International Journal of Students Research in Technology & Management
Vol 3 (01), January 2015, ISSN 2321-2543, pg 223-227

DESIGN AND FABRICATION OF WEIGHT SENSING SYSTEM FOR PRODUCTION LINE

[1]Abdulrahman Al Siyabi [2]Dinesh keloth kaithari

Department of Mechanical and Industrial engineering

Caledonian college of engineering

Muscat, Sultanate of Oman

dineshkk36@yahoo.co.in

Abstract— Most of industries in our area are still using old techniques to measure the quality of their products. These old ways of measuring the quality are not applicable for every product and the checking is only by random samples. This method may affect the company if more products are out of production tolerance. So, this project is to design and fabricate weight sensing system that can be used in a production line in which the system can accept a specific weight to go in production line and reject others. The idea of this project comes after seeing the effects of going out of weight tolerance for some products that require quality. So, this report will screen the previous works and technologies which are related to the topic in literature review chapter to get benefits from them and avoid mistakes. No specific literature was identified with complete design of automatic weight sensing system. Personal interaction with the Reem batteries and power appliances results in the generation of the idea for designing and developing light weight sensing system. This project has faced some challenges which are: To identify a sensor that is having more sensitivity for the light weight and the method to amplify its low signal. These challenges have been solved by searching from different sources to get the best weight sensor and the suitable amplifier.

Keywords—Weight sensor; amplifier; Microcontroller; light weight; production line.

I. INTRODUCTION

In this decade the industry environment has a lot of changes in order to raise the quality of the products. So the factories are trying to get manufacturing system that has less human dependence and raise their abilities to compete and get more profits. In the past, the factories used to run their manufacturing manually, so the time and manpower were more to get the output product. Also, the checking of product quality was using primitive steps and it is based on random checking. Earlier the factories are aiming to achieve a high performance with fewer costs. In order to achieve that there is a need of using new technologies. In addition to that the demand of technologies to control the quality is high because most of companies want to get good reputation in the market and aspiring to achieve customer satisfactions. So this made engineers searching for solutions for those problems and trying to adjust the existing system in order to reach the optimal output.

Nowadays, Most of the industries are searching for the best technology to control the quality of their products and avoid mistakes. One of the weaknesses of production lines in some industries is that there are no automatic systems to check the weight of their products if it is on the tolerance or not. In some products the weight is very important from the tolerance point of view. For example if the weight of the mechanical parts of car is out of tolerance the facilities required will be different and the car will be considered as a defective car. This project aims to provide a solution for the quality issues by designing a system to sense the weight of the products automatically. The objectives are: design a weight sensing system that accept a specific weight to go in production line and reject others, second one is to fabricate prototype of the weight sensing system and test its performance by selecting low weight samples of product from industries .Finally, the project will cover the different areas of mechatronics engineering because it contains electronic part, electro pneumatic part and controlling part.

Weight sensing systems are very important to come up with perfect products with fewer defects. Most of the local industries are using the random manual checking to find out the defective products. However, the goal of this project is to design and fabricate a prototype of weight sensing system of production line that can measure very light weights. The request of this system came from a local industry called Reem batteries. They faced a lot of problems of returns of batteries which are under warranty. So, the industry made a study about this problem and they found that the problem is improper weight of the grid casting which is heart of the battery. The weight of grid casting is very important to get deep charge, discharge and working under hard conditions. Thus, an idea came out to design an automatic system that can control the weight of grids. This system will save money

for the company and it gives good reputation because of high quality products.

II. LITERATURE REVIEW

Design engineers are developing plans for the product to create a certain specification that include amount of acceptable variation. While doing the design of product they are considering about where and how the product will be used. After doing detailed discussions about the product engineers will come to know what should be the close tolerances for that product. Hence engineering tolerance is important to develop manufacturing process in order to meet the needs of the product (Nada et al, 2006).

