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IMPLEMENTATION OF AN AUTOMATIC WEIGHT PRINTING SYSTEM USING A LOADCELL CONVEYOR

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ABSTRACT

The implementation of an automatic weight printing system using a loadcell conveyor represents a pivotal advancement in modern industrial processes. This innovative system addresses the critical need for precision and automation in weight measurement and labelling, particularly in the context of pharmaceutical product packaging. By seamlessly integrating components such as digital speed control, relay, Arduino mega microcontroller, ultrasonic sensor, loadcell, HX711 module, inkjet printer, and a rs232 to TTL converter module. this system revolutionizes the efficiency and accuracy of weight-related tasks. The testing phase of the loadcell conveyor system confirmed the system's accuracy and reliability in weigh measurement. The result revealed a consistent characteristic.

1. Introduction

In the pursuit of automation and precision in industrial application, the Arduino mega microcontroller has emerged as a versatile and powerful tool[1-3]. This journal documents the creation and implementation of an innovative "Automatic Weight Printing System Using Loadcell Conveyor" that leverages the capabilities of the Arduino Mega. The project's core objective is to seamlessly integrate loadcell technology with conveyor systems, allowing for the real-time measurement and printing of object weights with precision and efficiency.

The use of an Arduino Mega as the project's control hub enhances its capability, providing a flexible platform for data acquisition, processing, and control[4]. In this journal, we will explore the fundamental principle of loadcell technology, the design and development of the loadcell conveyor system, and the integration of the Arduino mega to facilitate accurate weight measurement and automated label printing[5]. Moreover, practical implementations across diverse industrial settings will be discussed, highlighting the project's potential to optimize production processes and ensure product quality.

The purpose of this endeavor is to demonstrate the value of automatic weight printing using a loadcell conveyor. By comparing precision weight measurement technology with a weight measurement system using loadcell sensor. This project seeks to enhance efficiency, reduce errors, and offer real-time data management solutions. These capabilities align with the critical demands of modern industries, making this innovation a significant step forward in the pursuit of enhanced productivity and product quality.

2. Research method

2.1. How the system works

The loadcell conveyor design is tool with an automatic system that can measure the weight of product and print the weight automatically on the product. This system uses an ultrasonic sensor to detect product entering the conveyor and control the conveyor speed using digital speed control[6]. After product detection, the system gives 3 seconds to measure of the product using a loadcell and HX77 module.

Product weight data is sent from the Arduino mega microcontroller to the inkjet printer via RS232 to print the product weight on the product[7]. This system uses relays to turn digital speed control on and off[8]. This design concept prioritizes measurement accuracy, process automation, and effective connections between system components.

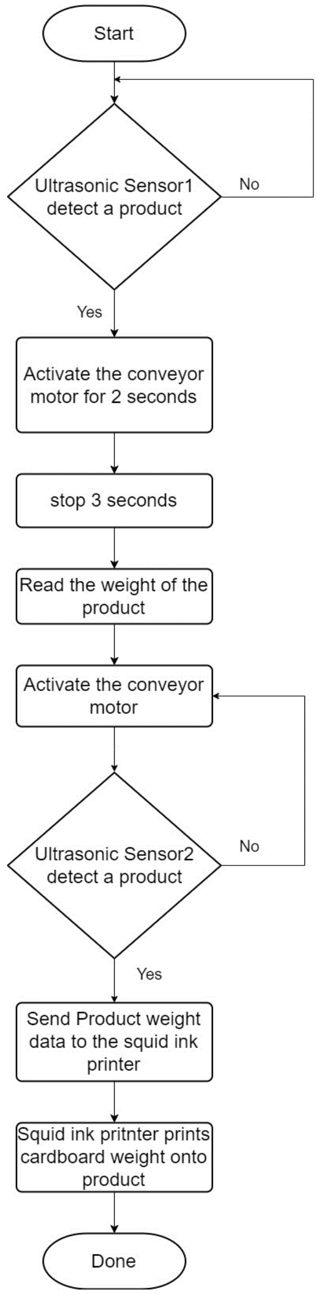

Figure 1. Block diagram of how a loadcell conveyor system works

Loadcell conveyor has tens components, they are Arduino mega microcontroller, AC motor, Digital Speed control, relay, ultrasonic sensor, HX711 module, loadcell sensor, RS232 to TTL converter module, inkjet printer, and 5V power supply. The model of loadcell conveyor system can be seen in Figure 2. To connect the components used, a PCB (Printed Circuit Board) is designed for the loadcell conveyor system to simplify the wiring process, and making it more efficient[9]. The PCB layout of loadcell conveyor can be seen in figure 3.

