**A PROJECT REPORT ON**

**Secure Cloud Storage To Farm Data**

SUBMITTED TO

MIT SCHOOL OF COMPUTING, LONI, PUNE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE

**BACHELOR OF TECHNOLOGY**

**(Computer Science & Engineering)**

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**2025- 26**

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**MIT SCHOOL OF COMPUTING**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

MIT ART, DESIGN AND TECHNOLOGY UNIVERSITY,

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is a bonafide work carried out by them under the supervision of Dr. Aditya Pai Hand it is submitted towards the partial fulfillment of the requirement of MIT ADT university, Pune for the award of the degree of Bachelor of Technology (Computer Science and Engineering)

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**DECLARATION**

We, the team members

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Hereby declare that the project work incorporated in the present project entitled **“Secure Cloud Storage To Farm Data”** is original work. This work (in part or in full) has not been submitted to any University for the award of a Degree or a Diploma. We have properly acknowledged the material collected from secondary sources wherever required. We solely own the responsibility for the originality of the entire content.

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**EXAMINER’S APPROVAL CERTIFICATE**

The project report entitled “**Secure Cloud Storage To Farm Data**” submitted by Pranjali Kulkarni (MITU23BTCSD079), Om Kalbhor (MITU23BTCSD040), Shivraj Yadav (MITU23BTCSD065), Mayur Magar (MITU23BTCSD034) in partial fulfillment for the award of the degree of Bachelor of Technology (Computer Science & Engineering) during the academic year 2025-26, of MIT-ADT University, MIT School OF COMPUTING, Pune, is hereby approved.

**Examiners:**

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**ABSTRACT**

*The proliferation of smart farming technologies has led to the generation of vast amounts of data from sources like IoT sensors, drones, and manual inputs, heralding the era of data-driven agriculture. While cloud platforms offer an indispensable and scalable solution for storing and processing this data, they also introduce significant and complex security and privacy challenges that can deter adoption. In a collaborative agricultural environment, diverse stakeholders such as farmers, agronomists, researchers, and government agencies require access to shared data, creating a critical and non-negotiable need for granular, context-aware access control. This paper proposes a secure, multi-tenant cloud storage system designed specifically for the nuanced requirements of agricultural data. The proposed architecture leverages end-to-end encryption using industry-standard protocols like TLS for data in transit and AES-256 for data at rest. Critically, it implements a robust Role-Based Access Control (RBAC) mechanism to ensure that users can only access data pertinent to their specific, predefined roles, adhering to the principle of least privilege. The system includes a user-friendly dashboard for intuitive data visualization and management, aiming to provide a secure, scalable, and accessible solution that empowers data-driven decision-making in agriculture. This paper provides an in-depth literature review of existing technologies, details the proposed system architecture and security protocols, analyzes potential threats through a structured threat model, and discusses the implementation of the RBAC model as the cornerstone of the solution for safeguarding sensitive information.*

***Keywords****: Smart Agriculture, Cloud Storage, Data Security, Role-Based Access Control (RBAC), Encryption, Farm Data Management, Data Privacy, Internet of Things (IoT), Cybersecurity in Agriculture.*

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# INTRODUCTION

## Overview

Modern agriculture increasingly depends on technology to improve productivity, resource efficiency, and decision-making. Farmers often need to monitor various environmental and crop conditions, such as soil moisture, temperature, humidity, images of crop growth, and storage conditions. However, traditional manual monitoring methods are time-consuming, inaccurate, and lack real-time data accessibility. To address this problem, this project aims to develop a **cloud-enabled farm data collection and monitoring system**. The system collects sensor readings and images from farm environments and uploads them securely to **AWS Cloud Storage (S3)**. User authentication and access control are handled using **AWS Cognito**, ensuring that data is isolated for each user based on identity. A **React web application** is used to allow farmers or agricultural authorities to view, analyse, and manage farm data easily from anywhere. This platform ensures **data security, scalability, real-time access, role-based access,** and efficient storage management, making it suitable for small, medium, and large-scale agricultural deployments.

## 

### 1.2 Purpose of the Project

The main purpose of this project is to develop a **secure, reliable, and scalable cloud-based solution** for farmers to:

* Record and store farm-related sensor data automatically.
* Upload images and crop-related media for growth tracking.
* Access stored farm data from any device and any location.
* Share farm activity records with agricultural experts when needed.
* Make data-driven decisions to improve crop productivity and reduce losses.

