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Automation of belt conveyor for carrying products

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Abstract

Belt conveyors are highly used in various industries for continuous path movement in carrying products. Sometimes it is seen that time interval of keeping products on the belt conveyor is greater than the time required for half revolution of conveyor (i.e. cycle time). Again in some cases, time interval between two products keeping on conveyor is not same. Consequently, unwanted cost arises. This increases the production cost. For overcoming this constraint conveyor can be switched on when product(s) is on the conveyor; otherwise the belt is switched off, when there is no product. In this project conveyor belt has been made automated. Belt only switches on when there is product(s) on the belt. This is how it minimizes idle movement of conveyor. So this automated belt conveyor is productive and cost efficient. Finally this paper addresses the complete automation of belt conveyor by reducing its operating cost and time.

Keywords: 3-5 conveyor belt, material handling,automatic, control unit.

1. Introduction

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Belt conveyor is most common in this case. Generally, belt conveyors have continuous motion in carrying products. The motor is always on whether there is product on the belt or not. This paper describes an automated belt conveyor that only run while the product is on the belt and it is off or is motionless while there is no product on the belt. This job is actually done by using microcontroller and other objects as IR sensor, relay, with a basic belt conveyor.

2. Construction

A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - 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[1].

2.1 Construction of current conveyor belt

The following figure (Fig. 2) shows the current conveyor belt.

1. Powered pulley: Conveyor pulleys consist of cylindrical devices that move the belt along its designated route.Powered pulley is powered with motor. While it is operating, the pulley adds pressure to the belt, which causes friction and produces a pull. Spiral or wing pulleys are designed to pull conveyor belt or tracks and are generally used for industrial conveyors. [2]
2. Idler: It is also a pulley but not powered. It just guides the belt for its destination. This provides adequate tension force and as low friction coefficient as possible. It can be adjustable for various values of tension force. A belt conveyor can have one or more or no idler.
3. Conveyor belt: Conveyor belts are typically made out of rubber or silicone, depending on the type of product being moved. Lumber plants generally use belts composed of wire mesh. Conveyor belts are also made to withstand extreme temperatures. Most belts are less than 1 inch thick, so the movement is smooth with other conveyor components. The two pulleys need to rotate simultaneously to help the belt along its designated route [2]. But for the purpose of this project we use motor cycle tube as belt.

4. Guide: It is used for guiding the products so that products don't fall from the belt. But this is not required for most of conveyor belt. As we use the motor attached with powered pulley directly, there is a large amount of vibrations. Again the belt is less wide. Do we have used guide.

Fig. 2. Current conveyor belt showing its various parts

5. Motor: Motor is one of the most important parts of conveyor. It is used to provide power to the powered pulley. This motor should be so powerful that it can supply power so that will rotates conveyor belt with products on it exceeding friction force. In this project we have used a AC 0.25Hp motor.
6. Power supply: To drive motor there is required a power source. It may beelectric(AC or DC), hydraulic, pneumatic etc. AC power has been used in this project.
7. Basement: A wood made basement has been used in this project. This is portable but in practice basement is fixed with the floor.

2.2 Construction of developed conveyor belt

To make the current conveyor belt automatic we have used a control unit(CU), in addition. CU consists of the following units

