For the 2007-2008 academic year, Rockwell Automation sponsored a project to design and develop a viable, miniaturized fluid sensor chip developed by Rockwell Automation Technologies Lab in Cleveland, Ohio.

Our team approached the project in a structured manner, completing several phases during which the team focused on specific areas in order to gain expertise and understand Rockwell Automation’s current capabilities and potential for growth within their current business model. Given these parameters, the team chose to focus on the food and beverage industry. This research was supplemented by an analysis of market need in terms of ability to deliver value, as well as achieve a unique and sustainable competitive advantage. Based on this analysis we decided to focus on the fry oil condition sensing as the target application.

Potential applications that we identified were then evaluated based on their value to execute and deliver proof of concept, as well as Rockwell Automation’s ability to scale and integrate within their current business model. Given these parameters, the team chose to focus on the fry oil condition sensing as the target application.

Meet our sensor

Rockwell Automation developed a multi-element fluid sensor, initially conceived to cover the most oils and greases. Five properties were identified as being the most important to monitor in these fluids, and sensing elements corresponding to calculating these properties were designed.

The chip currently has the following sensing capabilities:

- Temperature
- Electrochemical cell
- pH measure using open circuit potential
- Viscosity
- Dielectric

Phase 1: Market Research
In the 2007-2008 academic year, the SCOPE team sponsored by Rockwell Automation was asked to identify, assess, and recommend a business application for a fluid sensor technology. The team worked with Rockwell Automation’s Advanced Technology Center in Independence, Ohio.

The project was divided into two phases: the first phase involved gaining exposure to the processes used by Rockwell Automation’s current and potential customers, which helped to begin identifying applications.

Due to customers, our ability as a team to successfully deploy the technology and develop specific ideas within the area led to an analysis of applications within this significant market niche. Based on this analysis:

- 1. Oil Health Indicators
- 2. Free Fatty Acid (FFA) Content
- 3. Total Polar Molecules (TPM)
- 4. Surfactants (WET)
- 5. Dissolved Water
- 6. Metal Ions

**FDA Approval**

- FCS Certification needed for: Ag, Au, Pt, Pd, and Ti
- 120+ day process looks at Toxicology, Chemistry and Environmental

**Other Areas of Investigation**

- Preventative/corrective maintenance
- Failure Recognition
- Replacement
- End of life

**Phase 2: Roadmap**

- Ruggedly designed for industrial use
- Connection port in back for power signaling
- Modular sensing head:
  - Easy to install
  - Easy to clean
  - Easy to replace

Properties were incorporated onto the chip.
map to a Product

Technical Validation
1) Reliability/Repeatability testing
2) Determine optimal lab test conditions/development of test protocol
3) Ability to qualitatively distinguish between ‘good’ and ‘bad’ oil testing
4) Ability to quantitatively distinguish between different levels of FFA testing

Future Steps
Replicate good results in a manufacturing environment

Mechanical Design

3 LED buttons indicate fluid condition and allow for manual programming

Display panel shows actual oil quality and allows for manual programming

Optional analog control port allows for computer programming and collection of analog data

Actuator extracts oil sample for testing
Industry Selection

- Application: Clean-in-place systems
  - Between batches
  - Potential to reduce time consumed doing offline analytics
- Value: Faster changeover times lead to increased productivity
- Touring NY facility in November

Rockwell
- Immediately Applicable
- Builds Product Portfolio
- Potential for Growth

Scope
- Matches Team Skills & Interests
- Good Educational Experience
- Accessible

- Toured Cape Cod in Hyannis, MA

- Application: In need of facility with indicator cut
- Value: Consistently save oil
- Constraints: Clean production environment
The Team

Hans Borchardt (Mechanical)
Jonathan Cass (Engineering)
Helen Lewis-Rzeszutke (Electrical and Computer Engineering)
Eric Munsing (Mechanical)
Meenakshi Vembusubramanian (Electrical and Computer Engineering)

Faculty Advisors:
Rockwell Liaisons: Dr. Fred M...
Value Proposition

- Costs equate to annual savings of $4,200 per sensor per fryer
- Time equates to annual savings of $1550 per sensor per fryer
- Error equates to annual savings of $5,750 per sensor per fryer
- Annual savings for Cape Cod Potato Chip Factory: $103,500

Additional Value Added:

- Error - more consistent product, more reliable shelf life
- Timing frying process - cost reduction, longer shelf life
- Metal housing reduces noise
- Hose connection for discarded oil