The platform eliminates the need for manual data entry and provides **centralized cloud access** to all farm activities

The objectives are:

1. Cloud Storage of Farm Data : Store sensor readings and farm images in AWS S3 bucket in an organised folder structure.
2. Secure User Authentication : Implement AWS Cognito to allow login and ensure each user sees only their own data.
3. Role-Based Access Control : Assign roles such as Farmer, Expert, Admin to manage authorisation.
4. User-Friendly Web Dashboard : Develop a React-based web interface to display uploaded data in graphical or tabular format.
5. Scalability & Reliability : Use AWS cloud services to handle large data volumes and multiple users.
6. Real-Time Data Access : To reduce data management costs and infrastructure needs by utilizing cloud resources instead of physical storage systems.

## Scope of the Project

The scope of the project covers:

* 1. **Users**
* **Farmers** : Upload sensor readings and images; view crop data.
* **Agricultural Experts** : Analyze data and advise farmers.
* **Admin** : Manage users, roles, and data.
  1. **System Functional Scope**
* **Frontend:** React web application for login and dashboard view.
* **Backend / Security:** AWS Cognito for login and access control.
* **Storage:** AWS S3 for media and sensor data storage.
* **Access Policies:** IAM role-based policies to isolate user data.
  1. **Data Management Scope**
* Data is stored in structured format:
* /data/{role}/{userId}/sensor/
* /data/{role}/{userId}/images/
* /data/{role}/{userId}/profiles/
* Each user is isolated using **Cognito Identity ID**.
  1. **Geographic Scope**

The system is accessible from **any location worldwide** using web browser and internet.

* 1. **Future Scope**

This system can be expanded to:

* Real-time IoT device direct upload
* ML-based crop disease detection
* Automated irrigation triggers
* Android/mobile application support
* Integration with satellite weather forecasting

# CONCEPTS AND METHODS

## 2.1 Definitions

The concept of Secure Cloud Storage for Farm Data is based on integrating cloud computing, data security, and smart agriculture technologies to provide a reliable and safe platform for storing, accessing, and managing agricultural information. The system ensures that large volumes of data generated from farm activities are securely stored in the cloud and made available to authorized users for analysis and decision-making.

**1. Core Concepts**

**a) Cloud Computing**

Cloud computing provides on-demand access to computing resources such as storage, servers, databases, and applications over the internet.

It enables farmers to store data remotely without maintaining costly physical servers.

Common cloud service models include:

* + IaaS (Infrastructure as a Service): Offers virtualized computing resources (e.g., AWS EC2, Google Compute Engine).
  + PaaS (Platform as a Service): Provides an environment for deploying applications (e.g., AWS Elastic Beanstalk, Azure App Service).
  + SaaS (Software as a Service): Allows users to access applications via web browsers (e.g., farm data dashboards).

**b) Data Security**

Security ensures confidentiality, integrity, and availability (CIA) of farm data stored in the cloud.

Key mechanisms include:

* + Encryption: Protects data during storage (at rest) and transmission (in transit).
  + Authentication & Authorization: Ensures only legitimate users access data.
  + Access Control Policies: Define permissions for users (e.g., read, write, modify).
  + Data Integrity Checking: Ensures that data is not altered or corrupted during upload or transfer.

**c) Smart Agriculture**

Smart farming integrates IoT devices, drones, and sensors to collect real-time data such as soil moisture, temperature, humidity, and crop health. This data is then uploaded securely to the cloud for processing and analysis to assist in decision

# LITERATURE SURVEY

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# 

# PROJECT PLAN

## 4.1 Overview

## Modern agriculture increasingly depends on technology to improve productivity, resource efficiency, and decision-making. Farmers often need to monitor various environmental and crop conditions, such as soil moisture, temperature, humidity, images of crop growth, and storage conditions. However, traditional manual monitoring methods are time-consuming, inaccurate, and lack real-time data accessibility. To address this problem, this project aims to develop a cloud-enabled farm data collection and monitoring system. The system collects sensor readings and images from farm environments and uploads them securely to AWS Cloud Storage (S3). User authentication and access control are handled using AWS Cognito, ensuring that data is isolated for each user based on identity. A React web application is used to allow farmers or agricultural authorities to view, analyse, and manage farm data easily from anywhere. This platform ensures data security, scalability, real-time access, role-based access, and efficient storage management, making it suitable for small, medium, and large-scale agricultural deployments.

## 4.2 Project Objectives

* 1. Cloud Storage of Farm Data : Store sensor readings and farm images in AWS S3 bucket in an organised folder structure.
  2. Secure User Authentication : Implement AWS Cognito to allow login and ensure each user sees only their own data.
  3. Role-Based Access Control : Assign roles such as Farmer, Expert, Admin to manage authorisation.
  4. User-Friendly Web Dashboard : Develop a React-based web interface to display uploaded data in graphical or tabular format.
  5. Scalability & Reliability : Use AWS cloud services to handle large data volumes and multiple users.
  6. Real-Time Data Access : To reduce data management costs and infrastructure needs by utilizing cloud resources instead of physical storage systems.

