RESEARCH PROGRAM ON Livestock

CGIAR

More meat, milk and eggs by and for the poor

Community-based breeding programs (CBBP) – Mobile application development specification

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ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

ICARDA Science for resilient livelihoods in dry areas

CIAT International Center for Tropical Agriculture Since 1967 Science to cultivate change

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

SLU

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CGIAR is a global partnership that unites organizations engaged in research for a food-secure future. The CGIAR Research Program on Livestock provides research-based solutions to help smallholder farmers, pastoralists and agro-pastoralists transition to sustainable, resilient livelihoods and to productive enterprises that will help feed future generations. It aims to increase the productivity and profitability of livestock agri-food systems in sustainable ways, making meat, milk and eggs more available and affordable across the developing world. The Program brings together five core partners: the International Livestock Research Institute (ILRI) with a mandate on livestock; the International Center for Tropical Agriculture (CIAT), which works on forages; the International Center for Research in the Dry Areas (ICARDA), which works on small ruminants and dryland systems; the Swedish University of Agricultural Sciences (SLU) with expertise particularly in animal health and genetics and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) which connects research into development and innovation and scaling processes.

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ABACUSBIO LIMITED
BRIDGING SCIENCE & BUSINESS

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Prepared for ICARDA

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AbacusBio Limited

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Revision history

Version	Date	Description/notes	Author(s)
D01	16/05/2018	Initial document	Mark Teviotdale
D02	21/05/2018	Update to DREMS reference	Mark & Lobo
D03	05/06/2018	• Prepared for changed to ICARDA. • Android operating system now 4.3 (Jelly bean) • Changed data transfer rate to fortnightly.	Mark, Aynalem & Tesfaye
D04	12/06/2018	• Added sentences to FR-04 to explain adding these types of events to the device.	Mark & Aynalem
D05	28/06/2018	• Updating Android operating system to 6.1 to mitigate against security and support concerns.	Mark & Aynalem

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Glossary

Item	Description
AniCapture	Refers to the tablet application that will be developed for this project.
API	An **A**pplication **P**rogramming **I**nterface is a set of subroutine definitions, protocols, and tools for building application software. In general terms, it is a set of clearly defined methods of communication between various software components.
AWA	**A**niCloud **W**eb **A**pplication refers to the cloud-based web portal and database of the AniCloud product.
DREMS	DREMS it is the name of breeding program platform the software to register data is SGR (Flock Management System).
EDM	**E**xternal **D**ata **M**odule refers to the AWA module that researchers will use to approve or reject data that has been captured using AniCapture.
HTTP	**H**yper **T**ext **T**ransfer **P**rotocol
IP	An **I**nternet **P**rotocol address (IP address) is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. An IP address serves two principal functions: host or network interface identification and location addressing.
JSON	**J**ava**S**cript **O**bject **N**otation is an open-standard file format that uses human-readable text to transmit data objects consisting of attribute–value pairs and array data types (or any other serializable value). It is a very common data format used for asynchronous browser–server communication, including as a replacement for XML in some AJAX-style systems.
LDS	**L**ocalised **D**ata **S**et refers to the data that will be stored on a particular device that is setup for an enumerator and the village they capture data for.
MVP	A **M**inimum **V**iable **P**roduct is a product with just enough features to satisfy early customers, and to provide feedback for future product development.
Stakeholders	A person, group, or organization that is actively involved in a project, is affected by its outcome, or can influence its outcome.

