

Design Report

March 2024



Prepared By
DOUBLE DOUBLE CONSULTING

Prepared For
CANADIAN SHEEP FEDERATION



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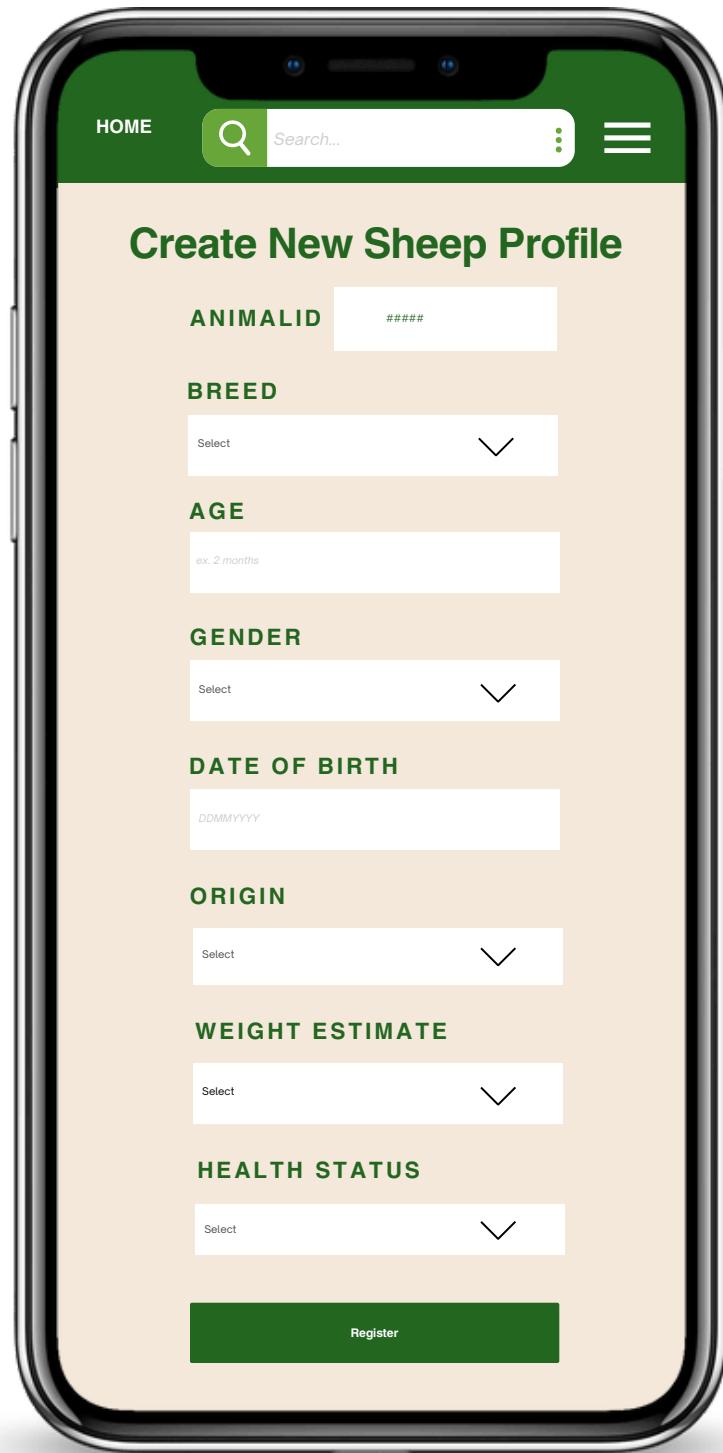
AI POWERED MOBILE APP: FARM-S

Introducing Farm-S, where cutting-edge technology meets innovative livestock management. We will be partnering with Genesmith, a company well accomplished in Australia and New Zealand for AI facial recognition technology within sheep livestock management. We intend to incorporate their AI technology within our mobile app, Farm-S. Farm-S will revolutionize the way farmers manage livestock by enhancing efficiency and traceability. This collaboration between Genesmith's expertise in facial recognition and Farm-S's intuitive user interface will enhance the user experience and facilitate stakeholder adoption.



Figure 1
Canadian Sheep
Federation Logo:
Designed by CSF

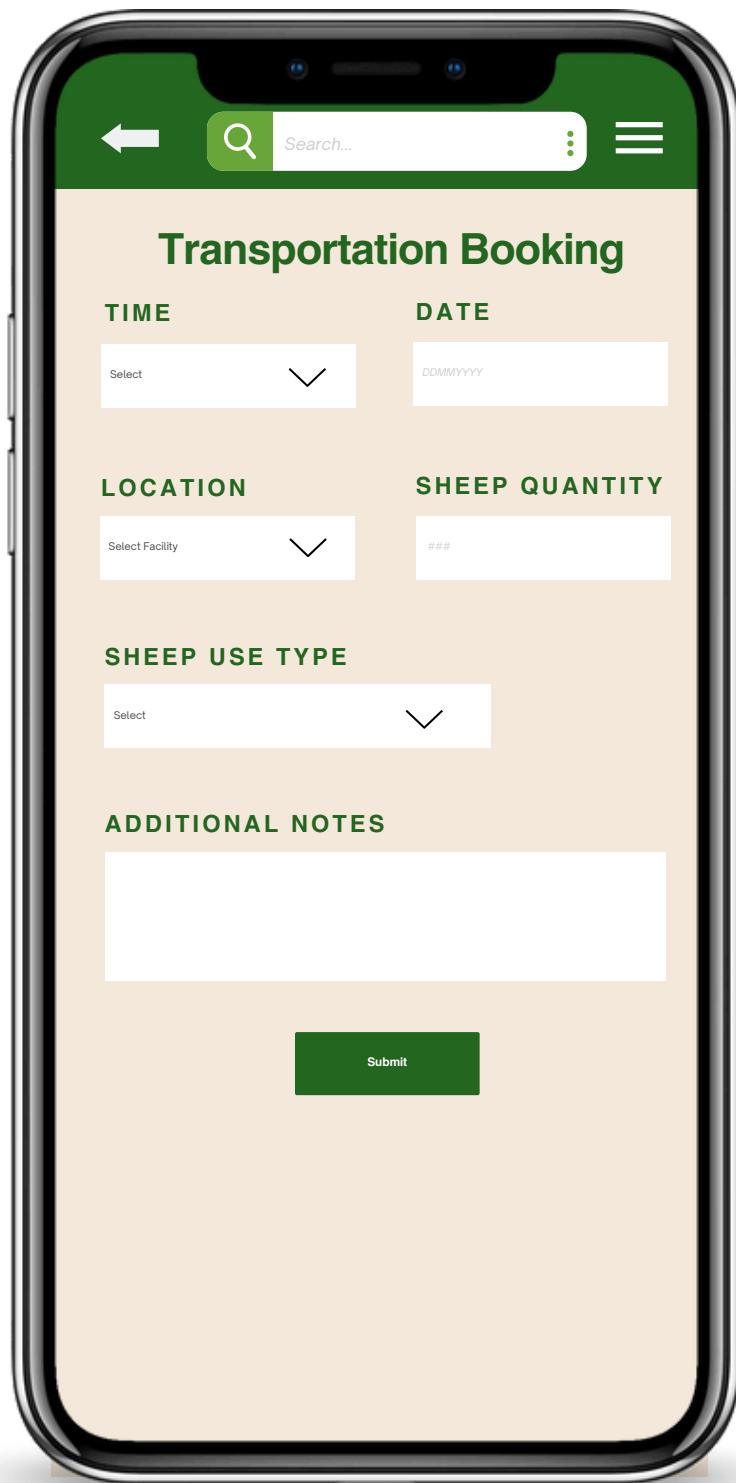
INPUT INTERFACE 1: REGISTER A NEW SHEEP PROFILE



