Portable Weight Measurement Instrument For Trolley

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Abstract- *The various stages of operations involved in the Portable weight measurement instrument for weighing vehicles are given. It is a portable device placed between the spring and chassis of the trolley of the vehicle to measure the weight of the sugarcane- filled trolley. Fraud in the incorrect weighing of farmers' yields has been happening for a long time. To stop these frauds and give the correct weight to farmers' yield we have made this device. With the help of this weight measurement instrument, farmers can measure their yields and approximate their weight themselves. They don't have to depend on anyone for weight measurement. Here spring is used for calculating the weight of the trolley. All the problems of the trolley's weight and various loads have been considered while making weight measurement vehicles. This instrument is designed to accurately measure the weight of boards or materials loaded onto trolleys in industrial settings. It has Arduino uno and advanced Ultrasonic sensor technology to provide precise weight measurements, contributing to efficient material handling and inventory management. The instrument offers real-time data display and recording capabilities, enhancing workflow optimization and reducing errors associated with manual weighing. Its compact design and user-friendly interface make it a valuable tool for industries reliant on board transportation and inventory control. Our instrument utilizes advanced Ultrasonic sensor technology and Arduino uno systems to precisely measure the weight of the trolley's contents in real-time. The collected data is then transmitted wirelessly to a centralized control system using Bluetooth module HC-05, providing immediate access to weight information for operators and managers. This real-time data enables better decision-making regarding load management, resource allocation, and adherence to weight regulations.*

I. INTRODUCTION

The accurate measurement of vehicle weights is crucial for various sectors, including transportation, logistics, and road safety. Traditional weighing methods often involve stationary weighbridges, which are expensive to install, require significant space, and lack mobility. The primary goal of our project is to create a Portable Trolley Weight Measurement Machine that offers a convenient and reliable method for determining the weight of loaded trolleys using a suspension of spring. The most common definition of weight found in introductory physics textbooks defines weight as the force exerted on a body by gravity. In this project we are going to work on the spring suspension principle, movement detected by laser instrumentation, As the spring gets compressed the laser detects movement and passes the signal further. The change in load per unit of deflection is generally expressed in pounds per inch. Spring rate is determined by the amount of force, in pounds, in kilograms required to constrict a spring by one inch or centimeters. If the rate of the spring is linear, its rate is not affected by the load that is put on the spring. The majority springs are made from open-coil steel wire (often stainless steel or highcarbon steel), but aluminum compression springs are also widely available. However, stainless steel compression springs are the most popular. The laser instrumentation works, Laser distance measurers work by sending pulses of laser light. The light reflects off a solid surface, and the measurer calculates the amount of time it takes for the reflection to return to the device. These distance sensors work based on the Time- Of-Flight (ToF) principle, which means that the sensor emits a laser beam and receives the reflection from it. Collaborately spring compression and laser instrumentation work for obtaining the digital output on LCD. The time that elapses between sending and receiving the laser light ensures that the laser distance sensor can internally determine the distance.

II. LITERATURE REVIEW

'Measurement and Instrumentation Theory and Application' by Alan S. Morris,[1] This book provides a comprehensive overview of measurement principles and instrumentation. It likely covers weight measurement as part of broader metrological concepts. 'Measurement Systems, Application, and Design' by Ernest O. Doebelin,

[2] while emphasizing measurement systems in general, this book might cover the principles and applications of different sensors, potentially including those used in weight measurement. 'Handbook of Weighing in the Process Industries' by Ringgold Inc., [3] This handbook might provide more specific insights into the practical aspects of weighing, particularly in industrial settings.

'Vehicle Suspension System Technology and Design', Amir Khajepour, The purpose of this book is to cover essential aspects of vehicle suspension systems and provide an easy approach for their analysis and design. [4] It is intended

specifically for undergraduate students and anyone with an interest in the design and analysis of suspension systems. In order to simplify the book begins with the introduction of the role of suspensions in cars and a description of their main components. The types of suspensions and their analysis are discussed. In addition, vehicle vibration is reviewed in detail and models are developed to study vehicle ride comfort. 'Sensors and Transducers', by D. Paranaiba, Sensors and transducers are used in automation in construction, domestic appliances, industries, transport, space exploration, defense equipment, health services, and other applications. Advances in processing and computation have opened up opportunities for very accurate control of plants. processes, and systems. [5] Sensors/Transducers have helped achieve substantial accuracy and control as automation of any kind begins with the measurement of certain system parameters of which sensors and transducers form an essential and indispensable part. The major activity of 'Pragati Engineering' Works is Manufacturing, Sub-classified into the Manufacture of trailers and semitrailers for transport of goods or passengers.[5] In this project for designing the trolley, we took reference of their experts who guided us how to design and build up the trolley for our project.

