Argonne National Laboratory
Rezy – AI Support Chatbot for EV Charger Reservation App (EVrez)

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Argonne National Laboratory: Advancements in Energy and Sustainability

- **Founded:** 1946 and is operated by UChicago Argonne LLC for the U.S. Department of Energy.
- **Research Areas:** Nuclear and Renewable Energy, Material Science, Environmental Sustainability, Advanced Computing and AI.
- **Business Model:** Collaborative partnerships with industry, government and academia for technology transfer and commercialization.
- **Notable Achievements:** Significant contributions to EV battery technology and climate modelling.

Argonne National Laboratory. (n.d.). *Argonne National Laboratory*. Retrieved April 22, 2025, from https://www.anl.gov/

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Business Problem: Enhancing the EVRez App

Argonne National Laboratory seeks to **develop a chatbot for its EVrez app to automate key functionalities,** including support ticket resolution, cancellation of invalid reservations, and generation of personalized EV charging analytics.

Our solution aims to enhance operational efficiency and user experience by fine-tuning an open-sourced LLM to implement a chatbot that can enable smooth, data-driven interactions for **streamlined task execution and improved employee support to minimize manual ticket resolution.**

Exploring User Stories for Chatbot Feature Brainstorming

User Need	Problem	Chatbot Role
Fixing a Stuck Reservation	Reservation didn't go through but is blocking the time slot	Auto-detect stuck reservations and assist in fix or cancellation
Offline Station Alert	User arrives at a non-functional charger	Preemptively alert users about offline stations
Account Access Issues	Unable to log in or view history	Guide through troubleshooting steps
Conduct Score Clarification	Confusion about a score drop	Explain score change using historical behavior
Charging Analytics	User wants personal usage stats	Generate personalized charging insights
First-time User Support	Needs help making their first reservation	Provide onboarding with step-by-step guidance

Automating the "Report an Issue" Ticket Flow by Identifying Current Pain Points

Current Pain Points

The "Report an Issue" button in the EVrez app generates support emails that are **manually classified and resolved by the Argonne team.** This process involves:

- Checking reservation and charging session data
- Canceling stuck reservations
- Investigating charger communication failures
- Responding individually to each ticket

Goals

Develop an **LLM-powered automation system** that:

Understands user-submitted tickets

Detects issue types automatically

Executes backend actions like:

- Canceling stuck reservation
- Notifying about offline chargers
- Classifying tickets for smarter routing

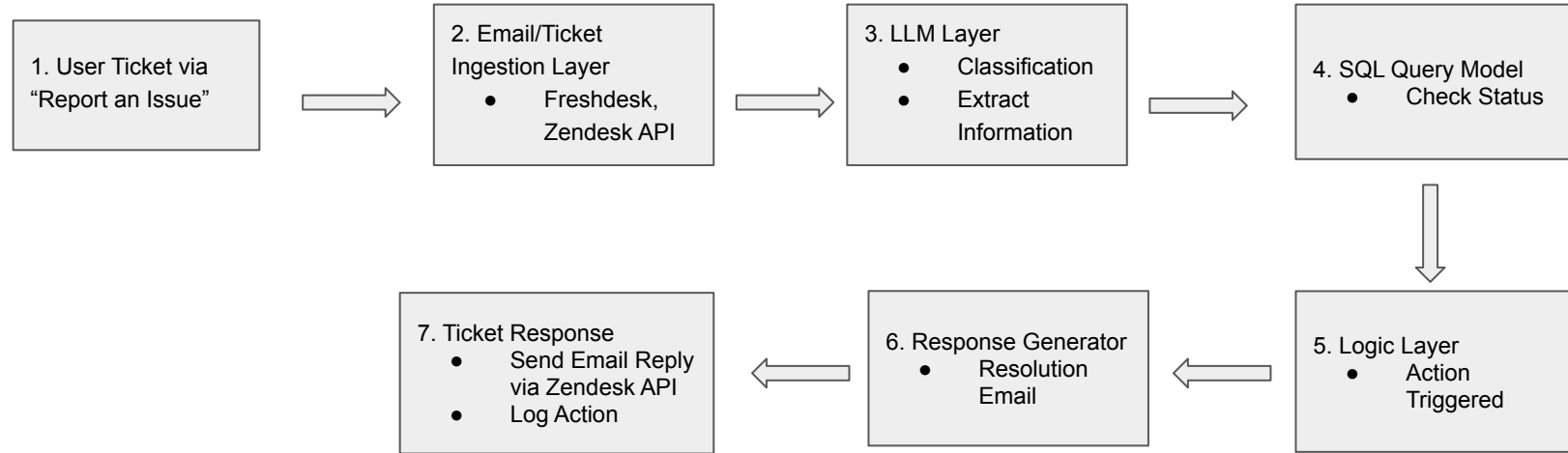Improves user experience and resolution speed

