

Computer Vision Qualified Infrared Temperature Sensor

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Agricultural Research Service

“Solving problems for a growing world”



- The agricultural RESEARCH agency of USDA
- Network of nationally coordinated labs and National Programs
- International collaboration
- Solving agricultural production problems of worldwide significance

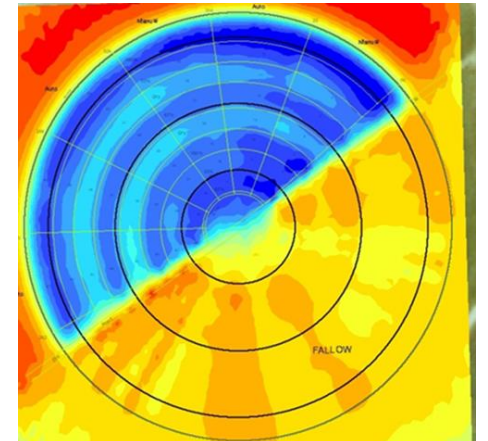


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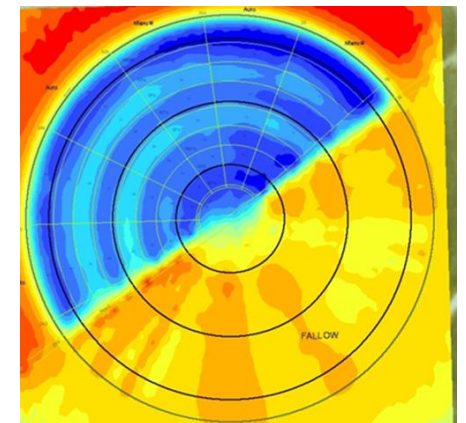
- 20% of all agricultural land is irrigated
 - 750 million acres irrigated worldwide (Food and Agric. Organization, 2019)
- 40% of all food and fiber is produced by irrigation
- Irrigation is vital in feeding a growing population (9 billion by 2050)

- LESS water available for irrigation
- THEREFORE, we must MANAGE what we have
- INCREASE crop per drop (or *decrease* drop per crop?)



Sensing crop irrigation needs – thermal band

- Crop leaf temperature is related to crop water status
- Shown to manage irrigation effectively since 1980s
- We want leaf temperature, BUT we also get everything else!
 - Very cumbersome and costly to process using conventional imagers
- THEREFORE: We need a fast wireless package to do it all!



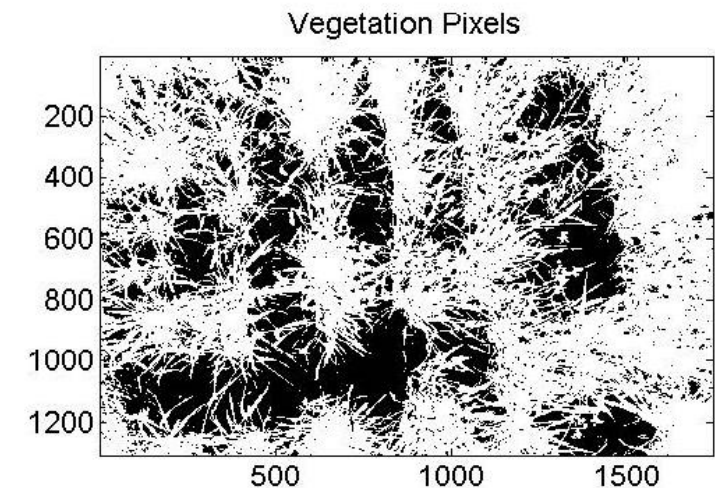
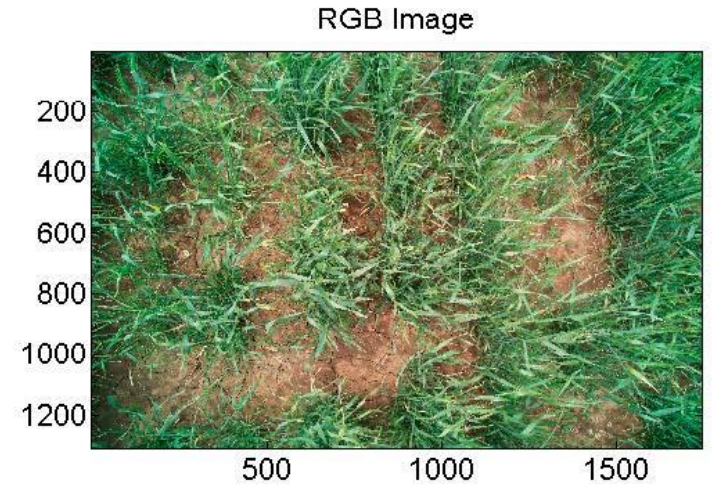
Computer Vision Qualified Infrared Temperature Sensor

