

Smart Integrated Farm Network for Rural Agricultural Communities (SIRAC)

1952045

Singh A.K., Iowa State University
Award Type (IRG), Solicitation Year (IRG-2, FY2020)

Principal Research Investigators (Name, Institution)

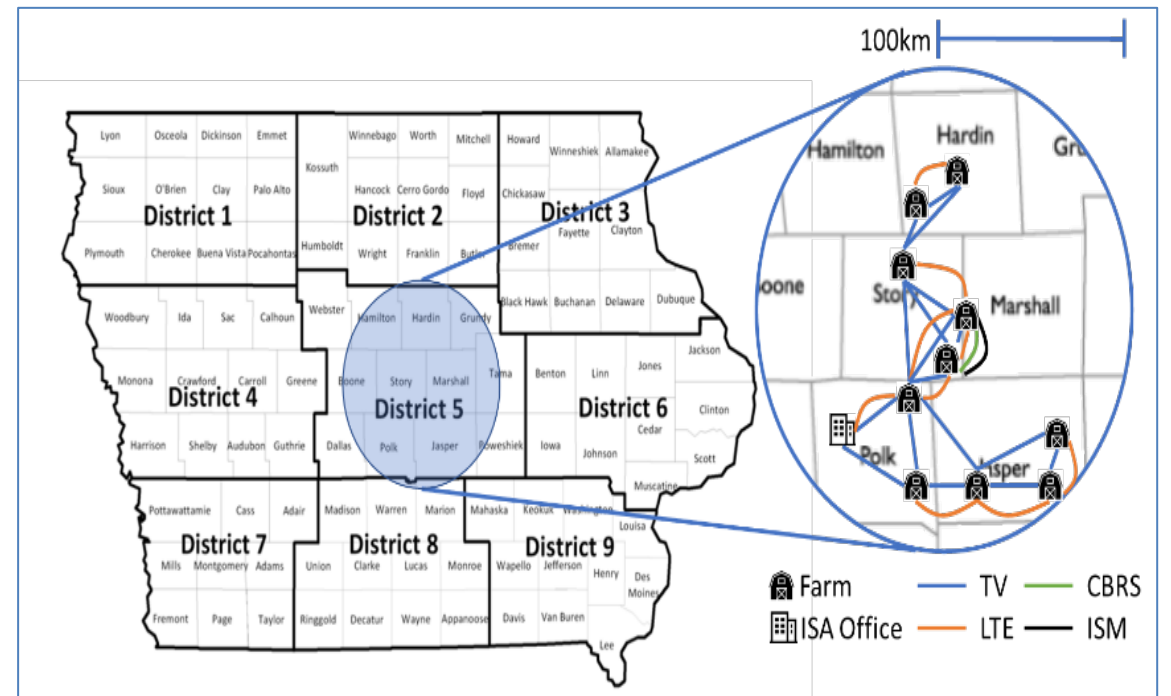
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Senior Personnel:

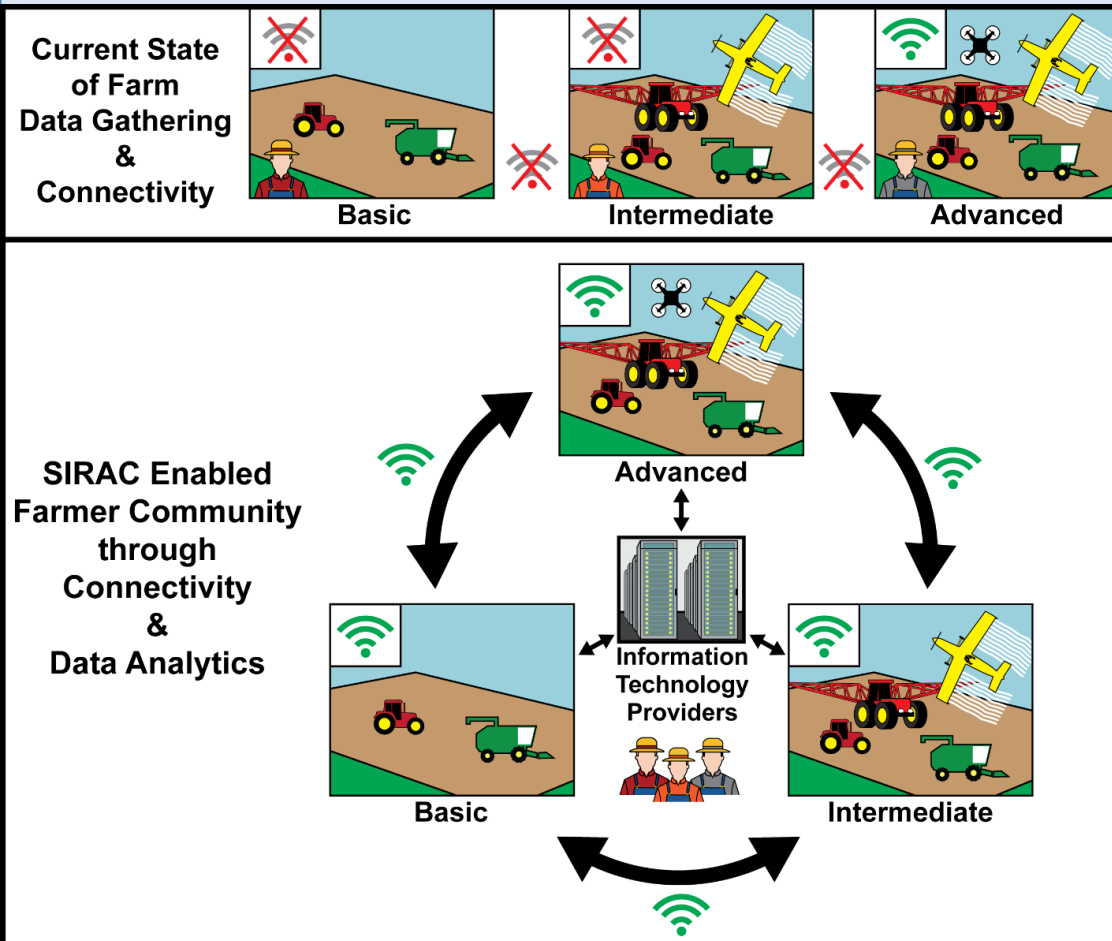
Soumik Sarkar, Iowa State University
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SIRAC Core Group Farm Locations and Connectivity Technologies



