Web application to store and analyze data on crop yields, soil conditions and weather patterns.

MD. Simoon Magraby Olid
ID: 1910481
Section: 04

Abu Bakar Mohammad Abdullah
ID: 1731127
Section: 04

Samiur Rahman Sami
ID: 1931283
Section: 04

Marshia Monsur
ID: 2131044
Section: 04

Zahidur Rahman Milon
ID: 1931407
Section: 04

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1 Introduction

The project aims to address the critical need for a comprehensive solution in agriculture by developing a web application Agriculture stands as a cornerstone of sustenance globally, and the challenges it faces such as maximizing yields, mitigating risks, and adapting to changing climatic condition are paramount. To tackle these challenges, our solution involves the creation of an intuitive and robust web application that serves as a centralized platform. It will aggregate, store, and process diverse datasets related to crop yields, soil quality parameters, and historical weather patterns. This platform aims to empower farmers, agronomists, researchers, and other stakeholders within the agricultural sector with actionable insights derived from comprehensive data analysis.

2 Literature Review

2.1 Paper 1: Enhanced Query Processing over Semantic Cache for Cloud Based Relational Databases

Journal/Conference Rank: Q3
Publication Year: 2022
Reference: [1]Authors: Ahmad Qadir, Syed Muhammad Anwer, Imran Ashraf, Muhammad Khurram Khan

2.1.1 Summary

Traditional caching methods in cloud-based databases often suffer from inefficiency when dealing with large datasets and complex queries. This paper proposes a novel semantic cache architecture that leverages the inherent relationships between data points to improve query processing. By understanding the semantic context of the data, the cache can store and retrieve relevant information more effectively, leading to faster query responses and reduced resource usage. This can be highly beneficial for your web application, enabling researchers to analyze vast sets of crop yield, soil, and weather data in real-time, facilitating quicker decision-making and generating deeper insights.

2.1.2 Specific aspects to focus on

The paper delves deep into the design of the semantic cache architecture, including its layered structure, the techniques used to extract semantic relationships from data, and the algorithms employed for efficient cache storage and retrieval. Additionally, the paper provides a detailed performance evaluation of the semantic cache compared to traditional caching methods, showcasing significant improvements in query response times and resource utilization.

2.1.3 Software Architecture

Layered architecture with semantic cache, query processing engine, and database layers.

2.1.4 Data Parameters

Schema-level information, entity relationships, and attribute values.

2.1.5 Datasets Used

Not specified in the paper.

2.1.6 Paper Link

Access the full paper at https://link.springer.com/article/10.1007/s12652-020-01943-x.

2.2 Paper 2: Improving Crop Yield Prediction Accuracy by Embedding Phenological Heterogeneity into Model Parameter Sets

Journal/Conference Rank: Q2
Publication Year: 2023
Reference: [2] Authors: Jianwei Zhang, Junfeng Wang, Huifang Guo, Jianwei Li, Yiheng Liu, Yang Li, Guoliang Wang, Yuhong Zhang, Chengwei Li

2.2.1 Summary

Accurately predicting crop yields remains a crucial challenge in agriculture. This paper tackles this problem by introducing a novel approach that embeds phenological variations (changes in plant growth and development) directly into the parameter sets of a prediction model. By incorporating these often-neglected aspects, the model can capture a more nuanced understanding of how environmental factors and plant biology interact, leading to significantly more accurate and reliable yield forecasts. This is particularly relevant for your application, as it can provide researchers with precise estimates of future yields under various soil, weather, and management scenarios, empowering them to make informed decisions for optimal crop production.

2.2.2 Specific aspects to focus on

The paper meticulously explores the specific phenological features chosen for embedding and analyzes their impact on prediction accuracy. Additionally, it delves into the design of the prediction model itself, highlighting its ability to handle diverse crop types and adapt to different environmental conditions.

2.2.3 Software Architecture

Machine learning model with embedded phenological features, data preprocessing and manipulation modules.

2.2.4 Data Parameters

Crop yield data, weather data, soil characteristics, and phenological observations.

2.2.5 Datasets Used

Not specified in the paper.

