Magnetized Ratchet

Ethan Diaz, Mokaddes Wahab, Javier Munoz, Dustin Rodriguez, Anthony Cuzo, Karen Ordonez,

Munjer Masrur

The City College of New York

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Professor Crystal Rodwell

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Ratchets are always a hassle. Every time there is a different automotive fastener found, a different socket size is needed to remove the fastener. However, with the innovation of the magnetized ratchet, it adjusts to the fastener that is being added or removed from the vehicle without having to ever change the socket. This tool comes in handy when the right socket isn't available and when the user is in a time crunch to get the task done. With a press of a button, magnets are charged, creating an electromagnetic magnet, and the ratchet is ready to use. Comfortability and effectiveness is the priority for our customers, so higher-quality materials is what the company strives for. With an initial funding of $10,000 that was gathered from friends and family, research and possible solution ideas to create this product were achieved, and potential prototypes can be developed. The electromagnetic magnets, the on and off buttons, and the rechargeable battery work together for the ratchet to function the way it was designed. A plan was developed to figure out how this innovation could possibly be manufactured and how it can be tested to make sure it works properly. The magnetized ratchet will make a difference in the mechanical world.

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Introduction

In 1835, the first patented wrench was created and credited to Solymon Merrick, who is believed to get the design from early coach wrenches. The wrench was created to tighten and loosen nuts and bolts. The ratchet was soon introduced in 1863, with the use of sockets, created by J.J Richardson. The ratchet is mainly used in the automotive industry but automotive companies require different socket sizes to accomplish various tasks in the field ("Haus of Tools," 2021). The changing of the tire, the fixing of the engine, and the construction of the interior require the removal and application of various fasteners that come in all shapes and sizes. The problem with various fastener sizes is that the socket for the ratchet needs to be changed every time the fastener is a different size.

With different-sized fasteners, it requires various sockets to remove and attach to the vehicle, and most of the time mechanics waste valuable time searching for the right sized socket. Instead of having to change the socket, there is a solution that will use an electromagnetic magnet to attach to the bolt and have a strong attraction that the bolt will be able to tighten and loosen easily. Any size up to ½ inch which is the usual highest size used on automobiles. This will help tighten and loosen different size bolts without constantly changing the socket size. A ratchet and a set of sockets are expensive and mechanics have to spend more money to get the right size socket to get the job done if they don't have it in their inventory. Instead of having a large set of ratchets and sockets that takes up space and costs a lot, there is one ratchet that works for various sockets at a better price.

Technical Description

Automotive fasteners are materials that mechanics use on a daily basis to fix and improve vehicles. Automotive fasteners consist of nuts, bolts, and washers, but the most common

fasteners used are bolts. The bolts are mainly made from stainless steel with a magnetic backing and are mainly located in the transmission, the chassis, the engine, the interior trim, the front and rear axle, and the steering (“Rapid Direct,” 2023). With the different sizes, styles, and shapes, the right tool to complete the job is likely lost or needs to be ordered, making the job a lengthy process for both the mechanic and the consumer. The development of the magnetized ratchet will help mechanics get the job done faster and provide mechanics more versatility in which jobs are done, as specialized ratchets and wrenches wouldn't be needed. The magnetized wrench adapts to the different automotive fasteners, reducing cost and the need for other wrenches and ratchets for jobs that require multiple and different ratchets to complete.

List of Parts

The magnetized wrench consists of 6 parts. The parts include an electromagnetic magnet, battery compartment,lithium-ion batteries, a rubber button, a rubber hand grip, and an aluminum copper shell. When the battery is activated with the press of a button, the magnets will activate from the current the battery is producing. Once activated, the ratchet will be placed on the automotive fastener and the magnets will attach itself to the intended fastener. The user will then use the magnetized ratchet as any other ratchet, by turning the ratchet to unscrew the fastener. After the user removes the fastener from the vehicle, the button has to be pressed to deactivate the magnets. Once the magnets are deactivated, the fastener will detach from the magnets and the ratchet is ready to use for the next fastener. This same process applies to screwing in fasteners back into the vehicle. To place the fastener back in the vehicle, the fastener is placed in the location it needs to be. The ratchet is then placed on top of the fastener and the button is pressed to activate the magnets. Once the fastener is attached to the magnets, the user screws the fastener

back into its place. After completion, the button is pressed, which deactivates the magnets and leaves the fastener tightened in its original location.

