

Design and Fabrication of Solar Powered Faulty Product Detection and Separation System

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ABSTRACT:

A Conveyor system is a common system of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy 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. Many kinds of conveying systems are available and are used according to the various needs of different industries. . The conveyor belt mechanism constructed here is a unique one & first of its kind that utilizes solar energy which is designed to count & display the dispatched items. One important feature added to the system is that it is designed to reject the faulty product from the conveyor mechanism.

Keywords: Belt, Relays, Motors, Sensors, Rollers.

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I. INTRODUCTION

A conveyor belt is the carrying medium of a belt conveyor system used in industries for transporting Finished goods from production unit to packing section. In general for short distance conveyors, two pulleys are used and are coupled with both ends of the mechanical structure and one pulley will be motorized to drive the belt system. The power pulley is called the drive pulley while the un-powered pulley is called the idler pulley. The same phenomenon is used here, but since it is a prototype module, basic concept will be proven with small mechanical structure with three metal drums or rollers.

One important aspect of the system is that the mechanism is made as automatic such that the uneven product will be sensed and rejected automatically through a separate mechanism by which the product will be pushed away from the belt. This mechanism attached to the main structure can identify the bigger box moving from the belt and by detecting this big box, conveyor belt will be stopped for a while to remove the box from the belt. For demo purpose we can use two different sizes of small carton boxes.

There are wide varieties of conveyor belt systems are in use for different applications. The conveyor system designed for Air ports can scan the passenger's luggage to detect the metal objects like weapons, gold, etc. Most of the conveyor belt

systems used for mining applications in open fields are supposed to carry the material to the long distances, at such places very lengthy conveyor belt systems vary from few hundred meters to kilometres length roller type of 'V' shape belt systems will be in use. In industries also different types of conveyor belts with different angles will be in use, some of these systems also carry material to certain height through ramp type of conveyor mechanical structures. The conveyor belt mechanism constructed here is intended to use in industries.

1.1 Mechanism

Various fields of technologies are included in this project work to create motion in the mechanism, because this system falls under the subject of mechatronics. The integration of electronic engineering, mechanical engineering, electrical engineering, & control technology is forming a crucial part in this design. Especially the control circuit designed with microcontroller plays dominant role in this project work. The term mechatronics is used to describe this integrated approach and therefore all above subjects are described in this project report in following chapters. Most systems that provide motion and force contain a mixture of Mechanical, Electrical, Electronic, and Digital Components. In fact, today most systems are mixed systems. The design of these mixed systems requires knowledge from all these fields.

1.2 Microcontroller

The controller used here is belongs to 8051 family architecture & often it is referred to as MCS-51. This microcontroller is having an 8-bit data bus. In this family some of the controllers are capable of addressing 64K of program memory and a separate 64K of data memory. The 8051 has 4K of code memory implemented as on-chip Read Only Memory (ROM). The 8051 has 128 bytes of internal Random Access Memory (RAM). The 8051 has two timer/counters, a serial port, 4 general purpose parallel input/output ports, and interrupt control logic with five sources of interrupts. Besides internal RAM, the 8051 has various Special Function Registers (SFR), which are the control and data registers for on-chip facilities. The SFRs also include the accumulator, the B register, and the Program Status Word (PSW), which contains the CPU flags. Programming the various internal hardware facilities of the 8051 is achieved by placing the appropriate control words into the corresponding SFR's.

II. MATERIAL SPECIFICATION

The overall function as per the circuit diagram begins with faulty product sensing circuit. Faulty product is defined as slightly bigger size box when compared with normal size box. For demo purpose, two different sizes carton or cardboard boxes can be used in which bigger size box is considered as faulty product and small size box is considered as acceptable product. Size of the box is detected through IR sensors for which two sets of IR sensors are used to detect both sizes boxes individually. Adequate boxes are allowed to travel through the belt and are delivered in to a big carton arranged below adjacent to the mechanism and un-allowed boxes are pushed away from the moving belt through a specially designed mechanism attached to the main mechanical structure. The following is the description of box sensing circuits.

2.1 Solar energy & panel

Solar energy can be converted in to electrical energy using solar panel constructed with photo-voltaic cells, it is a free energy source, safe and does not pollute the environment and thus will be



Fig 1. Solar panel

An extremely viable alternative in the days to come. One way to utilize the solar energy is to generate electricity directly from the sunlight by photovoltaic conversion. Since photovoltaic modules have now become extensively available in the country.

2.2 Conveyor belts

The conveyor belt system consists of a continuous moving belt that carries materials or packages from one place to another. This belting system is also used in conveyor transport systems such as moving sidewalks or escalators, as well as on many manufacturing assembly lines. A conveyor belt or belt conveyor consist of two end pulleys and is usually suspended with a continuous loop of material that rotates about them. The materials used often comprise rubber coated steel cords and fabric.



Fig 2. Conveyor belt

2.3 Ball bearing slides

It is also called "ball slides," ball bearing slides are the most common type of linear slide. Ball bearing slides offer smooth precision motion along a single-axis linear design, aided by ball bearings housed in the linear base, with self-lubrication properties that increase reliability. Ball bearing slide applications include delicate instrumentation, robotic assembly, cabinetry, and high-end appliances, which primarily serve the manufacturing industry but also the furniture, electronics and construction industries. For example, a widely used ball bearing slide in the furniture industry is a ball bearing drawer slide.

2.4 Mechatronics

Mechatronics is an engineering field which involves various fields of technologies working together can be called as Mechatronics. All most all electro-mechanical machines designed for hundreds of applications falls under the subject of Mechatronics. The procedure begins from mechanical structure and its related mechanisms driven through electrical components like motors, solenoid coils, etc. The control circuit that restricts the mechanical transmission through electrical devices will be in function based on the input & output signals obtained from the sensors.

III. MECHANICAL CONSTRUCTION

The basic mechanical structure that holds all mechanical, electrical & Electronic components is constructed with $\frac{3}{4}$ " aluminium right angles. Since the conveyor belt moving mechanism should able to cover little distance and solar panel occupies nearly 13" square space over the top of structure, nearly 40" rectangular structure with a height of 24" is considered and constructed accordingly. This is the main frame of this machine and entire control circuit along with its moving mechanism is arranged over this structure. The faulty product rejecting mechanism is constructed separately and it is attached to the main structure. This structure is also constructed using same aluminium channels.

3.1 Rack and pinion

To convert rotary motion of the motor in to linear motion, rack and pinion method must be adopted to create movements in horizontally moving mechanisms. A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack". Rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a rail car engages a rack between the rails and forces a train up a steep slope.

3.3 DC Motor

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power.



Fig 3. DC Motor

The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems.

A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings.

IV. CONCLUSION

The project work "Solar based faulty product detection & separation system is a unique system, the digital conveyor belt that counts the dispatched products & regrets the faulty product" designed and developed successfully, for the demonstration purpose a small prototype module is constructed & results are found to be satisfactorily. While designing and developing this proto type module, we have consulted few experts those who are having knowledge in mechatronics, these professionals working at different organizations belongs to Hyderabad helped us while fabricating the machine. Since it is a prototype module, much amount is not invested, the whole machine is constructed with locally available components, especially the mechanical components used in this project work are procured from mechanical fabricators, and they are not up to the requirement, lot of modifications must be carried out in design & is essential to make it as real working system. Hence, the machine is to be enhanced further for obtaining better results.

The prototype module constructed for the demonstration purpose can be said as automatic.

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