Example Scenario

"My charger didn't start. Can you cancel the reservation?"

Chatbot Action:

- Classify as *Stuck Reservation*

- Query DB → detect incomplete session

- Auto-cancel → Send confirmation email

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Laying the Foundation of the MVP LLM Schema

```
┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│ 1. User Ticket  │     │ 2. Email/Ticket │     │ 3. LLM Layer    │     │ 4. SQL Query    │
│    via          │ →   │    Ingestion    │ →   │  ● Classification│ →   │    Model        │
│ "Report an Issue"│     │    Layer        │     │  ● Extract      │     │  ● Check Status │
│                 │     │  ● Freshdesk,   │     │    Information  │     │                 │
│                 │     │    Zendesk API  │     │                 │     │                 │
└─────────────────┘     └─────────────────┘     └─────────────────┘     └─────────────────┘
                                                                                 ↓
┌─────────────────┐     ┌─────────────────┐     ┌─────────────────┐
│ 7. Ticket       │     │ 6. Response     │     │ 5. Logic Layer  │
│    Response     │     │    Generator    │     │  ● Action       │
│  ● Send Email   │ ←   │  ● Resolution   │ ←   │    Triggered    │
│    Reply via    │     │    Email        │     │                 │
│    Zendesk API  │     │                 │     │                 │
│  ● Log Action   │     │                 │     │                 │
└─────────────────┘     └─────────────────┘     └─────────────────┘
```

The initial MVP focuses on resolving support tickets via email. In the next phase, we plan to scale the model to handle tickets directly within the app through a chatbot interface.

- *DeepSeek GitHub: https://github.com/deepseek-ai/DeepSeek*
- *Almeida, R. (2024). *Fine-tuning DeepSeek for Custom Chatbots*. Medium Lyzr Agent for Ticket Systems. Medium. https://medium.com/@lyzr-ai/llm-customer-service-chatbot*

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Model Comparison: Exploring Open-Source Models for Fine-Tuning and Fit for EVRez

Model	Cost & Compute	Fit for EVrez
GPT (OpenAI)	O3-mini: $1.10–$4.40/1M tokens O1: $15–$60/1M tokens	Pros: Great for prototyping, ANL has an existing GPT model Cons: Costly, External API
MVP Choice: DeepSeek Chat 7B	$3–10 (2–4h, 1 GPU) Free model on HuggingFace Requires minimal storage	Pros: Cost-efficient, Private storage
Hugging Face Trainer	Free on Colab, $0.5–$3/hr on cloud Flexible time/storage	Pros: Good for pipeline integration Cons: External API

- OpenAI. (2024). *Pricing*. Retrieved from https://openai.com/pricing
- Rafael Costa de Almeida. (2024). *How to fine-tune DeepSeek-R1 using LoRA*. Medium. Retrieved from https://medium.com/@rafaelcostadealmeida159/how-to-fine-tune-deepseek-r1-using-lora-7033edf05ee0
- Hugging Face Documentation. (2024). *Training and deployment*.Retrieved from https://huggingface.co/docs/transformers/training

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Utilizing DeepSeek Saves on Storage, Cost, and Computational Complexity

- We can utilize **transfer learning methods** such as ULMFiT:
    - DeepSeek is pre trained using language modeling
    - **Adapt the domain to ticket corpus** to fine-tune weights
    - Fine-tune the model using a classification layer to identify a ticket's issue class

- Transfer learning takes **less time, compute, and labelled data** compared to training a language model from scratch.

