Modeling Climate Change Impacts on Cattle Behavior Using GenAI

A Pathway to Adaptive Livestock Management

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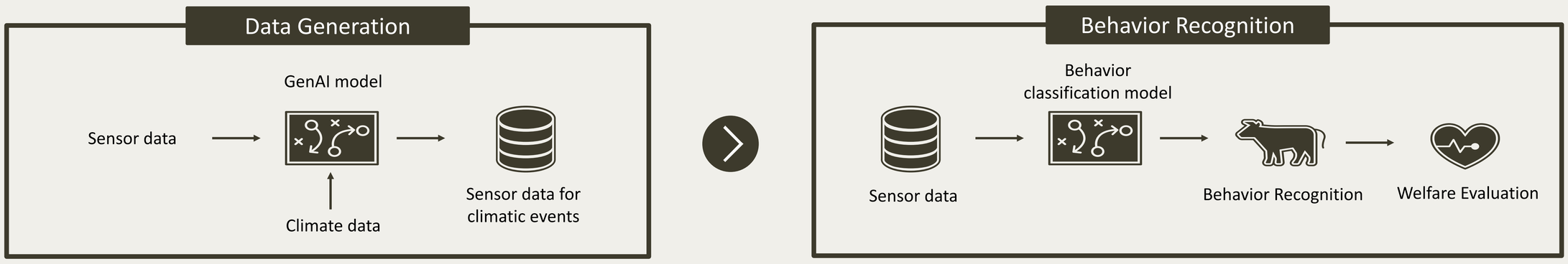
PROPOSED PROCEDURE

- **Goal:** Utilize generative AI to predict the impact of climate change on cattle
- **Relevance**: Proactive assessment of future challenges in livestock farming
- **Steps:** Climate forecasting, data generation, behavior recognition
- **Climate forecasting**: Develop future climatic scenarios to analyze cattle behavior
- **Data generation**: Learn generative AI models and synthesize realistic data for climatic scenarios
- **Behavior recognition:** Derive the cattle behavior for scenarios



FORECASTING

CLIMATE CHANGE OUTLOOK

- **Scientific basis**:
  - Analysis based on 6th IPCC assessment reports
- **Emission scenarios**:
  - High, medium and low emission scenarios
- **Heat stress focus**:
  - Cattle are very susceptible to heat stress
  - Focus on rising temperatures, especially high-emission scenarios

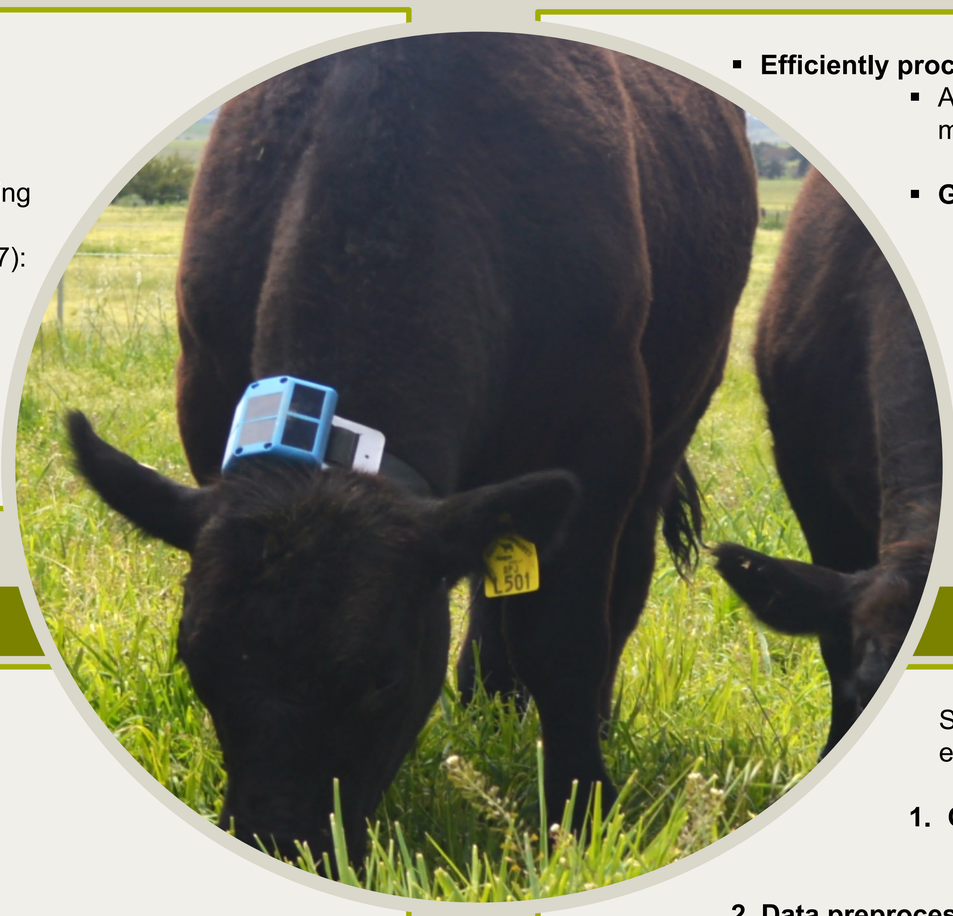
CLIMATE CHANGE IMPACT ON CATTLE BEHAVIOR

- **Climate Change impact**:
  - Focus on effects of heat stress on cattle behavior and welfare
- **Heat stress effect**:
  - Disrupted homeostasis, reduced feed intake and milk yield
  - Lowered reproductive efficiency, increased disease vulnerability
- **Objective**:
  - Forecast potential climate change scenarios
  - Develop adaptive strategies for enhanced livestock management

DATA GENERATION

CREATE SYNTHETIC SENSOR DATA WITH GENAI

- **Extensive review** on genAI applications for analyzing accelerometer time-series data
- **Key studies**:
  - Afandizadeh Zargari et al. (2023): Refining accelerometer data with genAI
  - Munoz-Organero & Ruiz-Blazquez (2017): GenAI model for human movement
- **Research focus**:
  - Utilizing GenAI and Deep Learning techniques like Autoformer to generate synthetic data



REASONS TO CHOOSE GENAI

- **Efficiently process large amounts of data:**
  - Accelerometer data is available with multiple measurements per second
- **Generating data for unseen scenarios:**
  - Models **learn relationships** and important characteristics without complex parameter tuning
  - Simultaneously **generate** realistic **data**
- **Effective adaptation** of the **transformer** architecture, utilize existing models

BEHAVIOR RECOGNITION

DERIVE CATTLE BEHAVIOR

- Deep Learning models provide **precise insights** into cattle **welfare**
- **Behavioral changes** detected through these models can **indicate health issues**, enhancing early intervention strategies
- **Deep Learning** models **outperform other** models in accuracy despite their computational demands

MODEL DEVELOPMENT

Steps to be taken to integrate all components effectively:

1. **Climate scenario development**
   - Model climate scenarios using baseline meteorological data
2. **Data preprocessing**
   - Perform quality checks, normalize data and add seasonal features
3. **Generative model application**
   - Adjust and apply generative models developed for similar data
4. **Cattle behavior model application**
   - Select the most accurate model and apply it to generated data
5. **Cattle welfare derivation**
   - Analyze classification results and derive conclusions on cattle welfare

CONCLUSIONS

- **Climate action**: Climatic scenarios highlight the urgency for climate interventions
- **Regional insights**: Guides retrieval of region-specific insights
- **Future research**: Supports studies on climate change adaptation

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