III. METHODOLOGY

A device consisting of multiple electronic components such as Arduino uno which further consists of a Microcontroller ATMega328, Ultrasonic distance sensor, Bluetooth module HC05, and 16*2 LCD. Arduino uno consists of a total of 14 digital input-output pins out of which 6 are analog input pins,6 configurable PWM outputs used for speed control and serial I2C for communication support 32 kb programmable flash memory, and 16 MHz clock Speed, The Arduino Uno is one kind of microcontroller board based on ATmega328, and Uno is an Italian term that means one. Arduino Uno is named for marking the upcoming release of the microcontroller board namely Arduino Uno Board 1.0. This board includes digital I/O pins-14, a power jack, analog i/ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header. All these can support the microcontroller for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a batter. An ultrasonic sensor senses the distance between the trolley tank and chassis in the form of the range which is connected to the Arduino Uno module. This sensor is used up to 3.3 volts to 5 volts and consumes 2mA when idle. The ultrasonic sensor is an electronic device used to measure distances. Because, measuring distance is an essential factor in many applications such as robotic control, vehicle detection, etc.

Sensors such as optical and sound are the most helpful. The detection distance between the trolley and chassis is about 2 cm to 450 cm and the working temperature is about -20 degrees to 70 degrees. Connect the VCC and GND pins to a 2.4V-5.5V power supply. The usage of the other pins depends on the operating mode selected. Select the operating mode of the US-100 Ultrasonic Distance Sensor by using the jumper on the back of the module. When the jumper is present, the sensor outputs the distance as binary serial data, otherwise, the sensor outputs a single pulse that has a width that represents the distance measured. Using the US-100 Distance Sensor in Serial Data Mode The ultrasonic sensor senses the distance and passes further to the Arduino Bluetooth module HC-05 is used to get output on mobile, HC-05 has a red light which indicates the connection status. This module works on 3.3 volts we can connect 5 volts supply voltage as well since the module has on board a 5 to 3.3 volt regulator. The data transfer rate of the HC-05 module can vary up to 1Mbps in the range of 10 meters. Mobile Bluetooth namely Serial Bluetooth Terminal is used and connected to Bluetooth module HC-05 which shows output on mobile also. The machine user interface is built with the help of a 16x2 LCD display. This display indicates the values of voltage, current, and power factor.

Embedded Components :

1. **Ultrasonic Distance Sensor**: The US-100 Ultrasonic Distance Sensor Module operates from a wide voltage range and provides both digital and serial data output modes. The US-100 features accurate temperature- corrected range detection. It can output the distance in millimeters using a serial data output mode. Alternatively, the distance can be calculated by measuring the amount of time that a digital output is held high. This sensor can be used with both 3.3V and 5V microcontrollers and only consumes 2mA when idle.

2.Arduino UNO

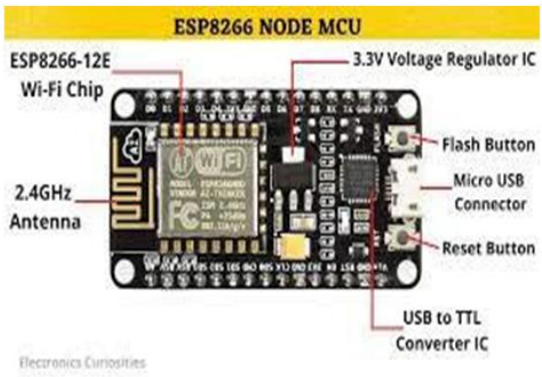
- Microcontroller: AT Mega 328
- Operating Voltage; 5V, as all the sensors used are operating at 5V level, they can be directly interfaced with Arduino
- Supply voltage: 7 – 20V, GSM module used in project requires 12V supply for its operation, so a single source of 12V becomes sufficient without requirement of the additional voltage regulator.
- 14 digital I/O pins
- 6 Analog input pins
- 6 configurable PWM outputs; used for speed control of motor
- Serial, I2C communication support
- Software serial supported libraries
- Libraries for easy hardware interface
- 32KB programmable flash memory
- Clock speed: 16 MHz

3.16*2 LCD Display:

The machine user interface is built with the help of a 16x2 LCD display. This display indicates the values of voltage, current, and power factor cyclic manner with an update rate of 2 seconds. Figure: 3.4.1 16x2 LCD display 16*2 LCD is used to display current, voltage, oil level and temperature value. A liquid crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light modulating properties of liquid crystals.

4.Node MCU:

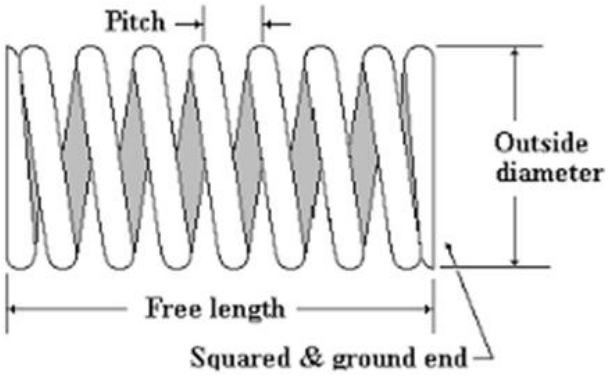
As Arduino began developing new MCU boards based on non-avr processors like the ARM/SAM MCU used in the Arduino Due, they needed to modify the Arduino ADE so it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors. They did this with the introduction of the Board Manager and the SAM Core. A "core" is the collection of software components required by the Board Manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language. Some ESP8266 enthusiasts developed an Arduino core for the ESP8266 WiFi SoC, popularly called the "ESP8266 Core for the Arduino IDE".[18] This has become a leading software development platform for the various ESP8266-based modules and development boards, including NodeMCUs. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language.



