# Axle Drum Nut Tightness Monitoring To Ensure Safety In Rear Axle Of Heavy Vehicles

**S.Venkatasubramanian, U. Ahalya, M.Harishene**

*Abstract--- Heavy vehicle demand is exceptionally strong in India. The rear axle is the driving axle of a heavy vehicle and hence it plays an important role. In rear axle, Brake drum and Hub are mounted with the bolt and is tightened temporarily. The mounted brake drum from axle assembly is then carried to chassis assembly for further process, where it needs to be tilted for reliable manufacturing. Several accidents occur while tilting the brake drum in chassis assembly which causes risks to human life as well as affects the quality and production. This paper aims to ensure safety in rear axle assembly through a proposed system which includes a conveyor mechanism, NODEMCU, IR sensors and ultrasonic sensor. The conveyor mechanism can be controlled locally through webpage.*

*KEYWORDS: NODEMCU, Arduino, conveyor*

## I. INTRODUCTION

Axles are an integral component of heavy vehicles. In a live-axle suspension system, the axles of heavy vehicles will serve to transmit the driving torque to the wheel, as well as to maintain the position of the wheels relative to each other and to the vehicle body. The axles of the vehicles should bear the weight of the vehicle plus any cargo. A non-driving axle, such as the front beam axle in heavy duty trucks and some two-wheel drive light trucks and vans, will have no shaft, and serves only as a suspension and steering component. The vehicle with non-independent rear suspension uses either a dead axle or a live axle. The dead axle only supports the weight of the vehicle, but the live axle besides fulfilling this task, contains a gear and shaft mechanism to drive the road wheels.

### FRONT AXLE ASSEMBLY

The front axle assembly consists of several stages. First, the axle beam is loaded at conveyor belt. Next, the axle arm is fixed to beam of steering with bolts. Later ,the track rod is fixed for the alignment of wheel which will help the left side of the tyre to turn along with the right-side wheel. Then, the air chamber and brake shoe are fixed along with the hub and lock set using axle arm.

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Then Fix the wheel drum to the both ends of axle arm. At the end, front axle is unloaded from the conveyor and it is taken to the chassis assembly

### REAR AXLE ASSEMBLY

The rear axle assembly consists of several stages. First, Load rear axle casing on pedestals. Next assemble the dust covers on brake shoes and tighten them with bolt and nut. Later, torque is applied on the mounting nuts. Then assemble the inner ring for oil seal and distance piece is fixed to align the outer and inner wheel bearings on the same axis. At the end, the rear axle is unloaded from the conveyor and it is taken to the chassis assembly.

## II. EXISTING SYSTEM

The method of developing rear axle is a continuous process. The assembling of each component in an axle at every stage has a specified time limit. Thus, the work in each stage has to be completed within the time limit by the worker to meet the production demand. In order to meet the demand and complete the work in stipulated time, workers will be urged to complete the task before the time elapses. This may result in manual errors which may cause unavoidable accidents.

The errors may be due to carelessness of the worker in fixing and ensuring appropriate tightness to the bolt. These errors cannot be pointed out easily by the workers in such a huge process.These minute errors sometimes results in huge production loss sincethe existing system lacks monitoring and control facilities to ensure the safe manufacturing of axle.
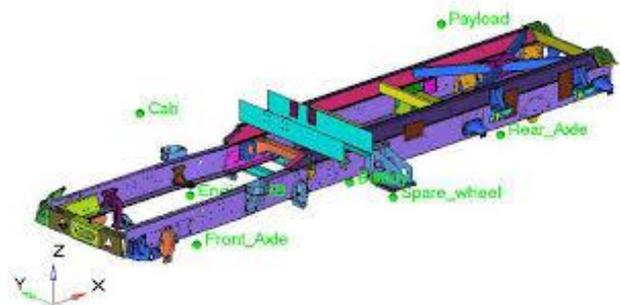


**Fig1: parts assembled in chassis frame**

## III. PROBLEM FORMULATION

There are several stages in manufacturing of heavy vehicle such as frame assembly, chassis assembly, engine assembly, front and rear axle assembly, gear assembly and finally testing of the assembled vehicle. Axle assembly is one of the most important stage in which rear axle plays a major role. In this assembly, the axle is mounted and developed stage by stage .Initially the brake drum and the hub are fixed with bolt temporarily in this stage .After the complete development of the rear axle, the developed axle is taken to the chassis assembly where all the important parts such as gear box, engine, axle, steering and other electrical parts are arranged on the frame of the vehicle.

