HCI-Based Solutions for Enhancing Agriculture and Animal Husbandry in Rural Settings

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***Abstract*—When they need it, many farmers in rural locations find it difficult to obtain accurate information regarding farming and animal care. They frequently lack access to training, current guidance, and even a veterinary hospital in the area. In order to address this, we spoke with a number of farmers and discovered the difficulties they encounter. Based on their requirements, we created a basic mobile application with four main functions: taking and uploading images to diagnose crop or animal diseases; participating in live or recorded training video sessions; receiving weather and new medication alerts; and quickly locating useful information on farming and livestock care. Based on their input, we also included capabilities like offline access and voice typing. The goal of this program is to make daily farming and animal husbandry a little simpler and more efficient. It is designed to be user-friendly, especially for people with limited digital skills.**

INDEX

I. INTRODUCTION

For many rural communities, particularly in nations like Bangladesh, farming and caring for livestock are vital. But farmers frequently struggle to get the right advice, timely updates, and professional assistance. Many of them lack access to formal training and local veterinary services, and many are unfamiliar with using contemporary technologies. This lack of assistance causes cattle and crops to be mismanaged, which lowers their income and productivity.

We conducted direct interviews with farmers engaged in both agricultural and animal husbandry to gain a deeper understanding of these concerns. We were able to create a mobile app that was customised to meet their demands thanks to their insights and recommendations. In order to make helpful farming information simple to obtain and comprehend, the app has handy features like SnapFarm Diagnosis, Virtual Academy sessions, real-time Watch Alerts, and an Information Desk.

Our objective is to make sure that even farmers with limited digital literacy may take advantage of our emphasis on voice typing, simplicity, and offline support. The goal of this initiative is to provide rural communities with digital tools that are actually appropriate for their everyday life.

II. LITERATURE REVIEW

A crucial area for improving agricultural methods, particularly for rural farming populations, is human-computer interaction, or HCI. From crop monitoring and animal-computer interaction to AI-powered assistance tools and user-centred systems built for inclusivity, a number of important themes and developments have been continuously examined across the 25 projects that were assessed.

Studies on animal behaviour analysis and interactive systems for livestock and zoo animals have demonstrated the growing popularity of animal-computer interaction. Goulart and Young demonstrated the potential of HCI in animal behaviour research by creating a system for utilising computer-mediated interfaces to study primates' colour vision. Similar to this, other studies have examined how AI sensors and health-monitoring wearables for livestock are enhancing animal welfare and early disease identification while lowering the workload associated with manual monitoring.

Convolutional neural networks (CNNs) and other AI models are frequently employed in the crop industry to detect plant diseases. Using picture datasets and deep learning techniques, several studies showed efficacy in identifying rice leaf diseases, tomato pests, and other plant health problems. These technologies were useful for implementation through mobile applications in rural environments where expert support is restricted because they frequently obtained over 90% accuracy.

Numerous studies stressed how crucial smart interfaces and augmented reality (AR) are to helping farmers. To assist farmers make quicker and more informed decisions, several researchers created AR-enabled monitoring devices that display crop health data in real time. The emphasis on user-centred design (UCD) is a common theme among these works. Research has shown how important it is to work with farmers to co-create digital tools, particularly in areas where digital familiarity and literacy are low. It has been demonstrated that participatory design boosts long-term adoption and trust. According to research from Australia, India, and sub-Saharan Africa, visual simplicity, voice interactivity, local language interfaces, and trust in advisory dashboards all greatly increase user engagement.

Offline access and voice-enabled solutions were also investigated. In regions with inadequate internet connectivity, researchers suggested ways that enable rural users to diagnose agricultural illnesses or receive notifications with voice commands and preloaded content. These characteristics increase the technology's usefulness and inclusivity.

AI-based analysis of health data and behaviour tracking using movement and video sensors were frequently used in cattle situations. When HCI technologies were appropriately integrated, production and animal pleasure were found to increase, according to papers on smart cattle and poultry farming.