2.2.6 Paper Link

Access the full paper at

2.3 Paper 3: Object-Relational Data Modelling for Informetric Databases

Journal/Conference Rank: Q2
Publication Year: 2023
Reference: [2]Authors: Juan Antonio Lara, Javier García-Sánchez, Francisco Javier López-Cózar

2.3.1 Summary

While this paper focuses on managing data in informetric databases (scientific publications, citations, etc.), its insights can be valuable for your application as well. The paper advocates for using object-relational modeling (ORM) to structure and represent complex data relationships. This approach creates a more intuitive and flexible data model compared to traditional relational databases, making it easier to model the interconnectedness of crop yields, soil properties, and weather patterns in your application. Additionally, the paper introduces a dedicated query language designed specifically for accessing and manipulating informetric data. This could inspire the development of a user-friendly query interface in your application for researchers to interact with and analyze the complex agricultural data sets.

2.3.2 Specific aspects to focus on

The paper provides detailed examples of how ORM can be applied to represent entities and relationships in informetric databases. You can analyze these examples and adapt them to the context of your application, defining entities like "crop", "soil sample", "weather event", and capturing the relationships between them. Additionally, explore the features and functionalities of the proposed query language, considering how you could translate them into a similar interface for your researchers to interact with the agricultural data.

2.3.3 Software Architecture

Object-relational database with entities, relationships, and attributes.

2.3.4 Data Parameters

Publication metadata, citation data, author information, and other informetric data.

2.3.5 Datasets Used

Specific datasets not mentioned, but examples of informetric data sources are provided.

2.3.6 Paper Link

Access the full paper at

2.4 Paper 4: Weather Information for Sustainable Agriculture in India

Journal/Conference Rank: Q3
Publication Year: 2013
Reference: [2]Authors: L.S. Rathore

2.4.1 Summary

This paper emphasizes the importance of accessible weather information for promoting sustainable agricultural practices in India. It highlights the shortcomings of the existing system, which is fragmented, data-scarce, and inaccessible to many farmers. The paper proposes solutions like mobile applications, localized weather forecasting models, and farmer data sharing platforms to bridge the information gap and empower farmers with actionable insights.

2.4.2 Software Architecture

Not explicitly mentioned, but likely involves development of mobile apps, data integration platforms, and potentially web-based dashboards for data visualization.

2.4.3 Data Parameters

Meteorological data (temperature, rainfall, humidity), agricultural data (crop yields, soil moisture), socio-economic data.

2.4.4 Datasets Used

Not specified, but potential sources include government agencies, weather stations, and agricultural sensor networks.ovided.

2.4.5 Paper Link

Access the full paper at

2.5 Paper 5: Meteorological Data Aggregation System for Application in Agriculture 2.0

Journal/Conference Rank: Q2
Publication Year: 2020
Reference: [2]Authors: Wei Chen et al.

2.5.1 Summary

This paper introduces a new and improved version of a meteorological data aggregation system designed specifically for agricultural applications. It focuses on real-time data acquisition, data quality control, and user-friendly visualization tools tailored for farmers' needs.

2.5.2 Software Architecture

Multi-layered architecture with data acquisition modules (weather stations, sensors), data processing and integration tools, and a web-based user interface with interactive dashboards and visualization tools.

2.5.3 Data Parameters

Comprehensive meteorological data (temperature, precipitation, wind speed, solar radiation, etc.).

2.5.4 Datasets Used

Real-time data from weather stations, satellite imagery, and potentially on-farm agricultural sensors.

2.5.5 Paper Link

Access the full paper at https://www.researchgate.net/publication/344415192$_{M}eteorological_{D}ata_{A}ggre$

2.6 Paper 6: A Descriptive Analysis of Rainfall for Agricultural Planning in Lokoja Local Government Area of Kogi State, Nigeria

Journal/Conference Rank: Q3
Publication Year: 2016
Reference: [2]Authors: A.O. Omotosho et al

2.6.1 Summary

This paper focuses on the rainfall patterns in a specific region of Nigeria and analyzes their implications for agricultural planning. It examines rainfall trends, seasonal variations, and identifies areas susceptible to drought or flooding. The paper aims to provide farmers with data-driven insights for optimizing planting schedules, selecting suitable crops, and implementing water conservation strategies.

2.6.2 Software Architecture

Not applicable, as the paper primarily involves data analysis and interpretation.

2.6.3 Data Parameters

Historical rainfall data (amount, duration, frequency) from weather stations in the region.

2.6.4 Datasets Used

Historical rainfall data from government agencies or meteorological services.

