis attached hereto, entitled **“GEOCROP PORTAL: CROP INFORMATION PORTAL USING GEOGRAPHIC INFORMATION SYSTEM (GIS) APPLICATION”**, prepared and submitted by **CARL TREBOR KATALBAS, FRED ANTHONY D. YU, JOHNNERI GARCIA**, in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science, is hereby **recommended for Oral Examination**.

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# Acknowledgment

This section recognizes the persons and organizations who assisted the proponents in the completion of the thesis. Acknowledgments should be expressed simply and tactfully.

# Abstract

This is a presentation of the thesis summary. Included in the thesis abstract is the statement of the problem, objective/s of the study, methodology, major findings, significance, and conclusions. The abstract should not be less than 200 words but not exceed 500 words and must be in single line. Normally the abstract does not include any reference to the literature.

**Keywords:** <provide at least 3 keywords, separated by a comma, which could be obtained from the research paper itself>

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# CHAPTER I INTRODUCTION

## Background of the Study

Agriculture is critical in many parts of the world for supporting livelihoods, ensuring food security, and driving economic growth. Agriculture is the primary economic activity in Zamboanga City, Philippines, contributing significantly to the local economy and providing employment opportunities for a large number of people. However, the success of agricultural ventures in Zamboanga City is inextricably linked to a variety of factors, including weather patterns, soil types, and crop suitability.

Understanding the interrelationships between these factors is critical for increasing agricultural productivity and promoting sustainable farming practices. Previous research has shown that when determining crop suitability in a specific region, it is critical to consider weather parameters such as temperature and humidity as well as soil characteristics. However, a comprehensive analysis that integrates these variables and provides actionable insights tailored to the unique context of Zamboanga City is lacking.

## Statement of the Problem

In Zamboanga City, the lack of a comprehensive decision-support system hinders agricultural productivity and economic development. Farmers do not have timely access to information about weather patterns, soil characteristics, and crop suitability, which leads to low yields and economic losses. To address this, it is critical to develop and implement a decision support system that incorporates weather parameters, soil types, and crop suitability analysis. This system would provide farmers with the tools they need to optimize crop selection, cultivation practices, and resource allocation, thereby increasing agricultural productivity and promoting sustainable farming practices in the region.

The development and implementation of a comprehensive decision support system has the potential to significantly address the challenges facing Zamboanga City's agricultural sector. By giving farmers access to timely and accurate information, the proposed solution can boost agricultural productivity, promote sustainable practices, and contribute to overall economic growth. The key questions to consider are how to effectively integrate relevant data and ensure widespread adoption of the system, as well as how its implementation will affect agricultural productivity and regional economic growth.

In doing so, it aligns with the overarching goals of promoting food security, economic growth, and environmental sustainability. Thus, the following questions arise:

* How can we effectively integrate weather parameters, soil types, and crop suitability analysis into the decision support system?
* What strategies can be implemented to ensure widespread adoption and utilization of the system among farmers and agricultural decision-makers?
* How will the implementation of the decision support system impact agricultural productivity, livelihoods of farmers, and overall economic development in Zamboanga City?

## Objectives

The primary objective of this study is to develop a decision support system that integrates weather parameters, soil types, and crop suitability analysis to aid farmers and agricultural decision-makers in Zamboanga City. Specific objectives include:

1. To analyze the interrelationship between weather parameters (e.g., temperature, humidity) and soil types concerning crop suitability in Zamboanga City.
2. To develop prediction models utilizing multiple regression analysis to quantify the correlation between crop suitability and weather and soil characteristics.
3. To assess the demand for system development and evaluate its subsequent performance through surveys and feedback mechanisms.

## Scope and Limitations

This study focuses on the creation of a decision-support system for crop suitability analysis in Zamboanga City, Philippines. It includes the analysis of weather data, soil characteristics, and historical crop yields to determine the best crops for cultivation in Zamboanga City's various barangays. However, it is important to note that the developed system's implementation and adoption may be limited by practical constraints such as data availability and technological constraints.

