IOWA STATE UNIVERSITY
Department of Agricultural and Biosystems Engineering

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Instructors: mea1@iastate.edu; koziel@iastate.edu

Tyler Carney, Adam Degaetano, Nicholas Niemeyer, Creed Tucker, Michael E. Anderson, Jacek A. Koziel

Hydroswing Door Automation

Client: BioCentury Research Farm, Boone, Iowa

Problem Statement

The client is an entity of Iowa State university located on the ISU BioCentury Research Farm.
Currently, the door is operated manually, and more efficient methods to operate the door exist such as using an automated system.

Objectives

Provide two complete solutions per the project scope. One OEM already available solution, and one Custom solution.

Both systems must:

1. Create a safe and efficient automated door open/close cycle

2. Reduce time spent waiting on the door to open and close

Constraints

- $1000 budget
- Components for two different solutions
- Door is used daily and cannot be out of service
- Components must be compatible with existing system

Scope

- Create two systems that can be retrofitted to the existing door for automated operation.
- Provide a decision matrix of which system is preferred, logic diagrams of electronics, and computer simulation of the system.
- System cannot interfere with machinery which enters/exits through the door.

Outside View of 18' x 40' Door:

Scale Definition			
Cost	1= Highest Cost (Least Desireable)	3=Medium Cost	5= Lowest Cost (Most Desireable)
Safety	1= Least safe	3= Medium Safety	5= Highest Safety
Reliability	1=Least Reliable	3= Medium Reliability	5= Very Reliable
Install/Support	1= Low or no Support	3=Medium Support	5= High Support

% Weight	Criteria	Name Brand OEM	Rating (Weight*Criteria)
20%	Cost	1	0.2
40%	Safety	3	1.2
30%	Reliability	5	1.5
10%	Install/Support	3	0.3
	Total:		3.2

% Weight	Criteria	Custom Design	Rating (Weight*Criteria)
20%	Cost	3	0.6
40%	Safety	1	0.4
30%	Reliability	3	0.9
10%	Install/Support	1	0.1
	Total:		2

Decision Matrix for determining which solution to choose

Custom Design System

- Fully custom design
- Cost of $1,170

Pros

- Lower cost
- High design flexibility

Cons

- No installation support
- Lower standard of safety
- Possible component compatibility issues

Name Brand (OEM)

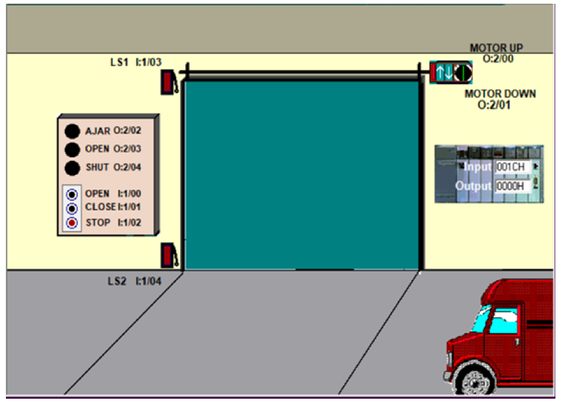
- Schweiss components
- Off the shelf solution
- Cost of $1,745

Pros

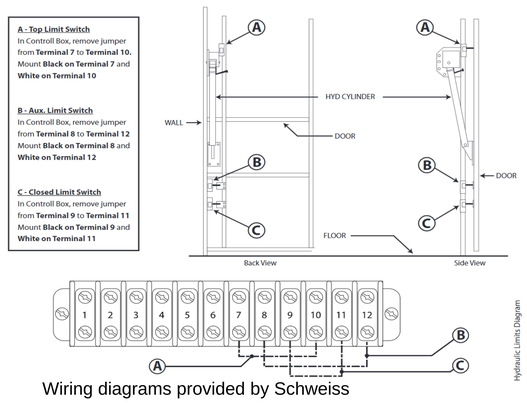
- Manufacturer components
- Installation support included
- Limited liability

Cons

- Higher cost
- Limited design flexibility



Digital Simulator for door



Wiring diagrams provided by Schweiss

Methods/Approach

- Develop a Decision matrix (right) to determine the best solution to suit our client's needs to automate the door
  - Name brand OEM
  - Custom design
- Research on PLC, photo eye sensors, and limit switches
- Safety considerations
- Use of LogixPro Simulation to prove operation logic
- All safety implementations should have a maintenance mode, so the door does not get stuck open for long periods of time.

Major Deliverables

- Suggest an automated electrical design system
- Design has visual and audible indications of movement
- System that only allows movement when the lock is disengaged
- Safety implemented in the door with light curtains

Recommendations

- We recommend using the OEM option, because of how well it met our client's expectations based on our decision matrix.

References

- https://www.bifold.com/
- https://signalguys.com/Strobe-Light-and-Horn-490SMT4_p_678.html
- https://www.grainger.com/

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