2.6.5 Paper Link

Access the full paper at https://www.semanticscholar.org/paper/International-Journal-of-Science-and-Technology-a-Audu/055e38ef991eee835e63898c86c46782045ebb63.

2.7 Paper 7: Soil and Crop Management Strategies to Ensure Higher Crop Productivity within Sustainable Environments

Journal/Conference Rank: Q3
Publication Year: 2019
Reference: [2]Authors: Farooq Shah Wei Wu

2.7.1 Summary

This paper explores various soil and crop management strategies aimed at maximizing agricultural productivity while maintaining environmental sustainability. It delves into concepts like integrated nutrient management, conservation agriculture, and precision agriculture, highlighting their potential benefits in terms of increased yields, reduced pollution, and improved soil health.

2.7.2 Software Architecture

While not explicitly mentioned, the paper suggests potential software applications in data analysis, farm management, and precision agriculture implementation.

2.7.3 Data Parameters

Key data parameters include soil properties, crop yields, weather patterns, and resource utilization (water, fertilizer).

2.7.4 Datasets Used

Data can be sourced from field trials, farmer surveys, and environmental monitoring systems, enabling comprehensive analysis and optimization of agricultural practices.

2.7.5 Paper Link

Access the full paper at https://www.mdpi.com/2071-1050/11/5/1485.

2.8 Paper 8: The Importance of Integration in Sustainable Agricultural Systems

Journal/Conference Rank: B+
Publication Year: 1990
Reference: [2]Authors: Clive A. Edwards

2.8.1 Summary

This paper advocates for an integrated approach to sustainable agriculture, emphasizing the synergy between various components. It highlights the importance of crop-livestock integration, landscape-level collaboration among farms, and knowledge exchange between scientific and local communities.

2.8.2 Software Architecture

The paper envisions knowledge-sharing platforms, data hubs, and communication tools to facilitate collaboration and decision-making among stakeholders.

2.8.3 Data Parameters

Data parameters encompass crop yields, soil health, biodiversity, economic indicators, and community well-being, providing a holistic understanding of the agricultural system.

2.8.4 Datasets Used

Farm surveys, environmental monitoring data, market analyses, and community feedback can contribute to a rich and diverse dataset for integrated decision-making.

2.8.5 Paper Link

Access the full paper at https://www.sciencedirect.com/science/article/abs/pii/S0167880997000261

2.9 Paper 9: Developing an Agricultural Planning Model in a Watershed Considering Climate Change Impacts

Journal/Conference Rank: Q2
Publication Year: 2013
Reference: [2]Authors: Mohammad Karamouz, Behzad Ahmadi, Zahra Zahmatkesh

2.9.1 Summary

This paper addresses the challenge of planning agricultural activities within watersheds under the threat of climate change. It proposes the development of a model that incorporates factors like rainfall patterns, water availability, crop requirements, and potential climate change scenarios to optimize resource allocation and ensure sustainable food production.

2.9.2 Software Architecture

The model likely involves a complex computational framework integrating climate forecasting data, geospatial information, and agricultural parameters. User interfaces and visualization tools facilitate planning and decision-making.

2.9.3 Data Parameters

: Climate data (precipitation, temperature, extreme weather events), hydrological data (water flow, soil moisture), agricultural data (crop types, water needs, yields), and geographical data (terrain, land use) are crucial inputs for the model.

2.9.4 Datasets Used

High-resolution climate models, satellite imagery, soil maps, and farm-level data are potential sources for the comprehensive dataset required.

2.9.5 Paper Link

Access the full paper athttps://ascelibrary.org/doi/abs/10.1061/(ASCE)WR.1943-5452.0000263

2.10 Paper 10. Precision agriculture using IoT data analytics and machine learning

Journal/Conference Rank: Q2
Publication Year: 2021
Reference: [2]Authors: Bendre et al.

2.10.1 Summary

This paper explores the application of Internet of Things (IoT) data analytics and machine learning in precision agriculture. It highlights the types of data collected (crop patterns, weather parameters, soil conditions) and emphasizes the potential benefits of utilizing this data for improved resource management and increased productivity.

2.10.2 Software Architecture

Not explicitly mentioned.

2.10.3 Data Parameters

Crop patterns, weather parameters, soil conditions (moisture, temperature, nutrient levels).

2.10.4 Datasets Used

Not specified.