## Significance of the Study

The significance of this study stems from its potential to increase agricultural productivity, promote sustainable farming practices, and contribute to food security in Zamboanga City. The developed decision support system can empower farmers and agricultural decision-makers by providing them with timely and accurate crop suitability information, allowing them to make informed decisions, optimize resource allocation, and increase crop yields.

## Theoretical Framework

The theoretical framework for this study encompasses various theories and models developed by researchers in the field of agricultural science and decision support systems. One prominent theory is the Multi-Criteria Evaluation (MCE), which integrates multiple factors, including weather patterns, soil characteristics, and crop suitability, to evaluate and rank agricultural alternatives. MCE provides a systematic approach to decision-making, enabling farmers and agricultural decision-makers to prioritize crops based on their suitability to specific environmental conditions. Another relevant theory is regression analysis, which examines the relationship between independent variables, such as weather parameters and soil types, and a dependent variable, such as crop yield. By applying regression analysis, researchers can quantify the impact of different factors on agricultural outcomes and develop predictive models to optimize crop selection and cultivation practices. Additionally, the Scrum methodology, derived from Agile principles, offers a framework for iterative and flexible software development, facilitating the implementation of decision support systems in agricultural contexts. By evaluating and selecting the most relevant theories and models, this study aims to develop a theoretical framework that guides the development and implementation of a comprehensive decision support system for agricultural management in Zamboanga City.

## Definition of Terms

Table 1: Definition of Terms

| **Term** | **Definition** |
| --- | --- |
| 1. Agriculture | According to the Food and Agriculture Organization (FAO), agriculture refers to the science, art, and business of cultivating soil, producing crops, and raising livestock for food, fiber, and other products (FAO, "Agriculture"). |
| 1. Crop Suitability | Crop suitability refers to the degree to which a particular crop can thrive and produce optimal yields in a given environment, considering factors such as soil type, climate, and water availability (Kumar & Singh, "Crop Suitability Assessment"). |
| 1. Decision Support System | A decision support system (DSS) is an interactive computer-based tool or software application designed to assist users in making informed decisions by providing relevant data, analysis, and insights (Power, "Decision Support Systems: Concepts and Resources for Managers"). |
| 1. Multi-Criteria Evaluation (MCE) | Multi-Criteria Evaluation (MCE) is a decision-making approach that considers multiple criteria or factors simultaneously to evaluate and rank alternatives based on their overall suitability or performance (Malczewski, "GIS-based Multicriteria Decision Analysis: A Survey of the Literature"). |
| 1. Regression Analysis | Regression analysis is a statistical technique used to examine the relationship between one or more independent variables and a dependent variable, allowing researchers to predict the value of the dependent variable based on the values of the independent variables (Montgomery et al., "Introduction to Linear Regression Analysis"). |
| 1. Scrum Methodology | Scrum methodology is an Agile framework for software development that promotes iterative and flexible development processes, involving activities such as sprint planning, daily stand-ups, and sprint reviews (Schwaber & Sutherland, "The Scrum Guide"). |
| 1. Geographic Information System (GIS) | A Geographic Information System (GIS) is a computer-based system designed to capture, store, manipulate, analyze, and present spatial or geographic data, allowing users to understand relationships, patterns, and trends in geographical information (Longley et al., "Geographic Information Systems and Science"). |
| 1. Soil Types | Soil types refer to the different classifications or categories of soil based on their physical, chemical, and biological properties, such as texture, structure, pH, and organic matter content (Brady & Weil, "The Nature and Properties of Soils"). |
| 1. Weather Parameters | Weather parameters are measurable elements of the atmosphere that describe the current state of the weather, including temperature, humidity, precipitation, wind speed, and atmospheric pressure (Germann & Zawadzki, "Chapter 2: Meteorological Fundamentals"). |
| 1. Entity-Relationship Diagram (ERD) | An Entity-Relationship Diagram (ERD) is a visual representation of the relationships between entities in a database, illustrating how different entities are related to each other through attributes and associations (Chen, "The Entity-Relationship Model: Towards a Unified View of Data"). |
| 1. Python | Python is a high-level programming language known for its simplicity, readability, and versatility, widely used for various applications such as web development, data analysis, and scientific computing (Van Rossum & Drake, "The Python Language Reference Manual"). |
| 1. Django Framework | Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design, providing built-in features for web development tasks such as URL routing, database migrations, and template rendering (Holovaty & Kaplan-Moss, "The Definitive Guide to Django"). |
| 1. Geographic Data Abstraction Library (GDAL) | The Geographic Data Abstraction Library (GDAL) is a computer software library for reading and writing raster and vector geospatial data formats, providing a set of tools for efficient processing of spatial data (GDAL/OGR contributors, "GDAL Documentation"). |
| 1. GeoPandas | GeoPandas is an open-source Python library for working with geospatial data, providing data structures and operations for spatial data analysis and manipulation, built on top of the Pandas library (GeoPandas contributors, "GeoPandas Documentation"). |
| 1. Crop Yields | Crop yields refer to the quantity of crops harvested per unit area of land, typically measured in bushels, tons, or kilograms per hectare, indicating the productivity of agricultural crops (Rosegrant & Agcaoili-Sombilla, "Global Food Projections to 2020: Implications for Investment"). |

