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Livestock Well-being Identification

The Team

- Adam Sweiger
- Meet Patel
- Asad Abdalla
- Mohammed Elbermawy
- Yannick Fumukani
- Rashed Alyammahi
- Lucas Chekwa
- Richard Gonzalez

Advisor/Client: Dr. Ashraf Gaffar, Teaching Professor [E CPE]

Project Context

- 2021 USDA Statistics on farms in Iowa:
  - Over 30 million acres
  - 84,900 farms
  - About 42 million livestock
- Our goal: Identify illness in farm animals
- How? By training an AI model to identify patterns in the spectrogram and differentiate between healthy and sick animals

Applications

- Identifying illness in farm animals
- Livestock farms
- Wilderness Conservation

Functional Requirements

- Capture the sound of different sick and healthy animals
- Encode the sound waves
- Train the machine to recognize different sound patterns
- Model should reach an accuracy that is desired by the client (TBD)
- Model should be scalable (able to handle different sized datasets)

Resource Requirements

- Linux Virtual Machine
- GPU
- Keras framework
- Anaconda
- Various sounds of sick and healthy animals

Design Overview

- Collecting sound recordings of healthy and sick animals
- Supervised Deep neural networks (DNNs)
- Validation strategies (cross-validation)

Design Complexity

- Requires comprehensive understanding of sound frequencies, vocalizations and noise animals make in various health states
- Detailed knowledge about the animals natural behaviors
- Robust recognition capabilities
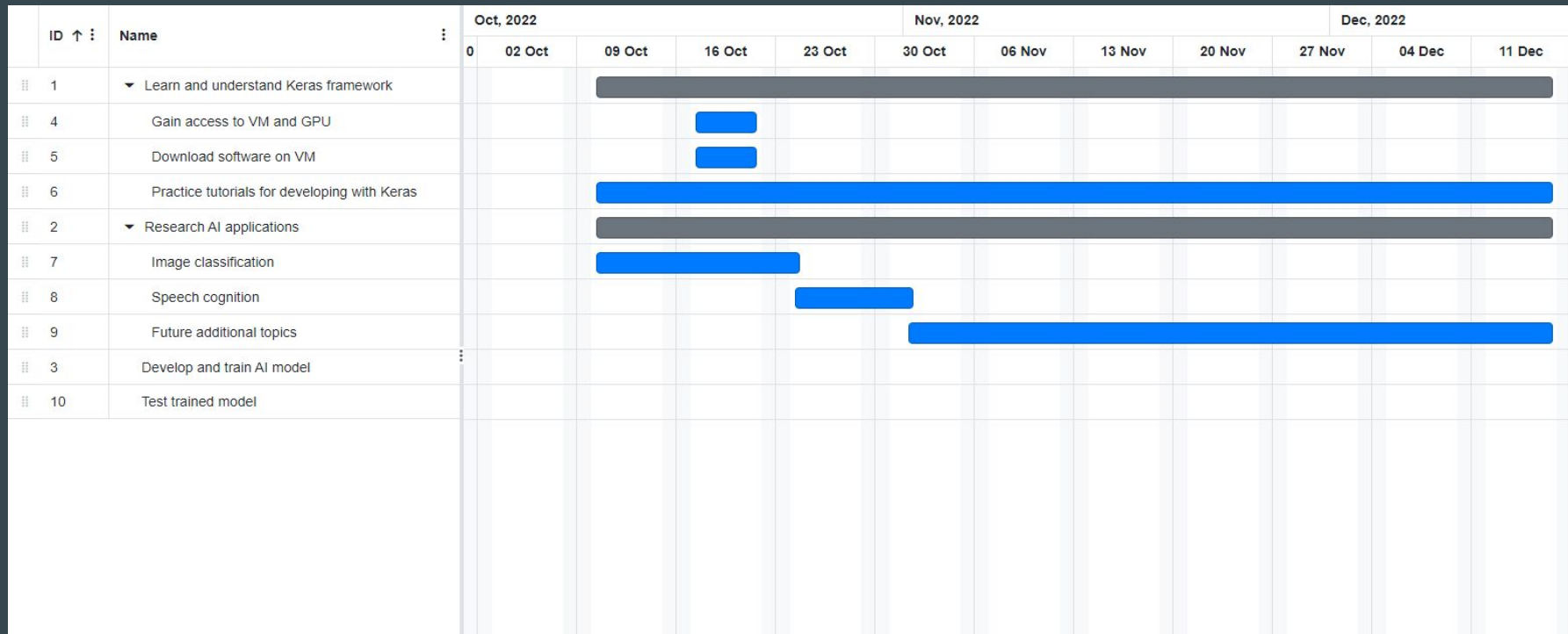- Analyze various aspects of an audio sample (frequency spectrum , timbre)
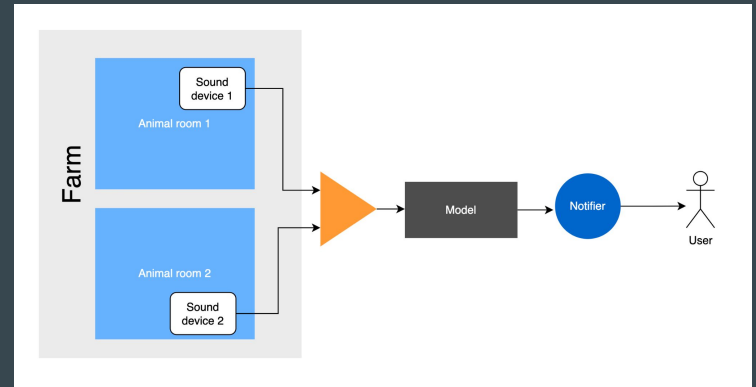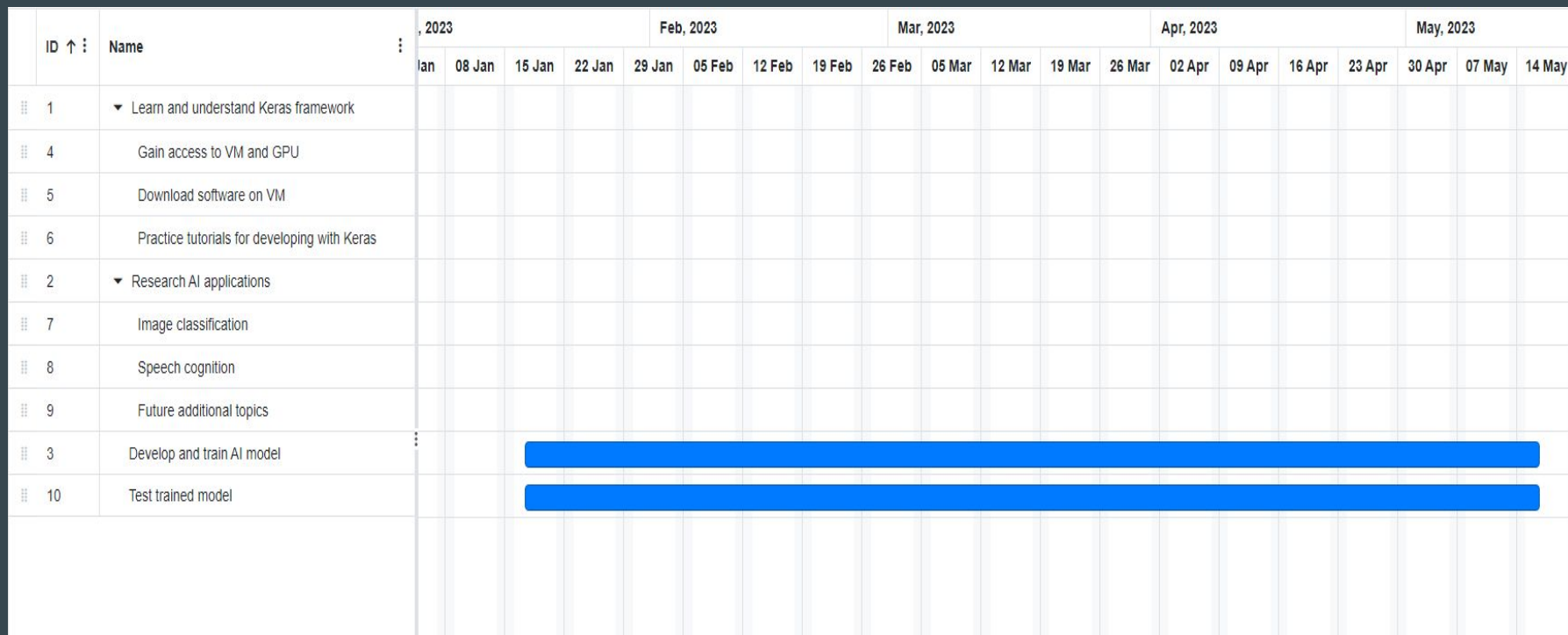
Example Functionality
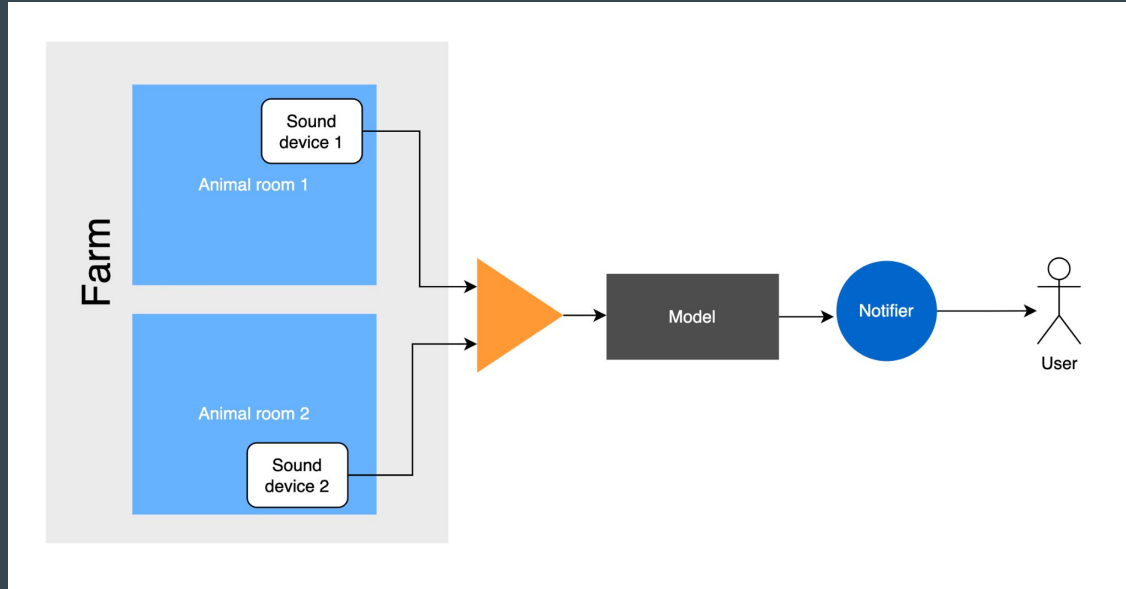
Project Plan

