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ARDUINO BASED FASTENERS COUNTING MACHINE USING WEIGHING METHOD

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ABSTRACT

In many mechanical production industries, components such as fasteners (nuts, bolts, screws, etc.) are manually counted by employees working in the Quality Control department. This manual counting process can lead to confusion for employees, especially when dealing with large quantities, and may result in counting errors. The count of fasteners can reach into the thousands and even millions in the production industry, making it a time-consuming task that can take several days to complete without errors. To address this problem, we have developed a solution called the 'Fasteners Counting Machine.' Our project enables employees to count a large number of components within seconds and with utmost accuracy. The core concept behind our solution is to count the components, such as fasteners, by measuring their weight. This can be expressed by the formula 'Count = Total weight / Weight of Individual piece.' This formula succinctly encapsulates our approach. Fasteners are typically manufactured in large quantities, with each piece being identical in shape and weight. This uniformity allows us to apply the weight-based counting method with confidence. Our project utilizes electronic components such as Arduino Uno, a strain gauge load cell, and an amplifier module. Fasteners are placed in a basket, and the count of fasteners is displayed on the machine's screen.

Keywords: Fasteners Counting, Arduino, Load Cell, Quality Control.

I. INTRODUCTION

Our concept revolves around counting a variable number of small components, such as fasteners, by utilizing their weight. In some large-scale manufacturing industries, specific machines are employed for counting and packaging fasteners. These machines incorporate high-tech sensors and control systems, driving the cost into the lakhs. They typically feature a moving tray or a pouring system that keeps fasteners in continuous motion, while sensors within the machine record the count of the fasteners. The count of the components is then displayed on a screen mounted on the machine. However, due to the high price and complexity of these machines, many small-scale industries cannot afford them for their counting needs. To address this issue, we have developed a solution. We have built a machine that enables employees to count fasteners in less time, while also ensuring more accurate results. Our machine utilizes a simple mechanism known as the 'counting by weighing' method. Thanks to its reduced complexity and a smaller number of components used in its construction, our machine is significantly more cost-effective compared to other industrial counting machines. Additionally, the working principle is straightforward and easy to understand. Since individual variants of fasteners in the industry have the same weight and shape, our weighing-based concept provides an efficient method for determining the total count of fasteners.

II. LITERATURE REVIEW

[1] **Priyadarshini Mahalingam et al. (2016)** Proposes a Design and build a Counting system using Smart Sensors for the Production and Manufacturing Industries to reduce the loss over shortage of Instruments or Components and increase in accuracy of counting the instruments or components. This methodology can be implemented in any Industry which uses Scale Counting method. The method uses Industrial Automation systems and smart sensors to maintain and bring the accuracy over counting. The implementation of this device helps to reduce the huge loss spent over by the companies for ages.

[2] **O.N.V.P. Bhagavan Kumar et al. (2023)** Showed the design was entitled Automatic Coin Sorting Machine for it is to sort the Indian coin denomination. This was done to be able to help different Institutions that deal with large number of coins in their daily operation. Some of these are banks, churches, charitable institutions and the transport sector. The sorting part of the design is basically mechanical as it sorts the coin through their physical size then counts them as they pass through the Arduino. An automatic coin counting and sorting

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machine prototype is developed by using ARDUINO-UNO as the main controller. This work included design the display panel to show total quantity of each coin and total amount.

[3] **Ashokkumar .R et al.(2022)** for counting of papers in academic institutions and industries, there are no feasible machines available. The design is mainly focused on cost effectiveness and for light to medium usages. The machine is constructed by using rollers, battery, DC motor, LED display, Arduino and IR sensor. In this machine initially we need to keep bunch of papers in the paper feeding tray, then the Arduino is reset. The LED displays the number of papers counted.

[4] **C. Sathishkumar et al. (2021)** In today's world, handing of papers is increased in shops and in institutions. In this generation, time has become the more important thing in every one's life. Counting and handling of papers in reprographies, stationeries, offices and educational institutions were done manually. It is difficult to count papers during peak working hours. Maintaining of big database in industries is difficult and it becomes too difficult in counting them. This generation people focuses to not waste their precious valuable time, manual counting will not be efficient and effective.

