High Efficiency Industrial Packaging Line Design Using Classic Control

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ABSTRACT: *The paper proposes a classical control system for an industrial liquid packaging line to achieve a high efficiency system this was obtain by a arranging the control system components such as relays and timers in a way that give a high efficiency. the result obtained have shown that increasing the efficiency was obtained compare with other classical control system .since the cost of packaging is major in production line this propose system will be consider as cost-effective system.*
Keywords: *Classic Control, Electrical relay, Timer ON delay.*

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1. Introduction

The term automation system identifies the technology that uses control system to manage machine and process reducing the need for human intervention.

The automation is introduced to perform repetitive, complex or heavy operations where the environment is unsafe or unsuitable for human operators. Moreover, automation is employed to obtain a high quality and fast production process [1]. The main objective of this design is to show the Implementation of packaging line using classical control system, Study of control systems and special classical control techniques to know the advantages and disadvantages of this type of control system, and finally to set a physical component (hardware) together with a simulation (software).

The steps taken in the proposed design included building up the software using Electrical control techniques simulator (EKTS). Then a simulation program was run to ensure the design. A hardware design was also set. Finally a comparison of simulation results versus those obtained from experimental was held.

2. Classical Control architecture

At the outset of industrial revolution, especially during sixties and seventies, relays were used to operate automated machines, and these were interconnected using wires inside the control panel. In some cases a control panel covered an entire wall. To discover an error in the system much time was needed especially with more complex process control systems. On top of everything, a lifetime of relay contacts was limited, so some relays had to be replaced. If replacement was required, machine had to be stopped and production too. Also, it could happen that there was not enough room for necessary changes, control panel was used only for one particular process, and it wasn't easy to adapt to the requirements of a new system. As far as maintenance, electricians had to be very skillful in finding errors. In short, conventional control panels proved to be very inflexible. Typical example of conventional control panel is given in the following picture [2].

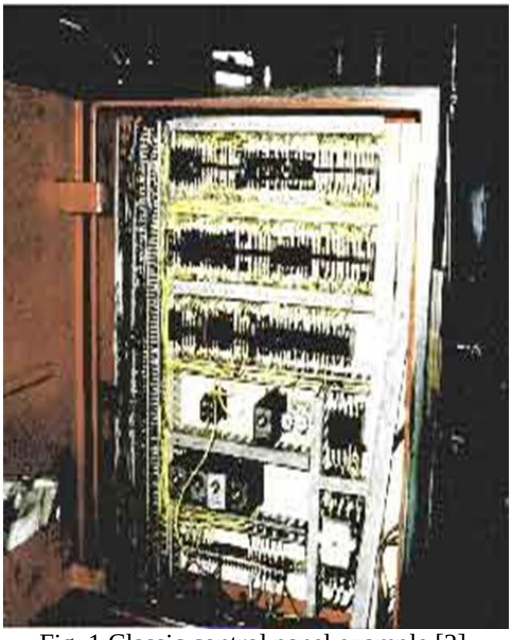

Fig. 1 Classic control panel example [2]

1. Disadvantages of the Classical Control

- Too much work required in connecting wires
- Difficulty with changes or replacements
- Difficulty in finding errors; requiring skillful work force
- When a problem occurs, hold-up time is indefinite, usually long [2].

The next flow chart explains the project sequence:

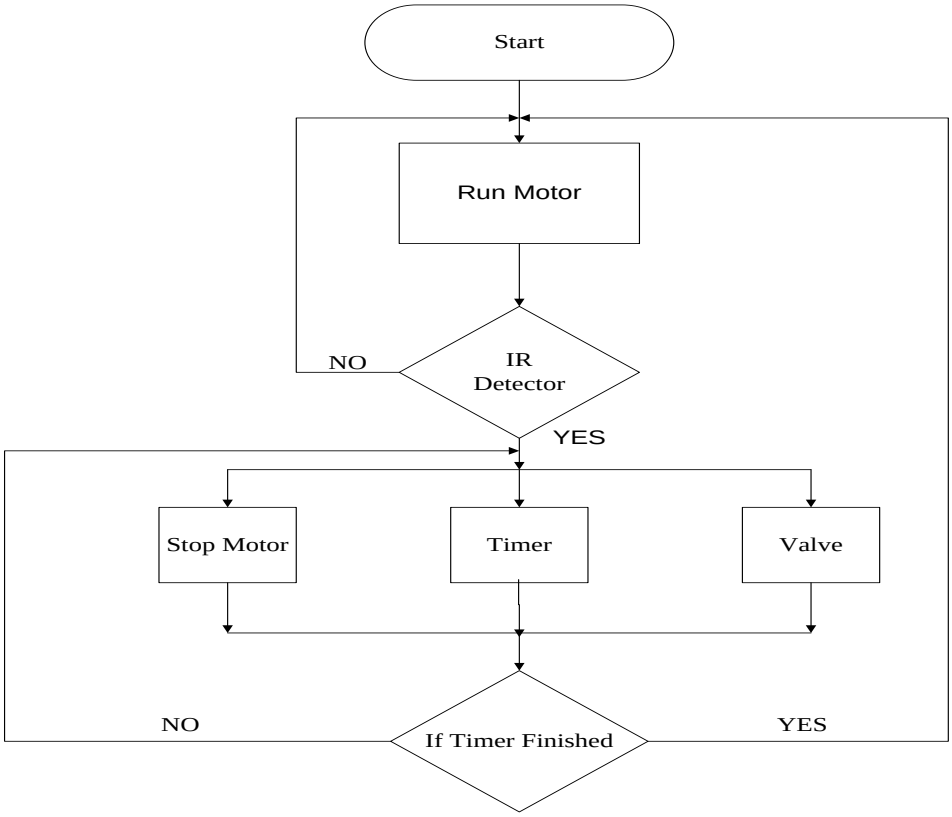

Fig 2 flow chart of the system

3. Hardware Design

1. CLASSIC CONTROL

This system is design to perform control steps automatically by press the main switch by operator (start) and Classical control is the one of the first system in the field of control and it's features is simple and the project contains the following component:

- Dc relays
- Switches.
- Timer on delay.
- Servomotor.
- Conveyer line.
- Infrared (IR) sensor.
- Solenoid valve.

First the implementation of the department of the classical control by the program Electric Control Techniques simulator (EKTS).
It is considers one of the best program that used for the modeling of the classical control circuit.
Simulation is a very important step, because the system will design without any installation or testing the actual circuit that lead to saving time, effort the component.

2. Solenoid Valve

A solenoid valve is an electromechanical valve that can be used to control the flow of liquid or gas. The solenoid converts an electrical signal in to a mechanical movement. The signal is sent to a coil and the movement occurs inside the valve.

A coil is assembled on to the valve body on an armature tube with an armature tube or moving core inside. The moving core is held in place by a counter spring. When the coil is charged the armature is attracted by its magnetic field and the main seal either opens or closes leaving a passage through the valve orifice [3].

Fig 3 Solenoid Valve [4]

3. Servomotor

The motors which are utilized as DC servo motor generally have separate DC source for field winding and armature winding. The control can be archived either by controlling the field current or armature current. Field control has some specific advantages over armature control and on the other hand armature control has also some specific advantages over field control. Which type of control should be applied to the DC servo motor, is being decided depending upon its specific applications [8].

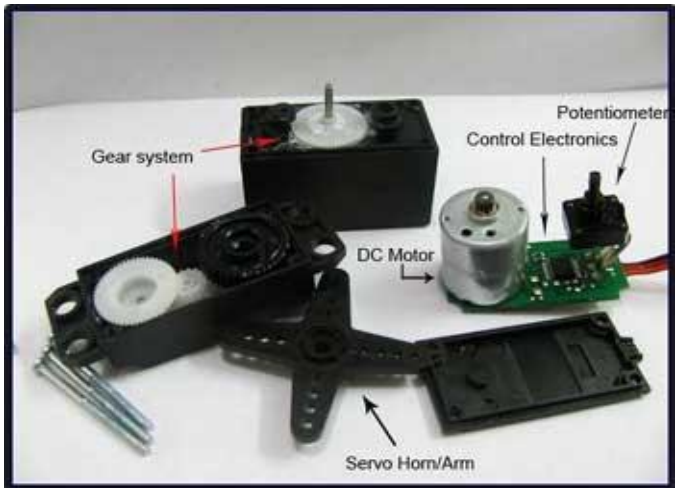

Fig 4 Dc Servo motor [5]

4. Software

Before implementing the system, it was first tested by the EKTS simulator.

2. Simulation

Simulation of a system is the imitation of the operation of a real-world system over time [6]. Simulation requires a model, which is a representation of a system used to answer questions, without doing experiments on the real system. Experiments may be too expensive or dangerous, the time-scale of the dynamics too long to allow performing experiments in a reasonable time interval, variables of interest may be inaccessible (may not be measurable or observable), and so on. A model can be seen as a simplified system that reflects some properties of the real system [7] [8].

The (EKTS) simulation will be used in this system.