Technology must adapt to local realities, according to socioeconomic studies, especially those that concentrate on livelihood status and organic farming in developing nations. For tech adoption to be effective, factors including cost, training, and gender engagement are essential. Some publications promoted farming systems diversification with the help of smartphone apps and digital dashboards for community-based alerts and training.

In sum, the reviewed literature supports a holistic, inclusive approach to designing HCI tools for agriculture. Key takeaways include:

- The power of AI in detecting diseases and monitoring both crops and animals.
- The effectiveness of AR and real-time data visualization in improving decision-making.
- The importance of user-centered and participatory design in ensuring accessibility and usability.
- The critical need for voice input, local language support, and offline functionality.
- The role of trusted intermediaries (e.g., advisors) in bridging the digital literacy gap.

The objective of our project, which is to create a useful, inclusive, and problem-solving mobile application for farmers and livestock carers, is directly influenced by these observations. In order to provide rural users with knowledge, diagnosis, and support, our solution integrates smart technology with human-focused design, drawing inspiration from previous case studies.

III. Study Procedure and User Evaluation

A. Methodology

We used a user-centred design method to develop and assess our Human-Computer Interaction (HCI) system for rural farmers and livestock caretakers. This covered user feedback, prototype creation, and ideation.

From our initial Affinity Diagram insights, each team member proposed three design ideas, out of which four were finalized:

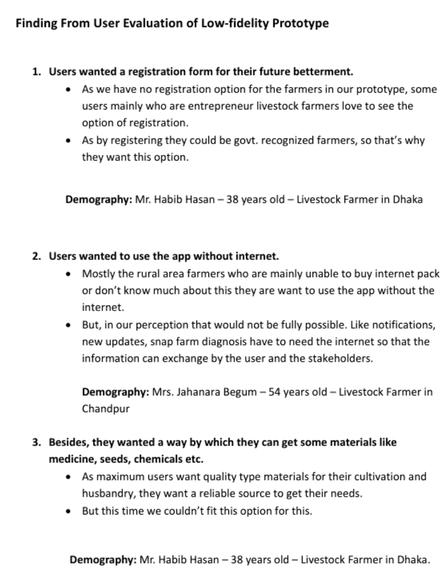
- **SnapFarm Diagnosis** – a picture-based diagnosis tool with integrated voice typing.
- **Virtual Academy** – live and recorded video workshops for practical farming knowledge.
- **Watch Alerts** – real-time updates on weather, diseases, medicine, and government notices.
- **Information Desk** – a searchable repository for crop and livestock management.

Fig. 1. Ideation and feature selection process

B. User Study Protocol

We conducted an initial user study to validate the design with real users. The protocol was structured as follows:

1) **Introduction:** Researchers introduced themselves and explained the project's background and goals to the participants.



Finding From User Evaluation of Low-fidelity Prototype

1. **Users wanted a registration form for their future betterment.**
   - As we have no registration option for the farmers in our prototype, some users mainly who are entrepreneur livestock farmers love to see the option of registration.
   - As by registering they could be govt. recognized farmers, so that's why they want this option.

   Demography: Mr. Habib Hasan – 38 years old – Livestock Farmer in Dhaka

2. **Users wanted to use the app without internet.**
   - Mostly the rural area farmers who are mainly unable to buy internet pack or don't know much about this they are want to use the app without the internet.
   - But, in our perception that would not be fully possible. Like notifications, new updates, snap farm diagnosis have to need the internet so that the information can exchange by the user and the stakeholders.

   Demography: Mrs. Jahanara Begum – 54 years old – Livestock Farmer in Chandpur

3. **Besides, they wanted a way by which they can get some materials like medicine, seeds, chemicals etc.**
   - As maximum users want quality type materials for their cultivation and husbandry, they want a reliable source to get their needs.
   - But this time we couldn't fit this option for this.

   Demography: Mr. Habib Hasan – 38 years old – Livestock Farmer in Dhaka.