Contents

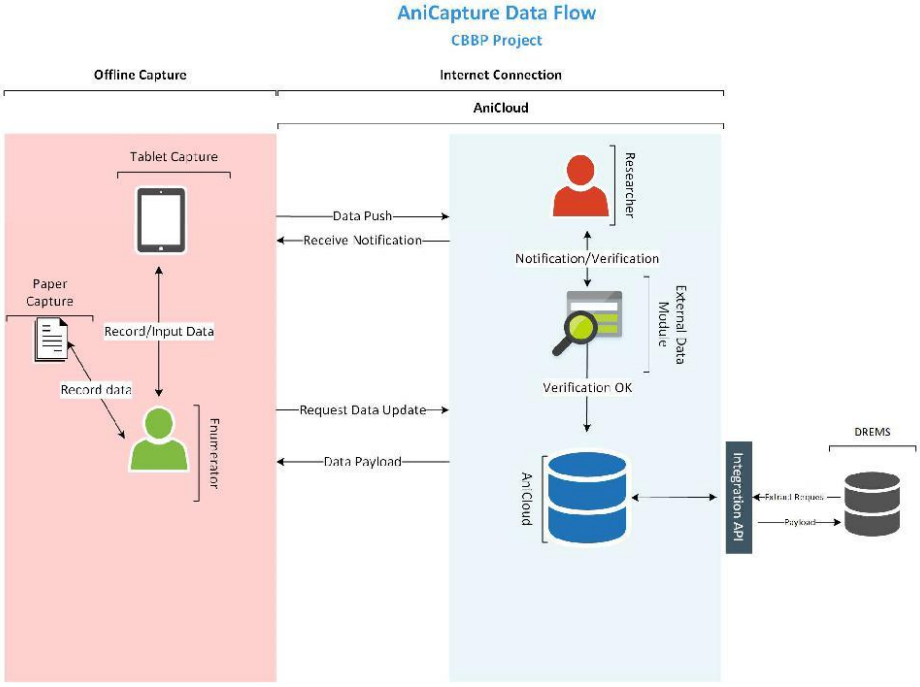
Solution Summary

This document describes the specification of the mobile application development for the Community-based breeding programme (CBBP). The development of this tool is part of the project "AniCloud Implementation in Ethiopia and Tanzania" (ACT-0100114) between the New Zealand Ministry of Foreign Affairs and Trade (MFAT) and AbacusBio.

The solution comprises of a mobile application that will target tablets running the Android operating system 6.1 (Jelly Bean). The mobile application will be available via the Google play store for users to download. Development of the AniCloud Web Application is required to manage data flow between the device and the AniCloud database. Users with appropriate permissions will approve data from the mobile application before it is made available in the main AniCloud database. An Application Programming Interface (API) will be established to transfer recording data and other assets to the DREMS system located at EMBRAPA.

Project Data Model

The Data model describes the process flow of data from point of capture to the DREMS system.



Collection

The enumerator initiates the data flow process. They're responsible for collecting and recording the data collected in the field. At present, the data is recorded via paper then collected by the researcher and entered into Excel. Once the App is implemented the enumerator can either collect data directly via the App or collect via paper and enter into the App at a later date. Going forward it would be beneficial for the data to be collected via the App so data can be checked and validated in the field and if required can be corrected. This process will provide robust data collection across the CBBP programme.

Data Transfer

When the data is collected and is ready to be sent to the researchers (usually every fortnight) the enumerator will connect his tablet to an internet connection and access the data transfer option in the App. When the data is successfully uploaded into the AniCloud EDM the data is in a draft state and the researcher will be notified via email. The researcher will then log into AniCloud and review and approve/reject the new data that has been collected.

Data Update

The App will store existing data from AniCloud that will enable robust data collection by the enumerator. Historic data present at the time of new data collection provides the enumerator with the opportunity to sense check the new information relative to what has been recorded previously. It is also important that previously recorded animals that have reached first breeding age are available to be identified as parents of new animals to be collected. The enumerator will be required to update this dataset when connected to the internet.

DREMS Integration

An API will facilitate the data transfer from AniCloud to the DREMS database. This API will be one directional meaning data will only flow from AniCloud to DREMS.

High Level Project Requirements

Requirements Priority

Each functional requirement in the tables below have been prioritised as either: Must Have (M) or Should Have (S):

- **Must Have**: This is either required to meet government legislation, policy or the business stakeholders cannot do business without it.
- **Should Have**: This is a requirement that is important to the business and would significantly impact benefits if it could not be delivered.

