Design and Development of Automatic Packing Line Controller

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ABSTRACT-This paper presents the Automatic packing line controller using microcontroller. It consists of feeding Conveyor is used to feed the job and it is mounted above the packing conveyor. The packing conveyor feeds the packing box. The jobs are feeded from the feeding conveyor to the packing box which is in the packing conveyor through IR sensor which is used to count the job while feeding to the packing box. The purpose of this project is to increase the productivity and reduce the human effort. This is a simple mechanism made up of prototype and fully automatic.

Keywords- Feeding, Packing, Sensors, Microcontroller, conveyors

1 INTRODUCTION

Industry automation becomes the global trend in manufacturing, packing process is one of the most uses in industry, more and more companies are switching to automation. This project is devoted to the use of automatic packing line control system in process machine system; the control system will play a major role in control on all parts of the project.

This project report is about design and development of an automatic packing line control system. Electrical DC motors control were used as actuators for the entire process to move the feeding and packing and conveyor belts, and the IR sensors used to count the job by system information. Conveyor belt used for transporting samples from location to another one, which would be packaged into a specific paper boxes later. The control system for the hardware project is to be controlled by the PIC 16F870 (28 pin IC) microcontroller. The program is stored in ROM of the Microcontroller to control the all the input and output devices of the actual prototype for the experimentation.

1.1 Conveyor Belt

A conveyor belt is one of many types of conveyor systems. The belt is a loop of flexible material used to mechanically link two or more rotating shafts, most often parallel. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

1.2. Packaging

Packaging is the technology of using conveyor belts for enclosing or protecting products (food, wood, and material) for storage, pack objects together into containers, sale, and use. Packaging also refers to the process of design, evaluation, and production of packages. Packaging can be described as a coordinated system of preparing goods for transport, warehousing, logistics, sale, and end use. Packaging contains, protects, preserves, transports, informs, and sells.

2.0 Components Selection and Hardware Structure

The Automatic Packing Line Control system is a combination of electronic, electrical and mechanical parts, Figure 1 shows the whole system proposed.

The input devices are the devices which are used to gather the information about the system which consist of switches, sensors in order to feed the controller (PIC microcontroller) by an information about the path.

The controller, which is the main element that operate the whole system by using the information from the sensors and take the decision before sending the signal to the output devices.

The output device are the actuators that converts the electrical signal into mechanical movement, the principle types of actuators are relay, solenoid and motors.

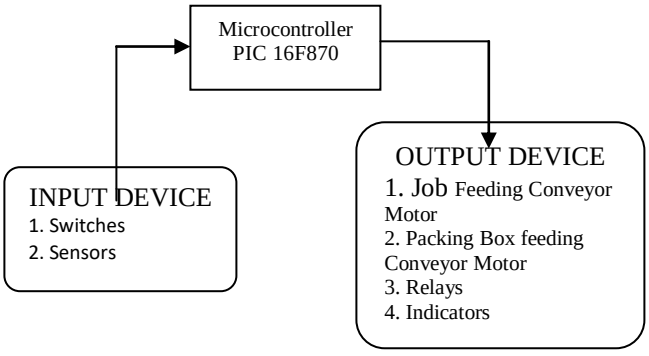

Fig 1 Automatic Packing Line Control System

2.1 Controller System

This system monitors the packing line control system by using PIC 16F870 (28 Pin IC Package) microcontroller. The pin details of the microcontroller are shown in figure 2

