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IoT Based Hydraulic Weight Lifter

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ABSTRACT: In today's world IOT (Internet of things) is getting advanced day by day which has made automation in every industry due to which machines can work automatically with the help of internet. Hydraulic weight lifter's are widely used in industries to lift heavy loads, but until now there is no any portable or human wearable weight lifter which can work on hydraulic basis. This prototype introduces a fully IOT controlled hydraulic weight lifter using an ESP8266 Microcontroller which can offer a complete wireless control through a web based interface. This prototype utilizes 12v DC Motors connected to oil pump, BTS7960 Motor drivers to control hydraulic pump to lift and lower heavy loads.

KEYWORDS: Internet of Things (IoT), ESP8266 Microcontroller, Hydraulic Weight Lifter, Wearable Lifting System, Wireless Control, Web-Based Interface, DC Motor Control, BTS7960 Motor Driver, Hydraulic Pump System, Industrial Automation.

I. INTRODUCTION

Hydraulic system's plays a crucial role in every industry and mechanical operations. They are widely used in automobile workshops, warehouses, construction's, etc due to their ability to handle heavy loads by using minimum energy. Oil is incompressible in nature and by using this feature i have got an idea of making a portable IOT based hydraulic weight lifter, this model can be lifted by a single person on his back and can lift & lower heavy loads in industries, warehouses, etc. The main goal behind making this project is to reduce the manpower, that means to lift heavy load where 2-3 persons (depend on Kg's of weight) are required to lift or lower the load, now here only one person will required to work to lift the heavy load and to lower it.

With the evolution of IOT, automation has become simpler and more accessible. IOT enables the systems to communicate wirelessly, enabling remote operations and intelligent decision making. This project is completely based on IOT, ESP8266 nodemcu microcontroller (includes wifi) is used as a brain of the project which is controlled by web based interface, the nodemcu controls both the BTS7960 motor drivers which controls the lifting and lowering motors. Motor rotates the oil pump which circulates the oil in modifies gas springs to lift and lower the load. The main goal is to create a wireless, safe and precise weight lifter using hydraulic principles to lift and lower the heavy loads.

II. LITERATURE REVIEW

Paper presents a **creative and engaging prototype** that highlights the potential of gesture-based interfaces for remote machine control. It succeeds as a **conceptual demonstration** and offers a solid foundation for future research and development.

Gesture Controlled Robot Using Arduino" contributes meaningfully to the literature of DIY gesture-based robotics by offering a **hands-on, reproducible system** for translating human motion into robotic commands.

III. PROBLEM STATEMENT & OBJECTIVES

a. Problem Statement

In industries, warehouses, etc the heavy loads are lifted using fork lift machines or chain pulleys which are manual, but chain pulleys are fixed and not portable and fork lifts are movable but cannot work in compact areas, so it causes a bigger problem in industries, warehouses, etc to lift heavy load and to keep it in required area and also it lacks in a remote operations as it is manually operated, additionally 2 persons are required continuously for work that is 1 for



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operating machine and 2nd is for arranging loads. There is no automation, no remote operations and no way to operate the machines from the safe distance or through a modern interface.

Therefore, there is a need for Smart IOT based hydraulic weight lifter for heavy loads which can be carried at the back of a person which is portable and can be carried in the compact areas where big machines can't reach.

b. Objectives

The main objective of this project is to carry the heavy loads and put it in a required area's only by a single person and not more than that using IOT based hydraulic system which uses web based interface to operate machine. There are more objectives of this project including:

- (i) To lift loads wirelessly.
- (ii) To replace manual switches with a web-based interface.
- (iii) To enable smooth lifting and lowering of loads.
- (iv) To incorporate a "Pressure Hold" feature.
- (v) To improve user safety.
- (vi) To reduce mechanical complexity.
- (vii) To create a low cost, IOT based solution.
- (viii) To provide reliable performance and easy maintenance.

IV. SYSTEM DESIGN

For making this project various mechanical components as well as IOT modules are used.

i) Mechanical Components

Modified gas springs: Gas springs contain a rod which is connected to a piston and the piston is surrounded by the O ring to prevent the leakage of the gas, the gas springs are filled with compressed nitrogen gas which is used to lift the heavy loads, but this gas is compressible, which means if the load is heavier than its capacity the gas springs will get lower and causes problems, so I have modified this gas springs into a hydraulic cylinder by replacing the gas with VG46 hydraulic oil which is incompressible and can be used for smooth lifting of load.

Structural frame: To wear the weight lifter on the back of a person, I have created a frame to mount the gas springs and other components, the frame is made of half inch Galvanize box pipes which are not heavy and can be worn easily on back.

Oil pump: Circulating the oil in gas spring is not easier, special pumps are made to circulate the oil as per the oil's thickness or viscosity, in this project bike's oil pump is used which is a geared pump connected to a motor, that motor rotates both oil pumps for lifting and lowering heavy loads by circulating oil through gas springs.

d) Hydraulic oil: Viscosity Grade(VG) 46 oil is used in gas springs as its viscosity or thickness is minimum and can easily push the gas spring cylinder up and down.

ii) IOT Modules & Electronics

a) Nodemcu ESP8266 Microcontroller: Esp8266 is a hardware module which has integrated wifi chip and can be used for various project internet related projects, I have used ESP8266 module as the brain of the project which controls both the motors in forward and backward direction using web based buttons.

b) BTS7960 Motor Driver : 2 separate BTS7960 motor drivers are used to control both the motors, these motor drivers are connected to Esp8266(brain) which gives commands to the motor drivers to operate as per user requirements.

c) 12volt Motors: Circulating oil into gas springs through oil pump is not easier, some special motors are required to circulate the oil due to its thickness or viscosity, so I have used 2 separate 12 volt wiper motors for 2 oil pumps which are high in torque and can easily circulate oil through oil pump.