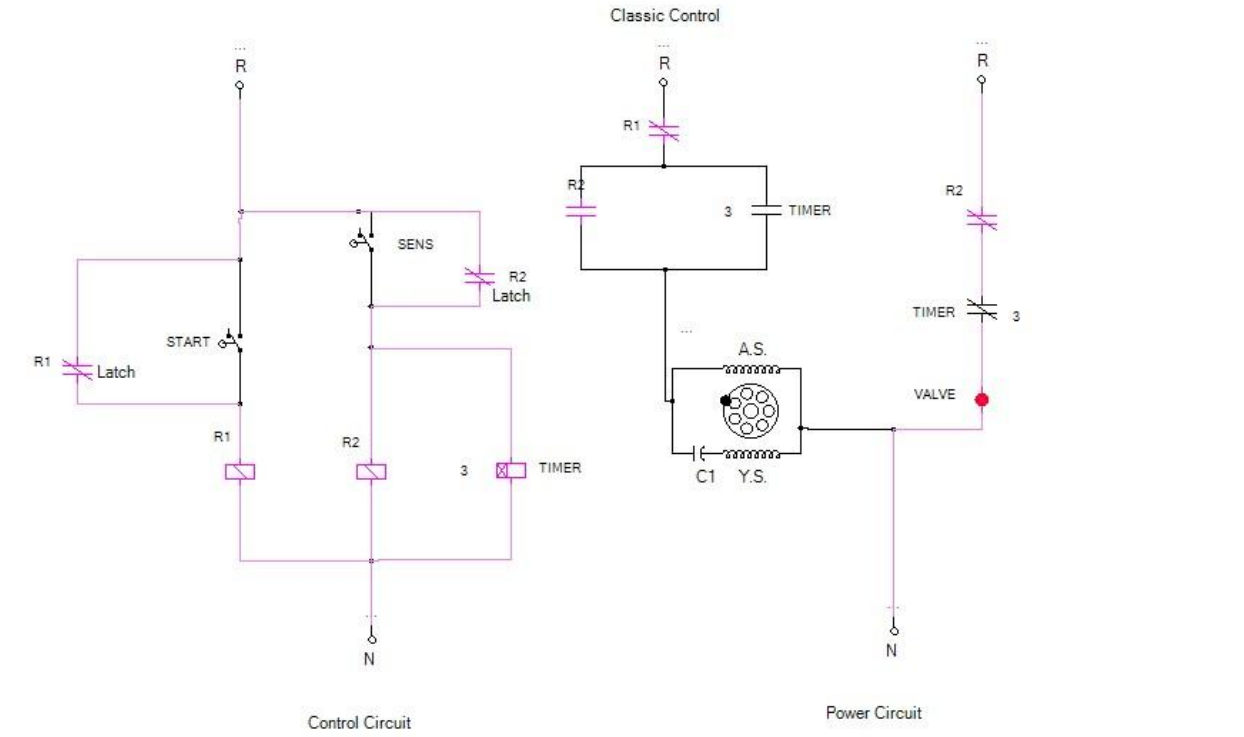

Fig.5 Screen capture of the proposed simulation program

The program will be explained as follows:

- The sequence can be stopped and restart at any time using the panel mounted stop and start push button.
- The run light will remain energized as long as the system is operating automatically.
- The run light, conveyer motor and solenoid valve will de-energize where the system is halted via the stop switch.
- The fill light will be energizing while the package is filling.
- The full light will energize when the package is full and will remain that way until the package has moved clear of the IR sensor.
- Stop the conveyer when the right edge of the package is first sense by the proximity sensor.
- With the package in position and conveyer stopped, open solenoid valve and allow the package to fill, filling should stop when the level sensor goes true.
- The fill light will be energizing while the package is filling.
- The full light will energize when the package is full and will remain that way until the package has moved clear of the proximity sensor.
- Once the package is full, momentarily pressing the start switch will move the package off the conveyer and bring a new package into position.

5. Hardware Configuration

Operation stages have been separated in order to facilitate

1. Conveyer Movement

Process begins when press start switch ,where passes 5 v dc for the first relay and this will cause magnetization of the coil of the relay and that lead to change the normal open contact to normal close contact and the normal close contact to normal open contact.

This property has been benefited to start motor by passing 12 v dc which run the motor through the normal open of the first relay.

This means that when switch is pressed, this will magnetize the coil, change the contacts, and then passed the 12 v dc to the motor which it was already connected to the ground. This will run motor and move the conveyer.

2. Packaging Step

After running the motor, which has moved the conveyer, next comes the stage of packaging.

First must stop the package carried by the conveyer by the optical sensor (IR) used in this process
The second relay wills magnetization when the package passes through the sensor.

The first task of the second relay is to stop the motor .and the second task is to open the solenoid valve which is considered as the basic elements in the packaging process.

When the relay magnetization the solenoid valve, it turn timer on delay to control the process of filling the package. After timer end of it adjust timing account it will start the motor again, the same process is repeated when passage of any other package move through the optical sensor.

6. Results

The system by the classical control is easy-to-install and less Cost-effective compare to the other control system such as PLC .But on the other hand making troubleshooting more difficult and its take more time.

7. Future Recommendations

Build another system as backup system such as classic control system and improve it to toggle automatically in case that if the main system stopped under any error occurred or to maintenance purpose.

8. Conclusion

The primary goal of this paper is to implement packaging line system using classic control system. A flow chart of the system was developed to describe the system. A simulation program of the whole system was run by using EKTS and followed by the implementation of the system using classic control component .Many test to confirm the performance and to obtain results were set. The simulation results were found fairly satisfying desire results.

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