[5] **Akhilesh Kumar et al. (2023)** Presented the design and fabrication of economically viable nut segregation and defect detection machine for fasteners industries. This prototype is developed to help manufacturers in achieving quality assurance at minimal cost. Simulations are performed in ANSYS to optimize the design parameters of machine prototype. Working of machine prototype is categorized in three stages: (i) linearization, (ii) slot allocation, and (iii) image processing. To segregate, the individual nut from the feeder motoring mechanism is adopted for the linearization stage.

[6] **Yan Li et al. (2022)** With the rapid development of railroad transportation in recent years, the traffic safety and maintenance decisions put forward more and more stringent requirements. Due to the harsh environment and other factors, railroad fasteners often break or miss. This poses a threat to railroad safety. Therefore, railroad fastener status detection is one of the important means to ensure the safe operation of the railroad, and the identification of railroad fasteners is the important technology of railroad fastener status identification.

[7] **Whyte Akpan et al. (2023)** said that there are issues related to the quality of service delivered in public health facilities as well as drug retail outlets. In the aspect of counting and dispensing of drugs, patients complain about the poor level of attention that they get from such places. Patient attendants working under pressure as a result of a great number of patients to be attended to in a short period of time may make mistakes and errors in the number of tablets counted. This usually leads to packaging of either few or more pills which 3 invariably leads to drug abuse. This research is concerned with the design and production of a drug counting and dispensing machine to solve these problems.

[8] **Rocco Furferi et al. (2019)** In the fashion field, the use of electroplated small metal parts such as studs, clips and buckles is widespread. The plate is often made of precious metal, such as gold or platinum. Due to the high cost of these materials, it is strategically relevant and of primary importance for manufacturers to avoid any waste by depositing only the strictly necessary amount of material. To this aim, companies need to be aware of the overall number of items to be electroplated so that it is possible to properly set the parameters driving the galvanic process.

[9] **N. Savelyev et al. (2022)** Conveyor belt systems are widely used to transport goods within production facilities. An obvious task arising in this scenario is counting items that pass through such system. In this paper we focus on a task of counting poultry eggs transported along a conveyor belt. We propose a computer vision-based solution successfully solving this task.

[10] **Chao Li et al. (2022)** The steel ball counter is designed to count a batch of small steel balls and to count a certain number of balls so that they can be bagged separately and reduce the amount of labour. The design and study of the counter mechanism and counting system is mainly focused on the design and realisation of the counter. The counting mechanism is designed using solidworks 3D software and has a dynamic simulation.

[11] **Kexin Qi et al. (2022)** designed an automatic visual counting system, which obtains the clear image of fasteners through the combination of shaker and visual system. Datasets including in sparse and dense conditions are constructed. An improved Blendmask instance segmentation network is proposed to realize fastener counting. And we propose an improved Blendmask instance segmentation network to realize fastener

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counting. The experimental test is carried out by using the constructed data set. Compared to many other state-of-the-art, the proposed method can get brilliant estimations.

[12] **Nimitha. M et al. (2019)** In this paper, the author explained about the machines available for counting only materials like paper, no comparable machine were available to neither count metal parts nor non-metallic parts.