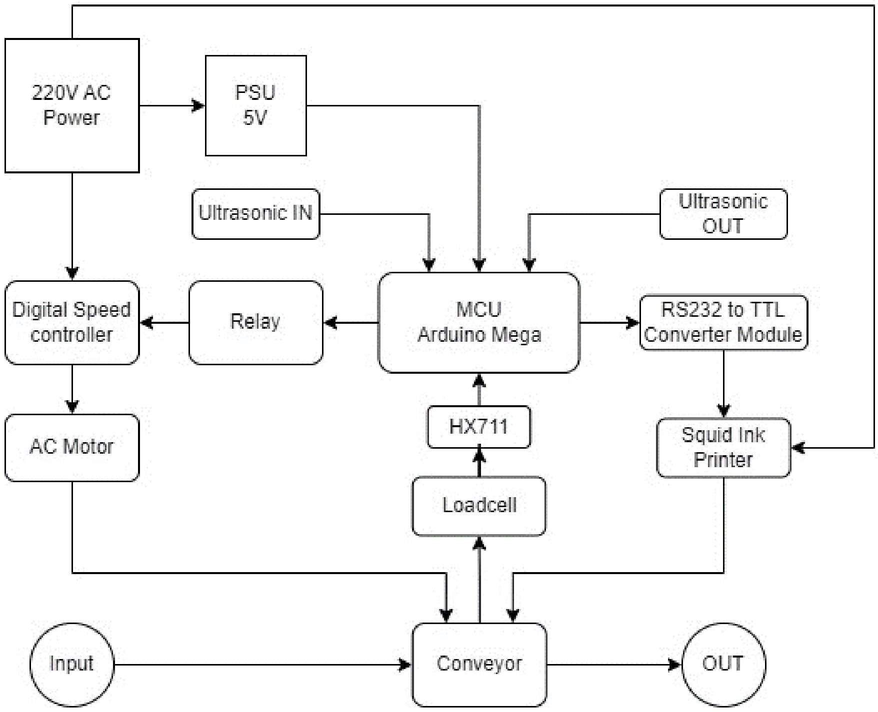

Figure 2. Block diagram of system design

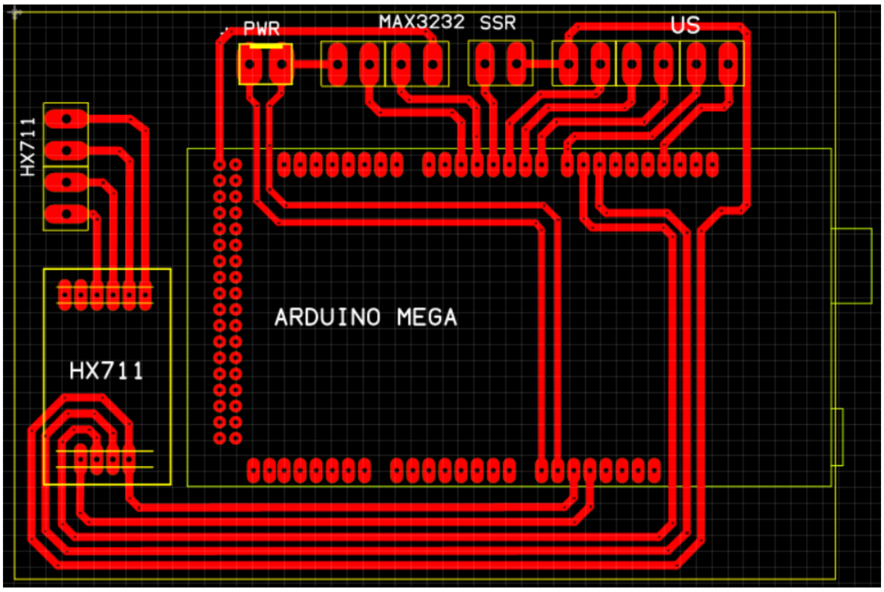

Figure 3. PCB layout of loadcell conveyor

2.2. Implementation of the system

Figure 4 shows the implementation of the design loadcell conveyor. Ultrasonic sensor, relay, RS232 to TTL Converter module, HX711, are connected with Arduino mega. Arduino mega acts as an input or output data processing module to control the entire system's operation. It receives input signal from the ultrasonic sensor for product detection, triggers the relay for conveyor speed control, interfaces with the HX711 loadcell amplifier module to acquire weight data, and communicates seamlessly with the RS232 to TTL Converter module for data transmission to the inkjet printer. This microcontroller orchestrates the precise synchronization of these components, ensuring that the loadcell conveyor functions as an integrated and automated system for accurate weight measurement and labelling.

The loadcell conveyor system comprises three integral sections: the Input Conveyor, The Weighing Conveyor, and the printing section. The input conveyor serves as the system's point of entry for the products or objects. Equipped with an ultrasonic sensor positioned at its entrance, this section plays a critical role in detecting the presence of incoming products. When a product approaches the conveyor, the ultrasonic sensor triggers a signal to the control system, often an Arduino mega. This signal initiates a sequence of actions, allowing products to enter the system smoothly, ensuring they are appropriately positioned for subsequent weight measurement and labelling.