Fig. 2. Introducing the project to users

2) **Project Overview:** Users were briefed about the app's purpose—bridging the information gap in farming and animal care.
3) **Warm-up Interaction:** Users shared their experiences and asked questions to build trust.
4) **Think-Aloud Method:** Users described their thoughts while using the prototype.
5) **Task-Based Scenarios:** Users were asked to perform the following:

Fig. 3. Warm-up session with farmers

Fig. 4. Think-aloud protocol in use

- Upload a picture via SnapFarm and describe the issue by voice.
- Join a live or recorded Virtual Academy session.
- Check Watch Alerts for real-time updates.
- Use the Information Desk to find a relevant guide.

6) **Conclusion:** Researchers thanked the participants and collected their feedback.

C. User Feedback and Insights

Key suggestions included:

- **Registration Request:** Users wanted to register using their national ID to receive formal recognition.
- **Offline Access:** Many asked for an offline version due to poor internet.
- **Material Access:** Users requested easier access to farming resources like seeds and medicine.

D. High-Fidelity Improvements

Based on the feedback, we updated the final prototype with:

- A full registration form with profession and ID fields.

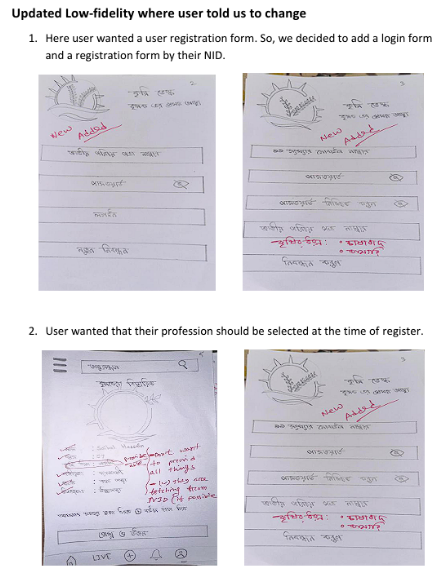


Fig. 5. Task-based user testing

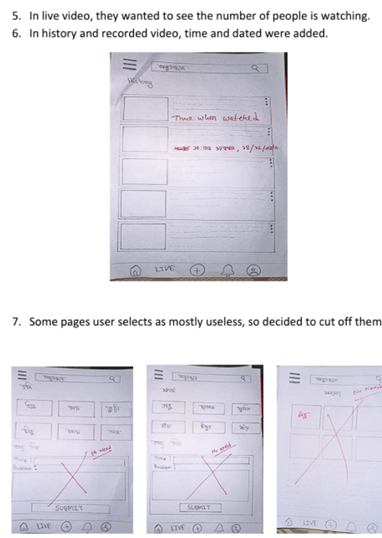


Fig. 6. Collecting feedback from users

- Dual voice typing for describing issues and questions.
- Simplified page layout and more intuitive navigation.
- Enhanced video section with timestamps and view counts.

IV. Proposed Prototypes

We created a high-fidelity mobile application prototype based on user input and the finalised feature set. The design prioritised offline usability, voice support, local relevance, and simplicity. A dedicated panel for each important feature makes it simple for users to engage with the system.

A. Information Desk

This searchable section includes curated guides, frequently asked questions, and best practices for both crops and live-

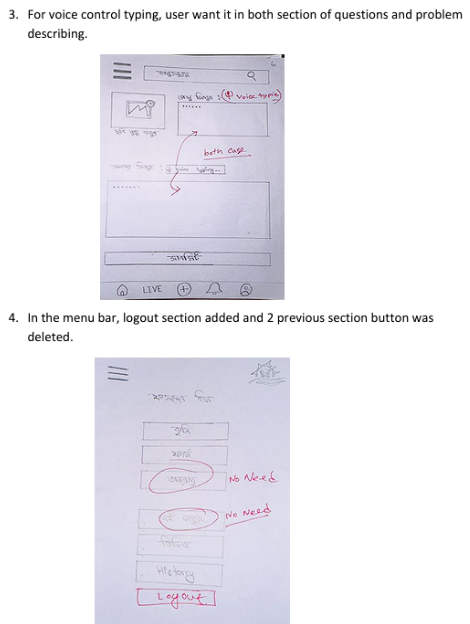


Fig. 7. Collected feedback and key suggestions

Fig. 8. Final high-fidelity prototype

stock. It supports voice input and is accessible offline.