## 4.3 Project Phase Timeline

|  |  |  |  |
| --- | --- | --- | --- |
| **Phase** | **Activities** | **Deliverables** | **Duration** |
| Phase 1: Requirement Analysis & System Design | - Identify user roles (Farmer, Expert, Admin)  - Define data access flow and storage structure  - Review AWS services (S3, Cognito, IAM)  - Design object key layout for S3 storage  - Create system architecture and ER diagrams | - Requirement Specification Document  - System Architecture Diagram  - Role-based Access Design  - S3 Object Prefix Structure Plan | Week 1–2 |
| Phase 2: Implementation & Development | - Configure Amazon Cognito User Pool & Identity Pool  - Setup IAM roles and policies for role-based access  - Create S3 bucket and apply prefix-based access policy  - Develop React Web Application for login/authentication  - Integrate SDK to upload/view data based on roles. | - Deployed Cognito Authentication System  - Working React Frontend with Login & Role-Based UI  - Secure Data Upload and Fetch Functionality  - Configured Cloud Storage with Access Control | Week 3–4 |
| Phase 3: Testing, Deployment & Documentation**Integration a H** | - Test authentication, data isolation & permissions  - Fix performance and logical issues  - Deploy final application on AWS (CloudFront / S3 Static Hosting)  - Prepare project report, user manual, and demo presentation | - Final Working System  - Deployment Logs & Test Results  - Final Project Report & Presentation Slides  - User Training / Demonstration | Week 4–5 |

## Table 4:1: Project Timeline

## 4.4 Project Outcomes

## Developed a secure cloud-based storage system using AWS S3 that organizes and stores farm data (sensor readings, images, and user details) efficiently with structured folder hierarchy.

## Implemented user authentication and access control through AWS Cognito, ensuring that only authorized users can log in and interact with the system.

## Enabled role-based data access (RBAC) so that Farmers, Experts, and Admins can only view or manage data according to their assigned roles, improving privacy and security.

## Built a React-based web interface that allows users to easily upload, retrieve, and view farm data from any device through the internet.

## Ensured data security and integrity by configuring IAM policies and identity-based access rules, preventing unauthorized users from accessing restricted data.

## Conducted test cases to validate correct access permissions, ensuring that data remains private to each user and role-based data isolation functions correctly.

## Gained hands-on experience in cloud computing, particularly in AWS services such as S3, Cognito, IAM, and CloudFront, enhancing practical cloud deployment skills.

## Produced documentation and a working demonstration, making the project ready for academic presentation and real-life extension into smart agriculture systems.

## .

# SOFTWARE REQUIREMENT SPECIFICATION

## 

## 5.1 Project scope

This project focuses on developing a secure, cloud-based platform for storing, managing, and accessing farm data collected from various sources such as sensors, crop images, and user inputs. It ensures data privacy and controlled access through role-based user authentication. The system enables farmers, experts, and administrators to collaborate effectively while maintaining security and data integrity.

**5.2 In-Scope Activities**

1. Cloud Storage Setup : Creating and configuring AWS S3 buckets for storing farm data securely.
2. User Authentication : Implementing AWS Cognito for login and identity management
3. Role-Based Access Control : Assigning user roles (Farmer, Expert, Admin) and restricting access accordingly.
4. Frontend Application Development : Building a React-based web interface for user interaction.
5. Data Upload and Retrieval : Allowing users to upload sensor readings and images, and view stored data.
6. IAM Policy Configuration : Implementing identity-based access permissions for secure data handling.
7. Testing & Validation : Performing test cases for access control, data privacy, and user isolation.

**5.2 Out-of-Scope Activities**

1. **Real-time IoT Device Integration :** The project focuses on cloud storage and security, not hardware connectivity.

2. **Mobile Application Development** : Only a web-based dashboard is developed in this phase.

3. **Machine Learning-Based Crop Predictions** : AI models are not included to keep scope manageable.