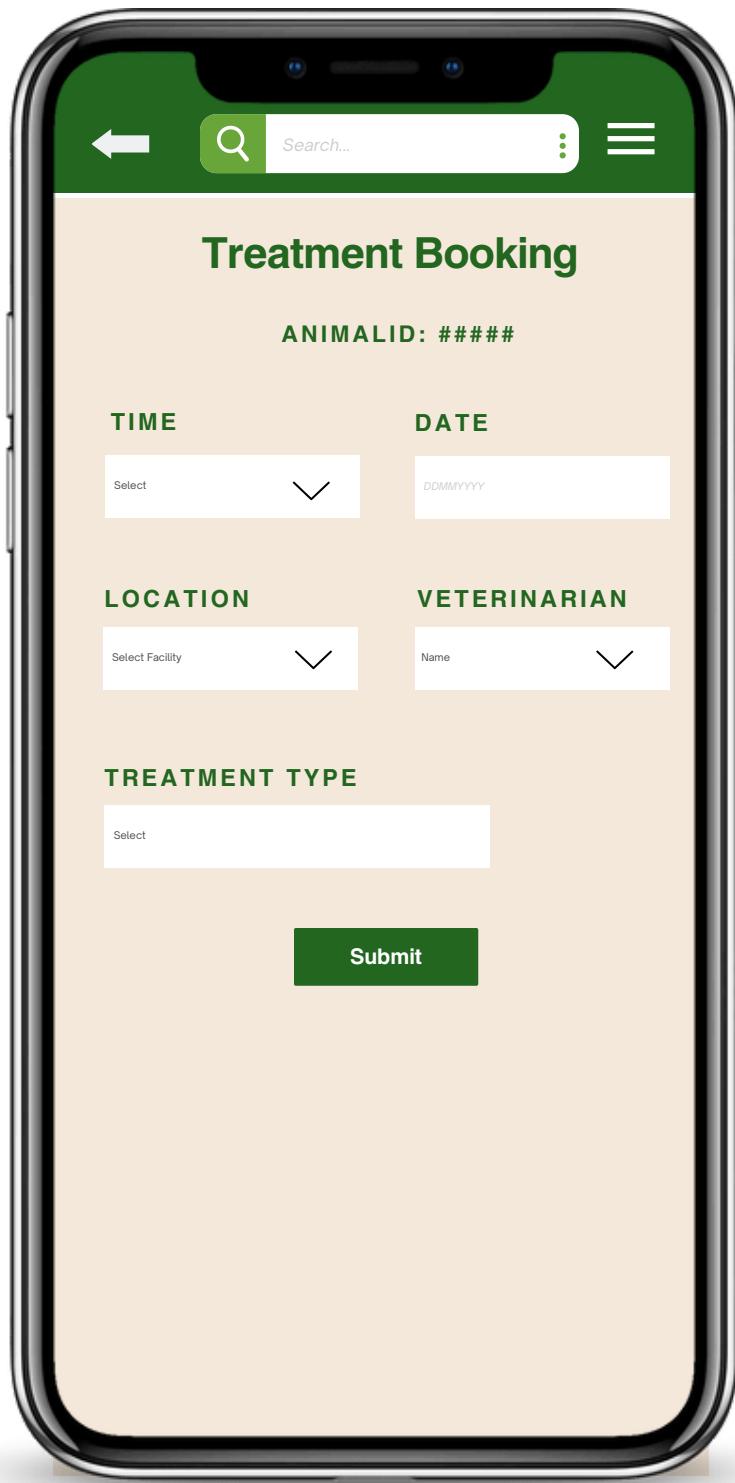
INPUT INTERFACE 1: REGISTER A NEW SHEEP PROFILE

Treatment List	
DATE:	#####
Animal ID	Status
01209123	In Pain
0374966	Treatment Pending
00210185	In Pain

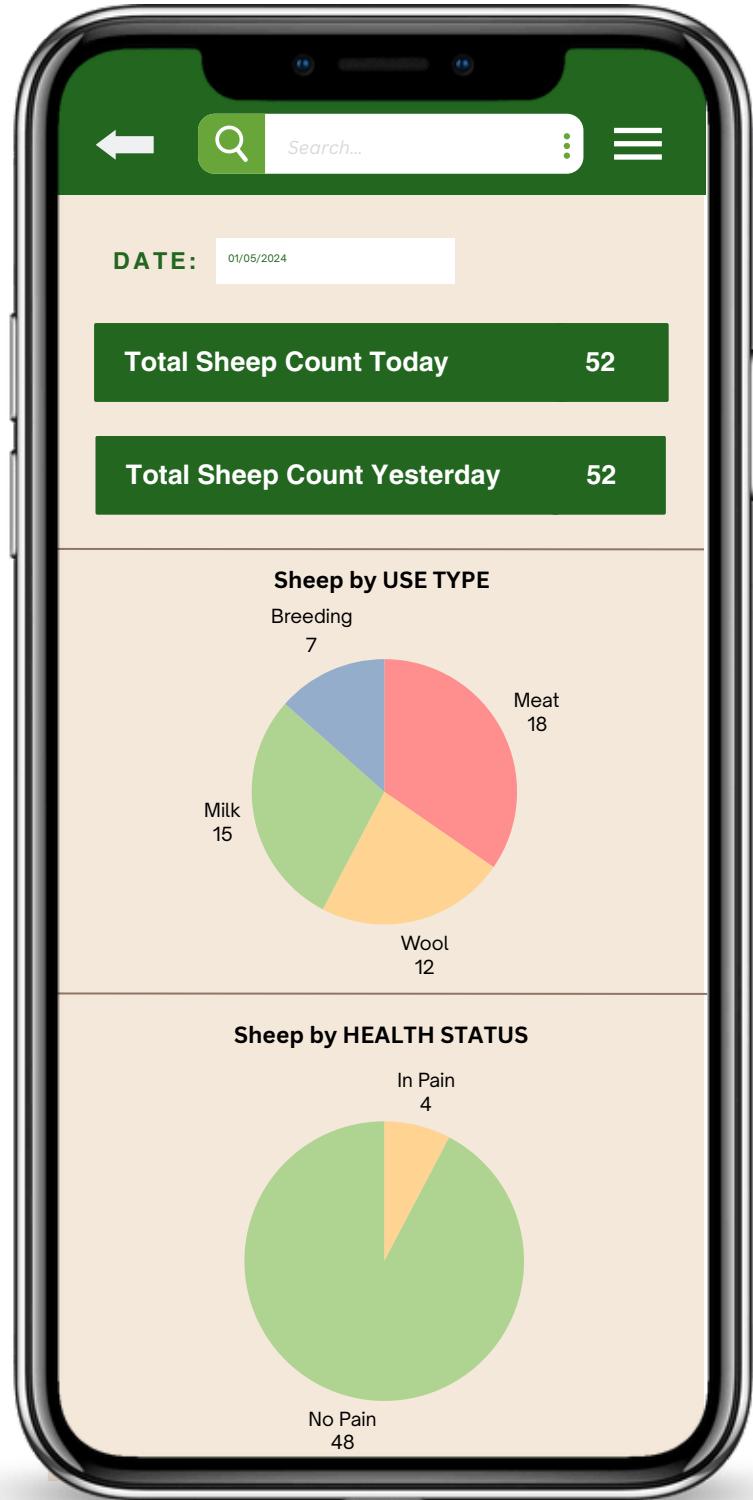
INPUT INTERFACE 2: TRANSPORTATION BOOKING