1. IR(infrared ray) producer
   It consist of

   a.Frequency producer for creating IR
   b.IR LED

2 IR receiver
   It consists of
   a. IR receiver circuit
   b. IR sensor
   c. Microcontroller
   d. Relay

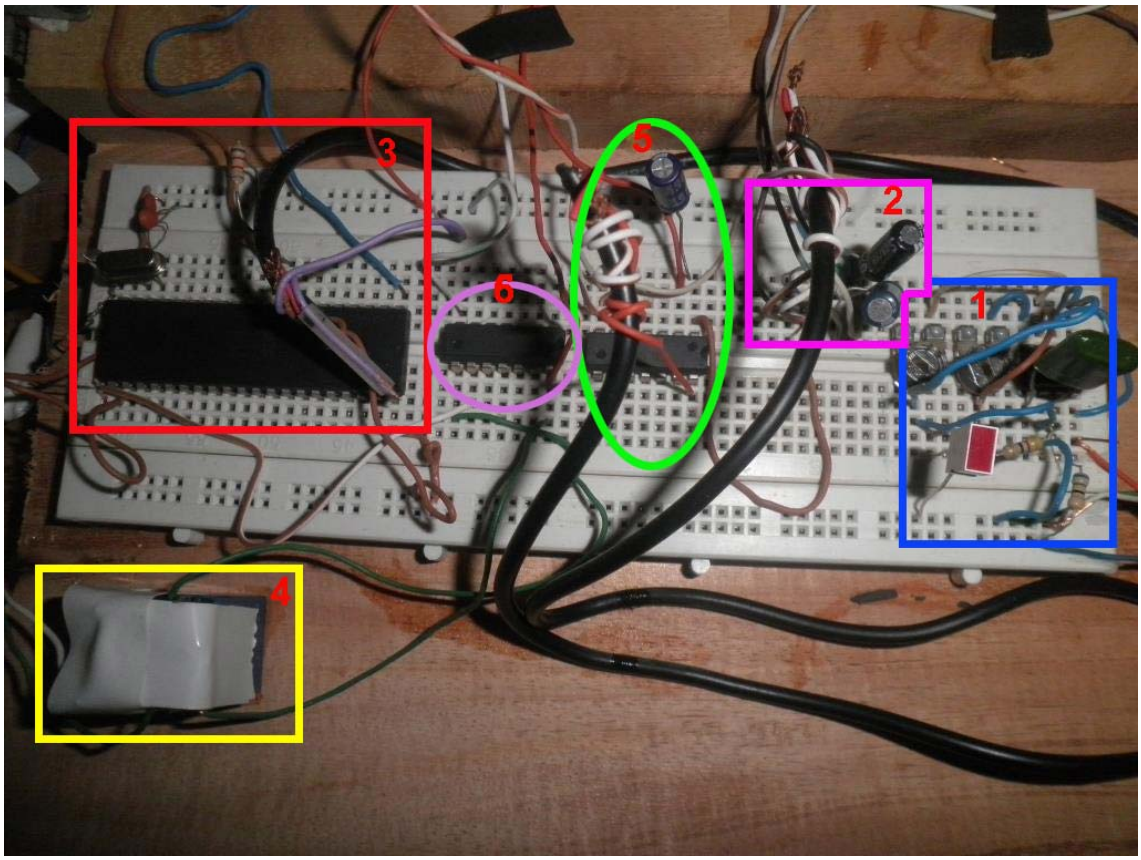

Fig. 2.2. CU(control Unit) of Automatic conveyor belt

3. Working Principle

To illustrate the working principle of automation function of the internal part is described below

3.1 IR producer

a. Frequency producer: It is circuit which can produce frequency of different values. To create IR it is necessary to make frequency 400000-1400000 m/sec [3]. Varying the variable resistor this frequency is achieved.

b. IR LED: Frequency produced from frequency producer is transmitted to IR LED. And it creates IRR(Infra-Red Ray). It can be seen using low resolution camera.

3.2 IR receiver

a. IR sensor: This is a readymade device that can sense the interruption of IRR on it. Fig. 3.2 shows IR sensor.When there is falling of product(s) on the belt, it makes an interruption of IRR on the IR sensor. So from sensing interruption IR sensor makes a pulse (short time 0 signal).

b. IR receiver circuit: This help to show the output(2.5-5 V) found from IR sensor. But this output is weak. To make it strong an inverter (inverter 4) has been used.

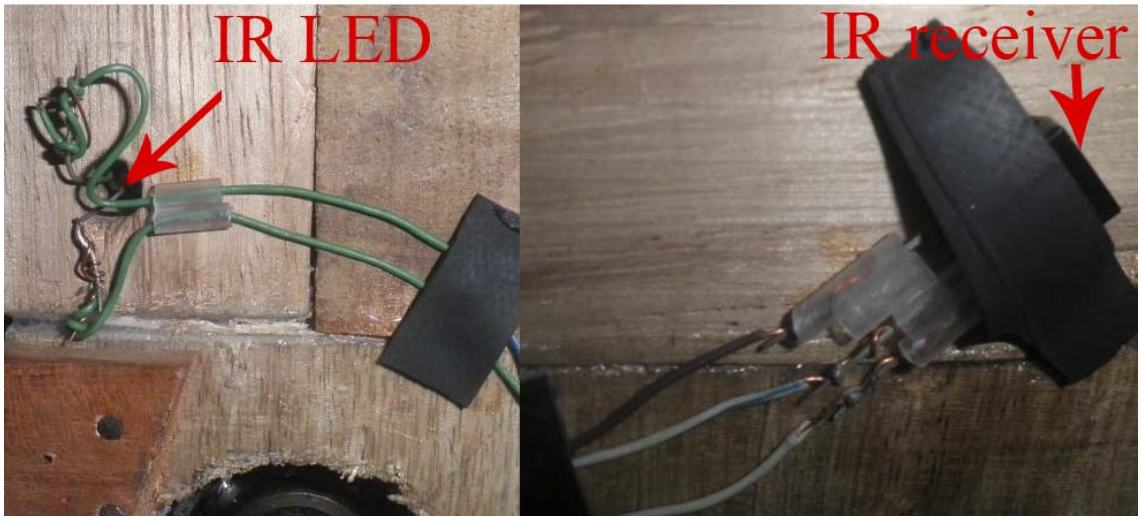

Fig. 3.2. IR LED & Receiver

3.3 Microcontroller

This is the heart of CU. It gets a pulse from IR receiver and gives an output (5V weak) for timedurationsuch that a product can be transmitted to its destination. I this project we consider cycle time 1.3 sec with some allowances. So again to make this output an inverter(inverter 5) has been used. But output comes as 0 i.e. ground, so to make it positive another inverter is used.

