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Development of Advanced Automatic Sorting Machine using Weighing Mechanism

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Abstract*: This paper presents, design, build, assemble and commission of an automatic Sorting machine by using Weighing mechanism. The popular measuring technique is weighing scales or weighing machines. Weighing machines are measuring instruments which are used to determine the weight or mass of an object. The electronic weight detection system is classified into two types: the strain/ force gauge load cell and the electromagnetic force system. Strain gauge load cells are the most common in industry. In this system, Weight of the object moving in the conveyor is measured .Then it is sorted based on its weight the measured. The weight of the product is feed to the controller. The standard weight of the product is set to the controller. When the weight is not equal to the preset value, the object is sorted in one side. If it meets the value, it is sorted to the other side. This is the basic mechanism used in the sorting machine by weight.

Index Terms*: Advanced sorting, Digital weighing scale, picking and placing, Weight measurement, Categorizing process.

I. INTRODUCTION

Industry performs the major role for manufacturing the daily necessity [1], [2]. Industry applications mainly depend on the customer demands. Growing demand is the main factor of productivity [3], [4]. Recent days automation is the main requirement of all industries [5], [8]. Implentation of new technology will increase the demand and productivity. Industry required replacement of manpower and increase the productivity [9]. Automation and robotics are performed the industrial task with high accuracy. Automation technologies are implemented to increase productivity, time consume and cost effective process [11], [12].

The weight of the object is measured by measuring device called as weighting scale. The weight of an object is measured using decimal units in gram (g) and kilogram (kg). Digital weighing scale is a sophisticated weighing device process with a help of software to record the measurements and process the results achieved during weighing. Sorting is the process of separating the objects based on their sizes, colours and shapes. In industry the sorting process is carried out depend on their sizes and colors [14], [15], [16].

Sorting process is commonly used in the manufacturing units of industries and they are usually processed based on the size. Main function of this advanced sorting machine is classifying the objects based on its colour, size, which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place [19]. These technologies are implemented with the aim to eliminate the monotonous work done by human, and to achieve accuracy in the work. The sensors involve that senses the object's weight and sends the signal to the controller unit for next process [20]. The main function of this machine is to sort the objects based on the weights in the assembly line. The weight of the object is measured.

II. PROPOSED METHODOLOGY

A. Automatic Sorting using Weighing Mechanism

In every manufacturing industry have a conveyor system. All the goods are transported in the conveyor system. Quality checking is a vital process in every industry to yield a good product. Usually the quality of the products is checked in the conveyor itself. After checking the products, the goods are sorted separately [21], [22]. Arranging items systematically is known as Sorting. There are two kinds of sorting process: Ordering and categorizing. Categorizing is a process of grouping items with similar properties separately. The categorizing process is carried in the conveyor itself to reduce the time consumption. Combining the two processes in simultaneously is efficient. Sorting is done with different properties. In growing Industrial sector, every industry are seeking to maximize the production to compete with the other industries [23]. [24].

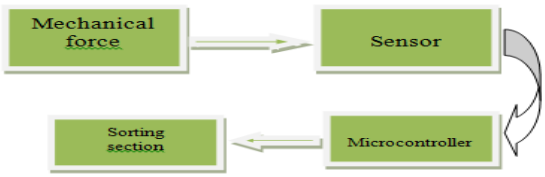

Fig 1. Sorting System

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Sorting process, that is categorizing the products based on their properties or characteristics. Our aim is to categorize the product based on the weight of the product. So the weight of the product is measured and set the product weight. This value is to differentiate the good product from the defect one. Now the weight of every product is measured then the measured value is sent to the controller. The measured value is compared with the preset product value [25]. When it meets the value, it is considered as the idle product. If it does not meet the requirement, it is considered as the defect. The challenge of this system is to reduce the time. The weighing system is incorporated in the conveyor system. The weighing mechanism is built within the conveyor beneath the belt of the conveyor system. The weight of the product is measured by the system during the transportation of the product [26]. The sorting process is carried out after the measurement based on the weight. As the weigh property of the product is used for the sorting process, it is simpler than the previous techniques.

B. Components Requirements & Fabrication Process

The fabrication part was divided into two as mechanical and electronic parts.

Conveyor System - A conveyor system is used to transport objects throughout the area in industries. Conveyors are most generally used in material handling applications. The system consists of a belt of fabric stretched between two pulleys, with at least one pulley operating under power. The belt is the transport medium which is wrapped around the pulleys which allows it to rotate around them. The powered pulley is known as driver pulley and the other pulley is known as idler pulley. The design of the system is modeled by using modeling software [7], [10].

