

1. Waste Image Capture Using ESP32-CAM

Slide Title: Smart Waste Sorting with AI

What You Say:

"Our smart bins are equipped with ESP32-CAM modules. These cameras capture an image of the waste every time something is thrown into the bin. This image is sent via Wi-Fi to AWS Cloud services for classification, ensuring that the sorting is automated, precise, and in real-time."

Technical Explanation:

"The ESP32-CAM takes a picture when waste is deposited, sending it via HTTP POST to an AWS IoT endpoint, where it gets stored in an S3 bucket. From there, the image is processed by our machine learning model."

Code Snippet:

```
cpp
// Send the image to AWS S3 using HTTP POST
mqtt.publish("image_upload", imgData);
```

2. Waste Classification Using AWS SageMaker

Slide Title: AI-Powered Waste Classification

What You Say:

"Once the image reaches AWS S3, a Lambda function sends it to AWS SageMaker, where our machine learning model classifies the waste into categories like organic, plastic, or glass."

Technical Explanation:

"This system continuously improves its accuracy by training on thousands of images, ensuring adaptability as waste types evolve. Using AWS SageMaker, our model processes the image in real-time and sends back a classification to the bin, which then sorts the waste accordingly."

Lambda Function Code:

```
python
sagemaker_client.invoke_endpoint(
    EndpointName='waste-classification-endpoint',
    Body=image_data_from_s3,
    ContentType='image/jpeg'
)
```

3. Monitoring Bin Capacity with Ultrasonic Distance Sensors

Slide Title: Smart Capacity Monitoring

What You Say:

"Our bins aren't just smart in sorting waste—they also know when they're full. Ultrasonic

distance sensors constantly monitor the bin's fill level, sending real-time data to AWS IoT Core."

Technical Explanation:

"These sensors use MQTT to publish bin fill data, allowing the system to track bin capacity and optimize collection schedules."

Code Example for MQTT Integration:

```
cpp
mqtt.publish("bin/fillLevel", fillLevel);
```

4. Autonomous Robot for Bin Collection

Slide Title: Autonomous Robot for Smart Collection

What You Say:

"When a bin is full, Phoenix sends a command to our autonomous robot, which navigates to the bin using pathfinding algorithms and LiDAR sensors. It then transports the bin to the recycling center."

Technical Explanation:

"Our robot integrates AWS IoT and RoboMaker services to ensure it navigates efficiently without human intervention. The system communicates with the robot through AWS IoT Core."

Code for Robot Activation:

```
python
robot.publish('robot/start', bin_location)
```

5. Cloud-Based Control and Monitoring

Slide Title: Real-Time System Control and Monitoring

What You Say:

"The entire system—from the ESP32-CAMs to the robots—is centrally monitored and controlled through AWS IoT Core. This platform allows us to visualize all bin statuses, robot activities, and sensor data in real time."

Technical Explanation:

"By integrating AWS services, Phoenix achieves centralized data collection, allowing us to visualize trends, monitor efficiency, and optimize routes in real-time."

6. Data Analytics and Optimization

Slide Title: Data-Driven Optimization

What You Say:

"All data from sensors, cameras, and robot activities are collected and stored for analysis. Using AWS tools like QuickSight and Athena, we can track trends, predict when bins will fill up, and continuously improve waste collection processes."

Technical Explanation:

"This data analysis helps us forecast waste patterns, optimize bin collection schedules, and enhance overall efficiency."

7. Environmental Impact of Phoenix

Slide Title: Phoenix and the Environment

What You Say:

"Phoenix not only addresses Tunisia's waste crisis but also directly supports global sustainability efforts. By reducing landfill usage, Phoenix promotes recycling and contributes to cleaner cities and a greener Tunisia."

Connection to Environmental Theme:

"The efficiency of Phoenix lowers the carbon footprint of waste management systems, cutting down on unnecessary trips, reducing the use of landfills, and automating the recycling process—making our cities more sustainable."

Prototype Demonstration

Slide Title: Live Demonstration of Phoenix

What You Say:

"Now that we've gone through the technical aspects, let's see Phoenix in action. Here's how the smart bins capture and classify waste, how the robot is triggered when the bin is full, and how the system makes real-time decisions to ensure efficient waste collection."

8. Closing: Call to Action

Slide Title: Join Us in Leading the Future with AI

What You Say:

"With Phoenix, we can solve real-world environmental problems through AI and automation. We invite you to support this initiative and help shape a greener, more sustainable Tunisia."