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PRODUCT SORTING AUTOMATION WITH PLC

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Abstract

Now a day there is a considerable growth and development in the field of automation both in industry and residential. The production rates of industries have considerably increased in recent years leading to the shortage of labors, because Industries are generally manufacturing similar type of product with little variation in size, color, weight and shape etc. In such industries the sorting of defective object plays a vital role as these industries cannot afford any human errors for selecting products. Thus, it becomes absolutely necessary to develop a system that could select the objects without any human interference with accuracy. Automation industry focuses on the development of automation with longer durability in the product, minimum rate, less maintenance, and to make system as simple operated. Thus, we have developed a system for sorting/Selecting object with any metallic
impurities using sensor and motor controlled by Programmable Logic Controller (PLC) and the conveyor in the system which allows to flow the object in front of the sensors for deciding sorting logic in (PLC).

Keywords: Automation, PLC, Sorting, Stacking

I. INTRODUCTION

In the present development in industrial manufacturing products which depend on research and innovation. The countries in the world are marked on the basis of having high rate of production and quality is as developed countries, whereas the countries with low production rates are as underdeveloped countries [2].During the processing of raw material to convert into product, which is processed to earn a value for sale. Therefore, manufacturing is 'adding the value' to raw material. The value which has been earned by the product will have more cost allowing factor to the organization to make more money out of it [1].Industries generally manufacture similar type of products with little variation in size, color, weight and shape etc. Hence sorting/Selecting plays a vital role in the industries. In the olden days when demand of product was less, it was possible to process manually for sorting the similar object or product, but now a days, with the increase in product demand the production industries can't afford manual sorting of the products. This scenario has forced the industries to opt automatic system of the sorting and packing process. Proper selection of finished products is also very essential for the industry. As an example, stacking of boxes in the warehouses requires large amount of labor cost, which is expensive, therefore automatic system in this area, will be more helpful to make the process easy and economy. For the development of industry of any country, the economy of that country is an important issue. In developing any industry economy is the main factor to be considered, hence it is necessary to make cost effective automatic system which must be affordable [2]. Also, the system should be able to enhance the rate of production by removing defective object properly. The stacking should be done properly without fail. In this paper, cost-effective automation system for sorting lightweight objects for any metallic impurity has been developed. The importance of this paper is, mainly focused on the removal of impure objects from the stack and stacking of the boxes in the stand. The process is done through PLC [4]. DC motor is used for pushing the object from the conveyor belt into the recycling bin. The system consists of two conveyor belts for the transportation of object and boxes. Further the stacking mechanism consists of lift and the stand for placing boxes. Conveyor belt brings the objects nearest to the sensor and hence logic for PLC is decided. The PLC is the programming of PLC is carried out for sorting the object, to count the object and also stacking of the objects. The system consists of four IR sensors for signaling the PLC and detects the presence of object and boxes and also counting them. The metallic defect is detected with the help of proximity sensor. In this paper, two conveyors are used naming as

product conveyor and box conveyor [5]. Here it is focused on th4 development of product conveyor and stacking model. Whole system uses DC Motors for powering the movement. The motors are interfaced with the PLC through relay cards. Sensors are placed on the metal plates and proximity sensor is hanged. One sensor mechanism is used for stacker lift. Also sensor technique is applied to detect the boxes.

II. BUILDING SYSTEM OPERATION

In our project, we have developed a tail end of the industrial process which had required large amount of labor power to smoothly operate. But by the use of automation this type of requirement has been decreased up to maximum extent, since here we have also modified stacking process & has made it automatically operated, so that, it will require less labor for the operation. Moreover, it's working and operating capability will also increase considerably. Here we have used two conveyor belt one for the products and other for the boxes in which these products will fill. This conveyor will lead the box to the platform which will be lifted and will be placed in the loading area where these boxes will be arranged automatically in the stand. These conveyors and lift will all be driven by DC motor with 12V 7amp battery. These motors will be interfaced with PLC through 24V relay.