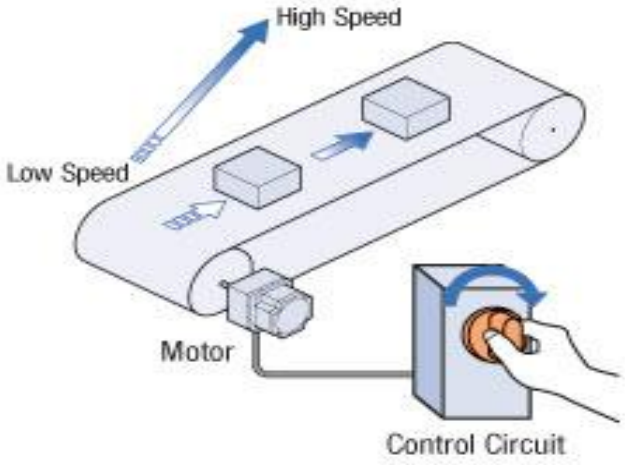


Fig 2. Conveyor system

The above described diagram shows a belt conveyor which are most widely used in the industries. But there are different types of conveyor used for different applications based on the needs. The types of the conveyor are selected based on the type of product that is going to be handled, sometimes changes due to the location of conveyor.

Fig 3.DC motor with gear box

The conveyor belt is automated by DC motor system. Automatically the object is moved to the detection process by using DC drive system

Weighing System - The balance was the main mass computing instrument designed. The balance scale is a simple device that is used likely far predates the evidence. For the mass measuring methods initially new mass is placed in one pan and standard masses are added to the other pan up to the beam is as close to equilibrium condition. These machines are also known as mass scales, or simply scale. In precision balances, for more accurate determination, the mass is given by the position of a sliding mass that is progressed along a graduated scale. Then Technology is enhanced in this field to precisely measure the mass. Different types of weighing scales were developed and are used widely based on the application [13]. The main goal of the weighing machine is to produce accurate results.

Mechanical System - Outer frame was made by cast iron and aluminium material. After the case was constructed the main parts were joined together. The roller, shaft and the belt units were joined on the case .The rolling unit is fixed to above and below of the aluminium holder. Frame unit were attached to the ground firmly and holes are made in the board for the installation of electronic component. This frame unit material is selescted based on literatures [6].

The mechanical parts of the system are fabricated on step by step process. Each steps need to be performed with high concern inorder to yield a good furnished system. The pictures of the fabrication status are included below.

Fig.4. Mechanical assembly of conveyor 1

Electronics System - The electronic section comprises of a micro controller that is integrated with a LCD and relay units. This controls the total mechanism with timer process. The action of spraying and heating of discs were totally preset with timer control in the microcontroller. LCD display device is used to show the current operation of the system.

Fig.5 Conveyor assembly with Electronics system

Controller unit provides necessary control the mechanical system. It also process the timer unit and display unit using many algorithms and gives control commands for the next process. The electronic system is highly responsible for the proper working of the spraying machine.

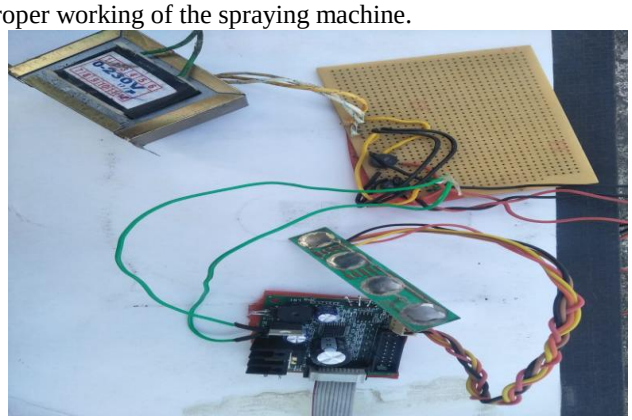


Fig 6. Controller Unit

Sensor - Proximity capacitive sensor is preferred for Automatic sorting system [17]. When the sensor senses the object, it changes the capacitance value and detects the object. It can detect all kinds of objects both metal and non metal, easy to design, cost effective compare to the other sensors. The control unit is received the signal from the sensors for next process.

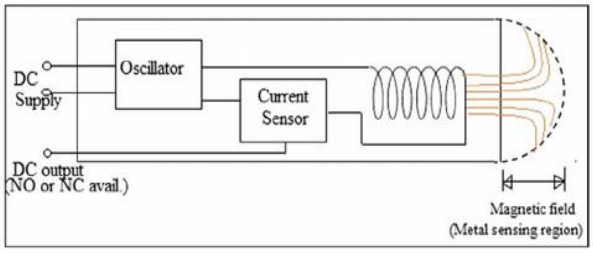


Fig 7. Proximity capacitive sensor

Accuracy of Load Cell - Whatever the application may be, the accuracy of the load cell is very important. Load cells are available on different capacity and accuracy classes. The use of different scale is based on the goods. Weighing is strictly regulated in the industries [18]. Due to the strict rules and regulations for weighing continually present new challenges to load cell developers. Calibration is also an factor that need to be considered for a precise system.

