Fabrication of a Conveyor Belt with Object Sorting and Counting Facility

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ABSTRACT

Present world is very much competitive world. Up growing technology is very much responsible in this case. The nation which have more updated technology, it dominates the world. To survive in the competition technology is very much important. Industry has very much influence on economy for a nation. Where there is industry, there must be production of some products. Technological improvement is very much necessary to industry for better product. Automation is very necessary for industry. Conveyor belt is used to carry this product from one station to another. It is a necessary tool in the production line of an industry. The objects can be sorted in a conveyor belt according to its height. For this purpose, a product will have to be placed on a conveyor belt which is operated by a motor. Then after checking the height of the product, the exact or lower than that height of the products will be thrown to the product box and the greater than the exact height products will be rejected to the waste box by automatic rejection process and the accepted products will also be counted automatically which is performed by user defined rules.

Keywords: Automation, Conveyor Belt, Microcontroller, Sensor, Proteus Simulation.

1 INTRODUCTION

At nowadays, industries are playing a vital role in the national and international economy. To keep existence to-day’s viable world, it is necessary for industry to focus both on quality and quantity of product. In the present state of intense competition, production efficiency is usually regarded as the key of success. Automation is very necessary for industry currently. Many industries need to produce various types of product at various types of range. It is important to systematize the production of multiple assortments of goods, in moderate extent, as well as achieving higher inclusive productivity and requiring minimum investment and equipment. In an industrial framework, we can express automation as nothing but a technology that is concerned with the use of mechanical, electrical, electronic and computer-based systems in the maneuver and control of production [1]. In this project, the task to be done is to design and enactment of an automated object sorting machine by their color using microcontroller and sensors and count the accepted ones after sorting. Both these tasks are done over a conveyor belt. Conveyor Belt is generally used to convey material from a station to another one, particularly in flexible manufacturing system (FMS) [2]. The foremost feature of this proposal is using microcontroller and sensors. Taking this matter under thought the project is made which is very convenient for industries.

2 AUTOMATION AND CONVEYOR BELT

Automation is the convention of apparatuses, control systems and information technologies to heighten productivity in the production of possessions and conveyance of services. The correct encouragement for applying automation is to increase productivity, quality beyond that possible with current human labor levels so as to realize economies of scale, realize expectable quality levels. In the scope of industrialization, automation is a step beyond mechanization. Though mechanization provides anthropological operators with machinery to assistance them with the brawny requirements of work, automation momentarily decreases the prerequisite for human sensory and mental necessities while snowballing load capacity, speed, and repeatability. It is Automation which plays an increasingly imperative role in the world economy and in daily involvement [3].

Automation has had a distinguished influence in a wide variety of industries elsewhere manufacturing. Industrial automation pacts with the optimization of energy-efficient drive systems by precise measurement and control technologies. Nowadays, energy efficiency in industrial processes is becoming more and more relevant. Semiconductor companies like Infineon Technologies are offering 8-bit micro-controller applications for example found in motor controls, general purpose pumps & fans to reduce energy consumption and thus increase efficiency. One of Infineon’s 8-bit product line institute in industrial automation is the XC800 family [4].

Conveyor belt is most advantageous stratagem in industry for various resolution which is computerized. Conveyors are durable and reliable components used in automated spreading and warehousing. In combination with computer controlled pallet handling paraphernalia this allows for more well-organized retail, wholesale, and industrial distribution. It is measured as a labor-saving scheme that allows large dimensions to move rapidly through a process, allowing companies to ship or receive higher volumes with minor storage planetary and with fewer labor disbursement [5].

A conveyor belt (or belt conveyor) comprises of two or more pulleys, with an unremitting loop of material that interchanges about them. One or both of the pulleys are powered, affecting the
belt and the material on the belt forward. The powered hoist is baptized as the drive pulley while the unpowered pulley is called the idler. 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 transference industrial and agricultural materials, for example grain, coal, ores, etc. largely in alfresco sites. Commonly, companies providing general material handling type belt conveyors do not provide the conveyors for bulk material handling [6].