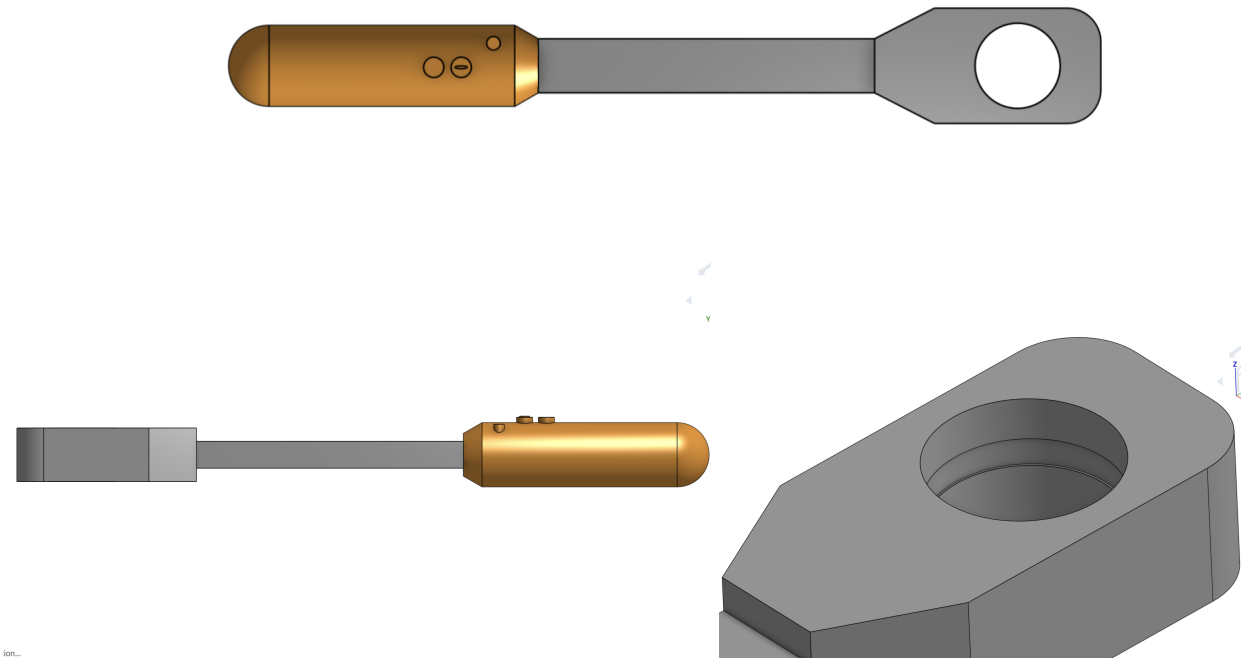

Figure 1: 3D Model View of Magnetized Ratchet

Aluminum Copper Shell

The shell of the magnetized ratchet consists of an aluminum copper casing that has a length of 110 mm and a diameter of 12 mm. It is silver in color and is very lightweight. Also, aluminum copper metal has a density of 0.276 pounds per cubic inch and it has a low oxidation rate when in contact with high levels of heat which is important when working in cars. When cars are being worked on in mechanic shops, the car is still hot as it is being worked on. This low oxidation rate allows for the longevity and durability of the ratchet to last. The purpose of the shell is to cover and organize the wires that are connecting the electromagnetic magnets and the batteries.