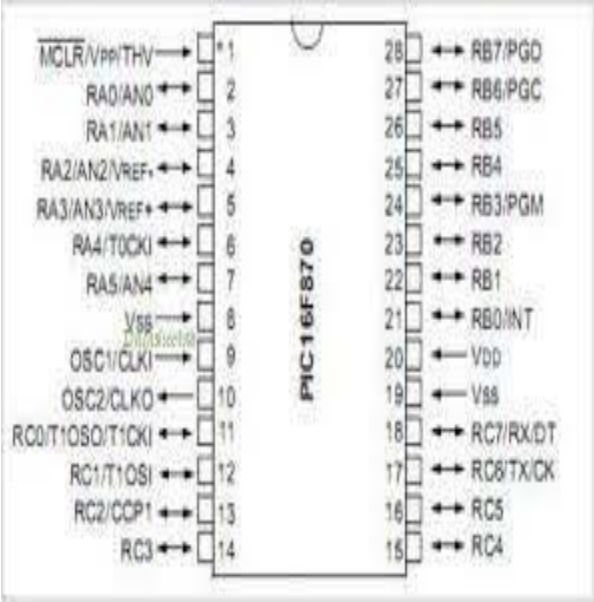

Fig 2 Pin details of PIC Microcontroller

2.2 Job Feeding Conveyor Unit

The conveyor belt is rotated between the driving and driven pulley by AC Synchronous motor. The motor and conveyor belt assembly is mounted separately on a wooden board. The height of the job feeding conveyor unit is arranged slightly above the packing conveyor unit. This conveyor system is used to feed the jobs continuously towards the packing conveyor through the IR Sensor. The jobs are conveyed through the belt conveyor. The job feeding conveyor unit is shown in figure 3

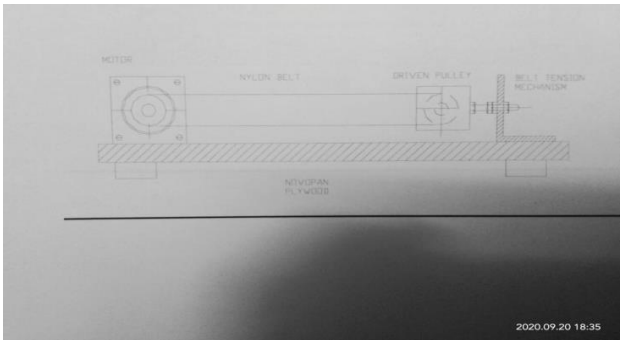

Fig 3 Job Feeding conveyor unit arrangement

2.3Packing Box Feeding Conveyor Unit

The packing box is conveyed in the belt conveyor. The conveyor belt is rotated between the driving and driven pulley by the AC Synchronous motor. A wooden stage is arranged below the nylon belt in order to avoid the slack. A plastic channel is arranged on the stage to guide the packing box. A magnetic sensor is fitted at the side of the plastic channel. This conveyors system feeds the packing box. The whole arrangement is shown in figure 4.

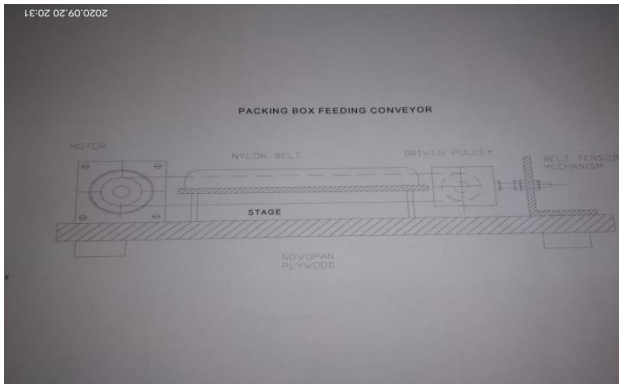

Fig 4 Packing Box Feeding Conveyor unit

2.3.1 Pulley and Belt

In this prototype model, One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. Both the pulleys are mounted on the bracket. The belt is made of nylon material, which is in red color. The width and length of the belt is cut from the main sheet and its ends are pasted. The schematic diagram of drive and driven pulley are shown in figure 4 and 5.