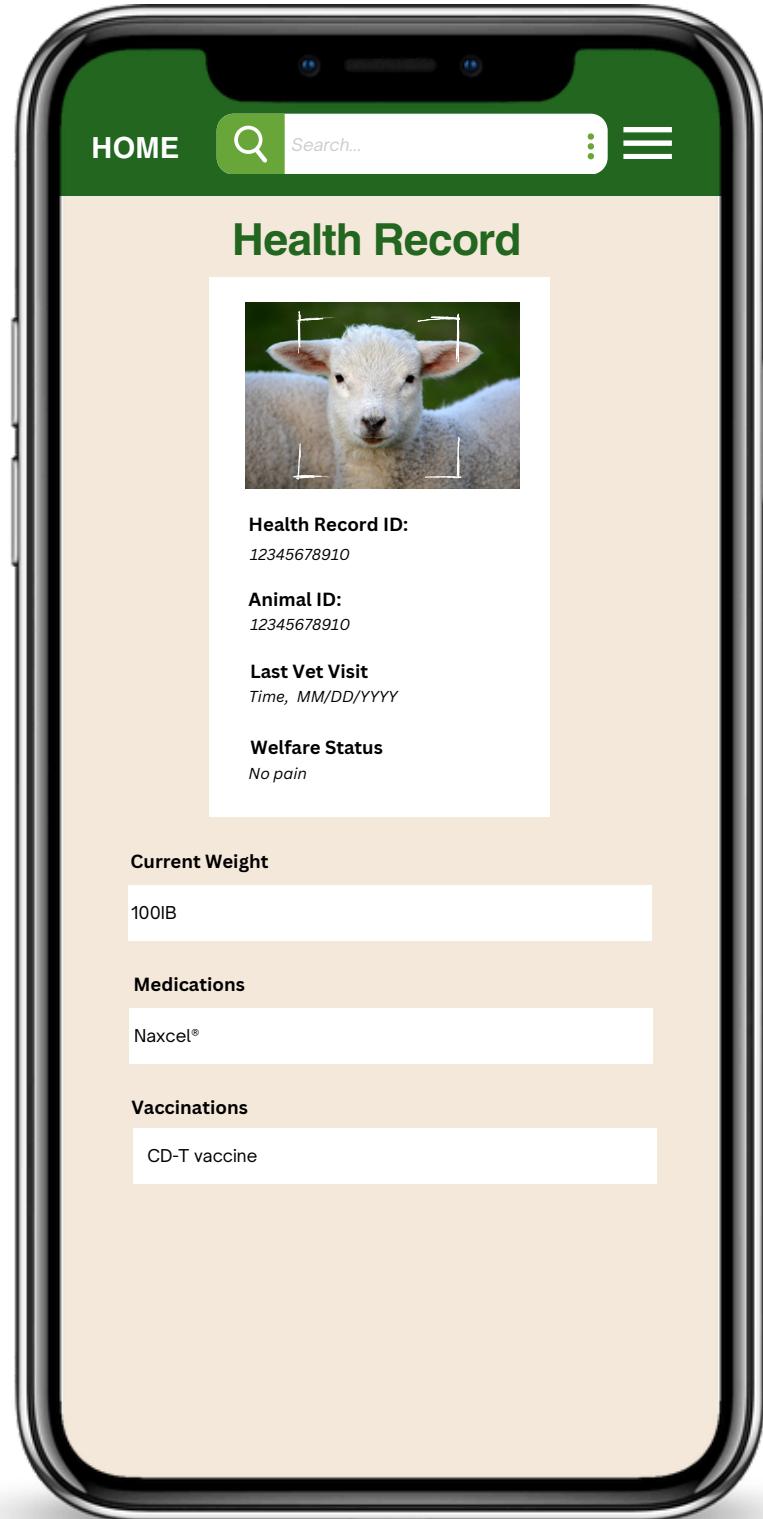
INPUT INTERFACE 3: TREATMENT BOOKING



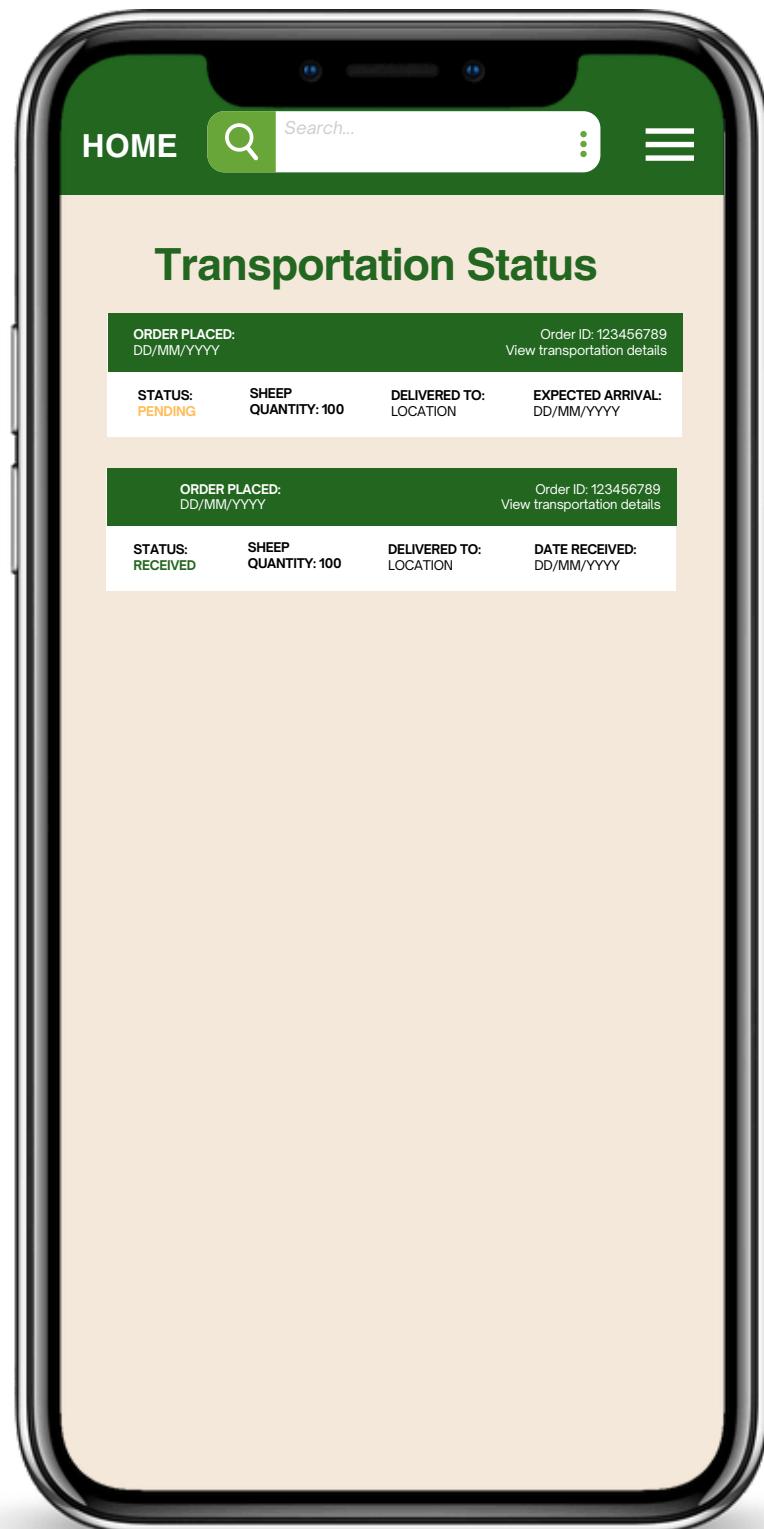
OUTPUT INTERFACE 1: TOTAL SHEEP COUNT



OUTPUT INTERFACE 2: HEALTH RECORD



OUTPUT INTERFACE 3: TRANSPORTATION STATUS



FARM-S WALKTHROUGH FORMS

Create new sheep profile form

Once a farmer enters an unregistered sheep's facial scan into the system, the system flags this sheep, and the sheep's unique facial identifiers are assessed using AI. The farmer is then prompted to create a new profile. From the Input Interface 1 design, you can see how the sheep is assigned a unique Animal ID and linked to the farm's Premise ID (shown in the "Sheep" and "Farm" entities in the ERD diagram, Appendix F). The farmer can then input basic information to register their sheep such as breed, age, gender, date of birth, origin, weight estimate, and health status ("InPain" or "NoPain"). The farmer can then simply click "register" to save all the information, linking it to the sheep's biometric scan and saving it into the sheep database within AgroLedger, a comprehensive blockchain database. Upon successful registration, the system will display a confirmation notification. This notification confirms that the sheep has been registered with a new profile, assigned a unique Animal ID, and is traceable through AI facial identification. This way, if any updates or changes need to be made to the sheep's profile in the future, farmers can pull up the profile by inputting a facial scan of the sheep. For example, if the sheep undergoes changes in health status or other details, these can be updated accordingly in the system.

Transportation form

To transport sheep to market facilities, the farmer first would receive a request for sheep from a market facility, as outlined in UC-4. This external trigger prompts the farmer to initiate the transportation process. Before proceeding, the farmer ensures that all necessary preconditions are met, including categorizing the sheep by use type (meat, milk, breeding, or wool) based on their characteristics, confirming compliance with health requirements by checking their health status records, and saving this information into the Transportation Database. To fulfill the transport request, the farmer then fills in the transportation booking form shown by Input Interface 2 with basic transport information including the time, date, location (Premise ID, linked to the facility's address), quantity of sheep, sheep use type, and any additional notes relevant to the transportation event (this relates to the "Transportation" entity from the ERD, Appendix F). Once the farmer submits this form, the transportation is booked and a confirmation data flow will be sent to the farmer.

Treatment form (treatment booking)

Referring to UC-4, the system creates a list of sheep that are "InPain" using facial recognition by assessing five areas of a sheep's face. This list of sheep that need treatment, called the treatment list, is saved to AgroLedger's health database and then sent to the farmer. Using the treatment form (Input Interface 3), the farmer can then register a treatment event by entering key information such as the Animal ID (linked to the sheep's profile for tracking health history and treatment records), time, date, location (Premise ID), veterinarian, and treatment type. This information allows for proper documentation and tracking of the treatment process. The treatment event is booked once the farmer clicks "submit", saving the pending treatment into AgroLedger. Once the treatment is completed, the farmer updates the health status of the sheep's profile to "NoPain" in the Sheep_Database.