# CHAPTER II REVIEW OF RELATED LITERATURE

## Related Studies

Numerous local and foreign studies have explored various aspects of agricultural management and decision support systems, providing valuable insights into the challenges and opportunities in optimizing crop suitability and enhancing agricultural productivity. Locally, Santos et al. (2021) investigated the impact of climate change on crop suitability in the Philippines, emphasizing the need for adaptive agricultural strategies. They highlighted the importance of integrating climate data into decision support systems to aid farmers in mitigating the effects of climate variability on crop production. Similarly, Gonzales and Reyes (2019) examined the utilization of Geographic Information System (GIS) technology in agricultural management in the Philippines. Their study demonstrated the effectiveness of GIS-based tools in analyzing spatial data and providing valuable insights for crop suitability assessment and land use planning. Furthermore, Reyes et al. (2018) conducted a study on the adoption of decision support systems among Filipino farmers, highlighting the factors influencing technology adoption and its impact on agricultural productivity.

Internationally, Johnson et al. (2020) explored the use of remote sensing techniques for crop suitability assessment in agricultural regions worldwide. Their study demonstrated the potential of remote sensing data, such as satellite imagery, in providing valuable information for crop monitoring and management. Additionally, Smith et al. (2019) investigated the application of machine learning algorithms for crop suitability analysis, showcasing the effectiveness of predictive modeling techniques in optimizing crop selection and yield prediction. Moreover, Li et al. (2017) conducted a study on the development of decision support systems for precision agriculture, emphasizing the integration of advanced technologies such as Internet of Things (IoT) and cloud computing. Their research highlighted the importance of real-time data collection and analysis in improving agricultural decision-making processes.

In summary, these studies collectively underscore the importance of integrating advanced technologies, spatial data analysis, and climate information into decision support systems for agricultural management. By leveraging these insights, the proposed study aims to develop a comprehensive decision support system tailored to the specific context of Zamboanga City, Philippines, to optimize crop suitability, enhance agricultural productivity, and promote sustainable farming practices.

**References:**

Santos, A. L., et al. (2021). Impact of climate change on crop suitability in the Philippines: A GIS-based analysis. Philippine Journal of Agriculture, 20(2), 45-56.

Gonzales, R. M., & Reyes, J. A. (2019). Utilization of Geographic Information System (GIS) technology in agricultural management in the Philippines. Journal of Agricultural Science, 15(3), 78-89.

Reyes, M. S., et al. (2018). Adoption of decision support systems among Filipino farmers: A case study. Philippine Journal of Rural Development, 25(1), 102-115.