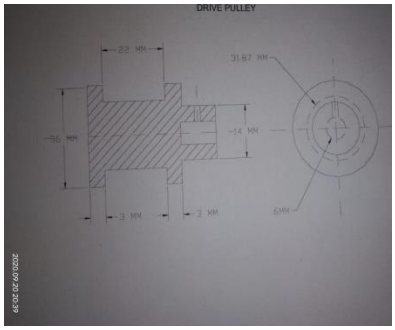

Fig 4 Drive Pulley

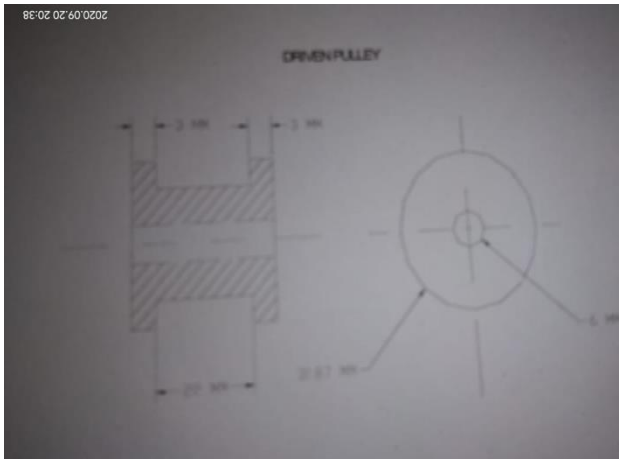

Fig 5 Driven Pulley

2.3.2 Mounting Bracket for Motor and Pulley

The motor and pulley mounting brackets are made from 2mm MS sheet. The sheet is cut and bends to the required shape and drilled as per the dimensions given in the sketch. The bracket is fixed on the novo pan board with the screws. The diagram for mounting motor mounting bracket is shown in figure 6 and 7

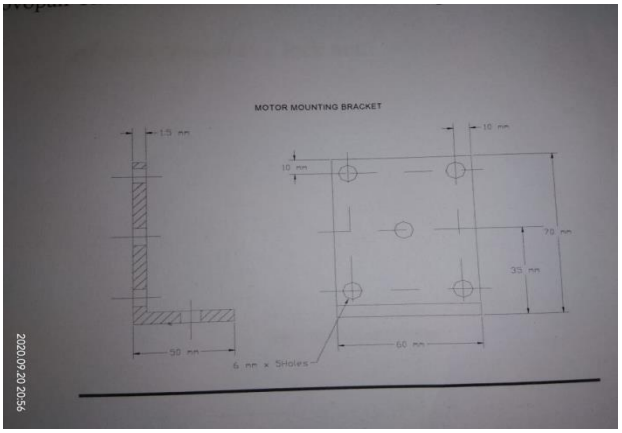

Fig 6 Motor Mounting Bracket

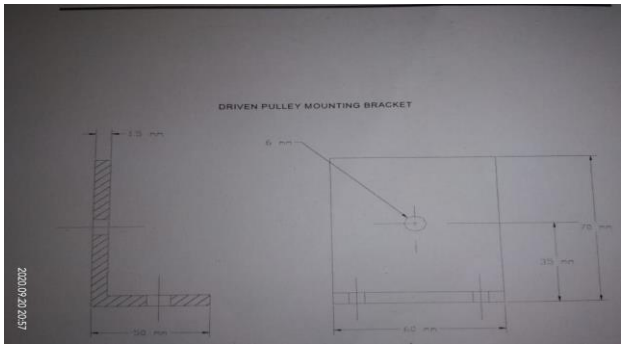

Fig 7 Pulley Mounting Bracket

2.3.3

The driving pulley is mounted in a fixed position and the driven pulley is mounted at a distance so that the belt can be stretched enough by using tension mechanism. The two nuts are used for this mechanism, one nut is for adjusting the tension and the other nut is used as a lock nut. The diagram for belt tension mechanism is shown in figure 7

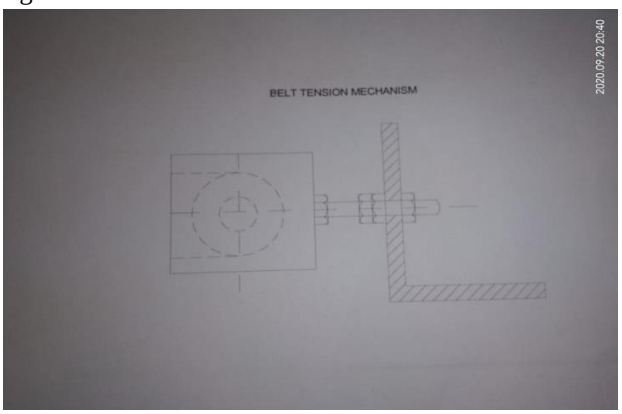

Fig 7 Mounting Motor and Pulley Assembly

2.4 IR Sensor Unit

To IR sensor is fixed at the side of the cross rail which is held in the taper between the two conveyors. When the jobs are passed through the IR sensors unit, the sensor counts the jobs for the packing purpose. The arrangement is shown in figure 8

