GRADUATE INDUSTRIAL RESEARCH SYMPOSIUM 2023

"Reshaping the Future through Science and Technology"

Development of an Automatic Contextual Agricultural Metadata Collection App

Md. Samiul Basir[1], Dennis R. Buckmaster[1], Yaguang Zhang[2]

[1] *Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, Indiana 47906*

[2] *Elmore Family School of Electrical and Computer Engineering, Purdue University, West Lafayette, Indiana 47906*

PURDUE UNIVERSITY

Agricultural and Biological Engineering

ABSTRACT

Data is the base of digital agriculture. Farm activities are the metadata for production data that are often recorded manually, hence erroneous and missing data often occur. A metadata collection app for contextual agricultural activities was developed for recording detailed information on who is doing what in which field, when, and how. It was developed for android smartphones and functions as a geofence responsive field recognizer using the GPS location of the app user. It records the accessed crop fields automatically with time and facilitates a rules-driven chatbot with validated options for collecting detailed metadata about the conducted activities in that accessed field. The app was designed as a multiple-user app for multi-crop and multi-filed usage and storing collected data in a cloud database. The app automatically records time, location, and operator's name, which reduces the chance of missing data, and the chatbot with validated options reduces errors in recording.

PRESENTER BIO INFORMATION

MD. SAMIUL BASIR

MS Student

Department of Agricultural and Biological Engineering, Purdue University

Problem Statement

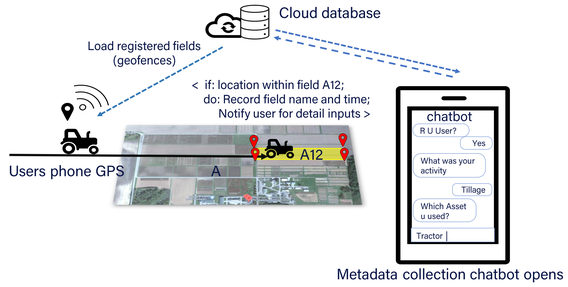
Digital agriculture refers to the digitalization and digitization of agriculture [1]. As the purpose of digital agriculture is to make precise decisions for on-farm activities based on previous data, it requires digital records of farm activities which are only possible with digital and interoperable tools like web applications, software, and mobile applications. Digital data record platforms offer interoperability [2], controlled access to data[3], and easy interpretability for decision support.

The demand for digital agriculture is not only getting agricultural data, but also the data behind the data, the metadata. A historic and digital record of metadata helps a farmer to take decisions on workers, assets, working efficiency, and detailed investigation of farming [4]–[6].

To record on-farm activities, Farm Management Information systems (FMIS) are available and popular, but those have the limitations of expenses, data inaccessibility, and non-interoperable data. Apart from this, the farm activity recording system is manual which leads to erroneous data and missing data.

The specific objective of this project was to develop a contextual metadata collection app for on-farm activities that will collect data with less human input to reduce error and missing data and to support users with interoperability and free access to data.

The Solution Idea



Metadata collection chatbot opens

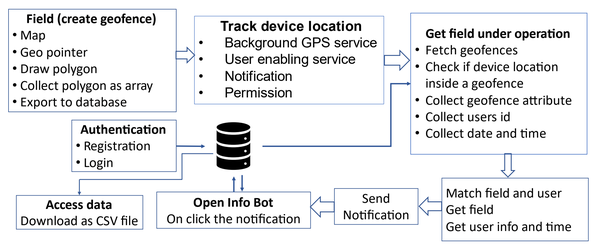
The user's phone has a GPS sensor, which can be used as a location tracker. If the user is inside a geofence/field, the app records the location and time and notifies the user. The user uses a rules-driven chatbot with validated options for further details about an activity.