SIRAC Project Overview

SIRAC Project Schematics



SIRAC Vision

To improve community-wide data sharing between farmers, we are developing **SIRAC**, a novel socio-technical platform to:

- Create a *smart and connected farm (SCF) network* that facilitates data sharing, knowledge exchange, and coordinated responses to production threats.
- **Goal 1:** Efficiently and cost-effectively improve management practices and crop yield.
- **Goal 2:** Contribute to community-led decisions on biological pest spread and mitigation and nutrient and water stresses.

SIRAC Project Overview

Use-Inspired Research

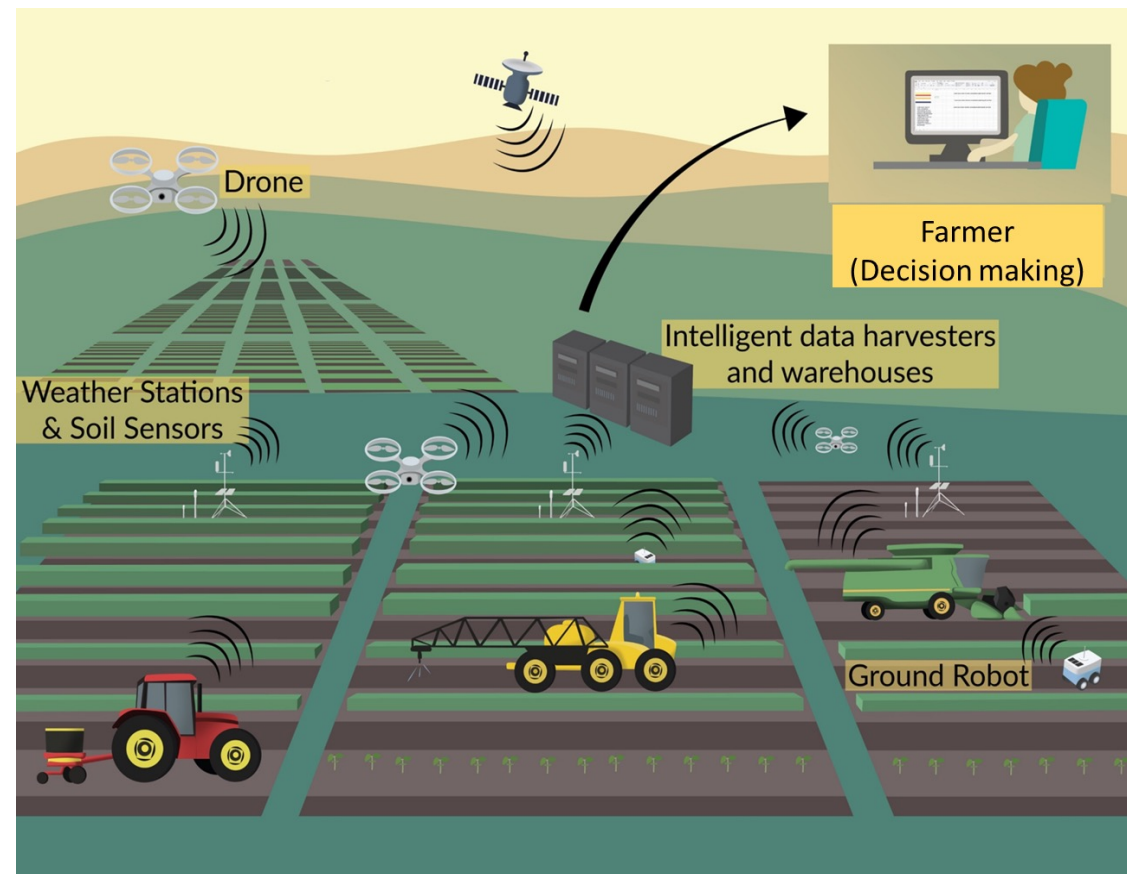
- ❖ SIRAC was formed with the active involvement of Iowa Soybean Association, an organization with 10,000 farmers, to tackle their need for farm connectivity.
- ❖ SIRAC involves eight farmers in the core group where research will be conducted, but the community of practice will actively involve more than 200 farmers, and knowledge dissemination will be done to the entire 10,000 IA farmers.