FARM-S WALKTHROUGH REPORTS

Daily Count Report

The daily count report benefits the farmer through automated counting of sheep as part of daily inventory management. In reference to UC-2, the farmer will set up their mobile device at the front of the sheep's pen every day. As the sheep are let out, the mobile device records a video and automatically captures the faces of each sheep passing through the fenced area. The video system utilizes AI facial recognition technology to identify and count each individual sheep, as shown in Process 2.0. This helps maintain accurate identification and tallies of sheep, ensuring a precise count of all registered livestock. The system compiles photos of all sheep into a daily count file to generate a daily count report. This report will display the current count alongside yesterday's count, providing farmers with real-time updates on sheep numbers. This process is shown by Output Interface 1 and Appendix F. As such, farmers can take immediate action if there are discrepancies or missing sheep.

Treatment List Report

The treatment list report notifies farmers about sheep requiring treatment to maintain sheep welfare. In reference to UC-3, once the daily sheep count is finalized and all sheep pictures are compiled into the daily count file, the AI facial recognition system examines the health status of each sheep by analyzing their facial expressions. The health status is shown through Output Interface 2. It categorizes whether the sheep are "InPain" or "NoPain", updating each profile's health status which is then logged into AgroLedger under the respective Animal IDs. The status changes are shown in Process 3.0. The system generates a treatment list report of sheep, "InPain" and notifies the farmer to promptly identify and administer treatment. This helps farmers facilitate effective monitoring of sheep welfare, helping farmers quickly intervene when treatment is needed.

Transportation Status Report

The transportation status report assures farmers that their sheep shipment has successfully reached the market facility. In reference to UC-4, once the transportation booking confirmation is sent (refer to above), this initiates the transportation event. From the Transportation Database, the system retrieves the Animal IDs of each sheep selected for transport and notifies the farmer to gather the identified sheep. Once this is done, the system marks the transportation status as "Pending". The status changes are shown in Process 4.0. The shipment of sheep is finalized by the farmer and sent to the market facility listed on the transportation form. When the market facility confirms their shipment receipt, the system updates the status report to "Received", as shown on Appendix F. This is also used by Output Interface 3. Status reports help streamline communication between farmers and market facilities, minimizing the need for manual follow-ups or inquiries.

IMPLEMENTATION PLAN: TECHNICAL FEASIBILITY

The implementation plan will focus on incorporating AI with outsourced technology and change management. Refer to [Appendix A](#) for further information and [Appendix B](#) for a detailed breakdown of tasks. Technical and organizational feasibility analyses are conducted to ensure smooth execution.