- **Important Applications:**
    - Text Classification: Identify ticket issue
    - Named Entity Recognition: Identify employee sentiment for product
    - Question-Answering: Querying database for response
    - Text Generation: Responding to prompts in the chatbot

Tunstall, L., von Werra, L., & Wolf, T. (2022). *Natural language processing with transformers* (1st ed.). O'Reilly Media. Chapter 1: Hello Transformers. ISBN 978-1-098-10317-0.

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Exploring Data on Vehicle Information, Charging Statuses, Ticket Issues for Model Development

- **Datasets**:
  - Several tables related to account history, driver behavior, vehicle information, station and logical state statuses, OCP data, and station information
  - Dataset on tickets sent via email by drivers through the app

- **Can gain insight into:**
  - Driver preferences
  - Which stations have lost OCP connection
  - How many miles a driver will charge their vehicle
  - Station energy loads
  - Station reservations
  - Popular Stations
  - Driver pain points with the app and stations

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Ticket Data Has To Be Restructured for LLM Fine-Tuning

- Currently, the data is stored such that one ticket entry has information related to creation time, resolution time, status, and description

- For fine-tuning the data must be reformatted into a **message-response format**

    {"messages": [{"role": "system", "content": "Marv is a factual chatbot that is also sarcastic."}, {"role": "user", "content": "What's the capital of France?"}, {"role": "assistant", "content": "Paris, as if everyone doesn't know that already."}]}

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Evaluating LLM Performance on Ticket Classification Using Accuracy, Resolution, and User Satisfaction

Model Evaluation

Classification Accuracy Testing	Resolution Rate Metrics	User Satisfaction Measurement
• Measure accuracy of ticket issue classification (stuck reservations, offline stations, etc.)	• Percentage of tickets automatically resolved without human intervention	• Post-interaction surveys on resolution quality
• Confusion matrix analysis for misclassification patterns	• Average resolution time compared to manual process	• Net Promoter Score (NPS) for chatbot interactions
• Precision and recall metrics for each issue category	• Success rate of automated actions (cancellations, status updates)	• User retention and engagement metrics

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Final Model Will Improve Ticket Resolution and Technical Performance

Prospects of the Project

Operational Efficiency & User Satisfaction

- Reduction in manual ticket handling time

- Automated resolution of 40-50% of common support tickets

- Increased app engagement from improved support experience

Issue Resolution Insights

- Most common ticket types (likely stuck reservations and connection issues)

- For less common issue types, our model can be continuously trained and improved during future implementations through feedback loops

Technical Performance

- Response generation quality comparable to human support

- LLM expected to achieve >85% classification accuracy

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Executive Summary

	Project Background	Dataset Overview	Project Prospect
ANL	A **non-profit organization** funded by the Department of Energy collaborating with industry, government and academia groups for **technology transfer and commercialization.** Implementation of a **chatbot in the EVRez app to streamline ticket resolution** and improve employee service.	Datasets include tables with information regarding **EV stations, employee account behavior, and employee charging behavior**. Data needs to be **restructured** into the message-response training format.	Utilizing **DeepSeek** as the initial MVP for resolving tickets via Email **Evaluating the model** on classification accuracy, resolution rate metrics, and employee satisfaction surveys Overall aim is to **develop the chatbot** to match manual resolution and act as a customer service query tool.

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Thank You!