



MONASH University

*FITS225: Cloud Computing
BirdTag: Serverless Bird Media Tagging System*

Group number

129

Team Leader:

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Team Members

Chaoyang Zheng(34665099)

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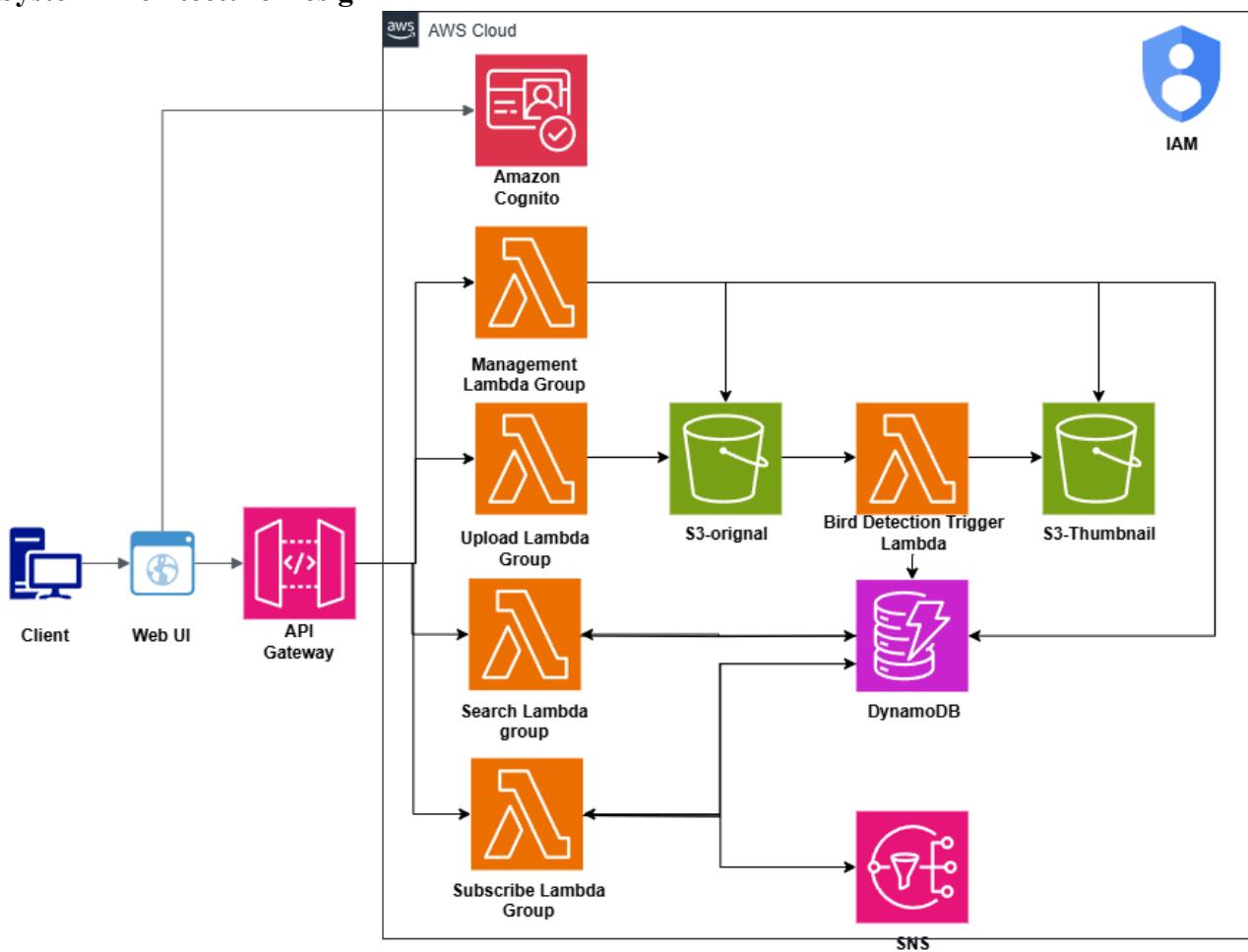
Yuchen Chi (33782695)

Introduction

BirdTag is a serverless web-based application developed for Monash University BirdBridge (MBB) to manage the lifecycle of bird-related media files, including image and audio uploads, automatic tagging, thumbnail generation, and searchable retrieval. The system is designed to help researchers and bird enthusiasts efficiently organize and access large amounts of field-collected media data.

