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Replacing PLC by Timer and Relay Circuit using Logic Wiring in Refill Sorting Machine

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Abstract:- The plc costs upwards of 60000 inr. For low budget projects it is not feasible to use such a high cost component. This plc replacement by the use of various components like electric brake drum motor, controlled by timers, relays as the intermediate components and optical sensors as the input devices. The output comes as sorting of the metal or any other parts according to if the part is fully assembled, partially assembled or not assembled at all. The whole project can cost about 200000 inr which is very expensive.

This machine serves the function of a much larger machine in a very cost effective manner and is mobile. The larger machines are bulky, have to be imported, expensive and takes lots of maintenance. This problem is solved by the machine developed in-house, thus saving cost, time and human effort.

I. INTRODUCTION

The elimination of PLC from the machine provides lots of benefits. To name some-cost reduction, maintenance, extra wiring and complex programs. This process is totally possible by the use of combination of inverter, SMPS, relays, sensors, electric brake drum motor and timers. All these components are common in PLC driven machines except the PLC is replaced by timers and relays. The experiment done was electromechanical based, the significance of it is, it has substantially reduced rework and rejections. these rejections proved to be uneconomical as any industry would not accept rejections and reworks because it increases the lead time and the loss in production, which results into overall slowdown of production, wastage of material and decreasing profits. The machine served the purpose of bridging the gap between the profit and loss, where it worked efficiently to reduce the losses and increase the profits and ease of use

II. WORKING

- *The First Condition*

The object comes in front of the sensor, the sensor senses it, when the sensor is high, i.e. it senses the Refill with tip and rubber capping, which is the final required product, it sends a signal to the timer through the relay to not activate the Pneumatic plunger on the conveyor and let go the final product to the packing area

- *The Second Condition*

When the refill only has tip but no cap it cannot be considered the final product, as the sensors used are optical sensors it will sense the metal tip whose reflection rate of the transmitted waves of light by optical sensors is high or in other language the response we get is faster because of the metal surface absorption of the optical rays is low, the rubber cap on the other hand has high response time as it absorbs a good quantity of the rays and takes its time to respond. This makes the sensor activate the plunger number 1 which pushes the refill into a sorting area.

- *The Third Condition*

The refill does not have a tip, the sensor will again sense the refill without tip and rubber cap, this time it will take slightly more time than the rubber cap as the material sensed will be partly plastic and ink, it will then use plunger to sort the refill.

- *The Fourth Condition*

In this condition the refill is missing and the sensor would not get any response and the plunger would not be working as there would be empty space on the conveyor.

III. COMPONENTS

A. Optical Fiber Sensors

The optical fiber sensors also known as fiber optic sensors, which is use for sensing by optical fiber or sensing element in the different areas like medical, pharmaceutical, environmental, defence, bioprocessing and food industries. By utilizing optical fibers as transduction elements, fiber-optic physical, chemical, and biosensors is at the top of in the past decades. With the rapid development of nanotechnology, as well as the increasing demands on smaller sensors with higher performances, fiber optical sensors with small size, high selectivity, fast response, high sensitivity, and low detection limits are trending in sensing system [1.2]

The nature of physical phenomena includes mechanical, thermal, electrical, magnetic, atomic and nuclear, each having the properties of bodies or physical systems. These natural properties based on some physical effects on part of the fundamental of physical sensors for measuring physical quantities and converting them into signals which can be read by an observer or instrument. For example, a thermocouple converts temperature to an output voltage which can be read by a voltmeter [3]. Physical sensors have been widely used in the micromachining field. The commonly used sensors include resistance sensors,

inductive sensors, capacitive sensors, photoelectric sensors and thermoelectric sensors [3].

B. SMPS

SMPS is defined as, when the power supply is included with the switching regulator from converting electrical power from one form to another form with necessary characteristics is called switch mode power supply. This power supply is used to attain regulated dc o/p voltage from the dc i/p voltage or unregulated ac.

C. Inverter

Inverters electronically control the electrical voltage, current and frequency of electrical devices such as the compressor motor in an air conditioner. They receive information from sensors monitoring operating conditions, and adjust the revolution speed of the compressor, which directly regulates air conditioner output. Optimum control of operation frequency results in eliminating the consumption of excessive electricity and providing the most comfortable room environment.