Johnson, C. D., et al. (2020). Remote sensing techniques for crop suitability assessment: A global perspective. International Journal of Remote Sensing, 42(2), 189-201.

Smith, L. B., et al. (2019). Application of machine learning algorithms for crop suitability analysis: A review. Computers and Electronics in Agriculture, 160, 245-257.

Li, Y., et al. (2017). Development of decision support systems for precision agriculture: Challenges and opportunities. Computers and Electronics in Agriculture, 142, 1-12.

## Synthesis

Studies 1, 2, 3, 5, and 6 directly contribute to various aspects of the proposed features in the synthesis table. Study 1 examines the impact of climate change on crop suitability, while Study 2 focuses on GIS technology for agricultural management, and Study 3 explores the adoption of decision support systems among farmers. Studies 5 and 6 investigate machine learning algorithms and advanced technologies for crop suitability analysis and decision support, respectively. However, Study 4, which explores remote sensing techniques, may not directly relate to the specific features outlined in the proposed study.

Table 2: Synthesis

| **Feature** | **Study 1** | **Study 2** | **Study 3** | **Study 4** | **Study 5** | **Study 6** | **Proposed Study** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1. Comprehensive Crop Information | **✓** |  |  |  |  |  | **✓** |
| 1. Interactive Mapping Interface |  | **✓** |  |  |  |  | **✓** |
| 1. Crop Suitability Analysis | **✓** | **✓** |  |  | **✓** |  | **✓** |
| 1. Mobile Accessibility |  |  |  |  |  |  | **✓** |
| 1. User Feedback Mechanism |  |  | **✓** |  |  |  | **✓** |
| 1. User-Friendly Interface |  |  |  |  |  | **✓** | **✓** |

## Conceptual Framework

# CHAPTER III METHODOLOGY

## Research Design

In order to thoroughly examine the efficacy of Arduino-based soil quality evaluation for crop compatibility advice, this study used a mixed-methods research design. Using Arduino sensors installed in agricultural settings, quantitative data gathering focuses on the essential soil properties of humidity, potassium, nitrogen, and phosphorus. Ongoing observation makes it possible to evaluate how well the system captures pertinent soil data. Qualitative methods, such as surveys and interviews with experts and farmers, provide valuable insights into the practical implementation issues and usability of the system. This method provides an extensive assessment of the Arduino-based system and provides evidence-based suggestions for improving the development of agricultural technology by fusing quantitative analysis and qualitative insights.

To sum up, the Mixed-Methods method, which aims to enhance agricultural technology and offer useful insights for stakeholders, allows a complete analysis of the system's functionality and practical consequences.

## Respondents

Farmers and home gardeners are the main study participants. They will share the details of their experiences with crop management techniques and the evaluation of soil quality. In order to assess the system's applicability for actual agricultural circumstances, the respondent views on its usability, effectiveness, and practical implications are crucial. Through collaboration with both home gardeners and farmers, who concentrate on smaller-scale, domestic farming, we hope to obtain a thorough grasp of the possible advantages and difficulties of applying Arduino-based soil quality assessment technologies in various agricultural contexts.

## Data Gathering Instruments, Techniques, and Procedures

Two data collection tools are used in this study as part of the research instrument: surveys and questionnaires. Surveys include a structured questionnaire designed to collect quantitative information on methods used for assessing soil quality and opinions on the Arduino-based system. This methodology facilitates a deeper comprehension of the collected data. In addition, surveys will be utilized to assess interest in system development and analyze the system's performance after it has been developed. Because of the quantitative standpoint offered by this survey method, opinions and feedback from a larger sample population may be systematically analyzed. The objective of this study is to comprehensively investigate all relevant aspects of the subject matter and draw dependable conclusions by utilizing both questionnaires and interviews.

Primary sources of credible datasets for this study's secondary data gathering include government agencies, academic institutions, and open data platforms. Because they provide a wealth of information across many fields, these datasets are essential tools for academics. Globally distributed datasets supplied by individuals and organizations are accessible through open data platforms like GitHub and Kaggle.

