Using AI in Livestock farming

# Project Overview

The project leverages AI to create solutions that provide value and insight into the health of livestock and plants. This is all to improve farm management and operation. Image and video processing is used to provide these insights.

# Business Problem

Livestock and plant health monitoring on farms is prone to inefficiencies:

1. **Inefficient monitoring**: Legacy methods of monitoring rely heavily on manual observation and periodic checks. Of which, both are labour-intensive and susceptible to inaccuracies and human error. Which subsequently leads to increase in resource consumption
2. **Data Limitations**: Reliance on outdated and inefficient data collection models leave decision makers with incomplete information which prohibits their ability to make timely and informed decisions
3. **Delay in Response:** With existing systems there is a delay between occurrence of issues and threats and their identification which can exacerbate problems and lead to outbreaks and escalations before they are addressed.

All of these lead to increased operational costs, loss of livestock and crops; higher risks and suboptimal farm management practices.

# Objectives

Farm wellness

Primary Objective

The principal objective is to develop an advanced AI-based system with the capability of receiving multimedia input and analysing the data. This is primarily directed at both livestock and crop farms. The overall achievement of the system will be to enhance overall farm productivity and sustainability.

Secondary Objectives

1. **Detect Anomalies:** Implement methods to quickly identify deviations from normal behaviour and unexpected events, including but not limited to, threats to the security of livestock and facilities
2. **Provide Actionable Insights:** Provide insights to farm managers, from data collected and analysed by the AI solution. These insights and recommendations must be actionable, useful and practical. The insights could be used make informed decisions about farm operations which optimises the overall productivity and efficiency.
3. **Enhance health Monitoring of Livestock and Plants**: The AI tool will continuously monitor the health of livestock and plants which will promote early disease detection
4. **Accessibility and Ease of Use:** Making data insights and analytics more accessible to farmers of all tiers.

# Solution and Innovation

Video Analysis:

**Whole Picture Approach**: System makes use of YOLO which processes video input using a single neural network instead of multiple like other models. This ensures the accuracy of the video analysis because the video is processed at a higher fps rate than other models that would need to break the video into individual frames. This ensures superiority in performance and efficiency.

Integration of Scientific Reasoning:

**Behavioural insights**: Drawing on latest research in animal behavour as well as trained models the solution is able to provide detailed explanations and context for observed behaviours. This offers a deeper understanding for causes and effects

**Customised Analysis:** System is able to tailor its analysis to specific animals and farm environments. This provides personalised insights that are relevant to operations

Easy to Use:

**Clear and Simple**: The interface is straightforward and easy to understand, even if you’re not tech-savvy. It gives you clear insights that you can act on right away.

Mobile Alerts: Farmers get updates on their phones, so they’re always in the loop, no matter where they are on the farm.

**Accessibility:** The Tool is available both online and on telegram which makes it accessible to farmlands and farmers of all sizes

**Multilingual Support**: The model can communicate in South African languages, making it accessible to a wider range of users and ensuring that more farmers can benefit from its insights.

Scalability and Adaptability:

**Scalable for all sizes:** Whether you’ve got a small family farm or a big commercial operation, this system can scale up or down to fit your needs.

**Adaptive Learning:** The AI continues to learn and adapt from new data, ensuring it stays relevant and effective as things change

Predictive Analysis:

**Early Disease Detection**: The AI can also detect signs of illness that are somewhat hard to see and/or identify by the farmer which allows farmers to take move into action before things worsen.

**Mating and Social Dynamics:** It determines when animals are ready to reproduce through observation of their behaviour patterns. This helps with mating management.

Welfare and Sustainability:

**Animal Wellbeing**: Improvement in livestock management ensures better livestock welfare and supports ethical farming practices.

**Resource Efficiency:** Smarter herd management ensues resource usage is more efficient, which reduces waste and assists in sustainability.

Competitive Edge:

Traditional methods rely heavily on manual observation and basic monitoring tools. These may not capture the full scope of animal behavour. This tool automates the process and provides a level of accuracy and detail that is hard to achieve manually.