1. Combination visible imager and infrared thermometer
2. On-board microprocessor
 - Uses novel algorithms to automatically extract vegetation temperature
 - Reduces data transmission load
3. Transmitter to send data by Wifi to base station



Computer Vision Qualified Infrared Temperature Sensor - TESTS

- Prototype TESTED over winter wheat in Bushland, TX
- Sensor aboard moving center pivot (ground-based platform), two seasons (2011 and 2013)
- Two treatment factors
 - Irrigation rates (water stressed or fully irrigated)
 - Disease (wheat streak mosaic virus) or no disease
- Performance compared to Fuji® imager (2013 only)
- Published in Casanova et al (2014), Sensors



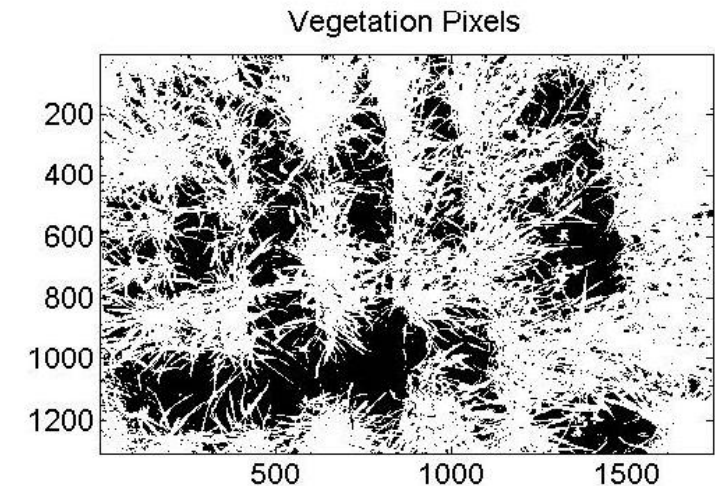
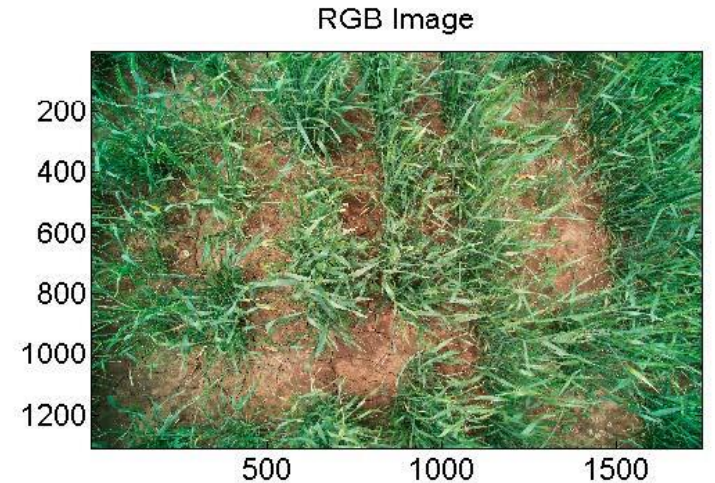
Computer Vision Qualified Infrared Temperature Sensor - RESULTS

BOTH Computer Vision Prototype and Fuji® imager could:

- Detect crop water stress
- Detect disease (wheat streak mosaic virus)
- Distinguish between the two (important for allocating water)

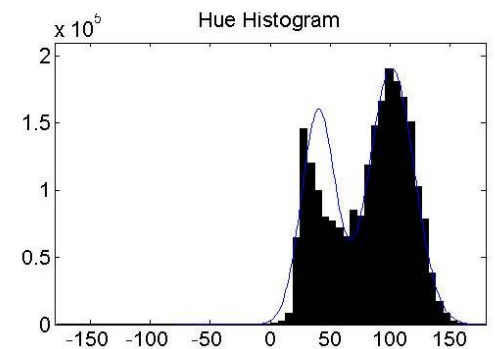
BUT

- Prototype processed images automatically and sent data wirelessly to base station
- Fuji® images had to be processed manually



Conclusion – Computer Vision Device

- Presently at the RAW TECH development stage
- Ground-based tests, but can be applied to UAS
- Designed to work SMARTER AND FASTER with imagery
- Mitigates the TOO MUCH DATA problem
- For the farmer:
Intended to reduce required irrigation management time!



Where do we go from here?

- ARS is seeking partner for:
 - Further development and testing
 - Market analysis
 - Commercialization
- Cooperative Research And Development Agreement (CRADA)
 - Commonly used to license patents
 - High success rate in commercializing previous ARS inventions



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