Automated Prototype Egg Conveyor and Separator

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Abstract

This paper will discuss the design of the Automated Prototype Egg Conveyor and Separator. The aim of this project is to support an already designed fully automated prototype chicken farm.
The purpose of designing this project is to transport the egg from the nest to the separator unit, where the eggs would be separated based on their height to two different locations. This unit will be powered from a dc power supply and consists of three main parts which are Egg Conveyor unit, Egg Separator, and Controlling unit. The Egg Conveyor transports the eggs from the nest to the conveyor. The Egg Separator unit is made of a ramp which inclines for the big size eggs and remains flat for the small size eggs. The Controlling unit will adjust the level of Egg Separator Unit based on the height of the egg. The Fully Automated Prototype Chicken Farm is controlled by an interfacing board that is connected to the computer and is comprised of the Light Unit, Food Supply Unit, Water Supply Unit, and Fan Unit.
In this project, the hardware units will be discussed in detail. This project would benefit mostly small scale chicken farms by reducing cost of operation, manual labor, and increasing productivity. Future additions to this project include building an incubator unit with correct facilities to hatch the egg.

Introduction

By the 1900's, an average chicken farm was an extension of the family kitchen. Most of the chicken farms were usually owned and operated by families and had no automation. Very few sold poultry products. Chickens were used for the same purpose as they are now which includes meat, eggs, and money. Most chicken or poultry farms today are owned and operated by companies and machines perform several tasks on the chicken farms since production is large scale. The use of automated machines in the production process is being incorporated. For example, there are automated machines for washing eggs[1], special machines for breaking eggs[2], egg cleaning, sorting, and grading machines[3], defeathering machines for birds[4], automatic water bowls and troughs[5], and machines capable of catching and caging chickens[6]. By the early 1900's, the number of broilers in produced in the United States averaged about 100 million. In a century, with the help of

technological inventions, poultry farms have grown tremendously such that more work can be done in less time. Statistics from the United States Department of Agriculture shows that by 2000, the number of broilers produced in the United States has grown to over 8 billion[7].

The Fully Automated Prototype Chicken Farm Unit combines an automated feeder, water, light, and temperature systems in a single chicken house. These systems are controlled by conditions set on the computer programs. The different units were controlled by the relay ports. The relays operated as switches to turn on or off the unit connected to that particular relay port. The automated chicken farm unit has a solar unit that extracts and converts energy from the sun to electrical energy. This energy is used to charge a battery which is used to power the chicken house. The solar unit has a single axis solar tracker that enables the solar panel to move from east to west in the direction of the sun and controls the alignment of the solar panel with the sun to obtain maximum energy transfer. The chicken house can also be powered from an electrical outlet[8]. A picture of the Fully Automated Chicken Farm is shown in Figure 1.

This Automated Egg Conveyor and Separator are able to automatically transport the eggs from the nest to the separator unit. This paper discusses the design of this project in three main parts. Part 1 describes the egg conveyor unit; Part 2 describes the egg separator unit and Part 3 discusses the relay circuits used for operating the units. A simple diagram for the Automated Egg Conveyor and Separator is shown in Figure 2. A picture of the Automated Egg Conveyor and Separator Unit is shown in Figure 3.