BirdTag is built on a fully serverless architecture, leveraging key AWS services such as Lambda, S3, API Gateway, DynamoDB, and Cognito to ensure high scalability, low operational overhead, and strong access control. Whenever an image is uploaded, an automated pipeline is triggered: thumbnails are generated, tags are extracted, and metadata is stored and indexed for real-time querying.

System Architecture Design



System Architecture

The Bird Detection system adopts a serverless AWS architecture designed for secure, scalable, and efficient image tagging and metadata management. The core components and their interactions are illustrated in the architecture diagram and described below:

- **Amazon Cognito** handles user authentication, ensuring that only registered users can access the system's functionalities through the Web UI.
- **API Gateway** serves as the single entry point to the backend services, routing requests from the client interface to the appropriate Lambda groups.
- **Upload Lambda Group** processes image uploads by placing original images in the S3-original bucket. The upload event automatically triggers the **Bird Detection Trigger Lambda**.
- The **Bird Detection Trigger Lambda** performs two main tasks:
 1. Uses a YOLO model to detect objects in the uploaded image.
 2. Generates and stores a thumbnail version of the image in the S3-thumbnail bucket.It then writes detected tags, image URLs, and user metadata into **DynamoDB**.
- **Search Lambda Group** enables querying the database by tag, URL, or similarity, and returns relevant thumbnail links.
- **Management Lambda Group** supports editing and deletion of images and tags based on user input.
- **Subscribe Lambda Group** manages user subscriptions to specific tags. When new images with matching tags are added, **Amazon SNS** sends notifications to subscribed users.

This architecture ensures modularity, scalability, and secure access across all components.

Functional Workflow

1. User Authentication: Users sign up and log in through the Cognito secure interface.
2. Media Upload: Authenticated users upload images to an S3 bucket through the frontend UI.
3. Thumbnail and Tag Triggers: S3 triggers a Lambda function to generate thumbnails and another Lambda function to run the bird species tagging model.
4. Metadata Logging: Tags and file URLs are stored in DynamoDB.
5. Search and Retrieve: Users query based on tags through a RESTful endpoint and related files are returned.

Team Contribution Table

Name	Contributions Summary
Tianyi Song ● 34621830 ● Team Leader	Designed and deployed RESTful API endpoints using Amazon API Gateway, enabling dynamic species-specific image retrieval powered by optimized, indexed DynamoDB queries.
Chaoyang Zheng ● 34665099	Developed an event-driven serverless architecture with AWS Lambda to perform real-time image processing, including automated tagging and thumbnail generation, triggered by S3 upload events.
Yuchen Chi ● 33782695	Implemented secure and scalable user authentication and authorization using Amazon Cognito, including customized login and registration workflows with integrated user role management and session handling.
Xi He ● 31159214	Built a modern, interactive frontend interface for image uploads and keyword-based search, ensuring smooth integration with backend services and resolving full-stack deployment issues across AWS environments.

User Guide

Testing Instructions:

1. Navigate to the hosted BirdTag web interface.
2. Sign up using an email address and password. Confirm the email through Cognito.
3. Log in and upload a bird photo from the upload screen.
4. Wait for the thumbnail to appear and for the metadata to be processed (approximately 10–30 seconds).

Navigate to the search screen, enter a known bird tag (e.g., "parrot"), and click search.

View full-sized images by clicking any thumbnail result.

Note: Use developer tools to verify network/API response logs if no UI output is shown.

Git Repository

Our full source code and documentation is stored in a private GitHub repository (for development) :

- Development Links:
https://github.com/Nauxuswatchout/5225_assignment
https://github.com/Nauxuswatchout/5225_assignment.git
- This is the clean full version:
https://github.com/Nauxuswatchout/Ass3_individual
https://github.com/Nauxuswatchout/Ass3_individual.git
- Links for display
birddetection01-a8atg6ejgqabetz.australiaeast-01.azurewebsites.net

All team members committed their respective contributions under individual branches and merged changes through pull requests. The repository has been shared with the teaching staff.

Cost Analysis

We used AWS free-tier services for testing and deployment. All components (S3, Lambda, DynamoDB, Cognito) remain within the free usage limits. The architecture supports cost-effective scalability due to the event-driven, on-demand billing nature of serverless components.

Conclusion

The serverless AWS architecture designed by BirdTag effectively addresses real-world research challenges with minimal maintenance costs and maximum scalability. By leveraging event-driven workflows and fully managed cloud services, the system ensures high availability, cost-effectiveness, and easy deployment. The collaborative development process follows best practices in security, version control, and system modularity, laying a solid foundation for continuous innovation and long-term sustainability.

