DESIGN, CONSTRUCTION, AND EVALUATION OF AN AUTOMATED CHICKEN COOP DOOR

By

Kyle Inks

Agriculture Systems Management
BioResource and Agriculture Engineering Department
California Polytechnic State University
San Luis Obispo
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First, I would like to thank my mother and father, Jan and Richard Inks, for the idea and need of an automated chicken coop door. Also for the love, support, and funding of my project.

Second, I would like to thank my advisor Dr. Kelly for his help and guidance throughout my project.

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Fourth, I would like to thank Dr. Zohns for helping/answering questions pertaining to my design, as well as help with some of the fabrication.
ABSTRACT

This senior project takes a look into the design, construction, and evaluation of an automated chicken coop door. The idea and need for such a door came from my mother Jan Inks. The parameters for the project include, low production cost, easy installation on existing coops, sleek design, automatically open at a set time in the morning, and automatically close at a set time in the evening.
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INTRODUCTION

Background

Chickens are prone to being attacked by many predators during the night. In order to keep your flock safe and alive, a good solution is to have an enclosed structure for the chickens to go in during the night. Rather than having to go out every night to lock them up in this structure, or early in the morning to let them roam the pasture. A good solution would be an automatic door installed on the structure. The door can be designed to include many different functions. These functions will be involved in how it opens and closes, and how it is set to open or close.

Justification

In having a fail proof door, it will automatically open and close to allow the chickens to roam pasture during the day and be safe from predators during the night. This door will avoid substantial risks of predators roaming the pasture during the dark hours. The door will increase productivity of the hens to lay eggs, and decrease the “costs” that are incurred if chickens were loss to predators. The design of the door will put in action the skills and education I have learned throughout my academic career at Cal Poly.

Objectives

The first objective will be to determine the design of the door. Different designs would be coinciding with the setup of the structure the door is going to be installed in. The next design element will be the type of timer setting or sensor that would be used. The second objective will be getting the correct materials, and components to construct the final design of the project. The third objective will be the actual construction of the design. After the construction of the door, the last objective will include testing and evaluating the completed construction of the design.
In order to get an understanding of what is in the market, a search took place to determine companies that sell automated chicken coop doors.

By looking into designs some companies produced for automated doors, it helped show a few different ideas ranging from simplistic to more complicated designs. Designs included basic swinging doors, and vertically opening doors. Different types of sensors or programs can be used to determine the time the doors either opened or close. The types of ways you can go towards in determining this include: light censoring, to close at dusk and open at dawn, and/or include a timer system that can be set for a certain time to either open or close.

A company called Automatic Chicken Coop Doors has a very simplistic model for sale. The door is a vertically rising door made of wood with a width of 30-7/8” and a height of 40-1/2”. The door is opened with a motor design somewhat resembling a fishing reel that lifts and drops the door. The motor itself is programmable to certain times that it will open or close. In order to run the motor, it must be powered by 120v 60herts 19watts.

NOPEC Corporation has a totally different design for an automated coop door. Their design opens outward in a swinging motion. The door is 11” wide by 15” tall and is extremely easy to install. Powered by a small electrical motor that swings the door open and close, there are two options to provide power to. You can either supply a trickle charger to the 12v to keep it charged or connect a solar panel in order to keep the battery charged.
charged. The door can either be operated manually, or you can attach a photo sensor that will open the door at sunrise and close it at sunset.

![Figure 2. NOPEC Corporation: Pullet Shut Automatic Chicken Door](image)

These two doors, although totally different designs, will help to determine the design of the door I will design and construct to meet the objective of my project. I'll take into account the different directions of opening and closing the door, as well as the different ways to do so. In my design I plan to incorporate a more mechanical system, easily programmable, with different options of opening/closing determinants, and have it be aesthetically pleasing. This is what will set my design apart from other designs out there.
PROCEDURES AND METHODS

Design Procedure

Main Frame

Aspects that were thought of in order to design the main frame of an automated chicken coop door involved selecting the type of material, having strength, durability, and aesthetically pleasing. Therefore I decided to build the main frame out of 18 gauge cold rolled steel. Using this material allows the door to be extremely strong and durable to keep out predators. With a good paint job applied to the finished product, it will be both aesthetically pleasing and able to withstand all weather. The main frame will be made up of two parts including the center skeleton attached to the front plate, and a removable back plate.

Opening/Closing of the Door

The design of the door will need to be able to open at a set time in the morning, and close at a set time in the evening. The door will open and close by the same method a linear actuator works. An electric motor will be attached to an all thread rod that will rotate in a fixed position. A coupler nut will be fabricated on the door, when the motor rotates the rod, the door will move either up or down the all thread rod.

Electronics

In order for the door to open and close at specified times, an electrical circuit must be designed and attached to the motor. I will be using a 24 VDC 1.7A power supply, 3 120 VAC relays, 2 mini-snap-action switches, and a 125 VAC programmable timer in order for the door to operate correctly.
**Construction Procedures**

**Individual Parts**

Before construction began, I designed and drew up a solid works drawing of the entire door assembly. The door assembly consists of seven different parts that will be attached to each other by rivets, welds, or bolts. The parts consist of a front plate, two spacer plates, the center skeleton, all thread rod, door plate, and back plate. A box was also be fabricated to house the electronics.