- Analyze AI domain and available technologies
- Learn how to use Keras development framework
- Collect sound data of different sick and healthy animals
- Develop AI model to analyze animal sounds
- Adjust the model until the client's requirements are met

Fall Semester Gantt Chart

ID ↑ ⋮	Name	Oct, 2022					Nov, 2022					Dec, 2022		
		0	02 Oct	09 Oct	16 Oct	23 Oct	30 Oct	06 Nov	13 Nov	20 Nov	27 Nov	04 Dec	11 Dec
1	▾ Learn and understand Keras framework												
4	Gain access to VM and GPU												
5	Download software on VM												
6	Practice tutorials for developing with Keras												
2	▾ Research AI applications												
7	Image classification												
8	Speech cognition												
9	Future additional topics												
3	Develop and train AI model												
10	Test trained model												

Spring Semester Gantt Chart

ID ↑ ⋮	Name	, 2023					Feb, 2023				Mar, 2023				Apr, 2023				May, 2023	
	⋮	Jan	08 Jan	15 Jan	22 Jan	29 Jan	05 Feb	12 Feb	19 Feb	26 Feb	05 Mar	12 Mar	19 Mar	26 Mar	02 Apr	09 Apr	16 Apr	23 Apr	30 Apr	07 May	14 May
1	▼ Learn and understand Keras framework																				
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6	Practice tutorials for developing with Keras																				
2	▼ Research AI applications																				
7	Image classification																				
8	Speech cognition																				
9	Future additional topics																				
3	Develop and train AI model			██																	
10	Test trained model			██																	

Risks and Mitigation Plan

- Model might not be developed well enough to achieve desired accuracy
  - Risk factor > 0.5
  - Mitigation plan: Improve code for the model, seek technical help from advisor

- Not enough sound data to achieve desired results
  - Risk factor > 0.5
  - Mitigation plan: Work with advisor to collect additional data from other sources

Test Plan

- It is not traditional testing.
- Measure and compare output.
- Measure the distance.
- Change the hyperparameters and train again.

Testing Results

- Ensure that AI Model can identify the sick from healthy ones
- Testing Process includes Validation and Verification Process
- In Validation step, we will test AI Model with set of known data and use it to verify if our model identifies the sick animal correctly or not
- In Verification step, we will test AI Model with set of new data to ensure that the output is still accurate

Testing Implementation

- We will receive the data from our client
- Convert the sounds to spectrograms
- Train the model using these sound datas
- Adjust the model until it meets our client expectations
- Ensure that the result is highly accurate at the end.

Conclusions

- What we've done so far:
  - Researched image classification, speech cognition, and sound patterns AI
  - Learned how to use Keras and TensorFlow
  - Conceptualized design of our model
- Plans for next semester:
  - Develop solution
  - Train model
  - Adjust model

Citations

- "2021 State Agriculture Overview." USDA/NASS 2021 State Agriculture Overview for Iowa, https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=IOWA.