The system uses two types of sensors for sensing objects as well as boxes with the help of PLC. The sensor consists of four units of 24V IR type and one specific type of proximity sensor, which will detect the defects present in the object passing through it. The sensors are mounted on metal stands across the conveyor belts from where the data will be required to take action. First IR sensor will be mounted at the starting of box conveyor, this sensor will start the belt, latch will be inserted to keep this belt on [6]. Second sensor is placed exactly opposite to product conveyor to stop the box. This sensor will sense the presence of box, only then the product conveyor will start. This will ensure that the product fall directly into the box and none of the product is wasted. Third sensor performs the job of counter as fixed number of object should be placed in the box for packing, this sensor will be mounted on one of the holding plated near the end of product conveyor. Main sensor for detecting defects, is mounted above the product belt, below which the products pass and will detect for any metallic defect. Fourth IR sensor is mounted on the lifting platform; this sensor detects the presence of any previously placed box in the stand. This avoids any accident in placing the packed boxes. The pusher consists of DC motor powered by 9V battery. It will have a pushing plate which will

be activated when any defective object is detected and it will be powered by small DC motor. Forward and reverse movement is done in the PLC ladder logic. When the box is placed at box conveyor by the operator, the box is sensed by sensor 1 and it will give signal to PLC to start the movement of box conveyor. This conveyor carries the box towards the filling area, as the box reaches exactly in front of product belt, second sensor will activate and sends signals to PLC to stop the running of belt and to start product conveyor. As product conveyor starts moving towards the box they are scanned for any defect or impurities present in them by the proximity sensor. If any impurity is found, sensor will give signal to PLC to stop the product conveyor belt and activate the pushing mechanism which removes the defective product. After this operation, again product conveyor will start and product starts to move forward. When they reach the end of the belt, sensor three will count the number of objects falling into the box. When the fix number of objects is passed, sensor will send signal to PLC to stop the product belt and start the box conveyor. As the in filled box has moved forward one more empty box will appear in front of sensor 2 and the process of sorting and filling is repeated. This process continues till the in filled box is reached to the lifting platform, finally, the fourth sensor gives command to PLC for stopping all the process till stacking of box is completed.
When fourth sensor is energized, lift activates with chain drive system and lifts the filled box to move upward till the place where it has to be placed. If sensor detects, no box is placed before to this box, then it will place the box in the empty space. Here also forward and reverse mechanism is used to move platform back and front for placing the box. After placing the box, the lift will return to its original position and sensor will send signal to PLC to continue the previously stopped process. PLC used in the Paper (project) is made by the courtesy of Delta Electronics India. It has 24 input and 24 output digital pins and 8 input output analog pins.

III. FLOWCHART DESCRIPTION

1. Box is placed on the conveyor and the sensor is cut and gives signal to PLC to start the belt of conveyor.
2. Box moves forward and reaches sensor 2 and gives signal to PLC to stop box belt conveyor and start product belt, thus identifying it as box in place.
3. Main sensor scans the product for any defect or impurity and if any found pushes the product into recycle bin. If no defect is found then product moves forward.
4. At the end of product belt the sensor counts the number of products falling into the box.

As predefined number reaches box moves forward and is packed.

5. When box has reached stacking platform the lift will carry the box and placed it at the desired place in the stand.

IV. SYSTEM PERFORMANCE ANALYSIS

Performance analysis includes the performance of the device with various inputs and by using different topologies applying to the device. Mitsubishi 1000 Nexgenie PLC requires Co DeSys software for coding purpose. The PLC and computer is connected by a RS232 cable. The program of the PLC can be performed in3 languages. From which ladder diagram is preferable as it provides easy electrical circuit representation and after development of the ladder logic it can be converted to secured code such as STL[3].Start sensor will start only if the box is detected Box in place product conveyors tarts Objects are counted and packed Main sensor scan the object defect detected? Boxes are stacked NO Defective object to recycle bin YES

V-COMPARISON OF & OLD AND NEWDEVELOPED SYSTEMS

SL No	Old System	New Developed System
1	Defects were checked manually	Sensors are used to detect defects
2	Time consuming and requires more labors.	System is faster and human effort is reduced
3	Counting and packing is difficult due to manual process	Counting is automatic and effortless also it is accurate.
4	Stacking of packed goods created lot of problem especially heavy goods	Stacking is automatic and PLC controlled hence no human effort is required.
5	Overall process was either done manually or used outdated technology resulting in accidents and errors.	Process is automated and chances of errors are negligible

CONCLUSION

In the earlier systems when the technology was not reliable to make processes completely automatic as they had many problems and failure, due to this drawback human intervention was required at every stage in the manufacturing process in the industry. This has resulted in

the time and production loss due to human and machine errors. But as the development in the technology took place sophisticated instruments and sensors are being used to reduce human interference and increase efficiency. In this paper, the system is built, which can be identified as defective object, counts the number of objects and fill them in the box, the boxes are arranged automatically. The complete process is automated and only one operator is required to monitor the process. The system is synchronized with PLC and sensors.