III. METHODOLOGY

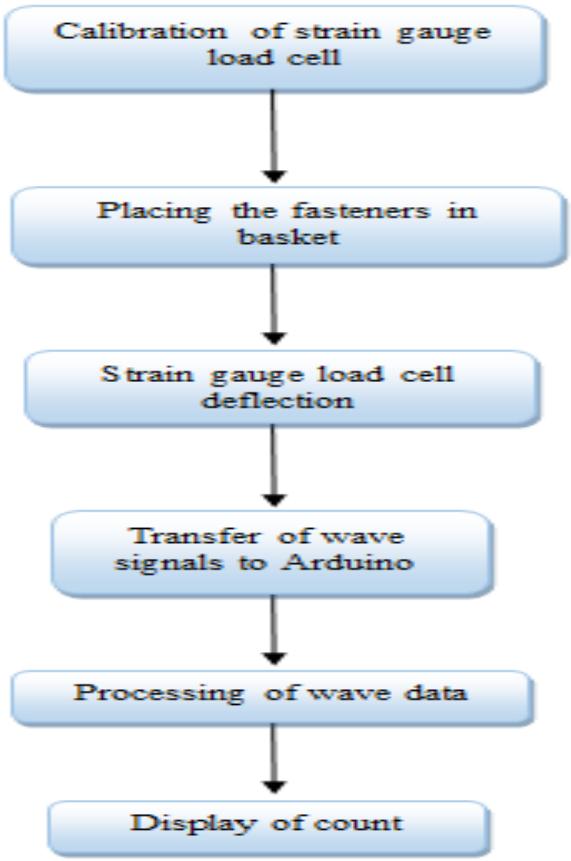

Figure1: Methodology Flowchart

Step by step procedure:

- The very first step is to calibrate the strain gauge load cell according to the components which is going to count, Then the components like fasteners are placed in the weighing basket set up
- One end of load cell is mounted on the base, and the another end is fitted with the weighing basket
- The Strain gauge load cell used here is capable of reading weight up to 10 kgs, We can increase the load cell kgs as per our need
- When the weight is being placed above the strain gauge load cell, it will start to deform from its original shape
- The deformation is recorded by the Arduino uno board through HX711 Load cell amplifier module, i.e. the amplifier module transforms the deformation wave signals into digital programmable signals
- Here the C programming which is feed in the Arduino uno controller board helps us to process the digital load cell amplified data
- The Arduino uno board has some storage to store the lines of code, by utilizing the storage facility the codes are being saved in the Arduino and worked during the counting process
- The lines of code process the function and send the output to the display unit
- The LCD (liquid crystal display) shows the count of the fasteners in digital number format
- The all components are mounted in the sheet metal base structure.

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FLOWCHART FOR BUILDING MACHINE

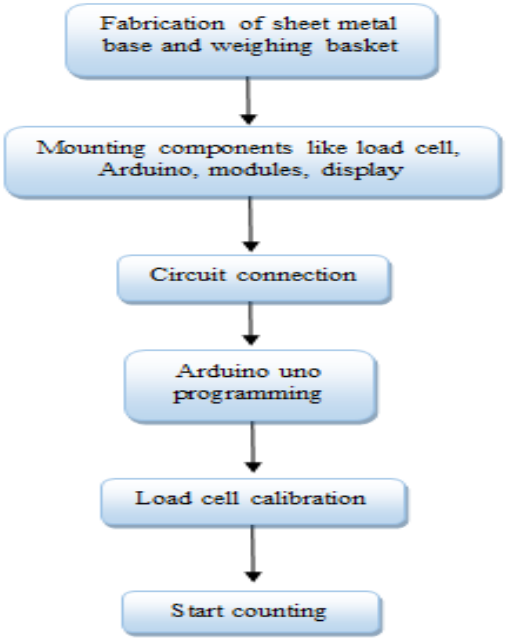

Figure 2: Flowchart for building the machine

This flowchart defines the building format of this counting machine.

Hardware setup:

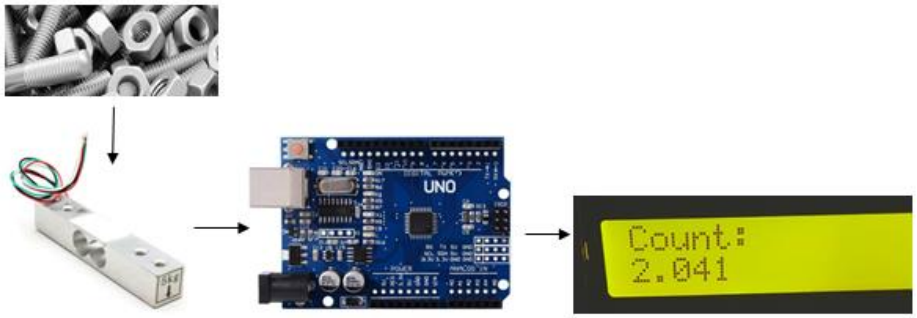

Figure 3: Process Flow

Table 1. List of components

SN.	Components	Quantity
1	Load cell	1
2	Arduino uno	1
3	Bread board	1
4	LCD	1
5	I2C Display module	1
6	HX711 Load cell amplifier module	1
7	switch	1
8	5V adapter	1
9	Jumper wire	As per need
10	Sheet metal base	1
11	Sheet metal basket	1