Id	Description	Priority
PR-01	Stakeholders require animal and trait data to be captured on a tablet platform.	M
PR-02	Stakeholders require that data can be captured either by the tablet device or paper book and entered into the device after collection.	M
PR-03	The tablet data capture platform must record data in an off-line environment.	M
PR-04	The tablet application must provide user authentication.	M
PR-05	The tablet application must support English and Amharic script languages for label translation.	M
PR-06	Stakeholders require that the tablet application is loaded with an LDS.	M
PR-07	AniCloud must store all data that is received by the tablet application in a pending state.	M
PR-08	AniCloud must notify the researchers group when data has been received from the tablet application.	M

PR-09	AniCloud must provide an external data module for researchers to approve or reject data captured on the tablet application.	M
PR-10	AniCloud must provide functionality to handle data that has been approved or rejected.	M
PR-11	AniCloud must provide an API to export data from AniCloud to the DREMS system.	M

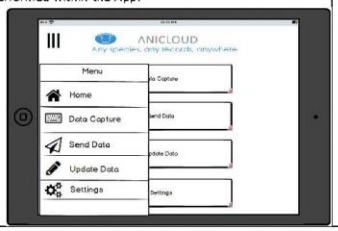
Non Functional Project Requirements

Id	Description
NFR-01	**Technology** **AniCapture** will be developed in the Microsoft development environment. Xamarin (Mobile app development & app creation software) will be used as the primary technology. **AWA** is a user interface response web application that is used with the Chrome web browser.
NFR-02	**Targeted Operating system** AniCapture will be released on the Android Operating system running 6.1 (Jelly Bean).
NFR-03	**Hosting** AniCapture will be available in the google play store for download. The API and the AWA will be hosted on Microsoft Azure cloud platform.
NFR-04	**Screen Real Estate** To maximise the screen real estate on the tablet devices, the data capture application will be designed to function in **Landscape** mode.
NFR-05	**Data Retention** The data captured in the tablet application and AniCloud is required for perpetuity. Archiving Any data generated on the device will be stored on the device for a minimum of 4 months
NFR-06	**System Uptime** Operational systems will target a system uptime of 99.5% within the boundaries of the Infrastructure and Application components that form Operational system. For example Infrastructure support services provided by the Microsoft Azure data centre are NOT taken into account.
NFR-07	**Data Loss** Operational systems will adhere to **maximum tolerable data loss** of no more than **24 hours** in the event of catastrophic failure.
NFR-08	**Capacity** The estimated overall number of transaction per year are:

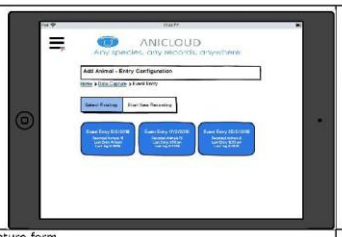
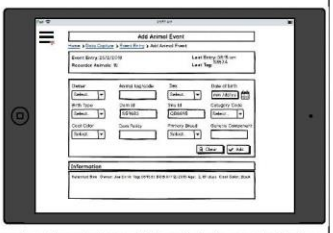
	New animals: 750 – 5,700 Event data rows: 62,000 - 75,000
NFR-09	**Recovery** The operational system needs to be recovered within 1 working day of a major failure (outage)

Functional Requirements

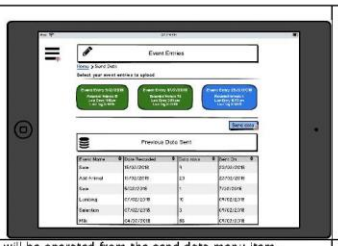
A functional requirement describes specific functionality that defines what a system is supposed to accomplish. The images used to describe this functionality are illustrative and don't reflect the final design of AniCapture.

Id	Function Area	Function	Description	M/S
FR-01	AniCapture	Authentication	When the user opens AniCapture they are presented with the authentication screen. If this is the first time the App has been opened on the device (initial app load), it will require an internet connection. The user is required to enter their AniCloud login details. 1. If the user fails's the authentication processes a label will display indicating this. **Note** there is no option to reset a user's login credentials, this should be done using the AniCloud Web Application. 2. If the user authenticates successfully and the LDS isn't configured the app will complete a setup phase. A notification will display to the user indicating this process. The LDS will be populated with village, animal and event data that the user has access to. When this process is completed the App will load into the Home screen. 3. If the app is offline the user will authenticate using the LDS so authentication is always required when accessing the app. 	M
FR-02	AniCapture	Home Form	The home form contains panels for the operations that can be performed within the App. 1. The panels will be sorted as per the illustrative screenshot here. This order isn't customizable in any way. 2. The flyout menu will contain the same items as listed on the home screen with the addition of "Home". This menu will be the primary navigation element for transitioning between the various operations. 	M