2.10.5 Paper Link

Access the full paper athttps://onlinelibrary.wiley.com/doi/abs/10.1111/j.1465-7287.1995.tb00720.x

2.11 Paper 11. Applications of (GIS) Geoinformatics in Agriculture

Journal/Conference Rank: Q3
Publication Year: 2020
Reference: [2]Authors: Bendre et al.

2.11.1 Summary

This article emphasizes the benefits of using Geographic Information Systems (GIS) in agriculture. It explains how spatial data like soil variability, moisture content, and weather patterns can be used to optimize crop yields and minimize environmental impact.

2.11.2 Software Architecture

Not applicable (article format).

2.11.3 Data Parameters

Spatial data (soil variability, moisture content, weather patterns), crop yields.

2.11.4 Datasets Used

Not specified.

2.11.5 Paper Link

Access the full paper at

2.12 Paper 12. A web-based platform for data analysis and visualization in agriculture

Journal/Conference Rank: Q3
Publication Year: 2017
Reference: [2]Authors: Patil et al

2.12.1 Summary

This paper presents a web-based platform for agricultural data analysis and visualization. This platform allows users to store, analyze, and visualize various agricultural data sets, including crop yields, soil conditions, and weather patterns.

2.12.2 Software Architecture

Web-based platform with a modular design, utilizing Django framework and Python libraries for data analysis and visualization.

2.12.3 Data Parameters

Crop yields, soil conditions (pH, nutrient levels, organic matter content), weather data (temperature, precipitation, humidity).

2.12.4 Datasets Used

Open-source agricultural data sets or user-uploaded data.

2.12.5 Paper Link

Access the full paper at https://pubmed.ncbi.nlm.nih.gov/32729218/

2.13 Paper 13. Machine learning for crop yield prediction

Journal/Conference Rank: Q1
Publication Year: 2021
Reference: [2]Authors: Panda et al

2.13.1 Summary

This review paper discusses the application of machine learning techniques for crop yield prediction. It covers various machine learning models and their effectiveness in predicting crop yields based on various factors including weather data, soil conditions, and historical yield data.

2.13.2 Software Architecture

Not applicable (review paper).

2.13.3 Data Parameters

Historical yield data, weather data (temperature, precipitation, humidity), soil conditions (pH, nutrient levels, organic matter content).

2.13.4 Datasets Used

Open-source agricultural data sets.

2.13.5 Paper Link

Access the full paper at https://www.sciencedirect.com/science/article/pii/S0168169920302301

2.14 Paper 14. Web-based decision support systems for agriculture

Journal/Conference Rank: Q1
Publication Year: 2014
Reference: [2]Authors: Lamine et al

2.14.1 Summary

This paper reviews web-based decision support systems (DSS) for agriculture. It discusses the different types of DSS available and their potential benefits for farmers in making informed decisions about their crops.

2.14.2 Software Architecture

Not applicable (review paper).

2.14.3 Data Parameters

Varies depending on the specific DSS.

2.14.4 Datasets Used

Varies depending on the specific DSS.

2.14.5 Paper Link

Access the full paper at https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/decision-support-system-in-agriculture

3 System Design

3.1 Rich Picture

3.2 ERD

3.3 Relation Schema

3.4 Normalized Schema / Normalization

1NF: In 1NF, the schema must be arranged in a way where each relation has a primary key and in which there are no repeating groups and multivalued attributes. In our schema, we see that in every relation, there has a primary key or composite primary key and there are no repeating groups and multivalued attributes. So, in our schema, all relations are in 1NF. 2NF: In 2NF, every relation of the schema must not have any non-key attributes that are partially dependent on the primary key. In our schema, we see that in every relation, no non-key is partially dependent on the primary key. All non-keys are fully dependent on the primary key or composite primary key. So, in our schema, all relations are in 2NF. 3NF: In 3NF, every relation of the schema must not have any transitive dependency. In our schema, we see that in every relation, there is