B. User Profile and Registration

Users can register using their NID or phone number and select their profession. This helps personalize content and officially recognize them as part of the farming network.

These screens represent the main functional areas of the prototype. All were tested with users during the high-fidelity

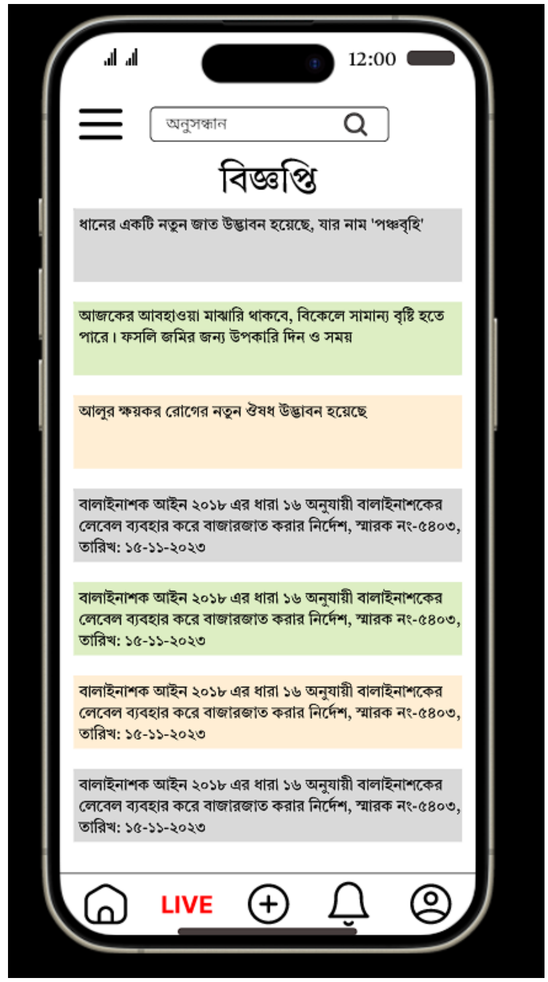


Fig. 9. Information Desk for general farming support

phase, leading to improvements in layout, color contrast, icon clarity, and button placement.

V. Discussion

What we discovered in the literature is supported by our field study: context-sensitive tools are essential. The presumption of constant internet or English literacy is the reason why many current technologies fail. With the goal of lowering these usability obstacles, our research creatively suggests a multimodal app interface that blends text, voice input, and visual icons. Farmers favoured a single software with offline functionality and audio-based support for both crop and animal demands. The participatory design approach informed design decisions, guaranteeing that features represent true user preferences. While addressing these shortcomings, we also took inspiration from programs like eKichabi and AgriAI.

VI. Proposed Prototypes

We proposed the following core modules:

1) **Snap Farm Diagnosis:** Users can upload images or describe issues via voice or typing to identify diseases.

Fig. 10. User registration and profile setup

2) **Virtual Training:** Provides access to live and recorded videos on crop/animal care, with ratings to guide quality.
3) **Information Desk:** Searchable knowledge base in Bangla covering farming tips, livestock care, medicines, and treatments.
4) **Registration and Personalization:** Farmers create a profile and see tailored recommendations and history.

Prototypes were created in Figma and refined through farmer feedback.

VII. User Testing of Proposed Prototypes (Bonus)

In follow-up sessions:

- Farmers liked voice interaction over typing.
- Image-based diagnosis was praised for simplicity.
- Registration and history tracking were requested.
- Farmers wanted information on affordable medicines and seed sources.
- Visual icons helped overcome literacy barriers, especially among older users.