Fundamental Research Contributions

- ❖ Enable real-time monitoring of threats to farm production, which is critical for dealing with pests, diseases, weather, and management issues.
- ❖ Develop smart sensing and IoT based flexible, scalable and efficient communication infrastructure for SCFs by interconnecting farmers and equipment.
- ❖ Exploit mobile crowdsensing and multiband dynamic spectrum access technology for rural connectivity; privacy-preserving data analytics for community-level decision-making across farms and monitoring real-time threats.
- ❖ Test translational research processes to create a feedback loop between researchers and decision makers in the farming community, informed by behavioral economics.

SIRAC Project Update

- Project started in October'20. Mid-semester start and Covid-19 hindered student recruitment. Following students are now a part of this project:
 - Bekee, Barituka: Ag and Applied Economics, Univ. of Missouri
 - Buckel, Maxwell: UG student, Missouri U. S&T
 - Carroll, Matt: Agronomy, Iowa State Univ.
 - Fatouhi, Fateme: Engineering, Iowa State Univ.
 - Menke, Kevin: Engineering, Missouri U. S&T
- Agreements with eight farmers have been signed and completed to begin project work
- Development of protocols for the feedback process between researchers and farmers and others in the community of practice (scientists, farmers, Iowa Soybean Association, etc.)



SIRAC Project Evolution

- We learned that the farmers have multiple layers of connectivity from broadband to no internet at the farm sites. We are working with them to explore a potential solution that is low cost but more easily adoptable for long- term farm connectivity.
- Project agreements were sorted between SIRAC collaborator universities and farmer organizations, and successfully completed.
- Students across organizations have been embedded in the project and working collaboratively to gear for 2021 farm season and required technology inputs.

Anticipated outcomes & Success measures for next year

Project Milestones:

- Data collection accomplished at farmer fields this crop season.
- A community of practice and baseline established; feedback loop process initiated with the node of farmers involved in SIRAC innovation, the farmers and others engaged in ISA (Iowa Soybean Association).
- Preliminary design of Wireless Smart and Connected Farm (SCF) Network.

Specific Research Activity:

- Drone and ground-based scouting and data collection on farmer field for crop health monitoring.
- Establishing initial conditions of farmers and others in the practice of farming (ISA) for the feedback loop process of the SIRAC Innovation.
- Design of efficient routing strategies for dynamic spectrum access networks.

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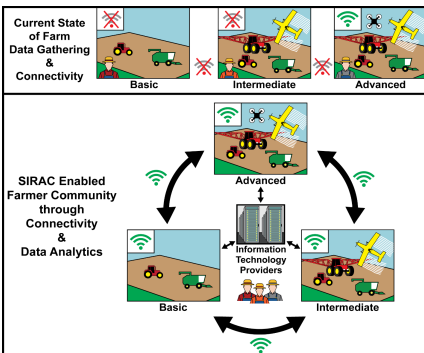
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Visual Schematic

Community: Agricultural Farmers in Rural Midwest. **Goal:** Build **Community of Smart and Connect Farms** to (1) Improve timely data sharing and knowledge exchange for coordinated responses to production threats, (2) Increase crop yield and profitability, (3) Improve farmer's overall wellbeing and quality of life.



Project Vision

- Create a *smart and connected farm (SCF) network* that facilitates privacy-preserving data sharing, knowledge exchange, and coordinated responses to production threats.
- **Goal 1:** Efficiently and cost-effectively improve management practices and crop yield.
- **Goal 2:** Contribute to community-led decisions on biological pest spread and mitigation and nutrient and water stresses.

Use-Inspired Research

- ❖ SIRAC involves IA farmers through ISA (Iowa Soybean Association) to tackle their need for farm connectivity.
- ❖ Project involved eight farmers in the core group. Research will be conducted using their farms fields, but the community of practice will actively involve more than 200 farmers, and knowledge dissemination will be done to the entire 10,000 IA farmers.

Fundamental Research Contributions

- ❖ Develop smart sensing and IoT based flexible, scalable, efficient communication infrastructure for SCFs by interconnecting farmers and equipment.
- ❖ Mobile crowdsensing, rural connectivity, privacy-preserving analytics for community-level decision-making on real-time threat monitoring.
- ❖ Innovative translational research process informed by behavioral sciences that addresses the characteristics of SIRAC (trust, data sharing and privacy preserving).