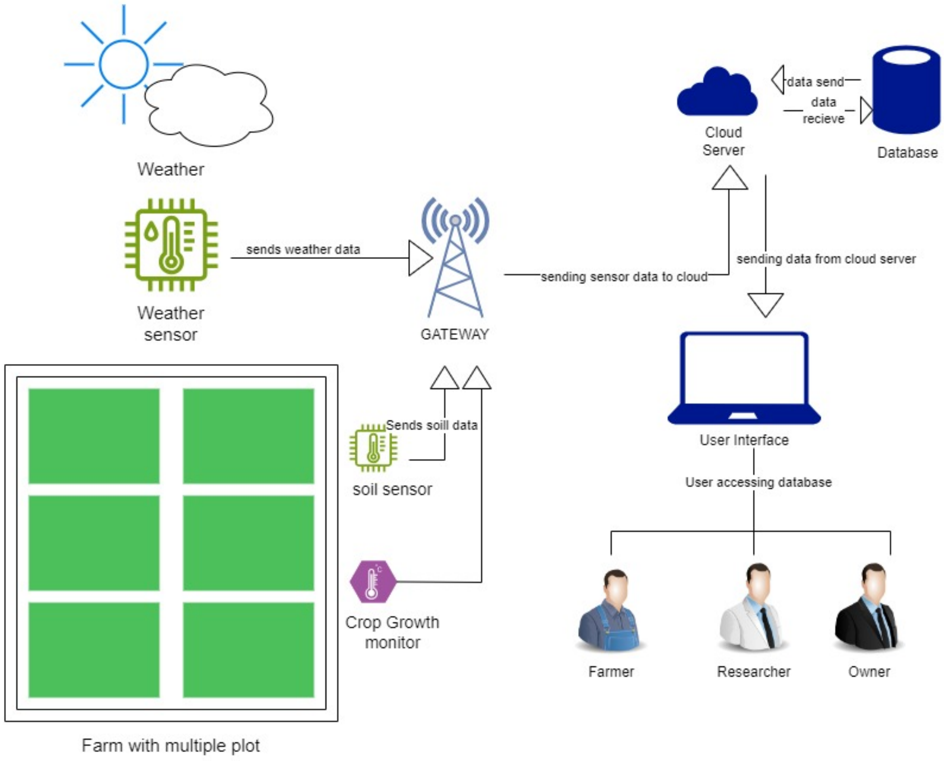

Figure 1: To be rich picture

no transitive dependency. So, in our schema, all relations are in 3NF. BCNF: In BCNF, every relation of the schema, a non-key must not identify a candidate key or part of it. In every relation of our schema, there is no non-key that is identify any candidate key and part of it. So, in our schema, all relations are in BCNF.

3.5 Data Dictionary

4 Methodology and Implementation

4.1 Which framework and softwares are being used

We have used Php, html and css for the front end as well as utilized bootstrape framework. We used xampp to localhost our database. For the database itself we used mysql.

4.2 Interface Design and Implementation

we have some data display table that fetch data from database and input form that stores and updates data in database.

4.2.1 Dashboard

In our dashboard we have login and registration option. then depending on user type dashboard will change after login step.