We evaluated the technical feasibility of Farm-S in two options: outsourcing or insourcing. Outsourcing involves partnering with Genesmith, an AI facial recognition technology developed to identify and track animals which is a viable option. They have successfully implemented the system on 73,000 sheep farms in Australia and New Zealand ([GeneSmith.ai, 2023](#)), which proves that the technology is highly credible and works. According to Doering & Gannett Washington Bureau (2013), 94% of farmers in the US own smartphones or mobile phones. Since Genesmith is designed as a mobile app, the user interface will be familiar and accessible to the majority of farmers. As Canada's sheep industry has 8,487 farms raising 827,200 sheep ([Agriculture and Agri-Food Canada, 2022](#)), this highlights a large-scale project. The AI facial recognition technology captures and analyzes sheep facial features in real-time. The assessed unique identifiers are then stored in AgroLedger, showing the compatibility between the two systems. While the lack of internet connection is a concern for farmers using mobile devices in rural areas, the OCR technology being developed by CSF allows farmers to access sheep profiles and update information without internet connection. In contrast, insourcing requires moderate familiarity with the technology and large project size. This poses greater uncertainty, risks, costs, and time to integrate with AgroLedger. Thus, CSF's mobile app can be powered by AI technology outsourced from Genesmith to provide effective and efficient technical feasibility.

IMPLEMENTATION PLAN: ORGANIZATIONAL FEASIBILITY

Resistance exists from stakeholders like organizational management and system users – Canadian sheep farmers – in adopting AI facial recognition. When assessing organizational feasibility, we look at strategic alignment and stakeholder analysis. Strategic alignment focuses on the fit between our AI facial recognition project and CSF's business strategy. The CSF hopes to evolve with the sheep value chain by growing their markets, increasing their stakeholders' value, and securing the future prosperity of the industry (Cansheep, 2024), all of which can be greatly achieved with AI technology. Furthermore, stakeholder analysis involves looking at the project champion, organizational management, and system users. Firstly, the project champion is Corlena Patterson, Executive Director of CSF who has extensive knowledge of CSF's business strategy and provides her time sharing CSF's goals. Having Corlena's guidance allows us to better strategically align our project to CSF's business strategy, which reduces risk in our project implementation. Secondly, organizational management and users will be more inclined to adopt AI technology outsourced through Genesmith, as they see this technology already has 100 existing clients which can influence and increase stakeholder adoption (GeneSmith.ai, 2023). Training sessions offered can also give management and users more time to spend strategically aligning to their business strategy and ease the uncertainty of the adoption (See Appendix B for a detailed breakdown of tasks regarding training and support). CSF is experienced and dedicated to training farmers and has previously implemented 20 national meetings to reduce the use of RFID tags (Cansheep, 2024). Thus, this helps to increase stakeholder adoption of the AI technology.

REFERENCES

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APPENDIX A: IMPLEMENTATION OVERVIEW

The implementation timeline will be from **April 9, 2024 – June 27, 2024** with a total span of 79 days (Refer to Appendix C)..

IMPLEMENTING AI WITH GENESMITH

During the Analysis Phase, research on vendors have been finalized and selected to provide CSF with an outsourced company, Genesmith. Genesmith is already well-established in the market as an AI livestock management solution (Refer to Appendix D for more details). A collaboration with an outsourced company will allow CSF to reduce costs, enhance customer experience through ongoing technical support, and improve future scalability of AI facial recognition systems within farms and livestock management..

CHANGE MANAGEMENT

Another key aspect to highlight is the change management process of transitioning stakeholders from RFID to AI facial recognition for livestock identification. With farmers, livestock handlers, and regulatory bodies being the main stakeholders of the AI system, detailed mapping of workshops, training sessions, and consultations have been provided in Appendix B and Appendix C to demonstrate the benefits and usability of AI facial recognition to these important stakeholders.

APPENDIX B:

IMPLEMENTATION TASKS

IMPLEMENTATION

Task Name	Duration	Start	Finish	Predecessors	Resource Names
Vendor Collaboration	6 days?	Tue 4/9/24	Tue 4/16/24		
Schedule a kickoff meeting with the vendor to formally initiate the project	1 day?	Tue 4/9/24	Tue 4/9/24		All Teams
Establish protocols for data privacy and protection measures	3 days?	Thu 4/11/24	Mon 4/15/24	2	IT & Risk Team
Develop risk mitigation plan	1 day?	Tue 4/16/24	Tue 4/16/24	3	IT & Risk Team
Development and Testing	1 day?	Wed 4/24/24	Wed 4/24/24		
Conduct user acceptance testing to validate system functionality and integrates with existing farm systems	1 day?	Wed 4/24/24	Wed 4/24/24	4	IT Team
Deploy Pilot System	10 days?	Thu 4/25/24	Wed 5/8/24		
Roll out the facial recognition system in a limited area of the farm as pilot deployment	1 day?	Thu 4/25/24	Thu 4/25/24	6	Project Manager
Evaluate performance under various conditions, including different times of day, weather conditions, and angles of sheep faces	1 day?	Fri 4/26/24	Fri 4/26/24	8	Field Research Team
Validate the accuracy of facial recognition matches and identify any areas for improvement	1 day?	Mon 4/29/24	Mon 4/29/24	9	Quality Assurance Team
Monitor its performance and gather feedback from users to identify any issues or areas for improvement	1 day?	Fri 5/3/24	Fri 5/3/24	10	System Administrators
Scale up deployment across the entire farm	3 days?	Mon 5/6/24	Wed 5/8/24	11	Project Manager
IT Training and Support	2 days?	Thu 5/9/24	Fri 5/10/24		
Establish a maintenance schedule to ensure ongoing reliability and performance of the facial recognition system	1 day?	Thu 5/9/24	Thu 5/9/24		IT Team
Assign dedicated IT support personnel to provide on-site assistance and guidance to farmers when necessary	1 day?	Fri 5/10/24	Fri 5/10/24	14	IT Team