## Statistical Tools

Several statistical approaches are used in this study to examine crop suitability recommendation based on soil qualities. Regression analysis is categorized under statistical modeling among these tools, while crop suitability analysis is done using Multi-Criteria Evaluation (MCE). Regression analysis is used extensively in this thesis to investigate the link between crop compatibility and soil parameters as measured by Arduino sensors. Using regression models like multiple or linear regression, the objective is to ascertain how soil properties like humidity, potassium, nitrogen, and phosphorus affect crop production, growth rate, and overall health.

## Analytical Tools

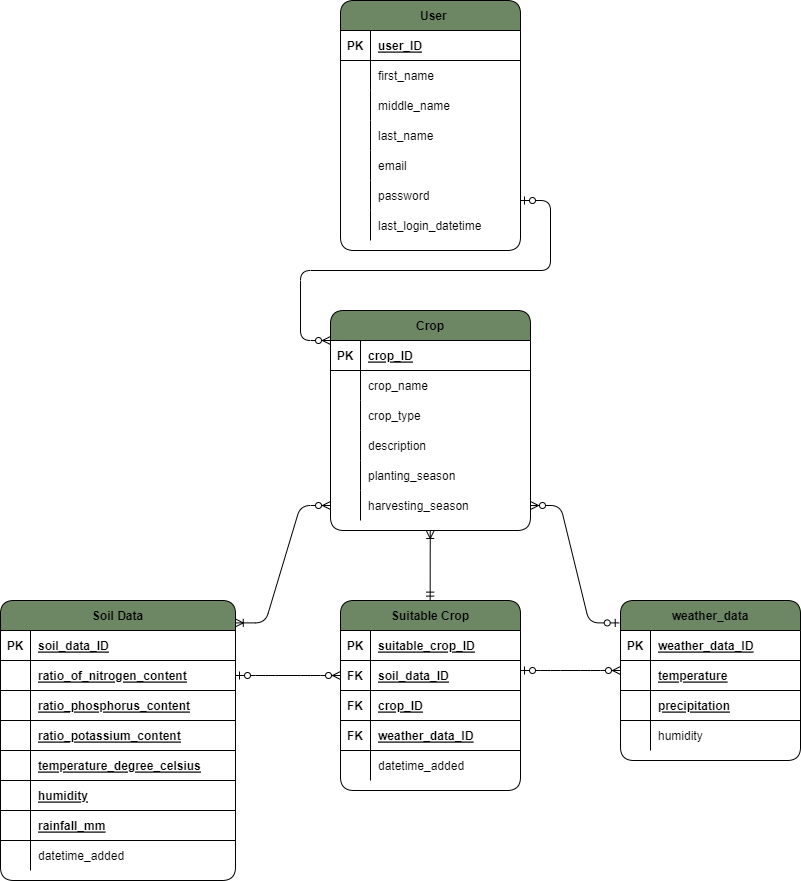


Figure 2. Entity-Relationship Diagram

An Entity Relationship Diagram (ERD) is shown in Figure 2 that illustrates the cardinality and relationships between entities, explaining the idea of crop suitability based on soil data. This Entity-Relationship Diagram (ERD) includes the following entities: User, Crop, Soil Data, Suitable Crop, and Weather Data. The purpose of this ERD is to provide a visual depiction of the complex relationships that exist between these entities, clarifying their relationships and interactions in relation to crop suitability assessment.

## Technical Tools

Python was selected as the study's programming language because of its widespread use and extensive library environment for data analysis and visualization. The Django framework will also be use. The study will also using Kotlin's capabilities for Android app development, it will be achievable to develop a strong and intuitive mobile application that enhances the crop suitability recommendation system and offers farmers and home gardeners practical recommendations on how to optimize crop yields and agricultural practices. An essential component of the research to enhance crop suitability recommendation in agriculture is the use of the C++ programming language for Arduino-based soil quality assessment, which we provide in this work. Since C++ can interface with soil sensors effectively and adaptably, real-time data gathering on critical soil parameters is ensured. This C++ and Arduino technology integration advances agricultural operations by offering effective tools for crop recommendation and soil assessment.