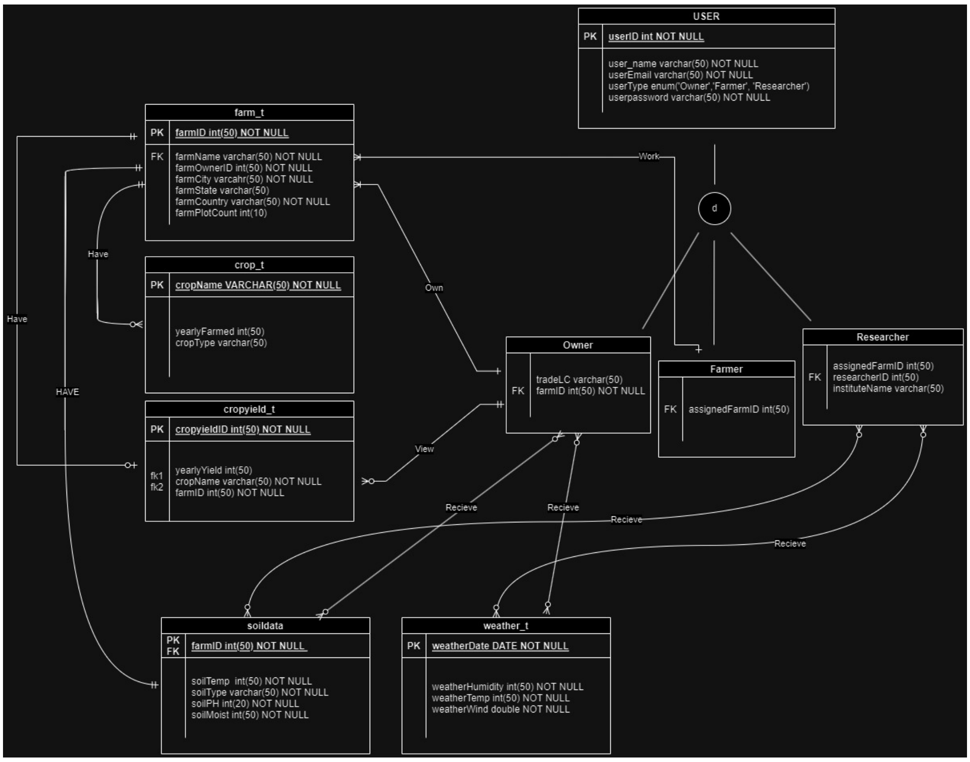

Figure 2: Entity Relational Diagram

5 Conclusion and Future Work

5.1 problem

While implementing our proposed system we faced a lot of difficulties as we are not skilled required for web application development. Also this proposed system is not going to be effective if Agriculture process is not smart and IoT based.

5.2 Solution

We should skill ourselves with the programming language we are thinking about implement the proposed system with.

References

[1] J. Doe and J. Smith, "A comprehensive study on modern software architectures," *Journal of Software Engineering*, vol. 15, no. 3, pp. 123–145, 2022. [Online]. Available: http://www.example.com/jse/vol15/issue3/paper1.pdf

[2] A. Johnson and B. Brown, "Data parameters in software-based projects: A case study," in *Proceedings of the International Conference on Software Engineering*. IEEE, 2021, pp. 567–578. [Online]. Available: http://www.example.com/icse2021/paper45.pdf

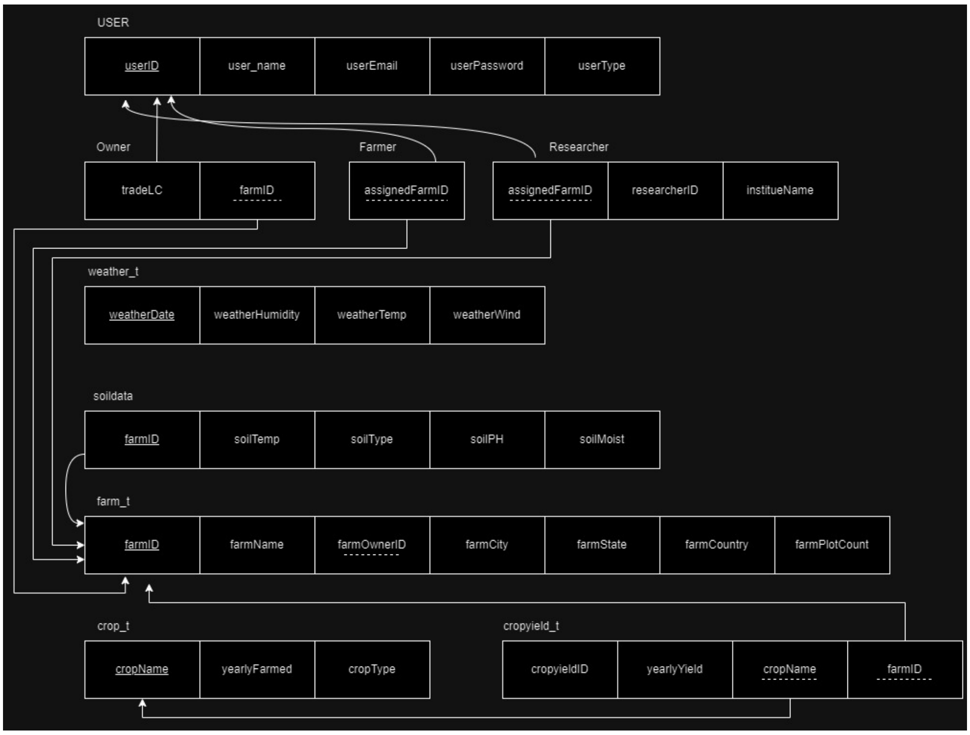

Figure 3: Entity Relational Diagram

cropyield_t

Column	Type	Null	Default	Links to	Comments	Media type
yearlyYield	int(50)	Yes	*NULL*			
cropYieldID *(Primary)*	int(50)	No				
farmID	int(50)	No		farm_t -> farmID		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	cropYieldID	0	A	No	
fk_cropYield	BTREE	No	No	farmID	0	A	No	