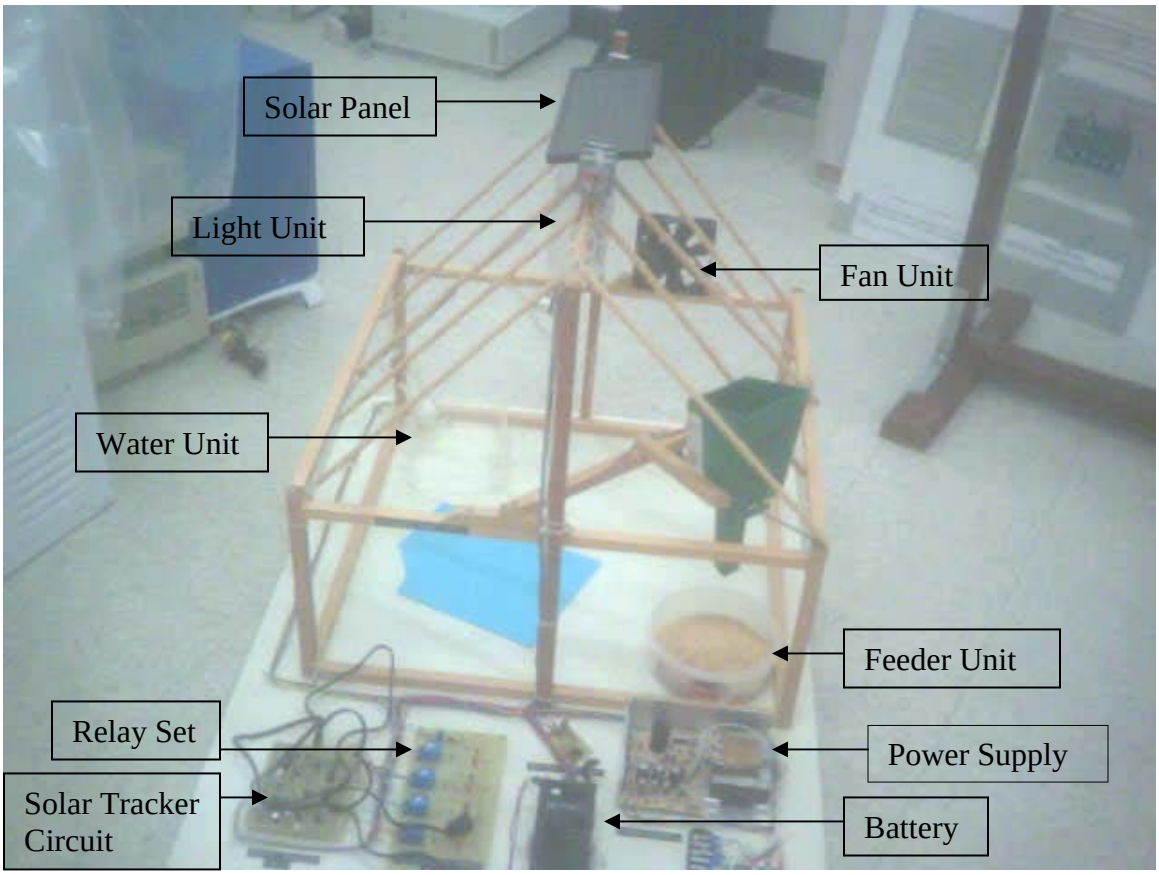

Figure 1. A Fully Automated Prototype Chicken Farm Unit

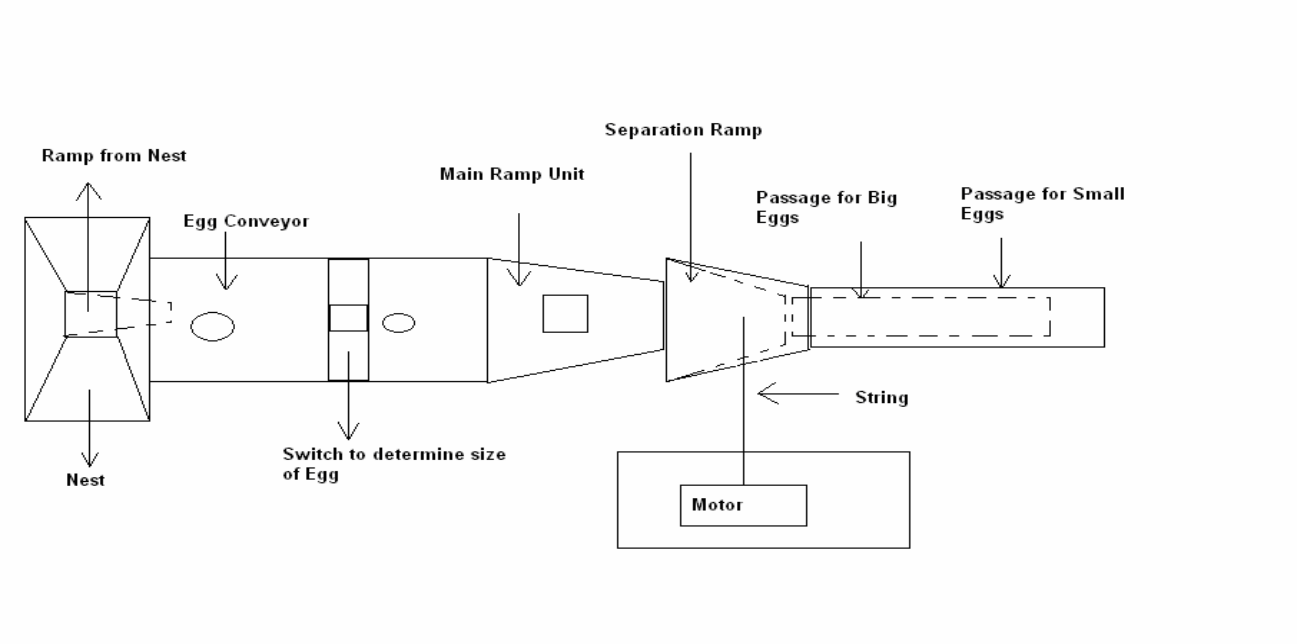

Figure 2: Simple Diagram of Automated Egg Conveyor and Separator Unit

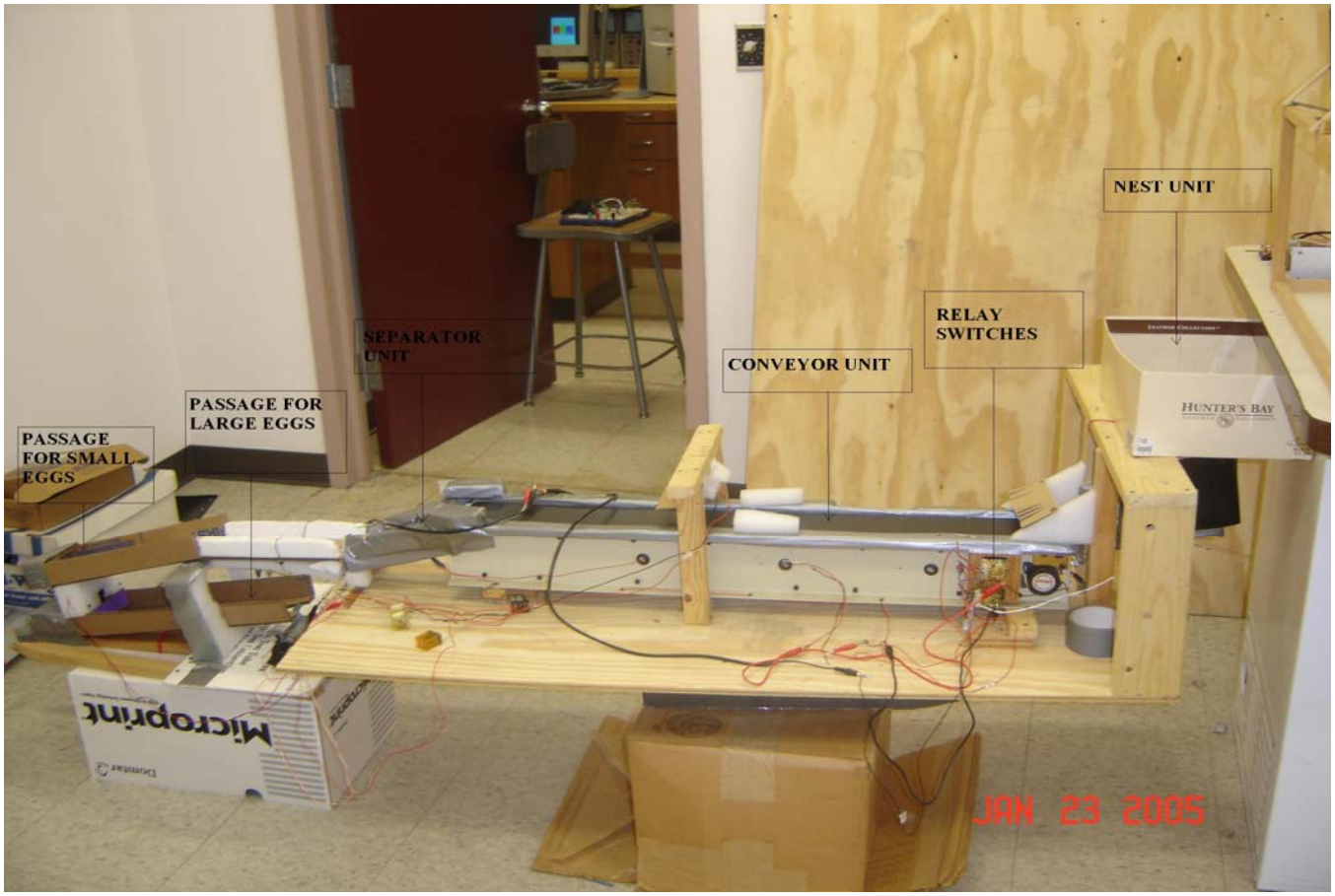

Figure 3: Automated Egg Conveyor and Separator

Part 1 – The Egg Conveyor Unit

The Egg Conveyor Unit is separated into three parts. It is controlled by one of the relay circuits.

1. **Nest Unit**: The nest was built from a carton box. The nest has a slightly inclined floor with a centered hole which allows the egg to roll out to the conveyor through a ramp attached underneath the nest. The nest ramp contains a relay switch to start the conveyor when an egg comes through.
2. **Conveyor Unit**: The main conveyor is used to transport the eggs from the nest to the separator unit. The conveyor also has a switch to determine the passage the egg follows based on the height. The movement of the conveyor is controlled by a relay switch which allows it to stop rolling when the egg gets to the end. The conveyor was donated by the construction department and some modifications were made to it to fit our application.
3. **Ramp Unit**: The ramp unit is used for transporting the eggs from the conveyor to the separation ramp. It contains the relay switch to turn off the conveyor when the egg drops on it. The ramp was made from Styrofoam.