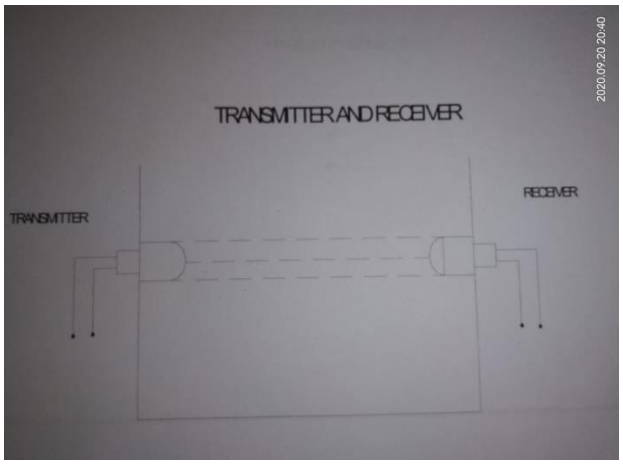

Fig 8 IR sensor

3 Electrical Circuit Details

The electrical circuit detail consists of the following parts.

1. Microcontroller system
2. Interface circuit
3. Power supply circuit (230 V to 12 V and 5V DC)

3.1 Micro controller System

This system monitors the whole system and controls the various parts in the packing line control system. The circuit diagram for the microcontroller board is shown in the figure 10

The sensors are connected to PORT A (ie) pin no 2 & 5. The RESET switch and the bulbs are connected to PORT B. The features of PIC16F870 are 64 bytes of EEPROM data memory, self programming, an ICD, 5 channels of 10-bit Analog-to-Digital (A/D) converter, 2 additional timers, a capture/compare/PWM functions and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications. The mother board circuit detail is shown in figure 10.

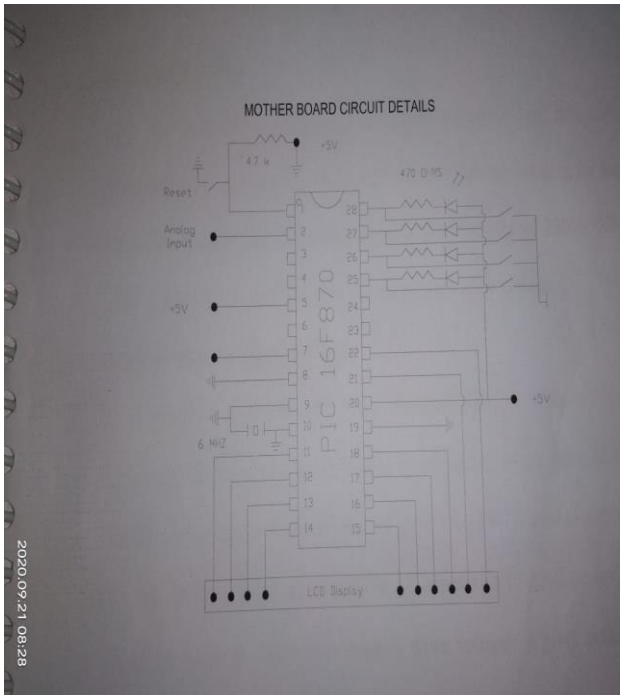

Fig 10 Mother Board Circuit Details

3.2 Power Supply Unit

All the electronic components starting from diode to Intel IC work with a DC Supply ranging from +5V to +12V. To achieve this voltage the procedure is used stepping down, rectifying, filtering and regulating the voltage.

The block diagram for power supply is shown in figure 11.

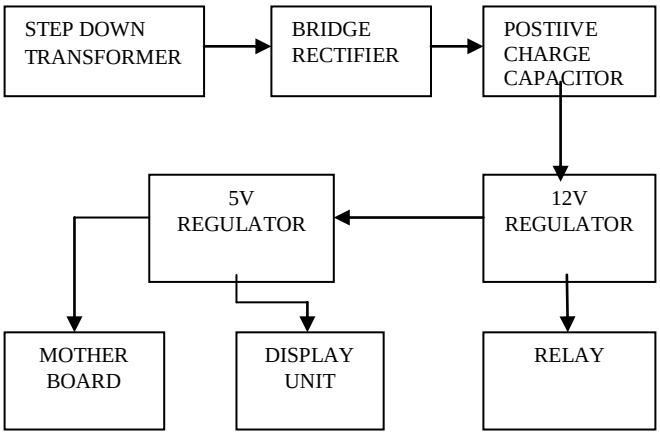

Fig 11 Block diagram for Power supply unit

3.3 Interface Circuit

To drive the 12VDC load, the 5V signal from the PIC 16F870 microcontroller is fed into the interface circuit. TIP 120 Darlington transistor is used for high speed switching purpose and the Diode IN 4007 is for the safety of TIP 120 transistor during the collapsing of magnetic field from the 12DC motor coil. The interface circuit is shown in figure 12.

