CAPSTONE EXPERIENCE 2014
Individual Row Yield

Agricultural & Biological ENGINEERING

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Problem Statement

A major trend in modern day production agriculture has been the use of data to improve farm efficiency. The goal of this project was to explore methods to increase the accuracy of yield maps – to bring the "precision" in spatial data collection of "precision agriculture" to a whole different level.

Project Goal:

- Enhance yield maps so as to know yield on a row-by-row basis
- Provide farmers with the ability to better utilize their planting and sprayer technologies which are already row-by-row
- Enable accommodation of micro-climate and micro-topography influences

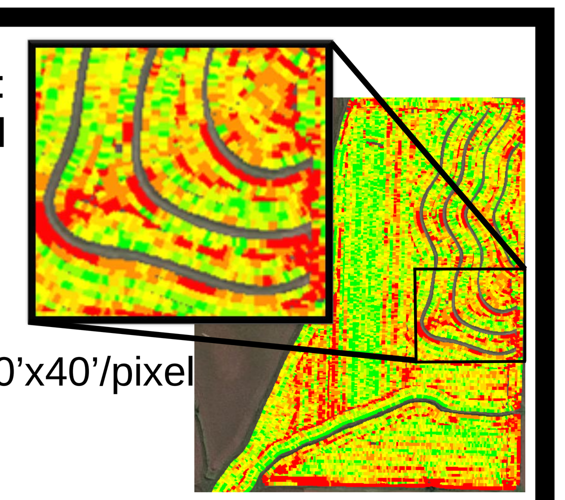
Impact

The increasing world population will require more food with less land availability. This design will help farmers increase yield and increase environmental sustainability. More food with fewer resources such as water, fertilizer, and herbicides will be a benefit to all.

Economical Benefits

1. Increase yield map accuracy
2. Locate specific areas of lost crop
3. Compare plant response to soil type
4. Evaluate specific nutrient levels
5. Analyze different hybrids
6. Locate specific compaction areas
7. Identify drainage problem areas

Individual row yield map: Accuracy increased to 1'x1'/pixel



Original map:40'x40'/pixel

Photo: wwwAgleader.com

Alternative Solution

- Electronic sensor to detect ear weight
- Ears pass over load cell located behind deck plates
- Millivolt reading is processed and converted into weight

Sensor location

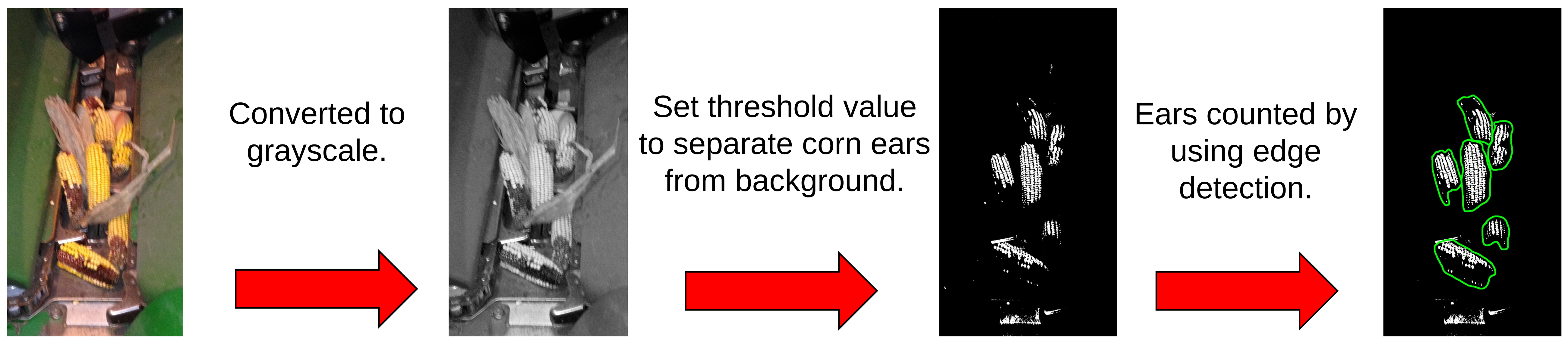
Limiting Factors

1. Ears often bounce out of the row
2. Limited space for hardware components
3. The environment in this area in not conductive to delicate electronic components
4. Inability to separate individual ear weights and plant readings

Proposed Solution

- Take advantage of existing image processing technologies already used in areas such as:
  - o fruit farm yield estimation
  - o weed analysis for spraying technology
  - o seed processing
- Use one GoPro camera for every 3 rows to optimize resolution
  - o camera frame rate capabilities allow combine operation through a full range of speeds
  - o camera has proven durability for harsh environments
- Use WIFI enabled components to simplify installation
- Customize image processing software (may require nominally 6 mo. to 1 yr. of programming)

Image Processing Steps



Software used for mock up: Gimp 2.0 and Paint
Technical support: Dr. Edward Delp (Viper)

Basic System Elements

GoPro Hero 3+ Black Edition- $400
Capabilities: 1080p HD video, 12MP photos, time lapse modes

Computer- $750
Capabilities: 4 core processing power, terabyte hard drive has the ability to store photos daily

Tablet- $400
Capabilities: Display app with ear count

GoPro Stand Mount- $15
Capabilities: Provides the desired height and angle needed to achieve the optimum image

Software: C programming language

Photos: www.gopro.com, www.apple.com

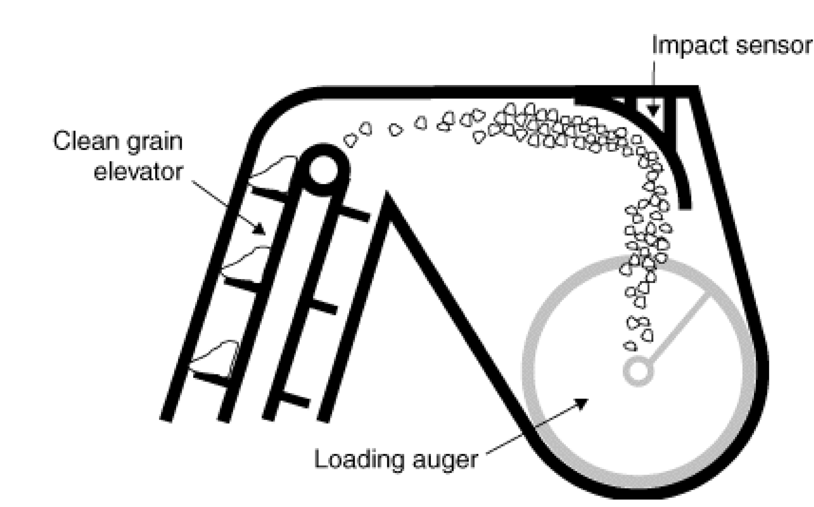
1. GoPro attached to the back of the corn head looking into row unit from above.

2. Computer processes images using written software.

3. Individual row yield displayed on tablet in the combine cab.

Systems Integration

- System works in conjunction with the pre-existing mass flow sensor.
- Compares percentage reading from the software with mass flow total yield number
- Operator has the ability to view yield data on a row-by-row basis



http://www2.ca.uky.edu

Sponsor: Aaron Ault
Technical Advisor: Dr. Buckmaster
Course Instructors: Dr. Engel and Dr. Stwalley

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