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IV. PARTS

STRAIN GAUGE LOAD CELL:

A Strain gauge load cell is essentially a transducer that converts force into a measurable electrical output, translating deformation into electrical signals. These load cells are commonly utilized in weighing machines. Strain gauge load cells belong to a category of load cells where a strain gauge assembly is positioned within the load cell housing to transform the applied load into electrical signals. The load cell measures the weight placed on it by detecting voltage fluctuations generated in the strain gauge during deformation. These strain gauges are typically affixed to a beam or structural component that deforms under the applied weight. Modern load cells often incorporate four strain gauges to enhance measurement accuracy. Of these, two are typically under tension, and the other two are under compression, and they are wired with compensation adjustments. When the load cell is in its unloaded state, the resistances of each strain gauge are equal. However, under load, the resistance of the strain gauges changes, leading to a modification in output voltage. This alteration in output voltage is measured and converted into readable values using a digital meter

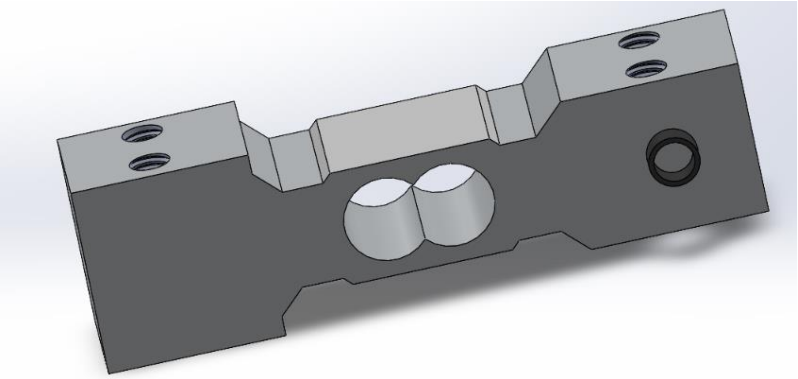

Figure 4: Load cell model

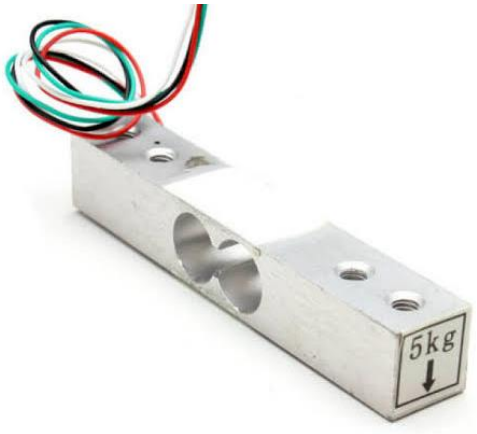

Figure 5: Load cell actual picture

ARDUINO BOARD:

In our research, the electrical signal received from the strain gauge load cell is converted into a count of the total components. We can observe several DIY projects online involving Arduino based weighing machines that convert the electrical signals from the load cell into weight outputs displayed on an LCD screen. The HX711 Load Cell Amplifier Module serves as a bridge between the load cell and the Arduino. It amplifies the deformation occurring in the load cell and provides an electrical signal as input to the Arduino. Following the amplification, lines of code are written using the Arduino IDE software. Simultaneously, specific libraries need to be installed for all the components connected to the Arduino, such as the display and the HX711 Load Cell Amplifier Module. Once these two tasks, i.e., code writing and library installation, are completed, the code is compiled and saved in the Arduino's memory. The code should also include calibration steps, the initial step in using this machine involves calibrating the load cell with a fastener placed on it. After calibration, the count is

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displayed on the LCD screen. The concept is expressed as 'Count of fasteners = total weight of fasteners / calibration weight of a single fastener".