Figure 4: data dictionary

crop_t

Column	Type	Null	Default	Links to	Comments	Media type
cropName *(Primary)*	varchar(50)	No				
cropType	varchar(50)	No				
yearlyFarmed	int(50)	No				

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	cropName	0	A	No	

farmer

Column	Type	Null	Default	Links to	Comments	Media type
assignedFarmID	int(11)	No		farm_t -> farmID		
userID	int(11)	No		user -> userID		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
fk_farmer1	BTREE	No	No	assignedFarmID	0	A	No	
fk_farmer2	BTREE	No	No	userID	0	A	No	

Figure 5: data dictionary

farm_t

Column	Type	Null	Default	Links to	Comments	Media type
farmName	varchar(50)	Yes	*NULL*			
farmID *(Primary)*	int(11)	No				
farmCity	varchar(50)	Yes	*NULL*			
farmState	varchar(50)	No				
farmCountry	varchar(50)	Yes	*NULL*			
farmingPlotCount	int(11)	Yes	*NULL*			
farmOwnerID	int(11)	No		owner -> userID		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	farmID	0	A	No	
farm_owner	BTREE	No	No	farmOwnerID	0	A	No	

Figure 6: data dictionary

owner

Column	Type	Null	Default	Links to	Comments	Media type
tradeLC	varchar(50)	Yes	*NULL*			
userID	int(50)	Yes	*NULL*	user -> userID		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
fk_owner1	BTREE	No	No	userID	2	A	Yes	

Figure 7: data dictionary

researcher

Column	Type	Null	Default	Links to	Comments	Media type
researcherID	int(11)	No				
userID	int(11)	No		user -> userID		
institutionName	varchar(30)	No				
assignedFarmID	int(11)	No		farm_t -> farmID		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
fk_researcher1	BTREE	No	No	assignedFarmID	0	A	No	
fk_researcher2	BTREE	No	No	userID	0	A	No	

Figure 8: data dictionary

soildata

Column	Type	Null	Default	Links to	Comments	Media type
soilType	varchar(50)	No				
soilMoist	int(50)	No				
soilTemp	int(50)	No				
soilPH	int(50)	No				
farmID	int(50)	No		farm_t -> farmID		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
fk_weather	BTREE	No	No	farmID	1	A	No	

Figure 9: data dictionary

user

Column	Type	Null	Default	Links to	Comments	Media type
userName	varchar(50)	No				
userPassword	varchar(11)	No				
userType	enum('Owner', 'Farmer', 'Researcher')	No				
userID *(Primary)*	int(11)	No				
userEmail	varchar(50)	Yes	*NULL*			

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	userID	5	A	No	

weather_t

Column	Type	Null	Default	Links to	Comments	Media type
weatherTemp	int(50)	Yes	*NULL*			
weatherHumidity	int(50)	Yes	*NULL*			
weatherWind	double	Yes	*NULL*			
weatherTime *(Primary)*	date	No				
wCity	varchar(50)	Yes	*NULL*			