One of the important and critical stages in chassis is the stage where the entire frame has to be tilted upside down to carry out further work process. During this tilting stage, there is a possibility of accidents taking place due to the falling of brake drum. Falling of brake drum occurs due to loosening of bolt fitted on the brake drum. This will in turn cause severe risks to human workers, results in quality issues and affects the total production of the industry. The brake drum bolt gets loosened due to vibrations when it is been carried from the axle assembly to chassis assembly through small trucks and sometimes even due to carelessness of the workers in checking the tightness of the bolt.

Chassis assembly is the main stage where the entire vehicle output is obtained. Huge numbers of employees are engaged in each stage to ensure fitting of all the required parts. But some manual errors are unpredictable and unavoidable that too in such a busy and fast processing stage. So to prevent these accidents, tightness of the bolt has to be ensured at the axle assembly itself. This paper aims at ensuring tightness of the bolt in axle assembly with a system which includes conveyor mechanism controlled by NODEMCU.



**Fig2: rear axle brake drum**

## IV. UPDATED SYSTEM

Axle assembly is done in various levels of stages over a conveyor belt. An axle consists of two brake drums each fitted on the left side and right side of the axle. Each brake drum carries 2 bolts to hold it firmly with the axle. Thus an axle carries 4 bolts which is needed to be tightened to avoid accidents. To monitor the process continuously from remote place, a webpage is designed which displays the monitored parameters( conveyor movement; detection of axle; bolt tightness on either sides of the brake drum). When the axle reaches a particular position in the conveyor where the tightness is to be ensured for brake drum nut, an ultrasonic sensor operates in the conveyor belt. When the ultrasonic sensor detects the axle in the conveyor, the conveyor is stopped.The IR sensor is used to detect the position of the

Nut header and intimates it to the webpage.As soon as the nut in the brake drum is completely tightened, green light will glow which ensures complete tightness in the nut.When the LED glows, it indicates to the operator that desired tightness is provided to the bolt in the brake drum. This ensures that two bolts on the left side of the brake drum is provided with required torque. Similar process is carried for the brake drum on right side. When the two bolts on right side is ensured with complete tightness, green light glows. The lamp glows red when the bolts are not tightened and the conveyor belt stops and further stage of process is halted.The corresponding information will be displayed in local webpage so that necessary actions can be taken accordingly.
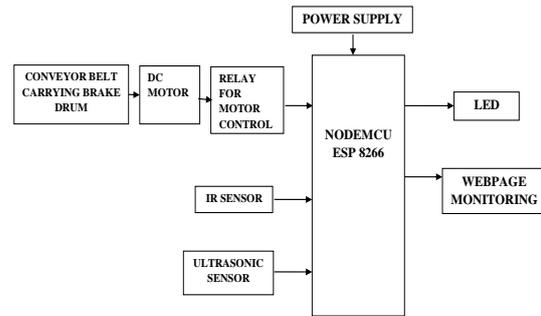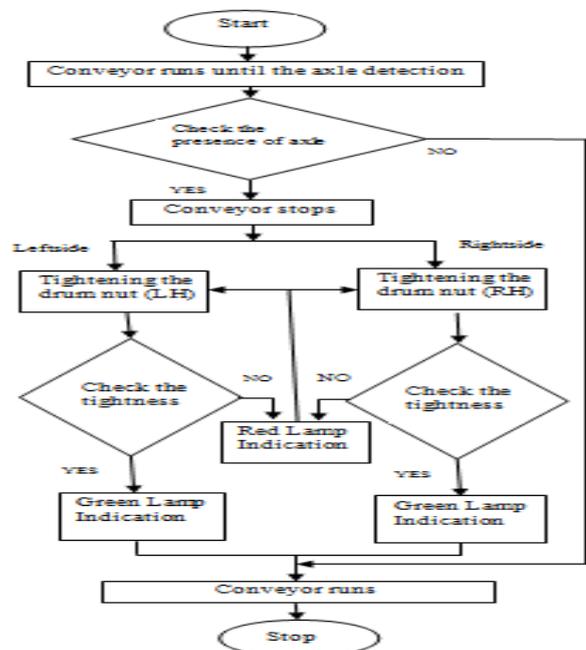


**Fig3:Block diagram representation of Proposed system**

## V. FLOWCHART REPRESENTATION FOR TIGHTNESS MONITORING

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## VI. HARDWARE& SOFTWARE IMPLEMENTATION

The ESP8266 microcontroller is a self contained Wi-Fi networking solution offering as a bridge from existing microcontroller to Wi-fi. This module comes with built-in USB connector and a rich assortment of pin-outs. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor.