3.4 Relay (6V)

Relay(6V) is one kind of switch that becomes on when it gets around 5 volt input. So getting output from relay it makes the switch on and motor starts. When the products reach to their destination relay gets 0 (zero) signal and motor become stop. The developed automatic conveyor belt is shown in Fig. 3.4.

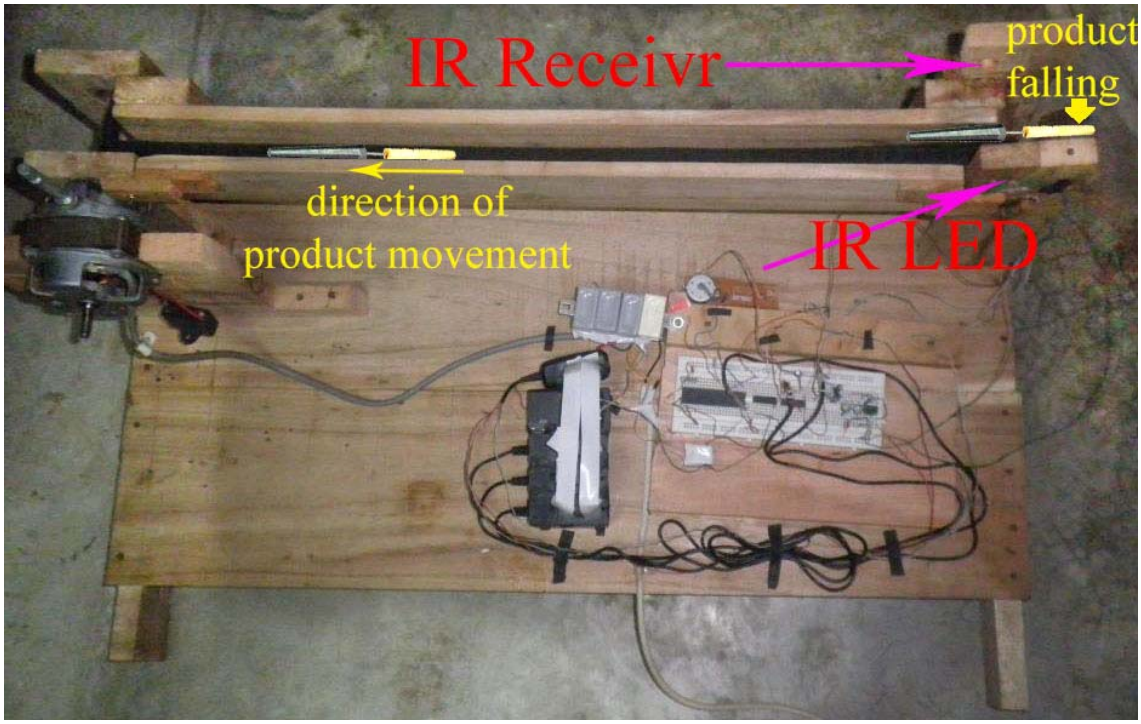

Fig. 3.4 . Automated conveyor belt

So when there is falling product on the belt, relay becomes on and stays for 1.3 sec. If another products fall within the time 1.3 sec, it remains on for more 1.3 sec from the time of last product falling. This process continues for infinite of time.

4. Result

After all an automated belt conveyor has been made that carry products whenever it falls on belt. After reaching the products to its destination, the belt become stop automatically. The belt become stop on the basis of time it requires to reach its destination.

5. Discussion

This automated conveyor belt can be used widely in various industries small or large. The cost of CU is not high rather low and it is around 1500 TK. The same CU can be used for very large conveyor belt without any problem. This conveyor can only be used if theproduct falling takeslarger than cycle time to fall. It can be used and will be efficient if products don't fall continuously within the cycle time.

There are some other limitations in this conveyor. First, if the products are a) transparent b) very thick c) falling speed is very high having small thickness or d) fallen like flow, IR sensor will not work. Consequently belt will remain stop. Second, if products fall on the be belt on other position than the position of IR sensor, belt will not stat. Third, when product(s) get hampered on its way and stop or proceed with a low motion IR sensor cannot sense it; so belt will stop keeping products on it.

However, the limitations mentioned above are not found in most case. So in this case this automatic belt conveyor can be used easily.

6. Conclusion

Making automatic belt conveyor is accomplished successfully. But in the figure it is seen that circuits have been kept on circuit testing board not on the circuit board. It is done for facing problem when plotting circuit on the circuit board.

7. References

[1] http://en.wikipedia.org/wiki/Conveyor_belt

[2] http://www.ehow.com/info_8049585_parts-conveyor-belt.html

[3] http://en.wikipedia.org/wiki/Infrared_spectroscopy