FR-03	AniCapture	Event Selection	Selecting "Data Capture" from the home form will display the data recording events. Users will then select the event they wish to record data against. 1. The ordering of these events is configured in the AniCloud database. 2. Events that will be available on the MVP product are: a. Add animal b. Weight Record c. Lambing Record d. Mating Record e. Selection Round 	M
FR-04	AniCapture	Additional Events	The following events will be added to AniCapture after the release of the MVP product. So, during the testing phase these events will be added incrementally. This will assist in testing the requirement of adding new traits to events or new events to AniCloud and enabling them to be added to the device automatically. All events listed below will be available on the device prior to go-live. 1. Death – Records the death of an animal and reasons for this. 2. Characteristics – For the selected animal, the date for these characteristics, if they are horned or polled and their fleece weight. 3. Disposal – For the selected animal, the date of the disposal, disposal fate (Breeding, Gift, Slaughter etc), Monetary value (if disposal contains a price) and remarks. 4. Milk Record – for the selected Dam the date they were milked, its morning and night milk and dried date. 5. Village Transfer – For a given animal transfer its data to another village within the CBBP programme.	S

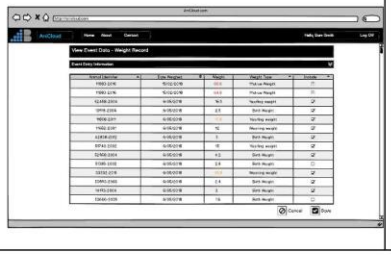
FR-05	AniCapture	Event Entry Display	Selecting a data recording event from the events form displays the event entry setup. 1. The default is to select an existing event entry to continue data entry. Users will pick this from the bubbles which will load the data entry form. Only event entries that haven't been pushed to the AniCloud application will be displayed as bubbles in the grid. 2. Clicking on the Start new recording will create an event entry before loading into the event data capture screen. 3. The breadcrumb (below the page header) navigation panel will transition back to the data capture or home forms. 	M
FR-06	AniCapture	AniCapture	Selecting or creating a new event entry will display the data capture form. 1. The first display panel provides the user with information on the current event entry. The user can reference when the last animal was entered and what its identifier was. 2. The second panel is for event data entry fields. Definition controls will have the same functionality as the Web Application version. Drop down or auto complete controls will auto-populate with values from the LDS, numeric controls will display warnings and errors for data and mandatory columns will be enforced. When the add button is clicked, the data entry fields will be validated before the confirmation window is displayed. If the form fails validation, a message box will display above the data entry panel. This will provide the user with feedback on how to fix all issues to validate successfully. The clear button will clear all the data entry controls, clicking on this will display a confirmation window, which needs to be accepted before this operation is performed. 3. The third information panel outputs data from the LDS when user selections are made. This helps the user confirm that the selected Animal, Sire and Dam they have entered are correct. It will also (for an existing animal) display the last record for the given event for that animal. The clear button will clear all the controls in the data entry and information panels. A pop-up will confirm this before the operation is executed. An add button will validate the data entry panel, checking definitions are valid and mandatory columns are populated. 	M

FR-07	AniCapture	Event Entry Confirmation	Each data entry will need to be confirmed before it is committed to the event entry. 1. A notification window will display if the user selects cancel. If they accept to this window it returns to the event data form with all data still present. 2. Confirmation will commit the data to the LDS ready for sending to the AniCloud platform. The interface will return the user back to the data capture form. The event entry panel will be updated with animal count and last tag data. The data entry fields will be cleared after the save to the LDS is completed with a successful message displayed to the user. 	
FR-08	AniCapture	AWA Transfer	Configuring data to send to the AWA will be managed from the Send data menu item. 1. Event entries that are currently active on the device will display in the "Select your event entries to upload" panel. The user will pick the entries they want to send to AWA by tapping on them. This will update to a different colour and shade informing the user they have been selected. 2. To un-select an event entry they will select it a second time. The "Send data" button will be disabled until one or more event entries are selected. 3. The "previous data" panel will display the last event entries that have been successfully sent to the AWA. This list will default to "sent on" date descending. 	M