Owing to use, mistreatment, drift or ageing, calibration at regular intervals should to be carried out to establish how the load cell is currently performing. Continuous calibrations are produced accurate result otherwise they are experimenting flawed data.

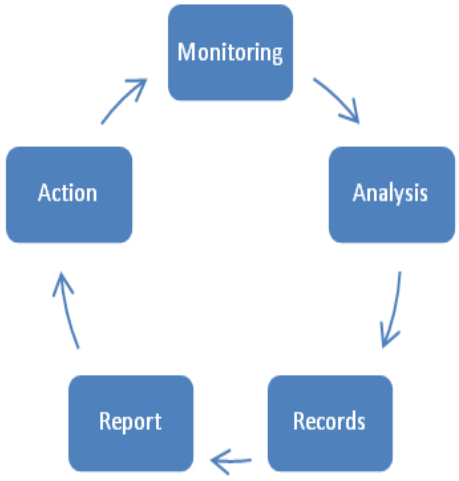
Calibration Standard Required			Tolerance Required					
			0.010%	0.020%	0.050%	0.100%	0.200%	0.500%
Deadweight	Calibration Lab capability (CMC)	0.002%	4.47	8.94	22.35	44.71	89.41	223.53
Deadweight		0.005%	1.96	3.92	9.81	19.61	39.22	98.05
Deadweight / Lever		0.010%	1.00	1.99	4.98	9.95	19.90	49.75
High End Load Cell		0.020%	0.50	1.00	2.50	4.99	9.99	24.97
High End Load Cell		0.050%	0.20	0.40	1.00	2.00	4.00	10.00
Good Load Cell		0.100%	0.10	0.20	0.50	1.00	2.00	5.00

Table 1: Calibration standard table

C. Operation of the System

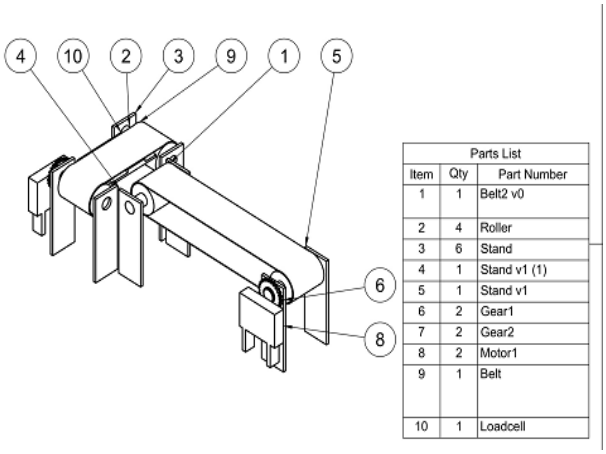
In this process, the manufactured products are moved in a conveyor one by one. Another conveyor is placed in such a way that the movements of the two conveyors are perpendicular to each other. When the product reaches the other conveyor, the weight of the product is measured. After the measurement, the controller analysis the results and gives out the result that need to be performed based on the output from the weighing output. When the product is good, it is moved to one side to store it. If the product is a defect one, then they are moved to the other side to remove to product from further process. This process can reduce the time consumption and lead to increased productivity.

D. Block Diagram



E. Assembly Details

The principles of the Automatic sorting machine using weighing mechanism have been demonstrated using suitable process. The design of the Automatic sorting machine using weighing mechanism has meet the all level of industrial expectations and it has helped a lot in making the advanced model. It is proved the quality operation with short span of time.



Parts List		
Item	Qty	Part Number
1	1	Belt2 v0
2	4	Roller
3	6	Stand
4	1	Stand v1 (1)
5	1	Stand v1
6	2	Gear1
7	2	Gear2
8	2	Motor1
9	1	Belt
10	1	Loadcell

Fig 8.Assembly details for sorting system

III. CONCLUSION

Thus the automatic Sorting machine using weighing mechanism can be used in all the manufacturing industries for automatic sorting of the products. Thus reducing the time.The production becomes more fast through this concept. This concept can be more useful for the industries that consider the weight of the product as an important property.

The Automatic sorting machine using weighing mechanism would able to provide a cost effective and efficient process for industrial purpose.

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