Appendix Main Page

The screenshot displays the main page of the Bird Detection platform, which includes a header, a top banner, a navigation bar, and two main sections: Platform Overview and System Workflow.

Header: The header features the "Bird DETECTION" logo, a "LOGIN" button, and a "REGISTER" button.

Top Banner: The banner shows a vibrant bird perched on a branch and contains the text: "Bird Detection: Intelligent Image Processing and Tag Subscription Platform". Below this, a subtext states: "After uploading an image, the system automatically detects its content and generates relevant tags. Users can search images by tags and subscribe to topics of interest to receive timely updates."

Navigation Bar: Below the banner are four dark rectangular buttons with white icons: "Upload" (a bird with an upward arrow), "Search" (a bird icon), "Subscribe" (a bird with a plus sign), and "Management" (a bird with a gear).

Platform Overview (Section 1): This section is titled "1 - Platform Overview". It includes a large image of a bird with a bounding box highlighting a specific area, and a detailed description of the platform's features and architecture.

Key Features of Bird Detection:

- Upload images directly via browser
- Automatic tag generation using object detection
- Multi-camera support system
- Search images by single or multiple tags
- Behavioral pattern analysis
- Subscribe to tags and receive SNS notifications
- Manage and delete uploaded images
- Scalable serverless backend (Lambda, API Gateway, DynamoDB)

System Workflow (Section 2): This section is titled "2 - SYSTEM WORKFLOW". It features an image of a person holding a parrot and a dog, and a detailed description of the workflow.

Technical Specifications:

- FastAPI-based backend running on AWS Lambda
- Real-time object detection using YOLOv8 model
- Tag data stored in DynamoDB with efficient indexing
- S3 bucket for original image and thumbnail storage
- JWT-based user authentication via Cognito
- Tag-based search using API Gateway endpoints
- SNS integration for tag subscription notifications
- Serverless and scalable cloud-native architecture

3 - WHY STUDY BIRDS?



Birds serve as crucial indicators of environmental health and ecosystem stability.

Understanding bird behavior and migration patterns helps predict environmental changes and assess climate impact.

Bird population monitoring contributes to biodiversity conservation and habitat protection efforts.

Benefits of Bird Research:

- Environmental health monitoring
- Climate change impact assessment
- Ecosystem balance indicators
- Biodiversity conservation
- Migration pattern analysis
- Species preservation efforts
- Habitat protection planning
- Educational research value

ABOUT US



Development Team

Tianyi Song (Masters of CyberSecurity)

Chaoxiong Zheng (Masters of CyberSecurity)

Yuchen Chi (Masters of Computer Science)

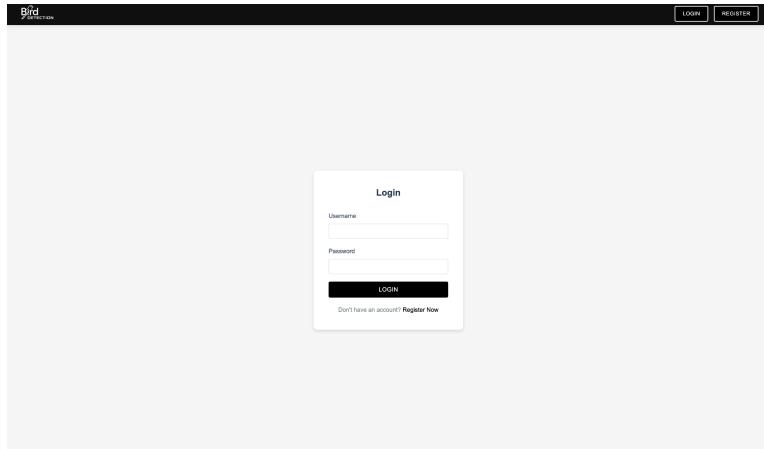
Xi He (Masters of Computer Science)

Contact us:

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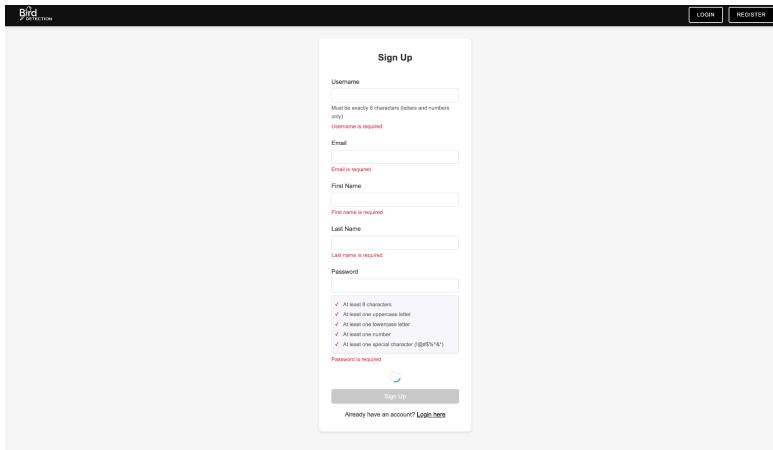


Log-in Page



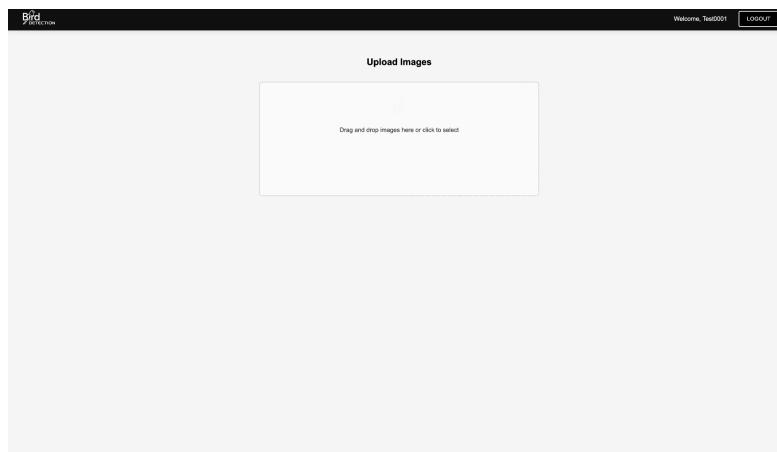
The screenshot shows a login interface. At the top right are 'LOGIN' and 'REGISTER' buttons. Below them is a 'Login' form with fields for 'Username' and 'Password'. A 'LOGIN' button is at the bottom of the form, and a link 'Don't have an account? Register Now' is below it.

Sign-up Page



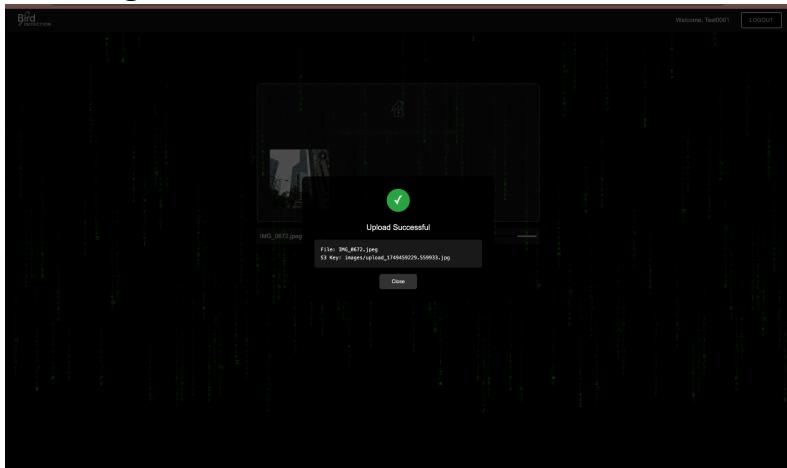
The screenshot shows a sign-up interface. At the top right are 'LOGIN' and 'REGISTER' buttons. Below them is a 'Sign Up' form with fields for 'Username', 'Email', 'First Name', 'Last Name', and 'Password'. The 'Password' field includes a password strength indicator showing 5 out of 5. A 'SIGN UP' button is at the bottom of the form, and a link 'Already have an account? Login here' is below it.