Part 2 – The Egg Separator Unit

The Egg Separator Unit consists of two parts. It is controlled by another relay circuit. The main conveyor is used to transport the eggs from the nest to the separator unit. The conveyor also has a switch to determine the passage the egg follows based on the height. The movement of the conveyor is controlled by a relay switch which allows it to stop rolling when the egg gets to the end. The conveyor was donated by the construction department and some modifications were made to it to fit our application.

1. **Separation Unit**: This ramp is responsible for separating the eggs based on their height. If the egg is small, the ramp lays flat and transports the egg to one of the passages. If the egg is big, the ramp inclines to another passage for the egg to pass. The ramp returns to its initial position after operation. The movement of the ramp is controlled by one of the relay switches. The ramp was made from Styrofoam.
2. **Passage:** The two passages are made of carton. They receive the egg from the separation ramp unit and allow the egg to roll to the end. At the end of each passage is a blockade to prevent the eggs from falling out of the passage.

Part 3 – Relay Circuits

There are two identical relay circuits used for this project in the egg conveyor and separator unit. The drop of an egg from the nest turns ON the conveyor by switching on the press button PB1 which plays the role of first detector of the egg's passage. The

instantaneous closing on the switch BP1 produces an excitation through the coil of the first relay S. This excitation causes a simultaneous change of state of the normally open switches S1 and S2 related to relay S. S1 and S2 therefore close up; the closing of S2 which is on the power line of the conveyor motor sends power to the motor and set it ON, while the closing of S1 which is on parallel to the press button BP1 helps auto-maintaining the excitation of the first relay by keeping the power supply closed. When the egg reaches the end of the conveyor, there is another press button there playing the role of an end-of-course detector. When the egg hits that switch BP2, a 12 V power is sent to K the second relay, its excitation produces the opening of its related normally closed switch K1. K1 being on the main power line supplying voltage to the first is then instantaneously open. This opening cut off the power to the relay S, the result is a reverse change of state of S1 and S2, and both switches go back to their normally open state. The conveyor motor stops since the auto-maintenance of the power supply line is lost. The system is now back to it initial condition awaiting next egg passage.
The same circuit is duplicated and used for the separation of large egg from small ones. In that case the first Switch PB1 (detector) senses the height of the big egg and turns on a motor that inclines the separation ramp and allows passage for the large eggs. When the large egg reaches that destination, it hits another PB2 switch to off the motor and allow a mechanism to bring the spring-board back to its initial position. If the egg is small, the height is not detected therefore nothing happens, and the small egg follows the straight passage. The circuit diagram for one of the relays is shown in Figure 4.

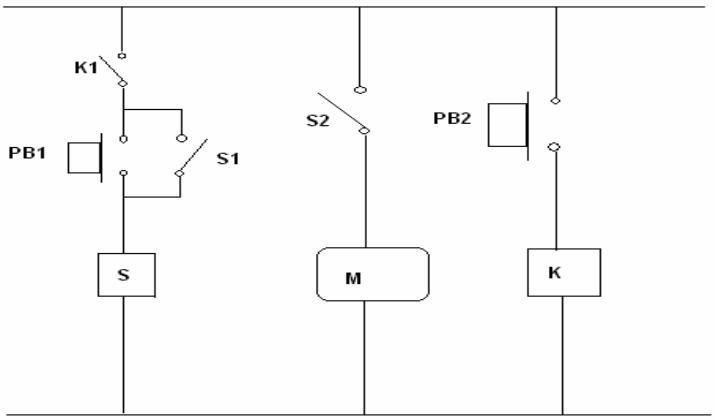

Figure 4: Circuit Diagram of Relay Switch

Conclusion

The Automated Egg Conveyor and Separator Unit was successfully completed and operated as designed. The eggs were transported automatically from the nest to different passages depending on their height. The separator ramp inclined to another passage for the large eggs and remained flat for the small eggs. Most of the materials were donated by the Construction department, Electronics Engineering Technology department and by team members. The project was very low cost and cost about $50. The entire unit was tested using boiled chicken eggs to prevent the egg from spilling on the project during testing. Some problems were encountered while designing the project. One of such problems included trying to interface the scale with the project. Our initial proposal was to use the weight from the scale as the criteria for separation. Since using the weight of the eggs was a problem, we decided to use the height as a factor for separation. Another problem encountered was in our initial effort of trying to build a conveyor for the project. The rods used in the middle had little friction with the conveyor belt; therefore, the belt was not able to rotate while we tested it. The group decided to use an already built conveyor that was donated and modified it to fit the application.

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