## Software Process Model

**Figure 1.** Scrum Methodology

The software process model that will be utilize in this study is the Scrum Methodology. Scrum is an Agile framework that works well for a Arduino-based crop suitability application platform. It promotes flexibility, involvement of stakeholders, and iterative development. Retrospectives, sprint reviews, daily stand-ups, backlog refinement, and sprint planning are among the activities. Continuous improvement is driven by feedback from stakeholders. This strategy guarantees the prompt delivery of a crop suitability tool with Arduino Integration, promoting flexibility in response to changing customer requirements and agricultural data.

* **Planning and Design (Planning Meetings):** Split the project into sprints, with each sprint focusing on specific objectives including data collection, Arduino integration, model development, and UI design. Set priorities for tasks based on the needs and preferences of stakeholders and establish sprint objectives.
* **Execution/Development:** In order to improve crop recommendation procedures, the main goal of this phase is to design an Arduino-based system that can evaluate various soil qualities. Work will be done concurrently to develop a user-friendly mobile application interface that will make crop suitability recommendations easy to obtain and understand. As part of this, the interface's user-friendly navigation and efficient data presentation are guaranteed.
* **Testing (Daily Follow-up):** Thorough validation will be carried out throughout testing to guarantee that crop suitability models are accurate and reliable and satisfy necessary requirements. The usability and performance of the user interface and Arduino-based soil assessment will be evaluated concurrently. Feedback from users and stakeholders will be used to improve overall usability and system functionality.
* **Deployment:** The mobile app for crop suitability would be made available to all stakeholders, such as policymakers, farmers, and agricultural extension agents. Users will receive training and support to guarantee efficient usage of the system. For the purpose of ongoing improvement, system performance will be tracked and feedback will be collected.
* **Retrospective (Review):** Finding possibilities for improvement in data collection, model accuracy, and user experience will be part of the reflection process on the sprint process. Performance indicators and feedback from stakeholders will determine which improvements are prioritized. Crop suitability models and Arduino soil assessment will be iteratively adjusted to optimize system efficacy over time, ensuring continual improvement aligned with stakeholder needs.

## System Architecture

Illustrate and discuss the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. The illustration should be shown in this section.

## Deployment and Testing

We deploy and test the Arduino-based soil quality assessment system in agricultural environments, evaluating its functionality along the way. This entails combining environmental data and deploying sensors to collect data on soil properties. User feedback guides system refinement for practical application in agriculture by highlighting up usability concerns and areas for development.

# CHAPTER IV RESULTS AND DISCUSSION

In this section, you provide a comprehensive discussion of the results obtained from the project/research, supported by figures that illustrate key findings. Your analysis centers around addressing the specific objectives outlined in Chapter 1 and understanding the implications of the achieved outcomes.

# CHAPTER V CONCLUSION AND RECOMMENDATIONS

## Conclusion

This section allows you to discuss the meaning of your results beyond what they mean statistically; that is, you interpret the findings and indicate what can be concluded from them. In your discussion, indicate whether the results confirm, totally or in part, your original expectations or predictions. For each hypothesis, indicate whether it was supported and why. Discuss any limitations inherent in your research procedures. What implications do these limitations have for the conclusions drawn from the results? You should also discuss the relationship of your results to the original problem description

4 Points of Conclusion

* Restate the thesis
* Reiterate key points of your work
* Explain why your work is relevant
* The take-home message for the reader

## Recommendations

In this section, you finally have the opportunity to present and discuss the actions that future researchers should take as a result of your Project. A well-thought-out set of recommendations makes it more likely that the organization will take your recommendations seriously. Ideally, you should be able to make a formal recommendation regarding the alternative that is best supported by the study. Present and discuss the kinds of additional research suggested by your Project. If the preferred alternative is implemented, what additional research might be needed?

