Assisting Smallholder Farmers in Developing Countries Using Information Communication Technology (ICT) Methods

Interdisciplinary Research Group

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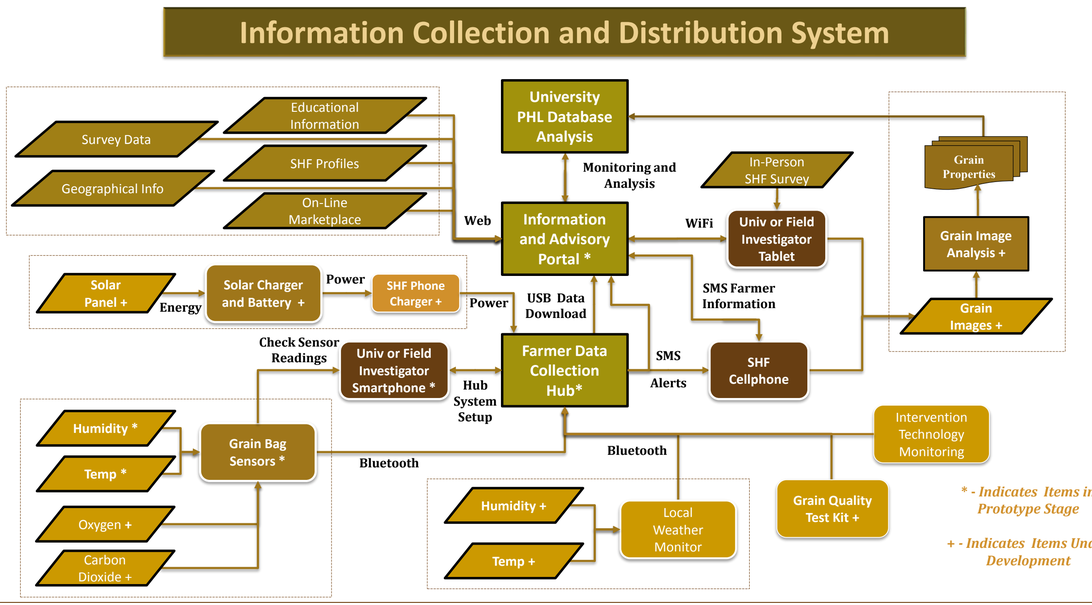
This research work is part of a project sponsored by the ADM Institute for the Prevention of Postharvest Loss – **"Reduction of Postharvest Loss: An Initial Collaboration with Bihar Agricultural University, Rajendra Agricultural University and the University of Illinois"**

- **World food production must keep up with the population growth. A third of food produced for human consumption is lost or wasted globally. Postharvest losses in India are estimated to be up to ~10 percent for grains per year, approximately equal to the total annual grain production of Australia**
- **Our project involves the implementation of Information and Communication Technology (ICT) methods for assisting in the education of smallholder farmers (SHF) to promote adoption of improved grain quality analysis, storage monitoring and marketing methods to reduce their postharvest losses (PHL)**

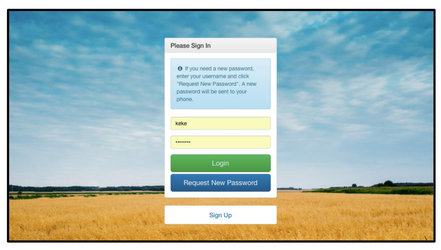
1. Information Collection and Distribution System

- **Approximately 85% of the world population has some level of mobile phone even in the remote villages of developing countries. How can we take advantage of this?**
- **An information ecosystem is being designed to assist and monitor smallholder farmer interventions as adoption grows across the state of Bihar, India**

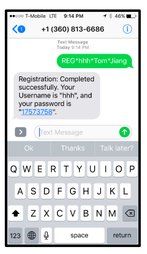


2. Farmer Information and Advisory Portal

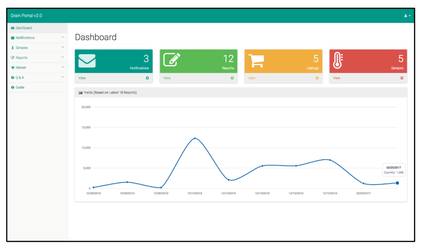
- **Individual Farmer Profile Information Accumulated by Field Investigators**
- **On-Line Marketplace for Farmers and Traders to Communicate Grain Sales**
- **Text Messages from Farmers Parsed and Data from In-the-Bag Sensors Accepted**



Layout of Functioning Prototype Portal



Text Communication with Farmer Simple Phones

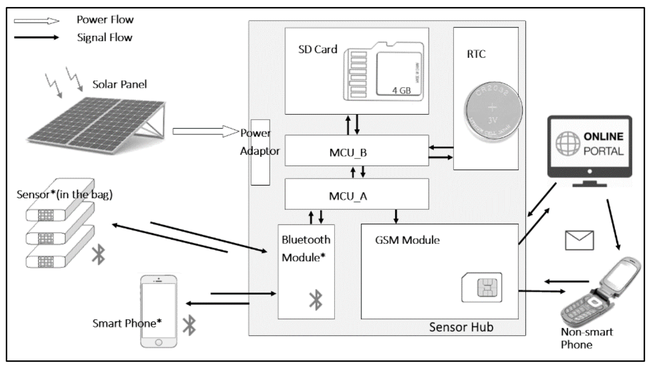


Dashboard Showing Farmer Information

Research Work Conducted by Asavari Tayal, ECE Undergraduate, and Designed and Implemented by Undergraduate Computer Science Students Chang Liu and Kelong Wu

