Semi-Automated Wheel Lift Mechanism

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Abstract—**Cars are everywhere and are the primary source of transportation for most of the population. One of the responsibilities of owning a car is having to do maintenance such as tire changes. Over half of injuries in a car shop are due to tire changes. The Wheelyft is a semi-automated lift mechanism that can aid in installing wheel and tire assemblies. With the use of ultrasonic sensors and a remote-controlled motorized lift, an Arduino is used to store the height value so that it can be recalled after the user is ready to re-install the wheel on the car. Also, with manually adjustable rollers, the lift can accommodate a wide range of wheel and tire sizes. The Wheelyft can be used by anyone in a shop or at home by DIYers that require an easy, stress-free solution to mounting wheels on their cars.**

I. Introduction

Many car repair shops, and tire change locations require technicians to remove and install wheels on cars for eight hours at a time. This device would relieve the stress of such strenuous activity. Generally, the only ways a wheel can be placed onto a hub is either lifting the wheel up above your head or shoulder height (when the vehicle is on a lift), or sitting on the ground and trying to lift the rim up with very little leverage. Instead, the user would be able to roll the wheel onto the dolly and use a mechanism to lift the wheel up or down. The inspiration for this project comes from the team's general interest in car repairs and desire to alleviate frustration with locating the stud holes on the hub. The purpose of this project is to create a functional prototype that can be tested and evaluated as a product for eventual production and sales to the public. Its value would be appreciated by all users as a means of making tire changing/transport an easier task.

II. Materials and Methods

The primary material used in this design is low carbon steel. The main lifting mechanism is welded and powder-coated to prevent corrosion. It is rated to support 180 lbs. The top support plate is 11 Gauge (0.120" thick) A36 steel. After finite element analysis was performed on this plate, it was concluded that it can support 1000 lbs easily. This value was chosen to estimate the load on the plate if a large SUV were to fall onto the roller supports. While the lift is not able to support a hydraulic jack failure, the plate itself would be able to withstand such a drastic occurrence. The rollers are galvanized steel. The roller supports are custom bent stainless steel brackets. Support blocks beneath the roller supports are constructed of Delrin plastic to save on weight and cost; they are still able to be drilled and tapped. The threaded rods and coupler are constructed of low carbon steel. The guide rods that run perpendicular to the rollers are constructed of 1566 Carbon steel. The support L brackets for the guide rods are constructed of aluminum. These brackets save weight and have great machinability, while still retaining strength to support the sliding roller mechanism. The crank handle is constructed of plastic with a pressed steel collar that can be captured with two nuts on the threaded rod. Finally all hardware is Grade 5 Steel.

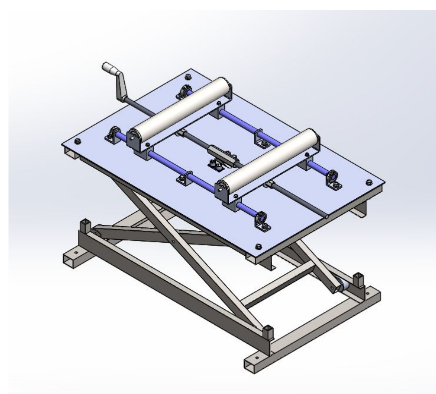

Figure 1: Final Design

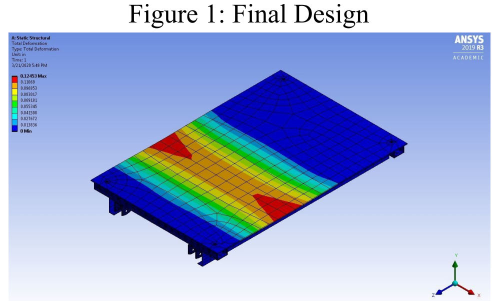

Figure 2: ANSYS Analysis

III. Results and Discussion

The final product that was designed allows for the use of a remote control to move the lift up and down and store the height at which the wheel is with the use of ultrasonic sensors. It has a height range of 19.05 cm (7.5 in) to 73.025 cm (28.75 in) and, for proof of concept, can support up to 180 lbs. The upper assembly of the device can accommodate a combined wheel and tire diameter between 55.88 cm (22 in) and 93.98 cm (37 in). The total cost to make this device was $601.15. Compared to other devices that accomplish similar tasks, this costs less, mainly because of the materials used but one of the main trade offs is that