The belt consists of one or more layers of material. They can be made out of rubber. Many belts in general material handling have two layers. An under coating of material to afford linear strength and shape christened a carcass and an over layer baptized the cover. The carcass is habitually a woven fabric consuming a warp & weft. The most communal carcass materials are polyester, nylon and cotton. The cover is frequently various rubber or plastic compounds quantified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is indispensable [7].

Material flowing over the belt may be weighed in transit using a beltweigher. Belts with recurrently spaced partitions, recognized as elevator belts, are secondhand for transporting loose materials up steep inclines. Belt Conveyors are castoff in self-unloading bulk freighters and in live bottom trucks. Conveyor technology is also used in conveyor transport such as moving sidewalks or escalators, as well as on numerous manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items. Ski areas also habit conveyor belts to conveyance skiers up the hill [8].

A wide diversity of related conveying machines is available, dissimilar as regards attitude of operation, resources and direction of conveyance, counting screw conveyors, vibrating conveyors, pneumatics conveyors, the moving floor system, which uses reciprocating slats to passage cargo, and roller conveyor system, which routines a sequence of powered rollers to convey boxes or pallets [9].

Rubber conveyor belts are generally used to transport items through irregular bottom surfaces, small items that would fall in among rollers (e.g. a sushi conveyor bar), or bags of product that would sag amid rollers. Belt conveyors are generally fairly similar in construction consisting of a metal frame with rollers at either end of a flat metal bed. The belt is looped from place to place each stretch and results in not as much of preservation for tension adjustments. Belt conveyors can be used to transport product in a straight line or through changes in elevation or direction. In certain bids, they can also be used for static accumulation or cartons [11].

There are numerous types of conveyor belt systems which are classified on the basis on power supply and mechanical setup similar pneumatic conveyor systems, vibrating conveyor systems, flexible conveyor systems, vertical conveyor systems and spiral conveyors, vertical conveyor with forks, heavy duty roller conveyors, mechanical conveyor belt. For categorization object in industry height sorting system is very much useful. Color and size are the most significant feature for precise classification and categorization of product [12].

Many researches have done on conveyor belt. Daniyan premeditated a belt conveyor system by using 3 roll Idlers for Crushed Limestone [13] while Aniket discussed the design calculations and contemplations of belt conveyor system for biomass wood by means of 3 rolls idlers [14]. There was also an analysis carried out by Seema on DISA pattern moulding machine to meet the obligation of advanced weight castings [15]. For weight reduction in sugar industry, Vijay also proposed a conveyor belt system [16].

<table>
<thead>
<tr>
<th>Objective</th>
<th>Literature Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical and Electrical Design</td>
<td>Ideas</td>
</tr>
<tr>
<td>Construction</td>
<td>Programming</td>
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<tr>
<td>Modification</td>
<td>Testing</td>
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<tr>
<td>Result</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1. Block diagram of the whole process of the project
3 METHODOLOGY
The first step before the project implementation was to review the project scope and research area. Then the next task was to design the mechanical structure of the conveyor belt which is to be built. Then, if all the design had been finalized, the implementation of the hardware and the circuitry took place. Reaching the pick of the project, the programming segment took place especially for the sensor input, sensing process and output to the servo motors in the punching mechanism. Last but not least, certain modification on the circuitry and software took place in order to make the system perform in finer movements. Thus, troubleshooting process also took place to correct certain faulty processes while the system was performing its task. While the whole process as shown in Fig. 01 was completed then a fully operational system had achieved.

4 DESIGN FACTORS
The following factors are considered to design the project:
- Material strength.
- Elasticity of the belt.
- Sorting time.
- Length.
- Velocity of the motors.
- Power consumed.
- Maximum size of the object.

5 BASIC COMPONENTS
The components of the project are listed below
- DC Motor (12 Volt)
- Shafts
- Bearing
- Wooden Base
- Rubber Belt
- Aluminum Plate
- Bread Board
- Transistor
- IR Sensor
- 20 MHz Crystal Oscillator
- Connecting Wires
- Microcontroller
- Light Dependent Sensor (LDR)
- Liquid Crystal Display (LCD)
- Battery
- Capacitor.