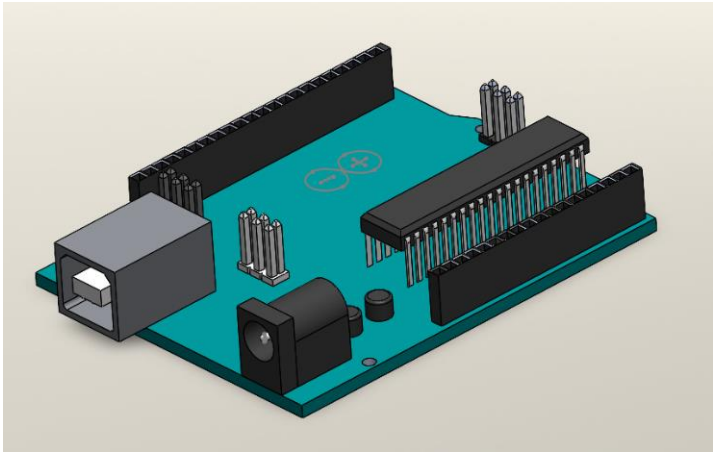

Figure 6: Process Flow

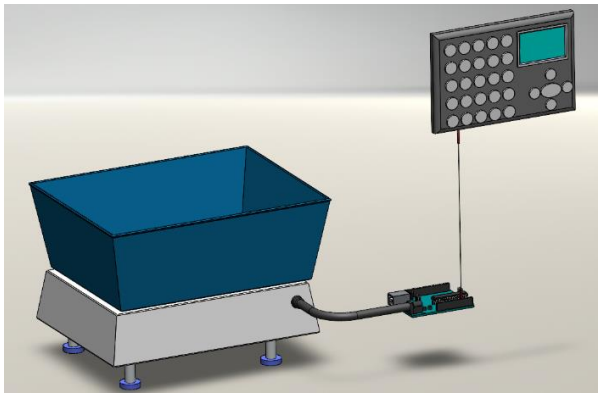

Figure 7: Conceptual design

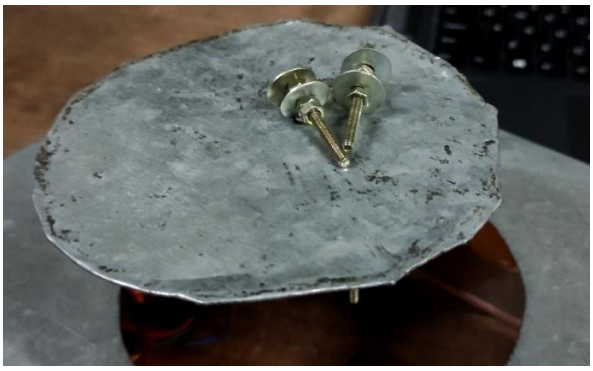

Figure 8: Prototype loaded with fasteners

Figure 9: count output of loaded fasteners

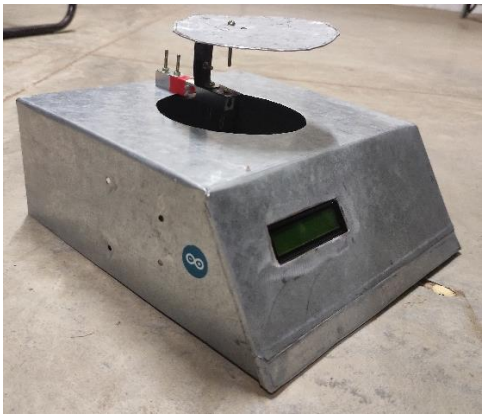

Figure 10: Actual prototype

V. RESULTS

The concept which we planned initially is to build a Arduino based fasteners counting machine. But this is not only for fasteners, we can use any small components which are all are same in size, shape and material. And we found a justifying result for our work.

VI. CONCLUSION

This concept arose when we faced challenges in counting thousands of fasteners during a student internship. Our primary focus was on the fasteners manufacturing industry. In many small-scale industries, there is hesitation from management to invest lakhs of rupees in counting machines. Our machine is designed with them in mind. The primary goal is to create a mechanism that saves human effort, reduces counting time, and

minimizes initial setup costs. Our project is notably more cost-effective, efficient, and straightforward compared to the counting machines already in use in many manufacturing industries. Additionally, this machine has applications in various other industries, such as medical, food, and cutlery, to name a few.

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