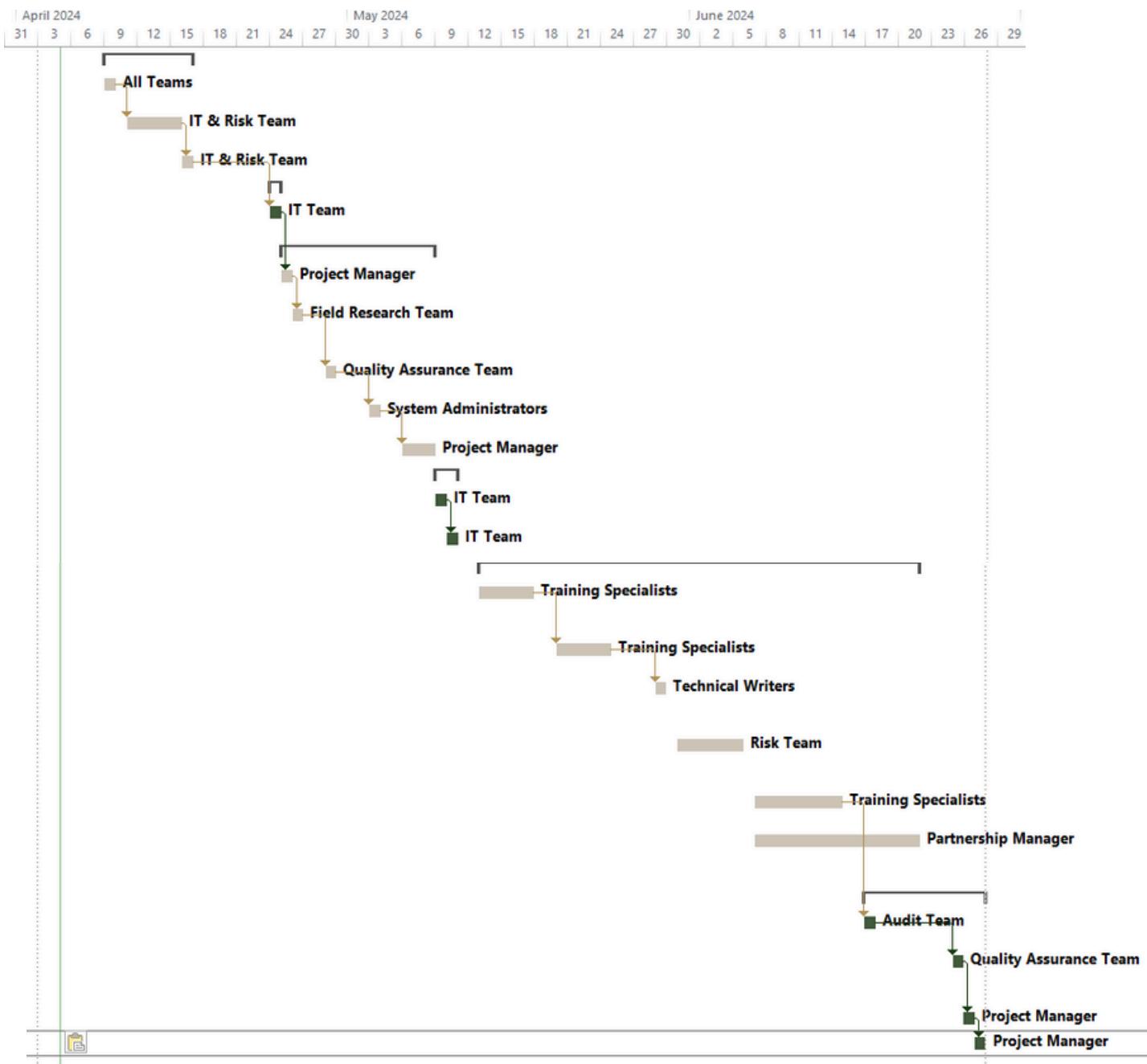
APPENDIX B: IMPLEMENTATION TASKS

IMPLEMENTATION

Task Description	Duration?	Start Date	End Date	Days	Team
Establish a maintenance schedule to ensure ongoing reliability and performance of the facial recognition system	1 day?	Thu 5/9/24	Thu 5/9/24		IT Team
Assign dedicated IT support personnel to provide on-site assistance and guidance to farmers when necessary	1 day?	Fri 5/10/24	Fri 5/10/24	14	IT Team
Stakeholder Training and Support	30 days?	Mon 5/13/24	Fri 6/21/24		
Provide instructor-led training sessions conducted in person or virtually to transition stakeholders from RFID to AI Facial Recognition	5 days?	Mon 5/13/24	Fri 5/17/24		Training Specialists
Provide 1-on-1 consultations with stakeholders to provide personalized support and guidance	5 days?	Mon 5/20/24	Fri 5/24/24	17	Training Specialists
Develop documentation, tutorials, and troubleshooting guides to assist farmers in effectively utilizing the technology for the long-term	1 day?	Wed 5/29/24	Wed 5/29/24	18	Technical Writers
Develop mitigation strategies to identify potential challenges and risks that arise during the transition process	4 days?	Fri 5/31/24	Wed 6/5/24		Risk Team
Create a feedback form to gather input from stakeholders on the transition to AI facial recognition systems	6 days?	Fri 6/7/24	Fri 6/14/24		Training Specialists
Partner with industry associations and government agencies to collaborate on outreach efforts and educational initiatives	11 days?	Fri 6/7/24	Fri 6/21/24		Partnership Manager
Post-Implementation	9 days?	Mon 6/17/24	Thu 6/27/24		
Conduct a post-implementation audit to evaluate the success of the implementation.	1 day?	Mon 6/17/24	Mon 6/17/24	21	Audit Team
Gather overall feedback from all stakeholders (farmers, livestock handlers, regulators, producers, farm markets) on the new system	1 day?	Tue 6/25/24	Tue 6/25/24	24	Quality Assurance Team
Identify lessons learned and areas for improvement	1 day?	Wed 6/26/24	Wed 6/26/24	25	Project Manager
Update documentation and processes based on feedback	1 day?	Thu 6/27/24	Thu 6/27/24	26	Project Manager

APPENDIX C: IMPLEMENTATION GANTT CHART

IMPLEMENTATION



APPENDIX D:

USE CASE 1

Use Case Name:	Create a New Sheep Profile	ID:	UC-1	Priority:	High
Actor:	Farmer				
Description:	The farmer scans sheep to register a new sheep profile and create a new animal ID.				
Trigger:	The farmer wants to register a new sheep.				
Type:	External				
Preconditions:	1. Farmer has access to AgroLedger and is listed under a farm. 2. There is an existing database (Sheep_Database) where all the sheep profiles and basic information (breed, age, DOB, gender, origin, weight estimate, health status) are saved to AgroLedger. 3. Each farm is already assigned to a specific premise ID to identify different farm locations.				
Major Steps:	Information for Steps:				
1. The farmer scans a sheep with a mobile device camera to recognize the sheep's biometrics (unique facial identifiers).	(i) Sheep Facial Image Scan				
2. The farmer inputs basic sheep information into Sheep_Database and the sheep is assigned an animal ID to complete the profile.	(i) Sheep Information (breed, age, DOB, gender, origin, weight estimate, health status) (o): Animal ID				
3. The farmer assigns the registered sheep to a farm (premise).	(i) Premise ID				
4. A confirmation notification showing successful registration of sheep into the system.	(o) Successful Registration Confirmation				
Postconditions:	1. Sheep registered with a new profile and gets assigned with a unique animal ID. 2. Sheep's information is saved or updated (Exception 1) to Sheep_Database.				
Exceptions:	Exception 1 (refer to Appendix A for more information): IF sheep are already registered in the system, they need to be rescanned and updated to keep track of sheep development in the Sheep_Database. <ul style="list-style-type: none"> Scan and update profile every month for the first three years of age. Scan and update profile every 6 months after three years of age. ELSE, refer to major step 1.				
Summary					
Inputs	Source	Outputs	Destination		
Sheep Facial Image Scan	Farmer	Animal ID	Sheep_Database		
Sheep Information (breed, age, DOB, gender, origin, weight estimate, health status)	Farmer	Successful Registration Confirmation	Farmer		
Premise ID	Farmer				

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https://ruminants-care.nl/uploads/images/FAWB_PainBooklet-Sheep_spreads-1-14.pdf

APPENDIX D:

USE CASE 2

Use Case Name:	Automated Daily Sheep Count	ID:	UC-2	Priority:	High				
Actor:	Farmers								
Description:	This use case details the automated counting of sheep as part of daily inventory management to maintain an accurate and up-to-date count of all registered sheep.								
Trigger:	The farmer needs to conduct a daily sheep count process as a routine to maintain operations.								
Type:	Temporal								
Preconditions:	1. All sheep profiles are registered in Sheep_Database with facial recognition data. 2. AI facial recognition system is made available through a mobile device								
Major Steps:		Information for Steps:							
1. The farmer inputs a video recording filmed from a mobile device to count the sheep.		(i) Video Recording							
2. The video system captures photos of each sheep that passes by.		(o) Individual Sheep Photos							
3. The video system compiles photos of all the sheep into a file. It's named after the date in the following format: DDMMYYYY (all numerical) and saved to AgroLedger.		(i) All Sheep Photos (o) DailyCountFile (DDMMYYYY)							
4. The video system counts the number of photos in the DailyCountFile. The system outputs the total number of sheep in the video and displays the number of sheep counted yesterday for reference.		(i) Photo Count (o) Total Sheep Count (Present day) (o) Total Sheep Count (Previous day)							
Postconditions:	1. Farmers have accurate and up-to-date counts of all registered sheep. 2. DailyCountFile to identify individual sheep								
Exceptions:	Trigger for manual action is needed when: <ul style="list-style-type: none"> The system fails to recognize sheep and an error flag is displayed to the farmer. The farmer needs to manually take a picture of the sheep and add it to the DailyCountFile. Trigger for re-scan is needed for the following: <ul style="list-style-type: none"> The previous day's total sheep count is inconsistent with the total sheep count on the present day. 								
Summary									
Inputs	Source	Outputs	Destination						
Video Recording	Farmer	Individual Sheep Photos	Video System						
All Sheep Photos	Video System	DailyCountFile (DDMMYYYY)	AgroLedger						
Photo Count	Video System	Total Sheep Count (Present day)	Farmer						
		Total Sheep Count (Previous day)	Farmer						

APPENDIX D:

USE CASE 3

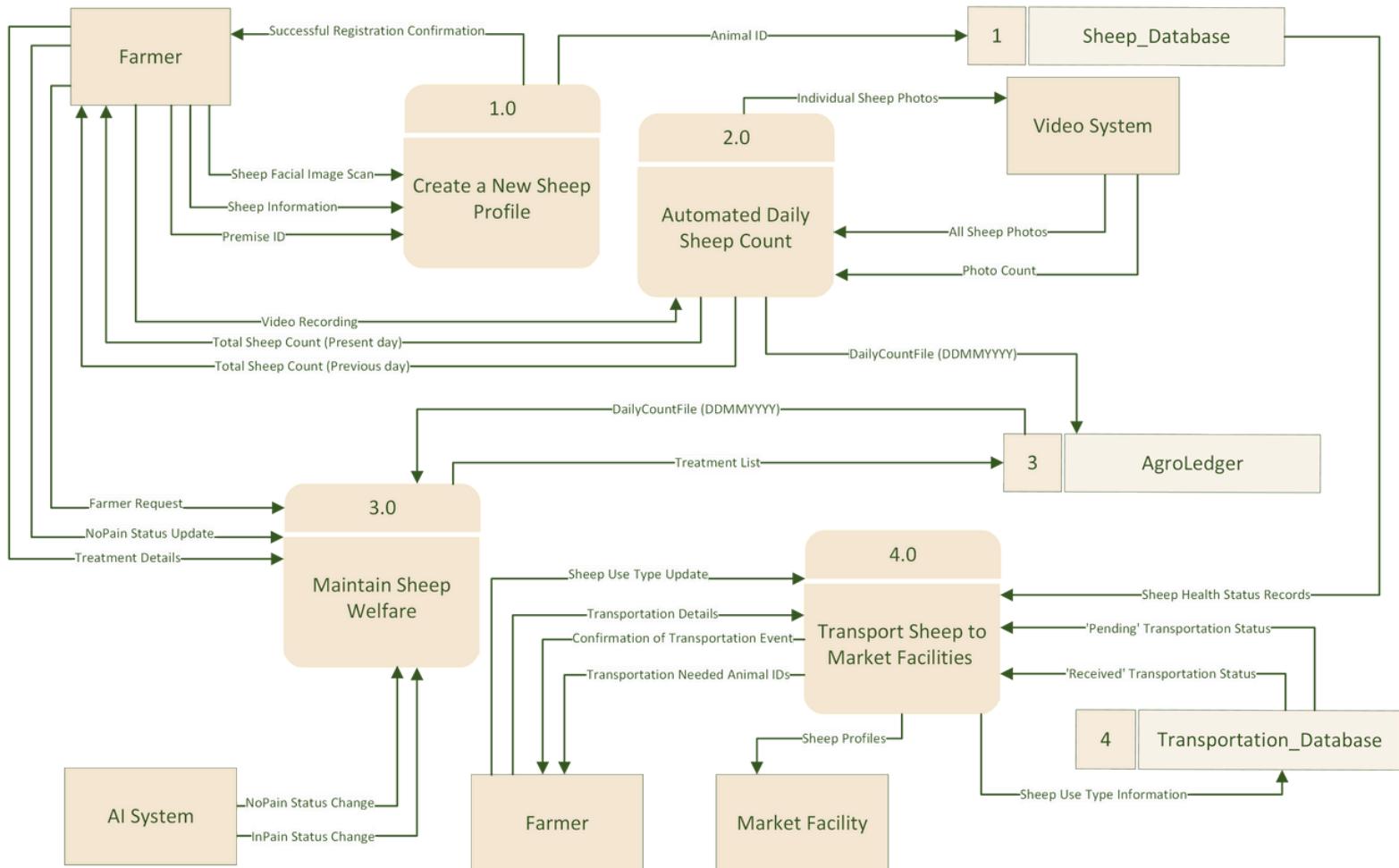
Use Case Name:	Maintain Sheep Welfare	ID:	UC-3	Priority:	High
Actor:	Farmer				
Description:	The farmer monitors sheep behavioural patterns for early detection of health issues through the AI facial recognition system.				
Trigger:	The farmer needs to update the health status of all the sheep after the daily count is completed.				
Type:	Temporal				
Preconditions:	1.The daily sheep count is completed. 2.All sheep pictures are saved into the DailyCountFile.				
Major Steps:	Information for Steps:				
1. The farmer inputs the photos of all the sheep and prompts the system to identify all the sheep according to their unique facial identifiers (biometrics).	(i) DailyCountFile (DDMMYYYY) (i) Farmer Request				
2. The AI facial recognition system identifies the health status of the sheep through visual facial detections and categorizes whether the sheep is in pain or not in pain. The health status of the sheep is saved into AgroLedger under the animal ID.	(i) InPain Status Change (i) NoPain Status Change				
3. A list of sheep in pain is compiled and the farmer is notified of the sheep that need treatment.	(o) Treatment List				
4. The farmer updates the sheep health status on the Sheep_Database to NoPain when sheep treatment is completed. The treatment details are updated to the original Treatment Needed List (including treatment type, date, and the vet the sheep was treated By).	(i) NoPain Status Update (i) Treatment Details (type, date, vet)				
Postconditions:	1.Treatment for pained sheep is completed. 2.Sheep_Database is updated with NoPain Status Change and Treatment Details				
Exceptions:					
Summary					
Inputs	Source	Outputs	Destination		
DailyCountFile (DDMMYYYY)	AgroLedger	Treatment List	AgroLedger		
Farmer Request	Farmer				
InPain Status Change	AI System				
NoPain Status Change	AI System				
NoPain Status Update	Farmer				
Treatment Details (type, date, vet)	Farmer				

APPENDIX D:

USE CASE 4

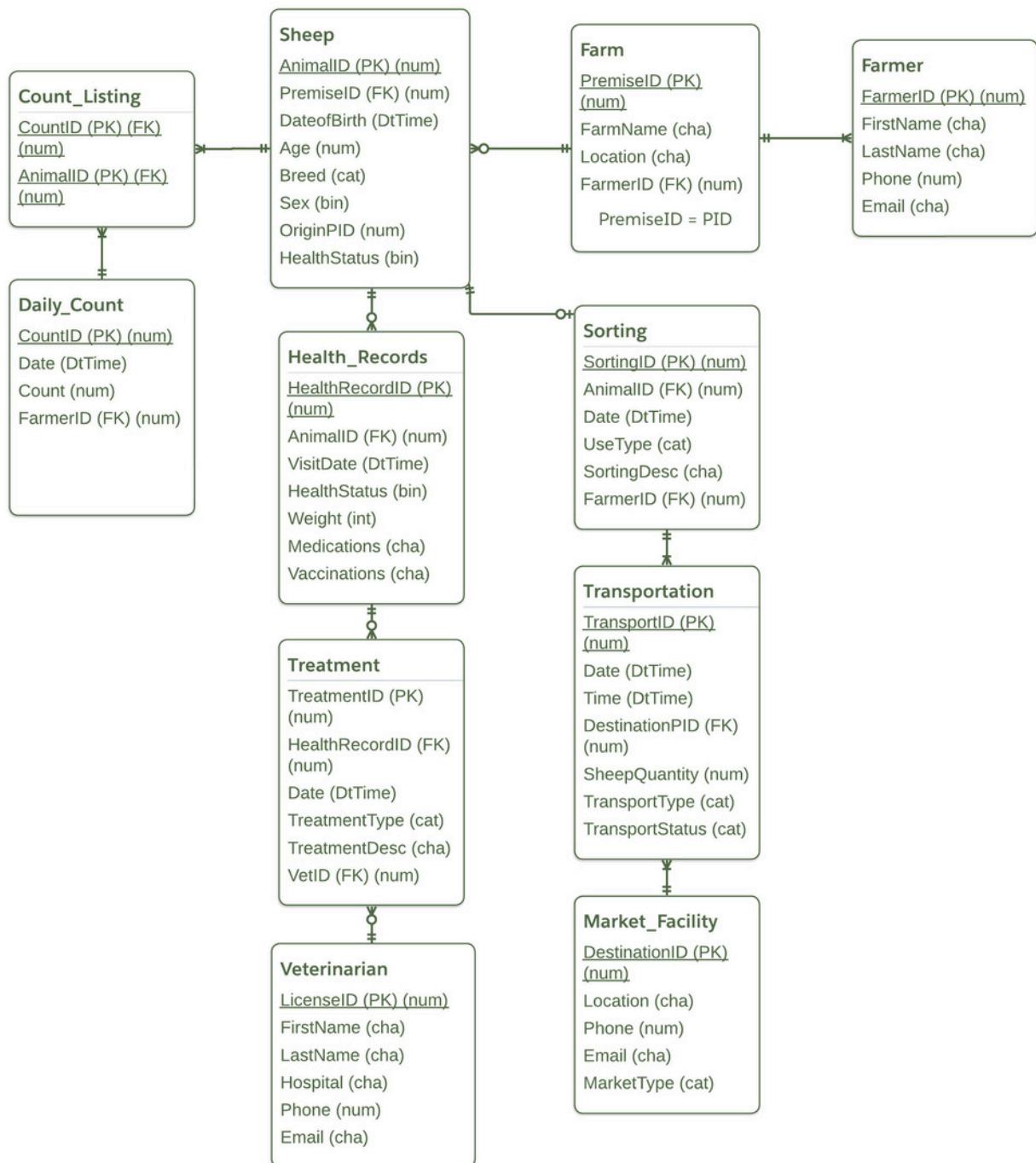
Use Case Name:	Transport Sheep to Market Facilities	ID:	UC-4	Priority:	High
Actor:	Farmer				
Description:	The farmer needs to sort and transport sheep to their destination facility.				
Trigger:	The farmer receives a request for sheep by a market facility for sheep transfer.				
Type:	External				
Preconditions:	1.The farmer gathers all the information about a sheep's use type based on characteristics. 2.There is an existing database for sheep sorting and transportation destinations (Transportation_Database).				
Major Steps:	Information for Steps:				
1. The farmer categorizes the sheep based on characteristics into market destinations (meat, milk, breeding, wool). The use type of the sheep is updated in the Transportation_Database.	(i) Sheep Use Type Update (o) Sheep Use Type Information				
2. Sheep health status records are extracted from the Sheep_Database to confirm compliance with health certification requirements required by the market facilities.	(i) Sheep Health Status Records				
3. The farmer creates transportation details (time, date, location, quantity of sheep, sheep use type) to schedule a transportation event to their market facility.	(i) Transportation details (time, date, location, quantity of sheep, sheep use type) (o) Confirmation of transportation event				
4. The AI system pulls the Animal IDs from the Transportation_Database of the sheep that need to be captured by the farmers and transported. The status of the transportation is changed to 'Pending' in the Transportation_Database during this process.	(i) 'Pending' Transportation Status (o) Transportation Needed Animal IDs				
5. Sheep profiles from Sheep_Database are sent to the destination facility's database. The status of the transportation is changed to 'Received' in the Transportation_Database when the destination facility confirms receipt of the sheep.	(i) 'Received' Transportation Status (o) Sheep profiles				
Postconditions:	1. Confirmation of sheep arrival from the market facility.				
Exceptions:	There may be no request for sheep by market facility for sheep transfer.				
Summary					
Inputs	Source	Outputs	Destination		
Sheep Use Type Update	Farmer	Sheep Use Type Information	Transportation_Database		
Sheep Health Status Records	Sheep_Database	Confirmation of Transportation Event	Farmer		
Transportation Details (time, date, location, quantity of sheep, sheep use type)	Farmer	Transportation Needed Animal IDs	Farmer		
'Pending' Transportation Status	Transportation_Database	Sheep Profiles	Market Facility		
'Received' Transportation Status	Transportation_Database				

APPENDIX E: PROCESS MODEL - LEVEL 0 DATA FLOW DIAGRAM



Being a process model, the main changes from the as-is system's DFD lie in how much of the data flows are prompted by the farmers. This contrasts with the as-is system, which may rely on manual data entry or less advanced tracking methods like RFID tags. Whereas in the to-be system, after being prompted by the user, there are additional data flow actions that are being autonomously triggered from the system such as the daily “Total Sheep Count” being assessed or “InPain”/“NotInPain” health status changes being automatic. The level 0 DFD showcases the proposed system's streamlined processes facilitated by AI facial recognition technology, allowing for efficient sheep management tasks such as registration, daily counting, health monitoring, and transportation scheduling.

APPENDIX F: DATA MODEL – ENTITY RELATIONSHIP DIAGRAM



The to-be system's ERD has not changed much compared to the as-is system as we focused on changes to the process of how data flows, not the data itself. Therefore, being a data model, the ERD would not be that different from the as-is system. For example, regardless of before and after, the database would still need to maintain information about sheep counts, farms, farmers, sheep profiles, their health and transportation records.