# Viability

Technical Viability

**Feasibility:**

There have been advances made with Artificial Intelligence and video processing technology. With the accomplished maturity level these allow for the deployment of highly accurate and reliable models for analysing livestock and plant behaviours. This is enforced by proven success of similar technologies in other sectors. This demonstrates the capability of our solution to handle complex data analysis tasks efficiently.

**Scalability:**

The system is designed with scalability I mind, the architecture used is capable of expanding in order to satisfy the requirements and tailor to the specific needs of the farms. Th architecture is capable of expanding without sacrificing performance which means it is anle to process and analyse increasing volumes of data. The system utilizes cloud-based infrastructure which can dynamically allocate resources based on demand, ensuring scalability across multiple farms regardless of their size or location.

**Integration:**

The system is developed with integration competences to ensure it can seamlessly connect with various existing farm management systems. As well as adopt to any new tools that will be used as continuous improvement. Disruptions to current operations are minimised and user adoption rates are enhanced. This is all achieved by embedding into familiar workflows. API-based integration ensures that the AI tool can easily communicate with major farm management software platforms, enabling real-time data exchanges and cohesive functionality.

Economic Viability.

**Market Demand:**

Market Research suggests that there is a “15% annual growth rate in the adoption of smart farming technologies, with particular interest in AI-driven solutions for behavioral analysis and health monitoring.” (Orsof, H.Y, Nov, 2023)

There is a viable trend in agriculture showing growing demand for precision agriculture and smart farming solutions. It is driven by the need for sustainability, increased crop yield, and enhanced livestock health, all of which are addressed by the System

# User Interface

The Tool is hosted online and as a bot in Telegram

A simple user interface is crucial for an AI model analyzing livestock behaviour. As it makes the system accessible and easy to use for farmers and livestock managers, each of which may have different levels of comfort with technology. By focusing on simplicity, the interface allows users to quickly access important information and insights. This helps them make rapid decisions about livestock management. The understated design ensures that essential features are clearly highlighted; preventing users from feeling overwhelmed by too much information. This UI reduces frustration and encourages regular use, while also making it easier to provide feedback for improvements. It is also important to note that simple interfaces work well on various devices like tablets and smartphones, which are often used in farming settings. Overall, a straightforward design ensures the tool is practical and effective, ultimately leading to better livestock management and productivity.

# Conclusion

We're really excited about the strides we've made with our AI-based tool for analysing video footage in livestock farming. This tool is a game-changer in how we understand livestock behaviour, monitor plant health, and enhance farm security through advanced video analytics.

Reflection on Project Evaluation Criteria

**Problem Identification and Definition**:

We began by pinpointing a significant gap in traditional farming methods—the lack of real-time, efficient monitoring systems. Our solution was crafted to fill this gap, ushering in a new era of data-driven farm management.

**Solution Innovation:**

Our AI tool breaks new ground by transforming complex video data into actionable insights, a leap forward from conventional, labour-intensive methods. Adding real-time security features, the tool offers an all-encompassing solution that modern farms truly need.

**Technical Implementation:**

We've adhered to the highest standards in coding and system design. The AI models are robust, efficient, and cleanly coded to ensure reliability and maintainability.

**User Experience (UX):**

We've designed the user interface to be as intuitive as possible, making sure it’s accessible to everyone on the farm, regardless of their tech skills. The feedback has been overwhelmingly positive, emphasizing ease of use and engagement.

**Minimum Viable Product (MVP):**

The MVP effectively tackles the core issues we set out to address. It's not just a proof of concept but a fully functional part of our toolkit that we’re eager to build upon.

**AI Implementation**:

The AI capabilities within our tool have transformed traditional farming operations by enabling faster and more accurate decision-making. This isn’t just an improvement—it’s a revolution in farm management.

Final Thoughts

Wrapping up, the success of our AI tool has shown us that the integration of technology into farming isn't just a possibility—it's a pathway to transforming the agricultural industry. We’re not only meeting our initial goals but also exploring how we can expand and adapt our tool to meet future challenges. The feedback from users has been inspiring, and we look forward to bringing this technology to more farms, helping to create a smarter, more sustainable agricultural future.