Upload Page

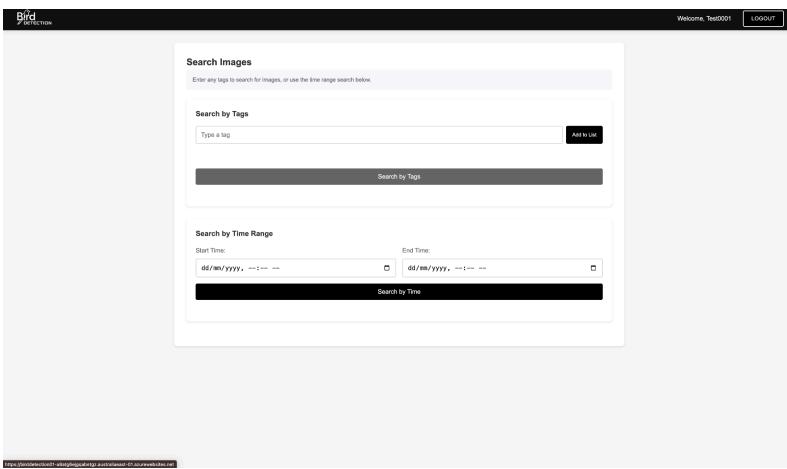


The screenshot shows an upload interface. At the top right is a 'Logout' button. Below it is an 'Upload Images' section with a large input area for dragging and dropping images. A placeholder text 'Drag and drop images here or click to select' is visible inside the input area.

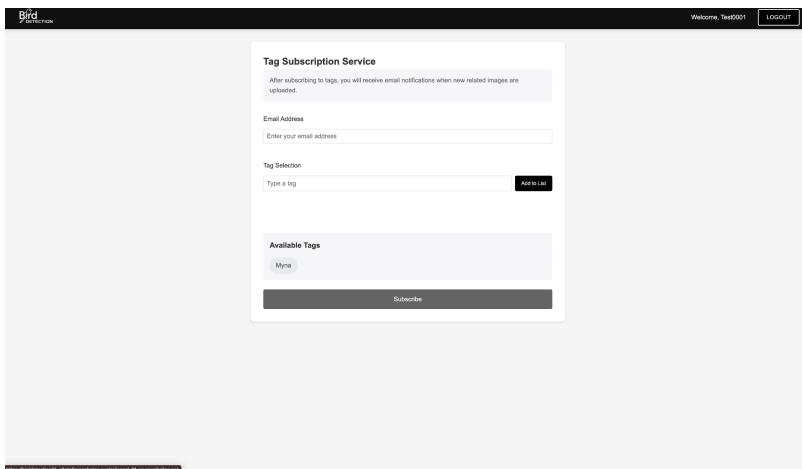
Successful Submission Page



Search Image



Subscribe Page



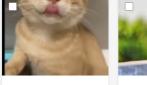
Management Page

Bird
DETECTION

Welcome, Test0001 | LOGOUT

Image Management

Filter by tag...

Image	Label	ID
	Myna	1d001f34-118f-54de-a24e-c05fc22adaf
	Owl	a79c1342-7d8c-52f4-a63e-13fb0e56fc
	Myna	1677205f-f12e-56aa-1cd8-c345f62e9460
	Owl	5486f6d6-1bd0-52c2-c138-f3abb79f4519
	unknown	8c13e3c3-9e4c-567b-98e1-6f80e43b20e
	Sparrow	32c05171-453b-5944-b513-6d911f923e98
	Crow	ed9797e0-8729-5321-9c21-02099112b3be
	Crow	5a1c7980-e485-5e78-8ef0-a4938839c57
	Kingfisher	39e3411b-8167-5195-8c23-8
	unknown	8c146ecb-0f6e-5cc4-99e3-5
	unknown	870bf14e-58db-579d-86ee-f
	Crow	1a770f59-e95c-580c-19fc-f

Deleted-image Page

Bird
DETECTION

Welcome, Test0001 | LOGOUT

Image Management

Filter by tag...

Image	Label	ID
	Myna	1d001f34-118f-54de-a24e-c05fc22adaf
	Owl	5486f6d6-1bd0-52c2-c138-f3abb79f4519
	Myna	1677205f-f12e-56aa-1cd8-c345f62e9460
	Owl	5a1c7980-e485-5e78-8ef0-a4938839c57
	unknown	8c13e3c3-9e4c-567b-98e1-6f80e43b20e
	Sparrow	32c05171-453b-5944-b513-6d911f923e98
	Crow	ed9797e0-8729-5321-9c21-02099112b3be
	Crow	5a1c7980-e485-5e78-8ef0-a4938839c57
	unknown	8c146ecb-0f6e-5cc4-99e3-5
	UNKNOWN	870bf14e-58db-579d-86ee-f
	Crow	1a770f59-e95c-580c-19fc-f

Deletion Complete
1 Images deleted successfully
0 Images failed to delete