The weighing conveyor is the heart of the system, responsible for precise weight measurements. Loadcell interfaced with an HX711 module, are integrated into this section. They perform the vital task of measuring the weight of products as they pass through. The Arduino mega, acting as the processing unit, receive weight data from the loadcell via the HX711 module. Conveyor speed control, managed by relay, ensure that each product is correctly positioned during the weighing process, maintaining accuracy and facilitating efficient data acquisition.

Finally, the printing section is the last stage of the system. It transforms weight data into printed labels applied directly to the product. RS232 to TTL converter module facilitate seamless data transmission from the Arduino mega to a dedicated printer, often a inkjet printer[10]. The printer's primary function is receives the weight data and print it onto the products in real-time. This ensures that each product leaving the loadcell conveyor system carries accurate weight information, contributing to quality control, traceability, and the overall integrity of the products. Together, these sections achieve the system's primary goal of providing accurate weight measurement and immediate labelling for products as they progress through the conveyor system.

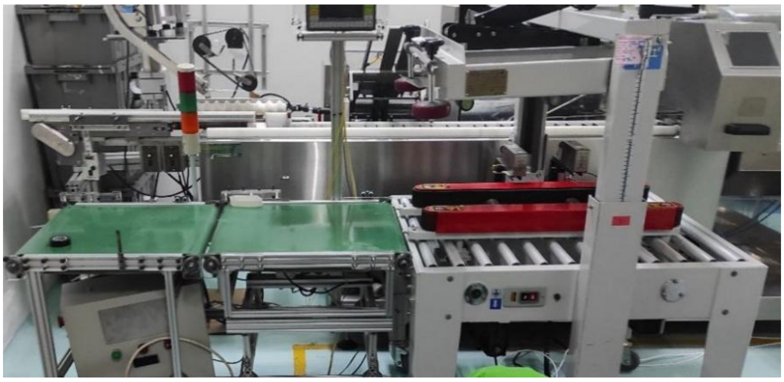

Figure 4. Implementation of the loadcell conveyor

3. Results and discussion

Testing the whole system was done by wiring all existing modules. The system power supply was used as a voltage source to power the entire module that was designed in the system. The core objective of this testing phase was to verify the accuracy and reliability of the weight measurement function using the loadcell conveyor.

Weighted testing commenced with the introduction of a 1 kg load into loadcell conveyor. The system's performance was closely monitored as it measured and recorded the weight of this load in real-time. The collected data was analyzed to assess the system's accuracy and consistency in measuring the 1 kg load. Weight measurement testing result using 1 kg load can be seen in Table 1. Subsequently, the system was transitioned to a knows 2 kg load similar to the previous test. Its performance in measuring the 2 kg load was scrutinized. Weight data for the 2 kg load was recorded an analyzed for variations from the expected value. Weight measurement testing result using 2 kg load can be seen in Table 2.

The collected weight data for both the 1 kg and 2 kg loads underwent thorough analyst determine the accuracy and reliability of the system's weight measurements under different load conditions.

Recorded measurements were meticulously compared to the known weights of the test loads, and any measurement differences values were examined.

TABLE 1. Weight measurement test using 1 kg load

Subject	Measurement by loadcell (gram)	Real weight	Measurement differences values	Average differences value
1	1004 gr	1000 gr	0.4%	0.4%
2	1005 gr		0.5%	
3	1005 gr		0.5%	
4	1004 gr		0.4%	
5	1003 gr		0.3%	
6	1003 gr		0.3%	
7	1004 gr		0.4%	
8	1004 gr		0.4%	
9	1004 gr		0.4%	
10	1004 gr		0.4%	

Based on the Table 1, showed the average differences weight measurement of a 1 kg load. The highest difference value obtained was 0.4%, the lowest difference value obtained was 0.3%, So the average difference between the weight measurements of a 1 kg load was 0.4%.

TABLE 2. Weight measurement test using 2 kg load

Subject	Measurement by loadcell (gram)	Real weight	Measurement differences values	Average differences value
1	2003 gr	2000 gr	0.15%	0.155%
2	2002 gr		0.1%	
3	2002 gr		0.1%	
4	2002 gr		0.1%	
5	2003 gr		0.1%	
6	2003 gr		0.1%	
7	2004 gr		0.2%	
8	2004 gr		0.2%	
9	2004 gr		0.2%	
10	2003 gr		0.15%	

Based on the Table 2, showed the average differences weight measurement of a 2 kg load. The highest difference value obtained was 0.2%, the lowest difference value obtained was 0.1%, So the average difference between the weight measurements of a 2 kg load was 0.155%.

4. Conclusion

Based on the test results, several conclusions were obtained as follows: when measuring weight using a loadcell, it was found that there was a difference between the weight measured by the loadcell and the actual weight of the load. This difference has the characteristic that the heavier the load being measured, the smaller the value of the difference. This characteristic can be caused by several factors, including the sensitivity and accuracy of the loadcell and HX711 module, dampening vibrations or external disturbances, as well as environmental conditions during measurement. Loadcell which has high sensitivity will provide more accurate readings but there may still be differences due to damping factors or other external interference.

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