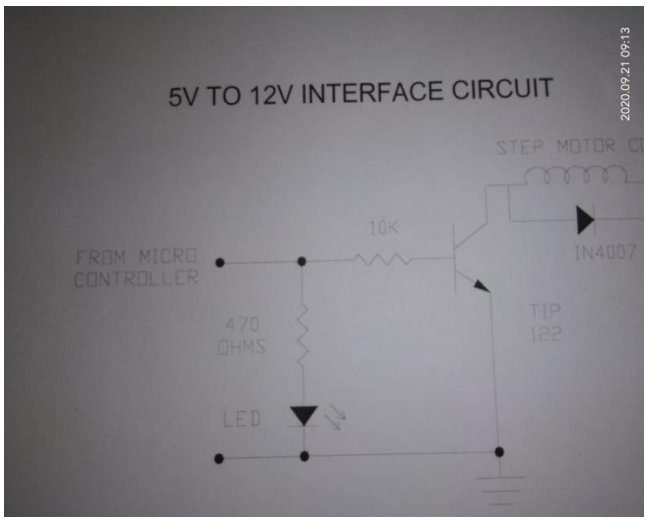

Fig 12 5V to 12V Interface Circuit

4 Experiment Results and Discussions

The prototype model is shown in figure 13 and consists of two sections

1. Component feeding section (Upper Rail)
2. Packing Box feeding section(Lower Rail)

4.1 Component Feeding Section

To start the operation press the ON switch in the switch box and the components are fed on the job feeding conveyor. These jobs are conveyed from the job feeding conveyor to the packing box conveyor through the cross rail. When the jobs are passed through the IR sensors which send the signal to the input of the microcontroller. The counter in the microcontroller count the IR signal and gives the output when the counted value reached the preset number in the controller counter.

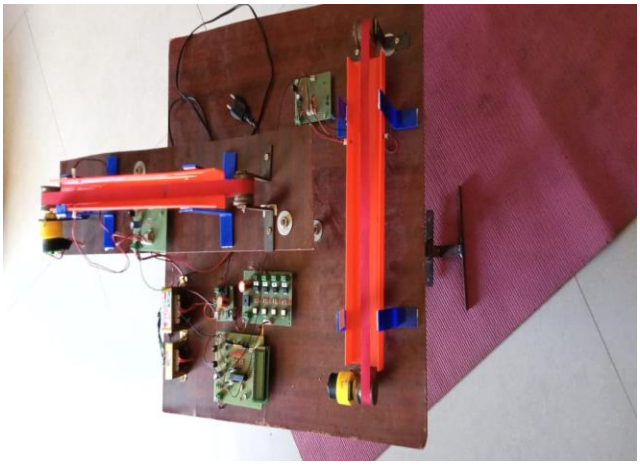

Fig 13 Automatic Packing Line Controller

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4.2 Packing Box Feeding Section

When the components are counted up to the setting limit, microcontroller stops the upper rail motor to OFF position and switch ON the lower rail motor. Hence the component filled packing box shifted, and the next empty backing box is comes to the packing section. The magnetic sensor sends signal to the microcontroller input by the magnet which is fitted on the packing box. The microcontroller switched OFF the supply of the lower rail motor when the magnet sends the signal to microcontroller input. Again the same process is repeated and packing box are filled and shifted with required components.

5 Conclusion

An automated packaging line controller prototype using PIC Microcontroller has been successfully design, constructed and implement based on control system concepts. The programming and operation of the presented prototype, in which the operation is passes through two stages, carrying empty boxes to desired location, and packaging the samples into the boxes. The experimental prototype tested to improve the automation processes with the use of the microcontroller. The packaging prototype was done to package ten samples per a box in very short time. Cost reduction mainly on the man power or personnel cost is achieved in this paper. Hence only one or two personnel are needed for the operation and maintenance with the automation system.

6 References

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