Figure 3. Front Plate  
Figure 4. Spacers  
Figure 5. Center Skeleton  
Figure 6. Back Plate  
Figure 7. Door Plate
Main Frame

The door had to be designed to open up big enough to allow a fully grown chicken to walk through it. The final dimensions are 22 ½ inches tall by 12 inches wide, with a depth of 1 ¾ inches. The front plate is extended 1 ½ inches on each side to allow attach ability to a structure. When the door is fully opened, the opening is 9 inches by 8 ½ inches.

The front plate, back plate, and door pieces were cut out on the C&C Plasma cutter in order for clean and accurate cuts. Remaining parts used for construction of the final product were cut using the shearing machinery, and bent using a bending brake.

The skeleton of the door was fabricated using a tig welder. The front plate, spacer plates, and the center skeleton were attached using 1/8 inch pop rivets. The back plate is designed to be removable, and is attached by nine small bolts.

Opening/Closing of the Door

5/16 - 18 all thread rod was used for the rod to raise and lower the door. In order to work smoothly, each end of the all thread was turned down on the lathe; the bottom end was turned down to ¼ inch diameter, ¼ inch up the rod. The top was turned down until the threads were completely off, and 3/8 inch down the rod to allow space for a set screw. Then a .02” diameter hole was drilled in the center of the rod in order for the motor shaft to fit. The rod is held in place between the two cross members by securing the motor to the motor mount and tightening the set screw to the motor shaft.
Electronics

In order for the door to open and close at specified times, a simple dial light switch timer was used. To allow the timer to operate correctly, I applied three relay switches within the circuit. The relays determine which direction the motor will turn when the timer switches on or off. Mounted on the center skeleton of the project, are two mini-snap-acting switches, these allow the door to stop when it reaches a fully opened or fully closed position by shutting off the power to the motor.

Figure 10. Snap Action Switches

Figure 11. Electrical Circuit

Figure 12. Electrical Circuit
**Testing Procedure**

Testing included manually rotating the dial timer in order for it to switch on and off. The relays operated correctly in changing the direction of the motor. Also the limit switches successfully stop the motor when it has reached a fully opened or fully closed position.

**Cost Analysis**

The end product ended up being fairly cheap, although not included in the table below are prices accrued from the use of shop 7, and labor costs. The costs are simply for hardware used to construct this project.

<table>
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<th>Item</th>
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<td>Steel</td>
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<td><strong>Total</strong></td>
<td><strong>$89.94</strong></td>
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Table 1. Cost
RESULTS

Completion of this project has provided my mother Jan Inks a fully operating automated chicken coop door. The door is durable, sleek, weatherproof, predator proof, and aesthetically pleasing. Long term results of this door will include increased egg laying, increase the safety of your chickens, and eliminate the need to open and close your coop manually.

3. Back View

Figure 14. Front View
DISCUSSION

Overall the design and fabrication of this automated chicken coop door involved certain skills that were needed. The main difficulty was coming up with a simplistic and small design to reach the objectives I had set for the project. With the help of Dr. Kelly, the electronics portion of the project came together very smoothly. The sleek design allowed me to improve, and learn more fabrication skills. I’m pleased with the end result of the project, and seeing it work.
RECOMMENDATIONS

My main recommendation would be to make the design smaller. The 9 x 8½ inch opening is a little overkill for a fully grown chicken. The door size could easily be reduced to a 6 x 6 inch cube. Therefore the entire dimension of the door would be 16½ inches by 15 inches with a width of 1¾ inch.

Also, for a more costly electrical design, using a PLC, and light sensor would make the door a lot more user friendly. Allowing the door to open at sunrise, and close 45 minutes after sunset, without needing to be programmed manually by the user.
REFERENCES


APPENDIX A
HOW PROJECT MEETS THE REQUIREMENTS FOR THE ASM MAJOR
ASM Project Requirements

The ASM senior project included a problem solving experience that incorporated the application of technology and the organizational skills of business and management, and quantitative, analytical problem solving. This project addresses these issues as follows.

Application of Agriculture Technology. The project involves the application of mechanical systems, power transmission, and fabrication technologies.

Application of Business and/or Management Skills. The project involves business/management skills in the area of machinery management, cost and productivity analyses, and labor considerations.

Quantitative, Analytical Problem Solving. Quantitative problem solving techniques include the determination of how much material and hardware will be needed.

Capstone Project Experience

The ASM senior project must incorporate knowledge and skills acquired in earlier coursework. This project incorporates knowledge/skills from these key courses.

- BRAE 129 Lab Skill/Safety
- BRAE 133 Engineering Graphics
- BRAE 151 AutoCAD
- BRAE 142 Machinery Management
- BRAE 301 Hydraulic/Mechanical Power Systems
- BRAE 302 Servo Hydraulics
- BRAE 321 Ag Safety
- BRAE 324 Principles of Agriculture Electrification
- BRAE 342 Ag Materials
- BRAE 343 Mechanical Systems
- BRAE 418/419 Ag Systems Management
- PM 225 Poultry Management
- CSC 110 Computers and Computer Applications
- ENGL 148 Technical Writing

ASM Approach

Agricultural Systems Management involves the development of solutions to technological, business or management problems associated with agriculture.

Systems Approach. The project involves the integration of multiple functions, designing, cutting, welding, and electrification.
**Interdisciplinary Features.** The project touches on aspects of mechanical systems, agriculture safety, and usability.

**Specialized Agriculture Knowledge.** The project applies specialized knowledge in the areas of mechanical and fabrication systems, and agriculture safety.
APPENDIX B
CONSTRUCTION DRAWINGS
Figure 15. Construction Drawings