IV. Logic

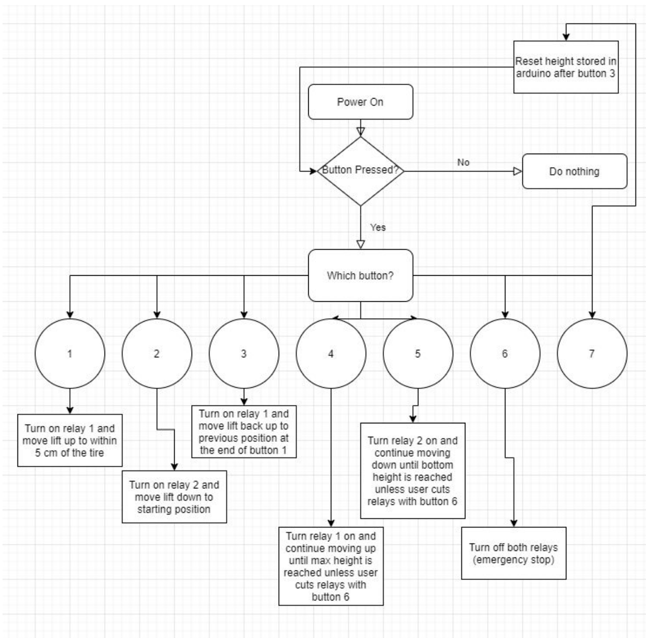

Figure 3: Logic Diagram

The control system controls the linear actuator in order to raise and lower the lift. There are a few options with this lift; raise/lower autonomously, raise/lower with no sensor input (manual), and emergency shutoff. The programming was implemented into an Arduino Mega 2560 Rev3 due to its ease of use and cost.

The relays' attached to the Arduino are also attached to the up and down buttons on the remote that came with the lift purchased instead of having to go into the actuator (essentially reprogramming the remote instead of the actuator). Also attached to the Arduino are two ultrasonic sensors which are used to measure the distance from the lift to the wheel. Once the sensors are within a certain range, in our case 5 cm, the signal to the remote is turned off which turns off the actuator until another input is received from the user. Once the signal is cut the time it took to get to the tire is stored as "elapsed time" (button 1). This time is then used to raise the wheel back to the height at which the wheel was at originally before being taken off the car (button 3). The elapsed time is also used to lower the lift back to the bottom with button 2. If working on another wheel, button 7 can be used to reset the values stored and start again. Buttons 4 and 5 are used to raise and lower the lift without any sensor input which means the lift will go up and down until the user decides to shut off the actuator with button 6.

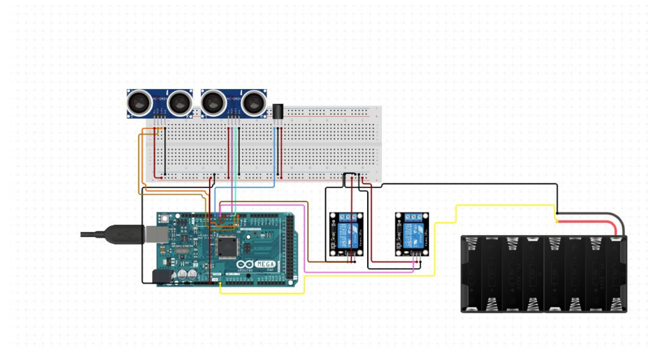

Figure 4: Circuit Layout

V. Conclusions

The wheel lift and orientation device should fulfil the needs of many do-it-yourself and professional mechanics. It will save back breaking attempts to replace a tire and wheel by allowing the user to have the device hold steady the wheel for eventual placement onto the lugs in the proper radial orientation to successfully install the lug nuts. Getting the first nut started is the most challenging task, after that, the rest of them fall into place more easily. This phase is usually what frustrates many mechanics if they don't have the luxury of a hydraulic car lift. With a well-planned approach to durability and economics, this device should make it affordable for most people

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References