				
FR-09	AniCapture	AniCapture	Sending event entries and receiving data updates from the AWA will be operated from the send data menu item. 1. When event entries have been selected the user can select the "send data" button. This will open a confirmation window which users will need to accept. 	M

			2. After accepting the confirmation window a progress bar will be displayed under the send data button. The text under the progress bar will detail the workflow that the application is currently performing. Firstly the "Package" operation will compress the data that has been selected to improve performance on devices that have a slow internet connection. The "Transfer" phase will send the data via the internet connection to the AWA API. When the data has been received and extracted successfully by the AWA it will return a success acknowledgement via the API to the device. Included in the acknowledgement contains the data required to update the device LDS. Updating the database will be processed as part of this operation. 3. The "Updating Events" operation takes the success acknowledgement and identifies and marks the event entries and their corresponding data as sent to AWA. These event entries will no longer be available for selection to be uploaded to the AWA. Records are added to the "Previous data sent" grid to inform the user these event entries have been successfully sent to the AWA. When the entire operation is completed the "Sending to AniCloud completed" message will replace the progress bar. 	
FR-10	AniCapture	Settings	The settings section of the application details the user that is currently signed into the app. 1. The interface will display read-only details of the user from the AWA. 2. The user can select the logout operation which will delete the LDS on the device. A pop-up will display asking the user to confirm this before the operation is initialised. Once the operation is complete the app will return to the login screen for a user to authenticate. 	M

FR-11	AniCloud	EDM	The external data module in AWA will manage the workflow of data from devices. 1. When data is received by the AWA it will alert users (researchers that manage the village) by email informing them that data is available for processing. 2. The External data module will display all event entries that are in a pending state (blue and green tiles). When a user clicks on a tile (indicated by changing green) the user has two workflows they can follow. 3. The first workflow is to check the underlying event data that has been included in the event entry. After selection of the event entry the user can click on the "check data button". This will load the "View event data page with the event data loaded in a grid format. The validation and range business rules will run over the data on load. If validation fails for a given column then this will be indicated in the grid (using the amber and red identifier). By default, if data is marked as invalid (red) then this data row cannot be selected for committing to the AWA database. The right side of the grid has the "Include" column. To not include individual data rows in the commit of the event entry the user will unselect it via the checkbox control. The user will save these updates which will return them to the external data module screen. 4. In the external data module screen, the user can select one or multiple event entries to confirm. Clicking on the "Confirm" button will transfer the data into the AWA database. Underneath the event entry selector is the "Submitted event entry panel". When expanded it will display a grid of event entries that have been committed to the AWA database with counts of event data that were submitted during this process. The Rejected Event Entries will detail event entries that have been rejected by the user. Inside the grid will contain an "Undo" button that allows the event entry back into a pending state. This action will make the event entry visible again in the event entry selector.	M



FR-12	AniCloud	API	An API will be available for the DREMS system to receive all data from the AWA database. For security DREMS will request data with the following credentials: 1. API Key 2. A static IP address of the server that is requesting the connection. These properties of the request object will authenticate the caller which will then allow the data to be downloaded. The response data object will be packaged and exported into CSV files or JSON with the following object lists: 1. Farm 2. Village 3. Animal 4. Event Data a. Animal death b. Characteristics c. Disposal d. Farm to Farm transfer e. Village to Village transfer f. Lambing g. Mating h. Milking i. Sire group j. Selection round k. Weight record	M

Out of Scope

Id	Description
1	Any modifications to the DREMS system. If modifications are required to accommodate the dataset from AWA then this will be done outside of this project scope.
2	Any other development activities that are not detailed in this specification document.
3	Any issues that are directly related to internet connection and speed.
4.	Out of scope for the MVP is reporting on the tablet device. This would be one of the main requirements in the next iteration of development. An example of this would be "on the fly" reporting capability. An animal has a merit index pushed down to AniCapture. Then, when an animal is weighed (and maybe some other information is added), the new information is real-time integrated with the existing merit index, and a final merit score for the animal is provide to the enumerator. This could inform (for example) which young males not to castrate, so as to be kept as a breeding male.