D. Relay

Relays are electromechanical devices that use an electromagnet to operate a pair of movable contacts from an open position to a closed position.

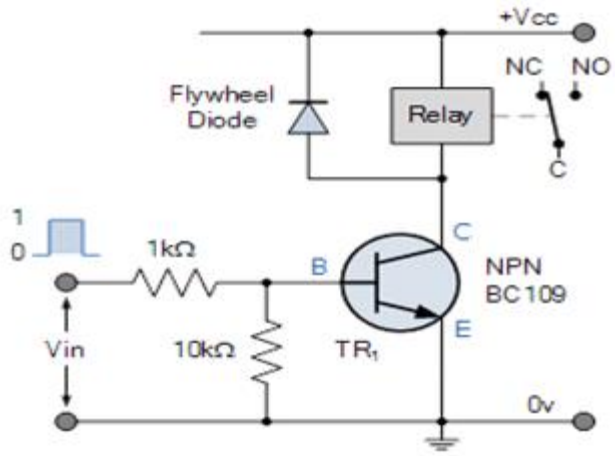

Fig 1

E. Timer

A control device that, after a predetermined time inter val, automatically starts or stops a system, machine used in industry or the home. The term "timer" is also applied to a monitoring device that signals when such a system, machin e, or apparatus is to be started or stopped. Depending on the principle of operation, a timer can be mechanical, hydrauli c, pneumatic, or electrical. The time interval of a timer is us ually predetermined in the same way as in a timing relay.

Timers are classified as single-shot, multishot, and repeat-cycle. In single-shot timers the time interval is usually set manually, for example, by moving the hand of the time indicator. In this case, the timer mechanism is simultaneously wound, and the timer will operate when the hand returns to zero. Multishot timers automatically operate several times with preset time intervals. Repeat-cycle timers operate with the same time interval (the period of the cycle) after equal periods of time. In multishot and repeat-cycle timers the sequence of time intervals, or the timer schedule, is prescribed by such means as a punched tape, a disk with pins, or a system of shaped cams.

F. Electric Brake Drum Motor

Brake motors are made with the application of an electromagnetic disc-brake onto an a.c. motor which operates in case of lack of current causing the blocking of the motor and of the other devices connected to it. The brake motor grants a high stop precision in case of voluntary interruption of current; it grants also a high safety margin should the interruption be accidental.

G. Beam Sensor

Photoelectric sensor consists with the light source, reflective beam receiver and through beam receiver [4, 5]. When the light source emits light on the yarn, some will be absorbed and some will reflect.

A photoelectric sensor emits a light beam (visible or infrared) from its light-emitting element.

A through beam type sensor is used to measure the change in light quantity caused by the target crossing the optical axis.

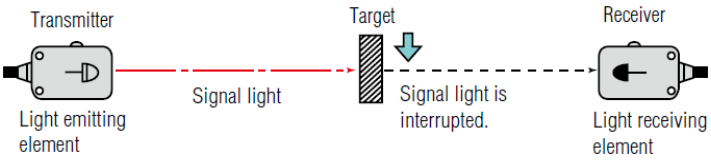

Fig 2

H. Pneumatic Components

The Pneumatic Rams and plungers are used to push the refills to their respective spaces. These plungers are driven by the compressor connection and are operated by the current signal sent by the relay which is first picked up by the Optical Sensor.

IV. METHODOLOGY

The Pre-existing technology works by using PLC as the main component for automatic functioning of the machine, which includes the feedback loop working for sorting of refills or any other parts by the use of optical sensors, this process is replaced by the use of optical sensors in conjunction with the relays, timers and logic wiring which helps to eliminate the use of PLC.

V. RESULTS

The Cost saving, time saving and space saving aspects of the machine are the main outcomes.

Cost saving of more than n 3, 50,000 INR
Time saved in construction, installation and transport.
Space saved up to 4 times more than the existing technology.

VI. CONCLUSION

PLC is a very useful device or system when used in much larger operations where the processes are very intricate, replacing it with other devices like timers and relays in combination with electric brake drum motors and optical sensors can be inexpensive alternative with the same efficacy.

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