Hi-Fi prototypes included improvements based on this input, available at: https://www.figma.com/design/iUxRg7zWec5NqjPUTCkuzC/HCI_figma

VIII. Summary

Our app merges multiple needs—disease help, training, alerts, and language support—into one platform. It eliminates barriers like internet dependency and typing skills. The voice and Bangla support allows farmers to identify problems and get quick, trusted solutions with minimal effort. Additionally, our approach promotes farmer autonomy and builds long-term self-reliance.

IX. Limitations and Future Work

- Sample size was small and limited to one region.
- LoFi testing lacked long-term usage analysis.
- Future work includes broader testing, feature scaling (telehealth, community chat), and exploring AI personalization.
- Plans include building a progressive web app version and adding regional dialects.

X. Summary

The goal of this project was to create an intuitive smartphone application that would help farmers and livestock keepers in rural areas. Through participatory design, field insights, and user interviews, we were able to identify the main issues that these communities confront, including poor connectivity, restricted veterinary access, and a lack of formal training.

In response, we created a high-fidelity prototype with four primary tools: an information desk, Watch Alerts, Virtual Academy, and SnapFarm Diagnosis. To meet the actual needs of rural users, each tool was designed with offline accessibility, local language support, and voice input in mind.

We used task-based scenarios and the think-aloud technique in an organised user research to test the prototype. Feedback resulted in a number of enhancements, such as improved video capability, easier layouts, and registration options.

The suggested system provides an inclusive, useful, and entertaining digital solution designed for low-resource settings, bridging the gap between farmers and essential agricultural knowledge.

XI. Limitations and Future Work

A. Limitations

Despite several successful implementations, our project had a few limitations:

- **Partial Offline Access:** While some content was made available offline, features such as updates, live videos, and recorded sessions still required internet access.
- **Incomplete Support for Input Needs:** Although users highlighted the importance of access to medicines, chemicals, and seeds, our current prototype does not provide features to fulfill these demands.
- **Lack of Social Connectivity:** We did not implement a community hub feature that would allow users to connect and share knowledge locally or globally.
- **No Telehealth Integration:** Telehealth functionality for animal care—such as live veterinary consultations—was not included in the current scope.

B. Future Work

Based on user feedback and the project's current scope, the following enhancements are recommended for future versions:

- **Expand Offline Capabilities:** Make updates and video content accessible offline through periodic sync options.

- **Integrate Supply Chain Access:** Build modules that allow users to order or find information on farming inputs like medicine, chemicals, and seeds.
- **Develop a Community Hub:** Add a communication platform (forum or chat) where farmers can ask questions, share solutions, and connect with experts.
- **Introduce Telehealth Services:** Enable remote veterinary consultation features to support livestock care in remote areas.

These improvements will help create a more holistic, accessible, and self-sustaining platform for rural agricultural users.

XII. Conclusion

Through the use of a mobile-based solution, this research shows how Human-Computer Interaction (HCI) principles can be successfully utilised to assist rural farmers and livestock caretakers. Through the use of a user-centred design methodology and the integration of actual user input, we were able to create a high-fidelity prototype that effectively tackles numerous issues encountered by agricultural communities, including inadequate training materials, insufficient connectivity, and a lack of professional direction.

To meet the unique requirements of rural customers, our solution incorporates features like Watch Alerts, Virtual Academy, SnapFarm Diagnosis, and an Information Desk. To guarantee usability and inclusion, special consideration was paid to offline access, voice typing, and local language support.

The user study found areas for development and verified the app's basic design. Even though we added capabilities like voice-activated input and partially offline content, several essential requirements—such input supplies, community engagement, and telehealth—remain as potential future paths.

All things considered, this project offers a useful, expandable foundation for creating digital solutions that empower marginalised agricultural communities. It might grow into a full support system for inclusive, sustainable, and intelligent farming with more work.

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