Methods

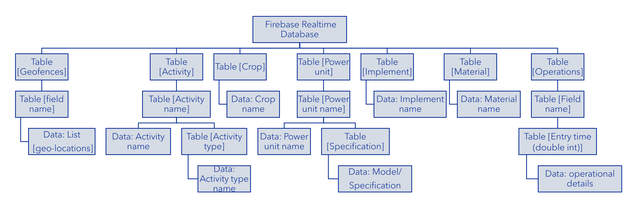
Development of the App

- Environment: Android Studio
- Language: Java
- Database: Google Firebase

Modules and Workflow Design

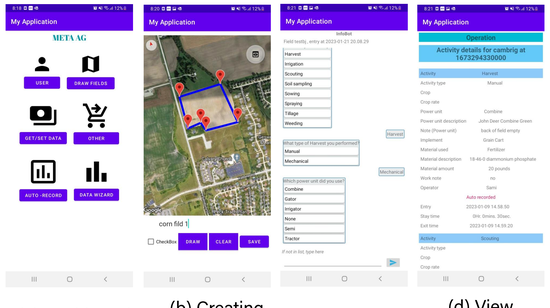


Data Arrangement in Cloud Database



Results

The Developed App



(a) Dashboard (b) Creating geofence (c) Chatbot (d) View collected data

Figure 1: Main modules of the developed app

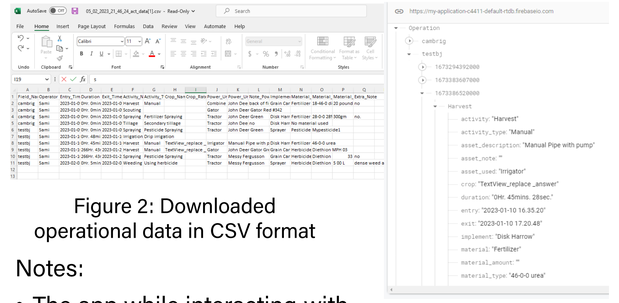


Figure 2: Downloaded operational data in CSV format

Figure 3: Stored operational data in cloud database

Notes:

- The app while interacting with cloud database (Creating geofence, accessing data, chatbot) needs internet access.
- The automatic detection of fields and recording fieldname and time works offline.

Conclusions

The developed app was able to record the location, time, and name of the operator automatically and record detailed data with less error. It was found to be able to reduce missing data and erroneous activity data as there are clickable options for answers in the chatbot. The app facilitates data interoperability and open-source technology for further research and development. It also offers a standalone tool or an integration with other FMIS tools for farming activity records.

References

[1] S. Brennen and D. Kreiss, "Digitalization and digitization," *Cult. Digit.*, vol. 8, 2014.

[2] B. C. Runck, A. Joglekar, K. A. T. Silverstein, C. Chan-Kang, P. G. Pardey, and J. C. Wilgenbusch, "Digital agriculture platforms: Driving data-enabled agricultural innovation in a world fraught with privacy and security concerns," *Agron. J.*, vol. n/a, no. n/a, Aug. 2021, doi: 10.1002/agj2.20873.

[3] R. Chauhan and A. Kumar, "Cloud computing for improved healthcare: Techniques, potential and challenges," in *2013 E-Health and Bioengineering Conference (EHB)*, Nov. 2013, pp. 1–4. doi: 10.1109/EHB.2013.6707234.

[4] H. Baumüller and M. Kah, "Going digital: harnessing the power of emerging technologies for the transformation of Southern African agriculture," 2019. doi: 10.4324/9780429401701-23.

[5] T. Daum, R. Villalba, O. Anidi, S. M. Mayienga, S. Gupta, and R. Birner, "Uber for tractors? Opportunities and challenges of digital tools for tractor hire in India and Nigeria," *World Dev.*, vol. 144, p. 105480, Aug. 2021, doi: 10.1016/j.worlddev.2021.105480.

[6] R. Fabregas, M. Kremer, and F. Schilbach, "Realizing the potential of digital development: The case of agricultural advice," *Science*, vol. 366, no. 6471, p. eaay3038, Dec. 2019, doi: 10.1126/science.aay3038.

Acknowledgement

This material is based upon work supported by the IoT4Ag Engineering Research Center funded by the National Science Foundation (NSF) under NSF Cooperative Agreement Number EEC-1941529. Any opinions, findings and conclusions, or recommendations expressed in this material are those of the author(s), and do not necessarily reflect those of the NSF.

PURDUE UNIVERSITY Agricultural and Biological Engineering

OATS

IoT4Ag The Internet of Things for Precision Agriculture an NSF Engineering Research Center