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FIGURES OF PROJECTS

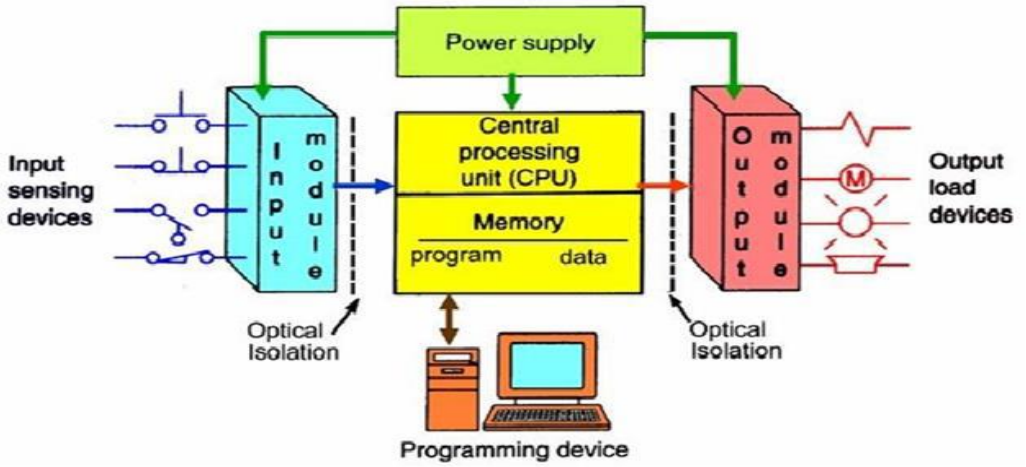

FIG – 1: Block Diagram of (PLC)