**Fig4:ESP -12E based NODEMCU**

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Its boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.The Arduino board started changing to adapt to new needs and challenge to products for IoT applications. .All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The NODEMCU is programmed using Embedded C and HTML code is used to display the information ( output ) either in webpage or in mobile phones.

## VII. SIMULATION OUTPUT & RESULTS

*First stage:*



**Fig5: Output terminal indicating that axle is not detected and conveyor keeps running.**
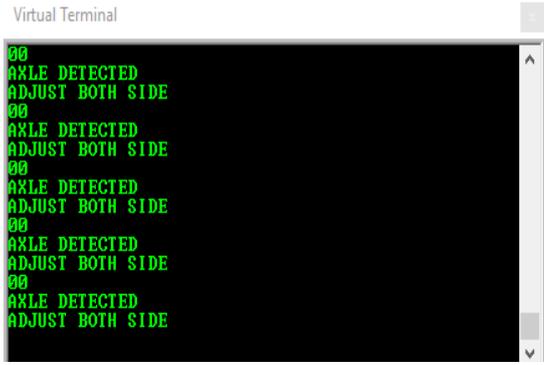
Second stage:



**Fig6: Output terminal indicating that axle is detected and displays that tightness is to be ensured on both sides of brake drum.**
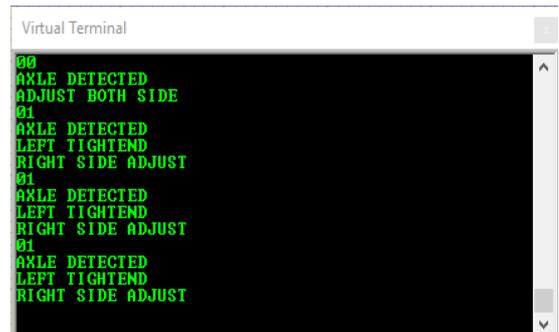
*Third stage:*



**Fig7: Output terminal showing that left side is tightened and indicates that right side nut has to be tightened.**
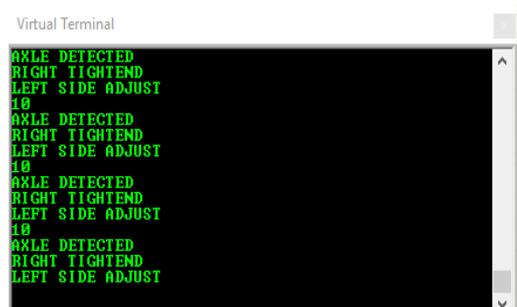
*Fourth stage:*



**Fig8: Output terminal showing that left side is tightened and indicates that right side nut has to be tightened.**
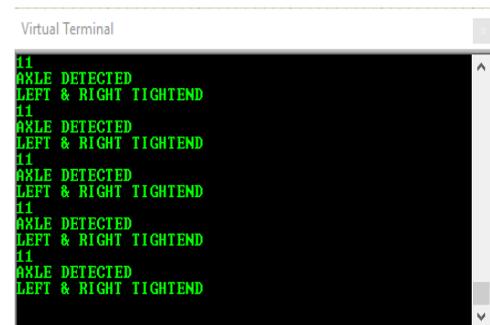
*Fifth stage:*



**Fig9: Output terminal displaying the tightness ensured in both sides of the brake drum.**

## VIII. CONCLUSION

The concept in this paper is to ensure tightness of the bolt in the brake drum of the rear axle so as to avoid the accidents that take place while manufacturing the heavy vehicle. The proposed system will be economical and simple. Nowadays, Wi-Fi connection is available in all the companies, industries, institutions etc. By implementing this concept, we can avoid accidents due to falling due to falling of brake drum while tilting the frame of the vehicle in chassis assembly. This reduces the brake drum damage thereby resulting in reliable manufacturing, increased quality in production and provide safe environment for the workers.

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