According to Mr.Zaid from Reem Batteries and Power Appliances Company, the measured weight of grid casting is too important to evaluate the quality of batteries. The company now is using digital balance to measure the weight of the grid casting. The grid casting has to be 321 gram with tolerance of ± 10 gram. The method that company is following is to take a random sample from the grids to check the weight. This method is not going through all the grids. Hence the probability of other grids to be out of tolerance is very high because of the high temperature in the machine that may causes a lot of manufacturing mistakes (Al-Saadi, 2013).

In any system, the controlling of mechanisms is most important element. Methods of controlling are improving over time to achieve the best accuracy and controllability levels for the controlled systems. Starting of the control system was based on manual as human being is the main element of it. After that, the control processes become more complicated and it is more crucial to get a control system that can handle data from different devices at the same time. At this point the relay (logical control system) was starting and then the bush buttons began to control the mechanism with less cost. Both of previous types couldn't handle the advanced technology and that was the starting point of controllers such as microcontrollers, PLC and pushbuttons(Epsg1wiki, 2011).

According to Jon (2001) the microcontroller is very suitable for many applications inside industries in which the control system is the brain of production processes. Programmable Interface controller (PIC) is the most common type microcontrollers because it has simplest design as it is easy to develop as well as it is cheap in price.

III. WORKING PRINCIPLE

Weight sensing is considered really important when it comes to the quality of the product. Sensing the weight of the product will help to accept or reject if the weight is out of tolerance. Factories that use manual methods in checking the weight of the system will face a problem later in quality of the products because the measurement will be only for the random samples. The system will be made simple in design and cheap in cost because the factory owners will be encouraged to install the system in terms of increasing the quality of their products.

Working principle of the system to accomplish the job of rejecting and accepting will be as shown in Fig.1. Firstly, the product will be placed on the plate of the weight sensor. The weight sensor will sense the weight of the product if it is on the tolerance or not. If the product is on the tolerance, the first cylinder will extend to push the product to conveyor of the production line and retract directly. But, if the product is out of the tolerance then the second cylinder will extend to push the product to the container. After the first product cycle is finished, the next product will be placed on the weight sensor plate.

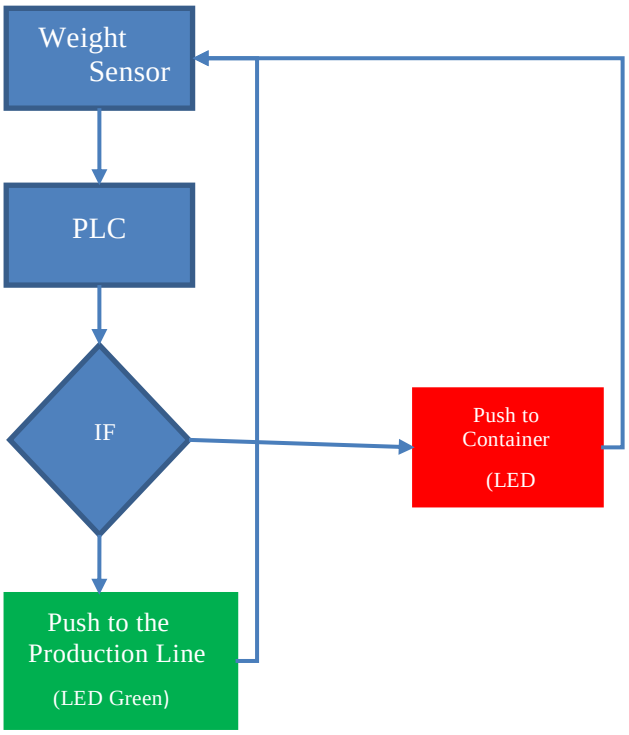

Fig. 1 Simple Flow chart of the weight sensing system for the production line

IV. RESULTS OF MECHANICAL PART TESTING

This section will show the causes of selecting parameters which are related to the mechanical part. Firstly, the pneumatic cylinders were tested to achieve the perfect generated force and pressure usage and sequence of the cylinders is designed to navigate the product smoothly to the conveyor (if accepted) or to the container (if rejected) . Fig 2 is representing the sequence of inserting two products; the first one is within the tolerance and second one is out of the tolerance.