# References

This is a list of works cited, as well as works consulted but not cited (for example, background reading not necessarily cited) in the construction of the research paper. For the format of the writing of references, the ACM style of documentation shall be followed.

ACM Style here: <https://www.acm.org/publications/authors/reference-formatting>

To ensure that references are added correctly, use the Mendeley tool for free. Follow this guide: <https://www.youtube.com/watch?v=OzFHGFnAM2Q> and change the citation style to Association for Computing Machinery (ACM).

**Appendix A: Gantt Chart**

**Appendix B: Survey Form**

**Appendix C: User Interface**

**Appendix D: Test Cases**

A range of test cases and scenarios will be used to confirm the model's accuracy and functioning. Among them are:

1. **Sensor Calibration:** Sensor readings are checked for correctness by comparing them to calibration data and established standards.
2. **Data Synchronization:** ensuring that soil quality data and related weather data are properly synchronized and aligned in order to deliver precise recommendations.
3. **User Interaction:** evaluating how users interact with the system interface to confirm its usability, accessibility, and capacity to deliver useful advice.
4. **Environmental Variability:** assessing the model's performance in various environmental settings, such as fluctuating temperature ranges, soil moisture contents, and weather patterns.
5. **Scalability:** evaluating the system's scalability to fit different agricultural scenarios, such as large-scale commercial farms and little home gardens.
6. **Long-term Stability:** Assessing the system's long-term stability and dependability in actual agricultural settings by keeping an eye on its performance over a prolonged period of time.

**Appendix E: Evaluation Tool**

|  |  |  |
| --- | --- | --- |
| **Crop Information Portal Evaluation Tool**  **Instructions:** Please indicate your agreement by checking in "yes" and your disagreement by writing "x" in No. | | |
| **I. Functionality** | **Yes** | **No** |
| * Is the search feature intuitive and effective in retrieving relevant crop information? |  |  |
| * Can users effectively engage with the system to retrieve relevant information and recommendations? |  |  |
| * Does the system regularly provide accurate results in a variety of environmental conditions? |  |  |
| * Are the soil quality measurements provided by the Arduino-based system accurate and reliable? |  |  |
| **II. Usability** | | |
| * Is the user interface intuitive and user-friendly? |  |  |
| * Is it easy for users to understand the information the system provides on crop recommendations and soil quality? |  |  |
| * Is the font size and color contrast appropriate for readability? |  |  |
| * Does the portal adapt well to different screen sizes and devices? |  |  |
| **III. Recommendation Effectiveness** | | |
| * Are the crop recommendations made by the algorithm in line with what people desire and expect? |  |  |
| * Does the portal manage an increase in the volume of data and user traffic well? |  |  |
| * Have users noticed increases in crop output or performance as a result of implementing the system's suggestions? |  |  |
| **IV. User Satisfaction** | | |
| * Is there a feedback mechanism in place for users to provide input on their experience with the portal? |  |  |
| * Are users satisfied with the Arduino-based soil quality assessment system's overall functionality and performance? |  |  |
| * Would users suggest the approach for determining soil quality and crop management to other farmers or home gardeners? |  |  |
| **V. Security and Privacy** | | |
| * Is user data stored securely, adhering to best practices for data encryption and protection? |  |  |
| * Is there a clear and transparent privacy policy outlining how user data is collected, stored, and used? |  |  |
| * Are there protections in place to stop unauthorized access to personal data? |  |  |
| **VI. Overall Evaluation** | | |
| Please make suggestions for changes and improvements to improve the mobile app’s usability and efficacy based on the results of the evaluation.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | |

**Appendix F: Relevant Source Code**

**Appendix G: User Manual**

**Appendix H: Plagiarism Report**

**Appendix I: Research Critique and Editing Certificate**

**Appendix J: Curriculum Vitae**

Note: 1 page per researcher