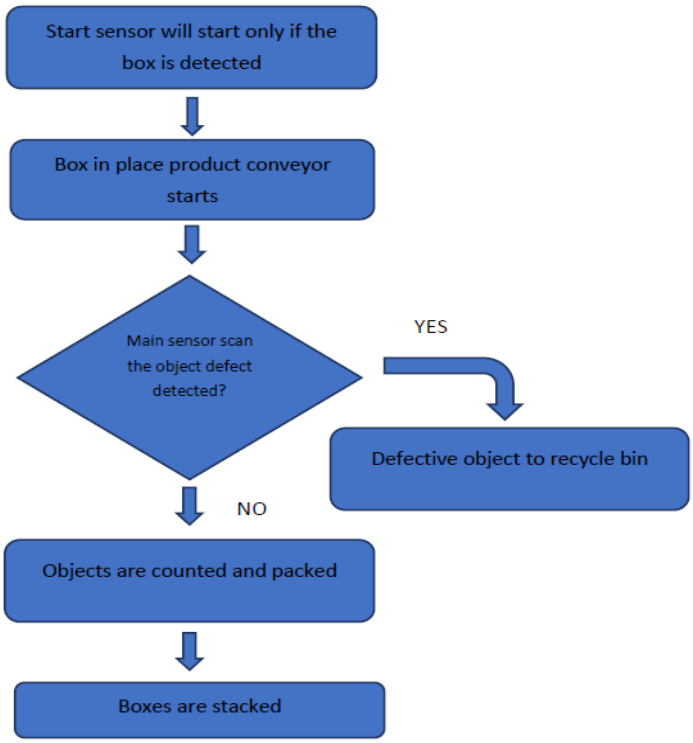

Fig - 2: Flow Diagram

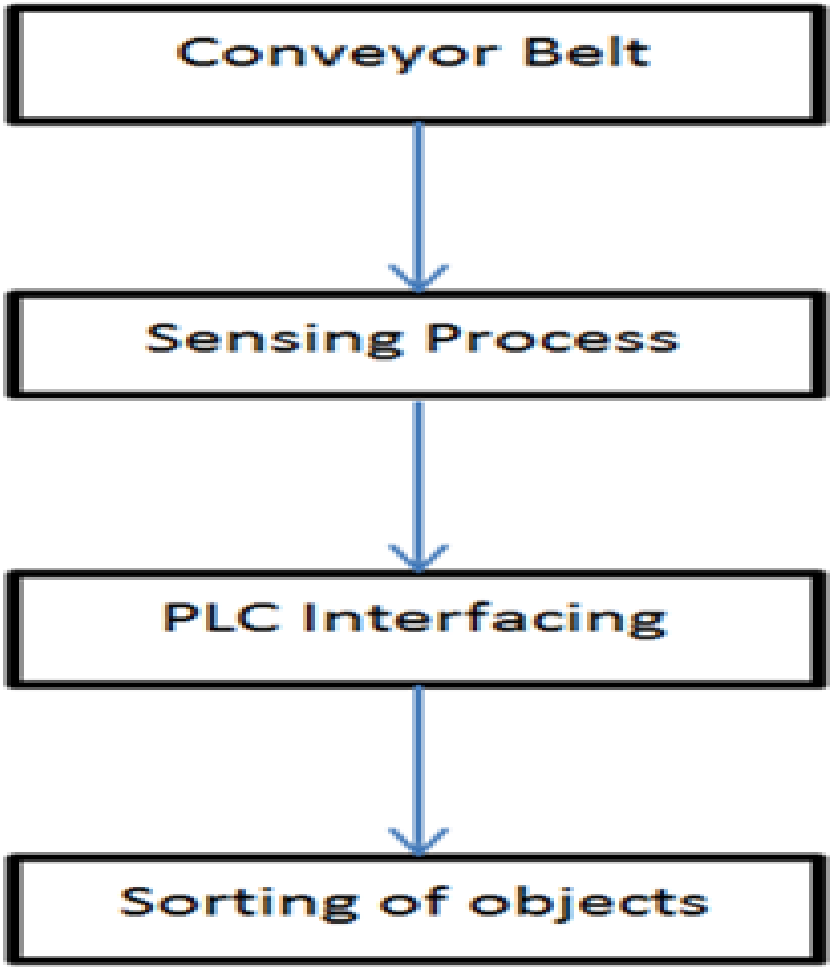

FIG – 3: DIAGRAM OF SORTING

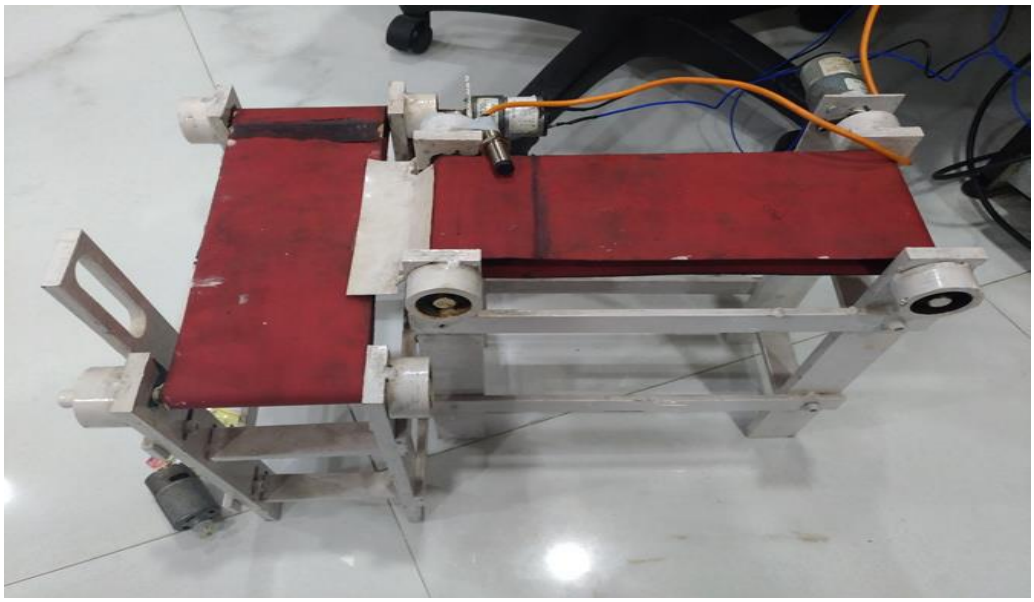

FIG - 4: Conveyor System

Fig – 5: Sorting Process