Hardware Components:

1.Spring:

Spring refers to a mechanical component that stores the energy when compressed by a load and releases it after the load is removed. Different forms of springs, including leaf, coil and torsion springs, are utilized in products such as automobiles. Modern vehicles integrate coil springs, while four-wheel-drive vehicles and older cars have leaf springs, which are metal layers connected to the axle. The product plays a crucial role in the vehicle suspension system to improve steering stability, traction, handling, and ride comfort. Moreover, it works with a variety of control arms, linkages, and shock absorbers. The springs play a major role in vehicle suspension systems, as they can absorb the impact.



Specification of Spring:

- Wire diameter - 5 mm
- Outer diameter - 65mm
- No of turns – 9
- Length - 200 mm

2.Trolley:

We have designed the trolley in such a manner that it is dimensioned with 3*2*1.5 feet with a weight carrying capacity of 150 kilograms, four springs of equal strength,diameter, no of turns and outer diameter is used in between trolley tank and wheel chassis. Four wheels of equal diameter are connected to wheel alignment which is flexible to the transportation facility.

Specification of Trolley

1) Length- 3 feet
2) Breadth- 2 feet
3) Width- 1.5 feet
4) Total weight capacity- 150 kg.

Overall Embedded circuit:

The big advantage we achieved is that our circuit is designed in compact size so it can carry reliably easily.

IV. RESULTS

For Observation analysis, consider 1 brick of 5 kg

Sr.No.	Weight	Distance
1.	Empty Trolley	228 mm
2.	5 kg	219 mm
3.	10 kg	213 mm
4.	20 kg	209 mm
5.	40 kg	170 mm
6.	Overload State	164

Advantages & Disadvantages:

There are various advantages of compact and portable weight-measuring equipment as mentioned below.

1. Compact size: The size of our machine is very compact so it can be fit easily anywhere.
2. Accuracy: our machine shows accurate values of weight with respect to materials.
3. Common technology: just by using present technology-based components we have designed this machine.
4. Versatility: Onboard weighing systems can be installed in various types of vehicles, from trucks and trailers to forklifts and agricultural machinery, making them versatile tools for weight measurement in different industries.
5. Operational Efficiency: Onboard weighing systems streamline weight measurement processes, reducing

delays and improving resource allocation. This increased efficiency leads to higher productivity and cost savings.

6. Environmental Impact: By preventing overloading and optimizing load distribution, onboard weighing systems help reduce fuel consumption and emissions, making transportation operations more environmentally friendly.

There are various disadvantages of compact and portable weight-measuring equipment as mentioned below:

1. Compact and portable scales may be less accurate compared to larger, more stable scales due to factors such as load cell accuracy, load factors, and environmental forces
2. Limited capacity: Portable scales often have a limited weight capacity compared to larger, stationary scales. This can restrict their use for measuring heavier items.

V. CONCLUSION

Our device is among the most generic and cheap of equipment of the sensitivity and reliability system. Regular monitoring of weight on LCD displays not only gives proper and accurate measurement but also adds to increased sustainability. The Arduino Unobased monitoring of weight is useful as compared to manual weight measurement and also it is reliable as it is not possible to monitor manually, under bad conditions, overload conditions, or voltage. Bluetooth is undergoing connection from the message sent to mobile. We can recover the system in less time. The proposed result system has shown that the system works well with accuracy, and the sensitivity of the scheme is very high in illegal and error situations. Monitoring weight will help identify or detect unforeseen conditions before any major failures lead to greater reliability and cost savings.

If the device is in a strange state, we know the accurate weight of the filled trolley. No manual method is required to calculate after this amazing device

REFERENCES

For this project, we have referred following material as resources:

[1] Alan S. Morris, ‘Measurement and Instrumentation Theory and Application’, Morgan & Claypool Publishers,2017.
[2] Ernest O. Doebelin, ‘Measurement Systems, Application, and Design’, Patranabis D publishers, 2003.
[3] Ringgold Inc, ‘Handbook of Weighing in the Process Industries’, this handbook includes amendments endorsed by the 87th National Conference on Weights and Measures during its Annual Meeting in 2002 published.
[4] Avest Goodarzi, Amir Khajepour, “Vehicle Suspension System Technology and Design”, Morgan &Claypool Publishers, 2017.
[5] D. Paranaiba, ‘Sensors and Transducers’, by PHI Learning Pvt. Ltd., 2003 Also, for the inputs; we have visited the following Industries:
[6] Pragati Trailers, Shirol, Dist-Kolhapur.
[7] Pragati Trailers, Shirol, Dist-Kolhapur.
[8] Vivek Trailers, Shiroli-MIDC, Dist-Kolhapur.