6 WORKING PRINCIPAL
To fabricate an automatic conveyor belt with object sorting and counting facility different types of motions, control systems, sensors and power supply need to be studied about.

At first, a wooden structure has been made. After that a circuit has been constructed to control the movements of the conveyor belt, the sorting system and the counting system. So, there are mainly three sections to construct this whole project. They are Mechanical Section, Electrical Section and Controlling Section.

7 BASIC STRUCTURE
The basic structure has been made by wood as shown in Fig. 2.

8 CIRCUIT
The circuit diagram as shown in Fig. 3 is simulated in Proteus software [17].
The implementation of circuit diagram on circuit board as shown in Fig. 4 is as above.

9 FINAL SETUP
The final setup as shown in Fig. 5 is as follows:

10 PERFORMANCE ANALYSIS
In the performance analysis, the applications, advantages and limitations are discussed.

10.1 Applications of the system
The sectors where the system can be implanted are described below.
- Sorting the product according to their height.
- Transportation of specific product to a desired place through conveyor belt.
- In different industries where huge amount of production is occurred.
- Ensuring quality control in mass production.
- By some modification, it can be used to detect any colored object.
- By some modification, it can be used to measure the dimension of a product.
- By increasing its sensing capacity, it can be used in industries.
- It is also very useful in laboratories and workshops.

10.2 Advantages of the system
The practicalities are below.
- Less time required to sort the product.
- Less manpower required.
- As the whole system is performed by machine there is less possibility of mistake.
- It can reduce cost of inspection.
- It can increase the percentage of good product.
- Conveyor belt can handle huge products with low cost at hazard environment.
- The installation cost and running cost of this system is very low. So, it is very economic.

10.3 Limitations of the system
The confines are
- Conveyor belt can be used for transporting heavy material at long distance, but the project has designed considering light weight and small distance.
- The sorting machine will only be able to sort the products according to their height.

11 COST ANALYSIS
The basic components and corresponding approximate prices are listed below:

<table>
<thead>
<tr>
<th>No</th>
<th>Components</th>
<th>Price(BDT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>DC Motor (2 pc)</td>
<td>260</td>
</tr>
<tr>
<td>02</td>
<td>Bearing (4 pc)</td>
<td>360</td>
</tr>
<tr>
<td>03</td>
<td>Belt</td>
<td>50</td>
</tr>
<tr>
<td>04</td>
<td>Screws</td>
<td>30</td>
</tr>
<tr>
<td>05</td>
<td>Microcontroller</td>
<td>200</td>
</tr>
<tr>
<td>06</td>
<td>LDR, Oscillator, Resistor, Wires, IR sensors</td>
<td>350</td>
</tr>
<tr>
<td>07</td>
<td>LCD</td>
<td>250</td>
</tr>
<tr>
<td>08</td>
<td>Bread board</td>
<td>300</td>
</tr>
<tr>
<td>09</td>
<td>Aluminum sheet</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1900</strong></td>
</tr>
</tbody>
</table>

Fig. 4. Implemented Circuit

Fig. 5. A camera view of the project from the top.
12 FUTURE DEVELOPMENT

Effectiveness of this project can be improved by following this recommendation:

- An additional power can be included for the absence of mains.
- The limited motor power limits the mechanical structure and a heavy structure can be obtained increasing power to have a smarter look & more effective power.
- Taking more care of the sensitive devices from the unwanted emissions can augment sensitively.
- Sorting by every way of dimension can be done by some modification.
- Improving the sensor quality, sorting can be done more accurately.
- Decreasing time delay, one can make the process fast.

13 CONCLUSION

Nowadays, in highly competitive world the industries need to be well equipped. The management of the highly integrity of supply of a production, through raw material to deliver finish product, through quality manufacturing is of paramount importance. To accelerate the process and to maintain the quality of the products, automation is required. Automatic production related process needs to be introduced. It is very necessary to bring diversity in products considering shape, size and colors, etc. By applying the idea of this project, an industry can easily sort the required product according to its height, convey them to the required destination and also count them. Though it has some limitations, by some modification this concept can be implemented in wide range of application.

References