3. Wireless In-the-Bag Sensors for Grain Storage Monitoring

- **Bluetooth Sensor Placed in Sealed Grain Bags to Monitor Temperature and Humidity to Ensure Conditions Remain Suitable for Preventing Spoiling of Grain**
- **Wirelessly Transfers Data to Local Hub for Data Collection and Timestamping**
- **Hub Sends Text Messages to Alert Farmer When Conditions Require Action**



Sensor System Block Diagram

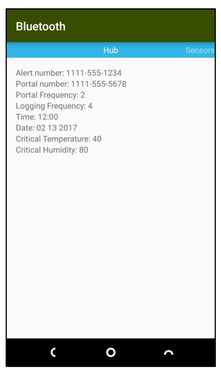
ITB Sensor Modules

Data Collection Hub

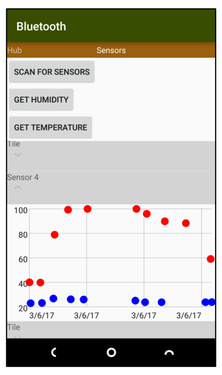
Research Work Conducted by Undergraduate Students Alejandra Martin Carabel, Matt Tsao, and Xin Ding in Sr. Design Class and Continued by Luis Ramirez, Haohang Huang, Junxiao Yang, Chutian Shao, Harsh Agrawal ECE Undergraduate Students

4. Grain Meter App for Interfacing to Data Hub and ITB Sensors

- **Configure Parameters in Data Collection Hub via Field Investigator Smartphones**
- **Upload Historical Temperature and Humidity Data from Hub and Graph Results**
- **By Interfacing Directly with Individual Sensors Phone Becomes Wireless Meter**



Modify Hub Configuration Functions



Plot Historical Readings Collected by Data Hub

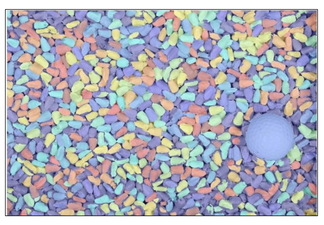
Connect Directly to ITB Sensors to Obtain Current Temp/Humidity Readings Inside Sealed Grain Bags

Research Work Conducted by Doug MacNerland UG Computer Engineering Student under Independent Study

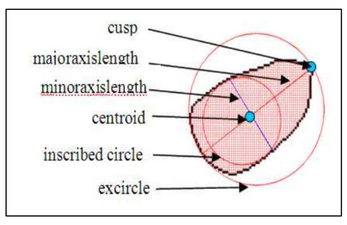
5. Determining Visual Qualities of Grain Using Computer Vision

- **Separate Individual Grain Particles from Image of Grain Sample using Image Segmentation Methods**
- **Future Determination of Visual Grain Quality Factors, Such as Grain Particle Size and Shape, Color and Condition, and Amount of Grain vs Foreign Matter**

Corn Image Taken by Extension Group or Farmer



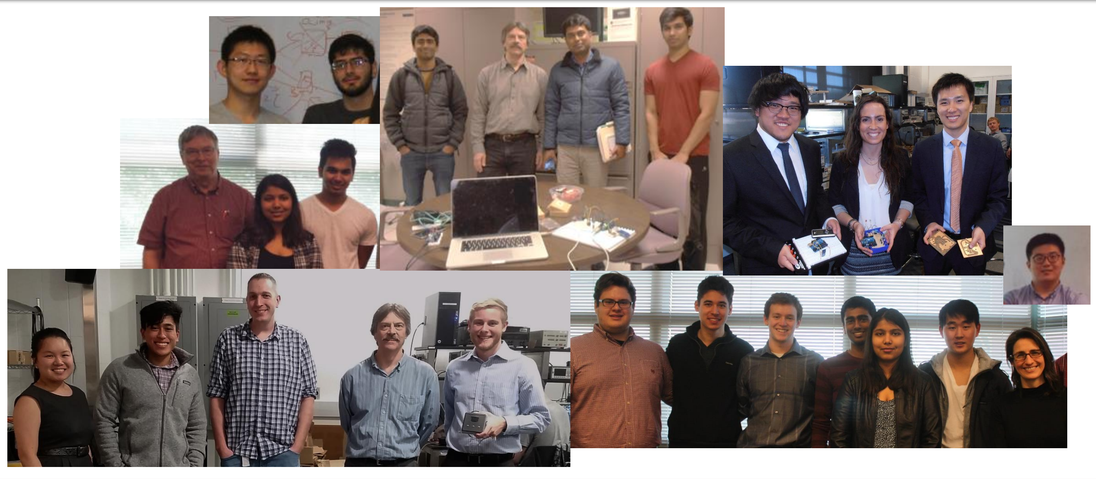
Corn Kernels Individually Identified by Image Segmentation



Future Automated Visual Quality Analysis

Research Work Conducted by ECE Graduate Student Xing Li

6. Student Opportunities to Join Our Project

- **If you have an interest in our project and would like to join our research group, we have several areas where you can contribute, such as computer vision image analysis, sensor systems and wireless communications development, web portal programming, and Android app development**
- **Contact John M. Hart at the Beckman Institute (jmhart3 @ illinois.edu)**

7. Thanks to All the Students for Their Hard Work!