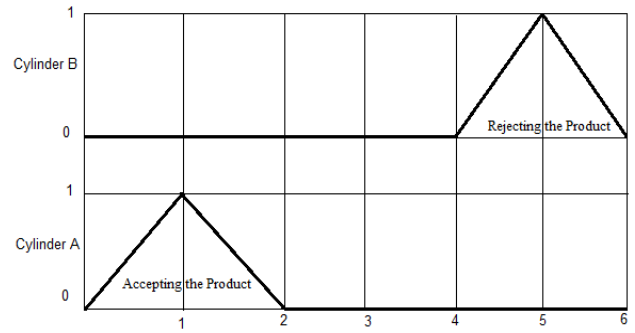

Fig. 2 Flow diagram of extending and retracting for the Cylinders

As shown in Figure 2, the cylinder A (which is responsible for pushing the product to the conveyor) has been extended for one second and retracted for a second. The next two seconds are to get the next product to be measured by the weight sensor. Then the cylinder B which is responsible for pushing the product to the container has been extended for one second and retracted within a second . This operation is controlled by the microcontroller.

In order to find the optimum operation range, some trials have been done to determine the best pressure for pushing the product without getting damage. This has been done using pressure gauge for each cylinder to measure the pressure within extending and retracting time.

Table 1 Result of testing pressure and time for pushing two products

Trials	Pressure (bar)	Time of pushing two products (sec)
1	1	0
2	1.5	8
3	2	6
4	3	6
5	4	5.9
6	5	5.7
7	6	5.4

Table 1 is showing that the optimal pressure range is between 2 to 3 bars because this gave the best speed to push the product without causing any damage to the product. When the pressure is 1 bar, the cylinders were not acting at all. In addition the pressures which are more than 3 bars are giving high force which can affect the product. These pressures (more than 3 bars) will waste the resources because the 2 bar is sufficient to perform the sequence perfectly. Pressure of 2 bar is selected for the system to avoid using un-needed power. Figure 3 is showing the time of operation for tested values of pressure.

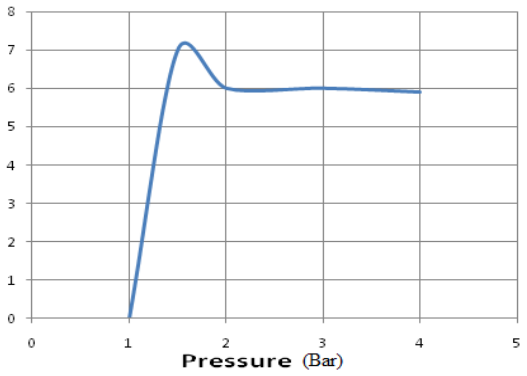

Fig. 3 Pressure Vs. Time Chart

The result was good except some leakage because of silencer part in pneumatic circuit got damaged and it has been replaced. The optimal pressure range is 2 to 3 bars because the measured time and the force generated were uniform. So the mechanical part is working properly without any failure.

V. RESULTS OF ELECTRONIC PART TESTING

Voltage signal is much better After connecting the weight sensor to the FUTEK amplifier and it starts from 3V until reach 3.3V when it is fully loaded. By testing the output after adding the second amplifier which is instrumentation amplifier the output voltage increase in terms of grams/volt to be read by the microcontroller as shown in the Table 2.

Table 2 Voltage as a function of mass

Trial No	Mass (grams)	Voltage (volts)
1	0	0.001
2	15	0.012
3	50	0.103
4	100	0.38
5	200	0.79

6	300	1
7	340	1.060

So the calibration becomes much easier. Microcontroller can read these results very precisely because it can read 1024 levels of voltage from 0-5 volts. From that it can be said that the electronic part is doing its work perfectly.

VI. RESULT OF CONTROLLING PART TESTING

Testing of microcontroller has been done after connecting it with the output of the second amplifier and LEDs. Microcontroller reads the voltage and activates the red LED when the weight is out of tolerance. However the green LED is ON when the weight is on tolerance.