Battery Compartment

The battery compartment is white in color, made with hard plastic and is 40 mm in length, and has a diameter of 12 mm. The purpose of the battery compartment is to hold the 5 lithium-ion batteries in place and send current through the shell, into the magnet. There are also 5, 4.2 volt lithium ion batteries that are connected to each other through wires in a + − + − + − series, referenced in figure 2, which will give the magnets a higher strength when 20v are sent to the magnets.

Figure 2: Battery Format Connecting Together

Electromagnetic Magnet

The electromagnetic magnet will be made from a circular-shaped iron and a copper wire will wrap 25 times around the iron to create the magnet. The copper wire will wrap around the iron and will connect to the batteries. Once the batteries are activated, the copper will be charged and create the magnet. The electromagnet would be 0.55 inches in diameter and height.

Rubber Covering and Button

There are two rubber casings that are used in the magnetized ratchet. The first rubber casing is used to provide grip and comfort for the user. The rubber casing is also used to hold the battery compartment and body together. This rubber casing is a red-orange color that is 100 mm with a 12 mm diameter. The second rubber casing is a black rubber used for the on and off buttons. The rubber buttons have a diameter of 3 mm and are used to provide comfort for the user and protect the user from any harm that can be caused by contact with the batteries and the

magnet wires. The third button has a diameter 2 mm to demagnetize the magnet momentarily to freely move the magnet while tightening or loosing the bolt.

Innovation Process

Materials

The magnetized ratchet will require help from several manufacturers and factories to be able to construct the product. The ability to construct the product requires a silver cylinder 110 mm by 110 mm aluminum bronze shell with an 12 mm diameter, a 100 mm by 100 mm orange rubber grip, with a 12 mm diameter, a 100 mm long white plastic battery compartment with 12 mm diameter, 4mm by 4mm round black rubber, on/off button, 5 4.2Volts lithium batteries, and a circular electromagnet that has a copper wire wrapped around 25 times.

To be able to source the right materials with the best quality, the need to go from manufacturer to manufacturer to determine what fits our needs is needed.. Also, after all the right materials are sourced, the search for the right factory that specializes in tools or the creation of automotive parts and vehicles is needed to be able to construct the product with the highest quality. To be able to find the best manufacturer and factory that is willing to produce our product with quality, it will take about 6 months to test and satisfy with the right factory.

Before the phase of finding and sourcing materials to manufacture the magnetized ratchet for consumer sale, various prototypes needed to be made to determine the right sizing, comfortability, effectiveness, and if the invention can actually work in the field of mechanics. The purchase of materials for prototypes would have to be purchased retail and out of pocket, to be able to construct and develop the prototypes.

Cost

	Materials	Price of Development
1.	Aluminum Bronze Scraps	$10.00
2.	4.2 Lithium Ion batteries x5	$6.40
3.	Copper Wire	$1.88
4.	Iron Scrap	$1.00
5.	Rubber	$10.00
6.	On/Off Slide Switch	$0.76
Total		$30.04

Figure 3: Price of One Unit

	Expenses	Price per Month
1.	Place to Rent	$5,000
2.	Labor Costs	$20,000
3.	5,000 Ratchets	$150,200
Total		$175,200

Figure 4: Expenses Per Month

The creation of the first prototype will cost around $30 for materials and will cost $5,000 for a studio to develop the prototypes and $20,000 for labor costs. Initial funding of $10,000 was gathered from friends and family, which is being used to create the first prototypes. During the process of trial and error with prototypes, the company will work alongside family-owned mechanic shops in the Bronx and Queens to test the functionality and effectiveness of our magnetized ratchet. Based on the feedback that is received from the mechanics, the feedback will be used and interpreted to adapt and make changes to the product, to allow for the innovation to work as intended. We seek to sell the magnetized ratchet at $100 per unit. A month of selling the

product will create a profit of $169,800 a month at the start of the company. There will be an increase of productivity from 5,000 units per month to 10,000 units per month within the first two years.