4. Automated Irrigation Control : Physical farm automation control is outside current software focus.

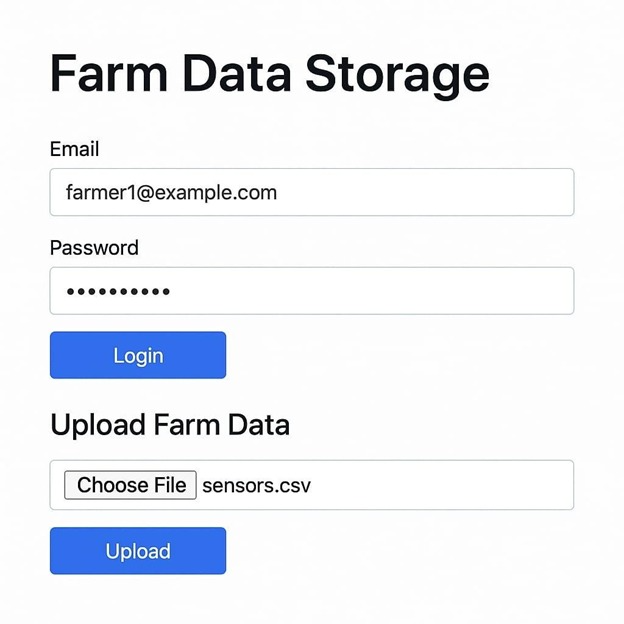
**5.3 Scope Summary**

This project covers the development of a secure cloud data storage and access system for smart agriculture applications. The system includes web-based user authentication, role-based access control, structured storage, and data viewing functionality. However, it does not include IoT hardware integration, data analytics, mobile app development, or automated hardware controls at this stage.

# RESULTS

## 6.1 Results

The developed system successfully achieved the goal of providing a secure and structured cloud-based storage platform for farm data. The platform allowed users to log in using AWS Cognito authentication and access the data stored in AWS S3 based on their roles. Farmers were able to upload and view their own farm sensor data and crop images, while experts could access global datasets for analysis. Admins retained full system control, including managing user accounts and permissions. The role-based access control policies ensured that data privacy was maintained, preventing any unauthorized user or role from viewing or modifying restricted data. The React-based web interface enabled smooth and user-friendly interaction with the cloud system.

**

**Figure 6.1:Results Snapshots**

# SOFTWARE TESTING

## 7.1 Overview

Software testing was conducted to ensure that the Farm Data Cloud Storage System performs reliably, securely, and accurately according to the defined functional and non-functional requirements. The testing process aimed to identify any errors, performance issues, or incorrect data handling before deployment. Both Black Box Testing and Functional Testing approaches were followed to verify user authentication, data storage, and access control mechanisms. Special focus was placed on validating Role-Based Access Control (RBAC) to prevent unauthorised data access.

**7.2 Test Environment Setup**

|  |  |
| --- | --- |
| **Component** | **Description** |
| Frontend | React.js Web Application |
| Backend Services | AWS Cognito (Authentication), AWS IAM (Permissions), AWS S3 (Data Storage) |
| Programming Languages | JavaScript (Frontend), JSON/YAML (IAM Policies) |
| Testing Tools | Browser Console, AWS CloudWatch Logs, Postman (for API validation) |
| Operating System | Windows |
| Network | Internet connection for cloud services |

Table 7.1 : Test Environment Setup

**7.4 Project Outcomes**

The system met all key functional requirements successfully:

1. **Secure Authentication:** Users logged in through AWS Cognito with protected session management.
2. **Controlled Data Access:** IAM role policies ensured that users accessed only permitted data.
3. **Cloud-Based Storage:** Farm sensor data and images were stored and retrieved securely from AWS S3.
4. **User-Friendly UI:** The React dashboard allowed easy navigation and file management.
5. **Scalability Achieved:** The architecture supports large data volumes and new user additions.

# CONCLUSION AND FUTURE WORK

**8.1 Conclusion**

The “Farm Data Cloud Storage and Authentication System” successfully demonstrates how modern cloud technologies can be leveraged to provide secure, scalable, and role-based access to agricultural data. By integrating AWS Cognito for user authentication and AWS S3 for data storage, the project ensures that only authorized individuals such as farmers, experts, and administrators can access specific data based on their needs and responsibilities. The implementation of role-based access control strengthened system security by preventing unauthorized access to sensitive farm records. The React-based user interface provided an intuitive platform for users to upload, retrieve, and monitor farm-related data. The system also ensures scalability, making it suitable for adoption at village, institutional, and government levels where large datasets are generated continuously. Overall, the project achieved its primary goals of improving data accessibility, enhancing security, and promoting digital data management practices in agriculture, contributing to the modernization and digital transformation of the agricultural ecosystem.

**8.2 Future Work**

Although the system performs its intended functions effectively, several enhancements can be incorporated to further extend its usability and efficiency:

1. **Mobile Application Development:** A dedicated Android/iOS application can be developed to allow farmers to upload and access data easily through mobile devices.
2. **AI-Based Data Analytics Integration:** Machine learning models can be added to analyze crop growth patterns, soil conditions, and weather data to provide automated decision-making suggestions.
3. **IoT Device Integration:** Real-time farm sensors (temperature, moisture, humidity) can be directly connected to the cloud system to automate data collection without manual uploads.
4. **Blockchain for Data Integrity:** Blockchain technology can ensure tamper-proof agricultural data records, useful for traceability and secure government policy applications.
5. **Multi-Language Interface Support:** The system can be enhanced with multiple regional languages to increase usability among rural farmers across different states.
6. **GPS Field Mapping:** GPS mapping features can be integrated to analyze field location-based data for precision farming applications.

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