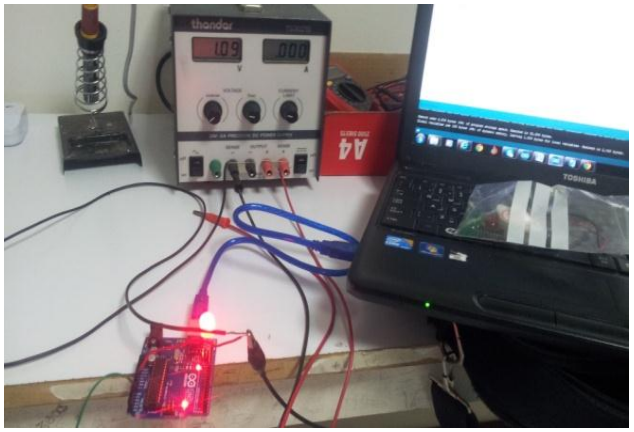

Fig. 4 Testing the Microcontroller

VII. RESULT OF TESTING WHOLE EXPERIMENT SETUP

Result of testing whole design was good because most of tested samples have been detected by the system. However, the value of accepting and rejecting can be changed easily by adjusting the voltage level inside the microcontroller. In addition when the VDC source is slightly changed the accuracy of the system will be less because the amplifier output will change at the same time.

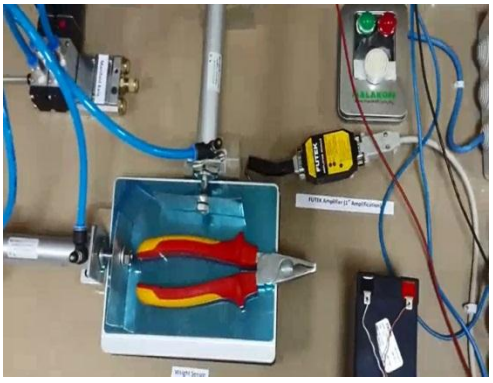

Fig. 5 Testing the system by samples

VIII. CONCLUSIONS

As explained previously the objective is to design and fabricate a system that can sense the weight of the products , put the correct product in the conveyor and push out the products which are out of the weight tolerance. The report can be summarized as follows.

- literature review has screened the different opinions, ideas and perspective about the technologies that are useful to project. So the best concept and technologies have been taken for the project and the wrongs and errors of similar project have been avoided.
- design has been created and it has been divided into three main parts which are Mechanical part, electronic part and controlling part.
- mechanical part has been designed to push the grid casting of the battery into the conveyor or container according to the weight.
- electronic part is measuring the weight by the full bridge load sensor and sends the signal to first & second amplifiers to be amplified.
- amplified signal is going to the processing phase which is done by the microcontroller.
- amplifying the signal of weight sensor was one of the main challenges of the project because it is giving very low output and for that purpose the signal is to be amplified two times on the system to obtain maximum accuracy of the sensor.
- program code was carried out to perform the optimal controlling of the project.

System can be developed in future according to the requirements of the products. In addition the ladder diagram design has been done to apply it in the future for real industry field. Finally the goal of doing this project has been achieved in the given time . Fabrication and testing of the system has been done perfectly.

REFERENCES

[1] Nada A., ElMaraghy, A. and ElMaraghy Waguih, H.,2006. Quality Prediction in Manufac-turing System Design. Journal of Manufacturing Systems [ONLINE],PP.153-171 , Available from:<http://search.proquest.com/docview/197636521?accountid=3 1923> [A ccessed 27th May 2013].

[2] Zaid Al-Saadi , HSE officer, Reem Batteries and Power Appliances, Interviewed [21st M-arch 2013].

[3] Epsg1wiki, 2011. History of Control Systems [ONLINE]. Available from:http://www.ePsg roup1wiki.dee.isep.ipp.pt/lib/exe/fetch.php?media=mc_vs_plc.png [Accessed21stApril2013].

[4] John I K, 2001.PIC microcontroller basic compilers. Gernsback Publications, [ONLINE] 2(7), pp. 50-52 Available from :<http://search.proquest.com/docview/204777789?accountid=31923> .[Accessed 27th May 2013].