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d) *12 volt SMPS*: To provide power to the motor a 12 volt SMPS is used which provides 15 amps of current to the motor and this power is 1st provided to motor drivers and then motor drivers provide power to the motors as per user command.

V. METHODOLOGY

i) *Project's Idea*: The idea for this project was inspired by observations made in various industries and warehouses, such as Flipkart warehouses, where loading and unloading of goods are carried out regularly. I personally visited warehouses to study the existing methods used for lifting heavy loads and observed that two or more workers are often required to handle such tasks. These observations highlighted the need for a safer and more efficient lifting mechanism.

ii) *Mechanical Idea*: The mechanical concept of this project was developed with guidance from my father and additional information obtained from online resources such as YouTube. I gained knowledge about mechanical components including gas springs, bike oil pumps, hydraulic mechanisms, and hydraulic oil, along with their working principles. This understanding helped in designing the mechanical structure of the system.

iii) *IOT Idea*: The idea of making the project wireless using Internet of Things (IoT) technology was suggested by my respected guide, Dr. Prof. Surekha Kohle. This concept enabled remote operation and monitoring of the system, thereby improving ease of use and operational efficiency.

d) *Mechanical and IOT Design*: The system was designed using a structural frame on which a modified hydraulic lifting mechanism was mounted. Gas springs filled with hydraulic oil were used to generate lifting force, which is controlled by a bike oil pump driven by a 12V DC motor. The IoT module, developed using nodemcu and a motor driver, enables wireless control of the system through a Wi-Fi interface. Commands sent from the user interface control the motor operation, thereby regulating the lifting and lowering of the load.



VI. IMPLEMENTATION

a) *Hardware implementation*: The hardware implementation involves mounting the gas springs, DC motor, and oil pump on a structural frame. A galvanized structural frame is used, on which a 1 × 1 ft plywood sheet is mounted. The motor, oil pump, and oil reservoir are fixed on top of this plywood base. Two galvanized box pipes are mounted on the rear side of both lifting arms. On the front side of these box pipes, half-round PVC pipes are installed to act as hand grips. On the rear side of the box pipes, gas springs are mounted. The operator holds the PVC hand grips to lift and lower the load safely and smoothly.

b) *Hydraulic System Implementation*: The hydraulic system was implemented by connecting the bike oil pump to the gas springs using high pressure rubber plastic pipes and copper pipes at the ends of oil pump and gas springs. Hydraulic oil (VG46) was filled into the reservoir and the whole system and air bubbles were removed to ensure proper pressure



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generation. The pump delivers pressurized oil to the gas springs, which results in vertical lifting of the load, and again 2nd oil pump delivers oil to gas spring to lower the load.

c) *IOT & Electronics Implementation:* The IoT system was implemented using NodeMCU as the brain of the system. The NodeMCU is connected to both BTS7960 motor drivers to control the direction and speed of the 12 volt DC Wiper motor. Wi-Fi connectivity is enabled for wireless operations using webpage based interface.

d) *Software Implementation:* The controlling program was developed using C++ language in Arduino IDE application. The software logic controls motor operation based on user commands received through buttons on webpage using Wi-Fi. Proper delay and safety conditions were included to prevent sudden movements and overloading.

VII. TESTING

The IoT-controlled hydraulic weight lifter was tested under real operating conditions to verify its performance, reliability, and safety. Initially, the NodeMCU ESP8266 was tested for stable Wi-Fi connectivity and successful hosting of the control web interface. Button-based commands were checked to ensure correct and immediate response for lifting, lowering, and pressure-hold operations. Both 12 V DC motors driven by BTS7960 motor drivers were tested individually and also together to confirm smooth directional control and adequate torque under load.

The hydraulic system was tested for leakage, pressure stability, and smooth cylinder movement during lifting and holding stages. The pressure-hold mode was specifically tested to verify continuous pressure maintenance without load drop after lifting. Safety testing confirmed that motors stopped immediately when control buttons were released, preventing unintended movement. Overall, the system operated reliably with stable wireless control, accurate motor response, and consistent hydraulic performance and currently 50 KG weight it can handle.

VIII. CONCLUSION AND FUTURE SCOPE

a) Conclusion

The IoT-controlled hydraulic weight lifter successfully demonstrates a smart, wireless, and reliable lifting mechanism using NodeMCU ESP8266. By replacing manual control, sensors, and traditional motor drivers with Wi-Fi-based control and high-current BTS7960 drivers, the system achieves efficient and safe operation for heavy lifting applications. The use of two DC motors and two BTS7960 motor drivers ensures smooth lifting and lowering with sufficient torque handling. The web-based interface provides real-time control without the need for external applications, making the system simple and user-friendly. The additional feature of a pressure-hold mode enhances system stability by maintaining hydraulic pressure after lifting, preventing load drop. Therefore, the project proves that it is cost-effective, scalable, and can be used by single worker and it is suitable for industrial and mechanical lifting applications, meeting the objectives of safety, automation, and ease of operation.

b) Future Scope

- i) Integrating the pressure sensors can lead to monitor real-time hydraulic pressure and display it on the web interface.
- ii) Adding Flex sensors can lead to lift and lower the load using hand gestures.
- iii) Using MPU6050 sensors motor driver will receivers commands by hand gesture same like flex sensors but efficiently.
- iv) Using heavy gas springs can lead to lifting and lowering heavy loads that is more than 50 KG.

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