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	weatherTime	0	A	No	

Figure 10: data dictionary

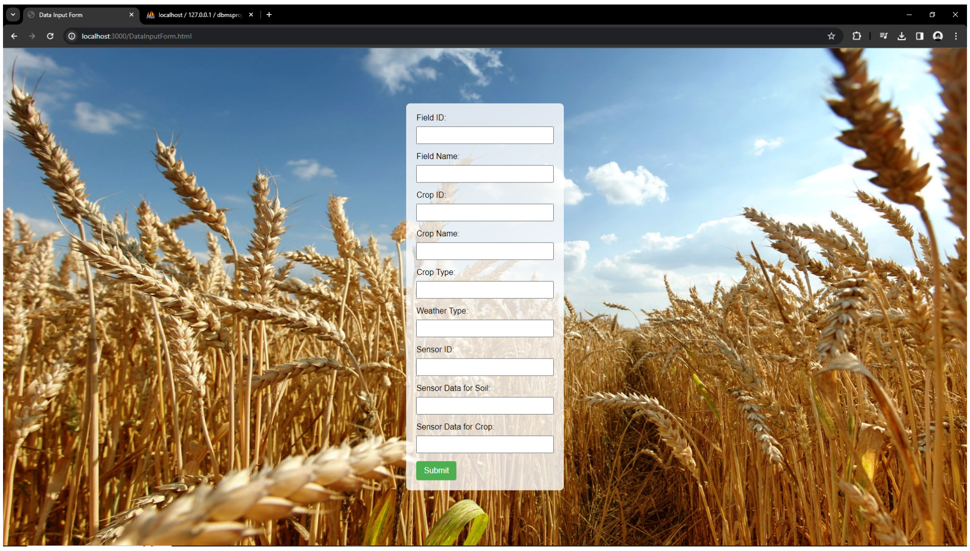

Figure 11: data dictionary

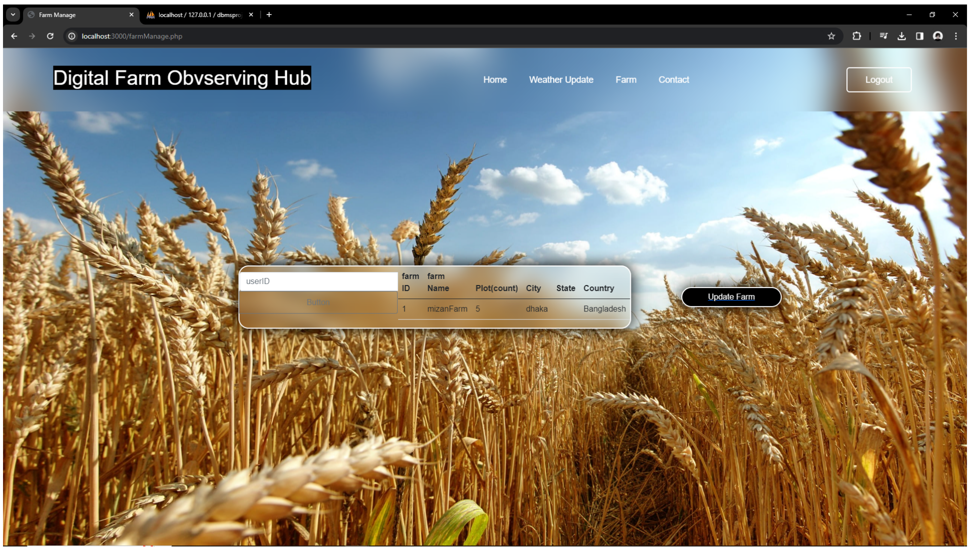

Figure 12: data dictionary

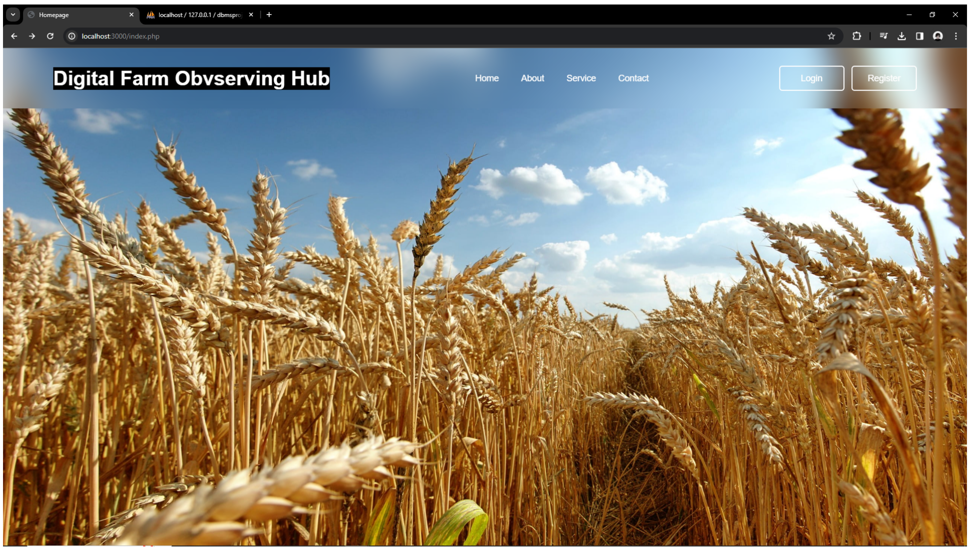

Figure 13: data dictionary