Brand	Item Name	Cost
Pittsburgh	225 Piece Mechanics Set	$149.99
Milwaukee	50 Piece Socket Wrench Set	$125.00
Magnetized Ratchet	1 Piece Ratchet	$100.00

Figure 5: Comparison of Mechanic Ratchet Sets

Mechanics ratchet sets contain most socket sizes that are found in cars. Looking at Figure 4, top trusted brands will cost you up to $150 for a set of ratchets and sockets. While there are a lot of pieces that come with the sets, that is not always a good thing. It takes time to switch out the sockets and find the right socket sizes. With the magnetized ratchet, there is no need to switch out the sockets, as the magnets adapt to the automotive fastener size. This allows for the job to get done quicker, while also saving mechanics money on tools. The magnetized ratchet also saves time and money for people who want to do hands-on work with the magnetized ratchet themselves. They do not have to buy a different socket size every time the bolt size is different, and it saves them money from having to buy large sets, with socket sizes they will never use.

Labor Power

The development of the prototype will take about 1-2 months and each mechanic shop will have a 2-week trial of testing the product. This process of development and receiving feedback will continue for how long it takes to develop a magnetized ratchet that achieves the goal of making a tool that can work for all fasteners found in vehicles.. There is no timeline for the completion phase of the final prototype. After developing the working prototypes, filing for a

patent is needed, to protect the idea and innovations from being stolen from other corporations. The filing will cost upwards of $20,000 and will take 22 months to get approved. After getting the patent filed, there is no other labor power required to bring this product to shelves and mechanic shops across the world. All the labor power will be sent to the factories that are working on the development and distribution of the product. Once the final prototype has been developed, each unit will sell for $70.

Appendices

Figure 6: Production Timeline

Before assessing the final product, its functionality must be tested. In order to test this, the manufacturer would complete the tasks designed for the ratchet in several conditions such as the handle being covered in some grease. If the user is still able to have a decent grip on the ratchet after it is coated lightly with grease then it passes the test. A test would be run to test the main feature where the ratchet would be used normally and if it is able to hold in and screw bolts that are three different sizes then it will pass the test.

Test for Durability

In order to assess how successful the product is it will be evaluated through its durability, reliability, and cost. When it comes to durability the wrench will be assessed in terms of how

long the end user uses the product before a part needs to be replaced or it breaks. For this, the body of the wrench, which is made of aluminum, will be evaluated through tension tests to see what it would take for the ratchet to break. From this test, the material and the shape of the ratchet is being evaluated. The second major component that will be tested is the electromagnet. Experiments will include putting the ratchet under extreme heat and doing drop tests to assess what it would take for the electromagnet to stop working. Repair trials would be a pivotal part of the durability test as designing it to be easy to repair can increase its overall lifespan. For this purpose, after the ratchet is broken, methods of repair will be explored utilizing the tools that would be available to the end user.

Survey for Reliability

To test reliability, sample tests would have to be done where the ratchet would be given out to different groups, such as mechanic shops and also individual users in order to evaluate how often the product is used and any defects or issues with the ratchet such as a handle that is hard to hold. The most important question asked when evaluating the ratchet, however, will be the effectiveness of the magnet as that is the core feature the wrench is built around. Other questions such as how often it's used, what they had issues with while using it, and how they repaired it, if they did, would be asked. From the feedback provided an improved second version of the ratchet can be developed.

Evaluation of Cost

Finally, in order to assess cost, the reliability data from the previous study would be used to assess who the ratchet is most useful for, in regards to cost. A second study will be run, after the first 6-12 months of sales, asking users what they think of the price in regards to how often they used it and would they recommend this ratchet to others, with the price tag of $70. These

questions have a different aim than the first which seeks to address the ratchet itself ignoring cost as a factor. This will help in determining what needs to be fixed for the ratchet.

The magnetized ratchet is a game changer for the mechanic world. With the reduction of tools needed, the less mechanics have to spend on tools to complete their job. It will also reduce the amount of money mechanics spend, and help speed up the repair process for the customers.

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