A Review on Design and Fabrication of Mechanically Operated Gate System

[1]Disha, [1]Jenish Mohan B C, [1]Karthik R, [1]Ningaraju R, [2]Dr Khalid Imran
[1]Students of Mechanical Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India
[2]Associate Professor, Department of Mechanical Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India

***Abstract*:** Entryways have become increasingly common in private settings, serving as entrances to enclosed spaces or gaps in fences to regulate passage. Nowadays, many entry gates are operated by automated systems, boasting various advanced features. The demand for automated or mechanically operated doors has been steadily rising. The described automatic gate system is designed to automate entrances to parking lots of residential properties, businesses, and public car parks. It utilizes a mechanically controlled mechanism comprising a base plate connected to an L-shaped rod, which is in turn attached to a pulley fixed on the gate's main body. This setup enables the gate to be raised by spinning the pulley, and it gradually descends with the assistance of a car boot shock absorber when the vehicle's load is removed. This system ensures continuous gate opening and closing without the need for an external power source. While operating the gate manually reduces the burden on individuals, it is designed to function automatically through mechanical movements without requiring external control.

Keywords: Mechanical Operated Gate, Pulley, Base plate, Boot shock

1 INTRODUCTION

These days, residential areas frequently employ gates. A gate is an entrance in a fence or a point of entry to an area surrounded by walls. Gates can regulate or prohibit access or departure. An automated gate operator opens a lot of gate doors these days. Those gates have a lot of unique features. Recently, there has been a rise in demand for mechanically driven or automatic gates. The automated gate outlined here is designed to operate at the entrances of public parking lots, businesses, and residential parking lots. One of the best tools for use in businesses, industries, universities, and educational institutions is the automatic gate. Because they save time, energy, and human strain when opening and closing manual gates, automatic gates are valuable and beneficial. They also protect gate operators from potential health risks associated with opening and closing manual gates in inclement weather. Gates used to be opened by humans applying force in the past. Manually controlled gates are the name given to these kinds of gates. A gate is an entrance in a fence or a point of entry to an area surrounded by walls. Gates can be strictly decorative or they can be used to restrict or prevent entry or leave. Although there are still many difficulties associated with manually sliding gates, these gates are still valued. A manually operated sliding gate necessitates the use of significant human effort to open the gate and creates significant friction between the rollers and the metal surface they move over. it also brings about unwanted noise which is as a result of the rollers which is made of metal and the metal path which it rolls on. Due to this factor, these days there has been advancement in gate creation which is known as an automatic gate.

1 MATERIALS AND METHODS

This study presents a low-cost, mechanically operated gate system for a best experience. This system prioritizes only the use of mechanical components without use of any external sources like sensors and motors.it is engineered to overcome the working as automatic gate but using only the hardware module. The following sections offers an in depth analysis of mechanical components detailing its design and functionality.

2 HARDWARE MODULE

The hardware module includes only mechanical components, which have been carefully selected based on the design requirements. The mechanical design encompasses the rolling methods and lifting systems using boot shock absorber, providing explanations for each choice and how they contribute to the overall functionality.

Which in turn both plays an important role in lifting and closing the gate automatically which uses only mechanical systems throughout the hole process in the design.

3 MECHANICAL MODULE

The mechanical design of the platform encompasses several key considerations that must be addressed during the design process. These include selecting an appropriate pulley diameter, selecting te required length of boot shock absorber, and conducting precise mechanical and stress calculations for the body. Additionally, other mechanical components must be carefully integrated to ensure smooth and reliable operation.

Further, attention must be paid to factors such as weight distribution, load-bearing capacity, and the durability of materials. Proper alignment and fit of the various mechanical parts are crucial to guarantee seamless functionality. Each aspect of the design plays a vital role in achieving a safe, stable, and efficient platform for the user.

4 NORMAL GATE OPENING METHOD

Many mechanisms are used in other conventional gate for opening and closing the gate in residential, parking and in house.

Figure 1: Normal gate

5 GATE DESIGN

The gate's body is utilized to restrict access and departure. Location of the vehicle The gate body design for our project is made of mild steel. The gate body measures 84 inches, the entire length measures 130 inches, and the height measures 36 inches. These measurements are all based on a standard automobile. This design also aims to increase its portability and lightness. We also designed this variant to allow for smooth pulley movement over the gate. Frame parts are essential to manufacturing and construction because they shape different structures and offer structural support. These sections, which are often composed of steel or aluminum, are available in a variety of sizes

and forms to satisfy particular load-bearing and design specifications. Typical examples of frame sections in building are I- beams and C- channels, each of which has special structural advantages. The intended use, load distribution, and structural stability are some of the considerations that go into selecting a frame section. To guarantee the overall strength and integrity of buildings, bridges, and other structures, engineers carefully choose and design the frame parts. Furthermore, developments in materials science lead to the creation of stronger but lighter frame sections, improving construction projects' sustainability and efficiency.

The calculations of the same is formulated below:

6.1 Stress for Gate's body:

M= Bending moment. $\frac{M}{I} = \frac{\sigma}{Y}$

I= moment of inertia.

σ= Stress.

y= Distance of points from neutral axis. M=P x L

M=20x914.4 M=1828 N.mm

I=Moment of Inertia $I = \frac{BH^3}{12}$

$I = \frac{20X20^3}{12}$

I=13333.33 $kg\ mm^2$

Y=Distance of points from neutral axis $Y = \frac{L}{2}$

$Y = \frac{20}{2}$

Y= 10 mm

Substituting all in the equation

$\frac{M}{I} = \frac{\sigma}{Y}$

$\frac{18288}{13333.33} = \frac{\sigma}{10}$

σ = 23.28 N/mm^2

Figure 2: Gate body

6.2 Parameters need to be considered while fabricating the automatic gate:

- Weight of the platform
- Diameter of the pulley
- Platform dimensions
- Boot shock absorber length.

6.3 The main components involved in our project:

- Pulley or roller
- Boot shock absorber
- Frame of the gate
- Base plate

Stress factor to be considered was calculated through the following:

6.4 Bending stress on base plate

M= Bending moment. $\frac{M}{I}=\frac{\sigma}{Y}$

I= moment of inertia.

σ= Stress.

y= Distance of points from neutral axis. M=P x L

M=325x550 M=178750 N.mm

I=Moment of Inertia $I=\frac{BH^3}{12}$

$I=\frac{20X20^3}{12}$

I=13333.33 $kg\,mm^2$

Y=Distance of points from neutral axis $Y=\frac{L}{2}$

$Y=\frac{20}{2}$

Y= 10 mm

Substituting all in the equation

$\frac{M}{I}=\frac{\sigma}{Y}$

$\frac{178750}{13333.33}=\frac{\sigma}{10}$

σ = 134.62 N/mm^2

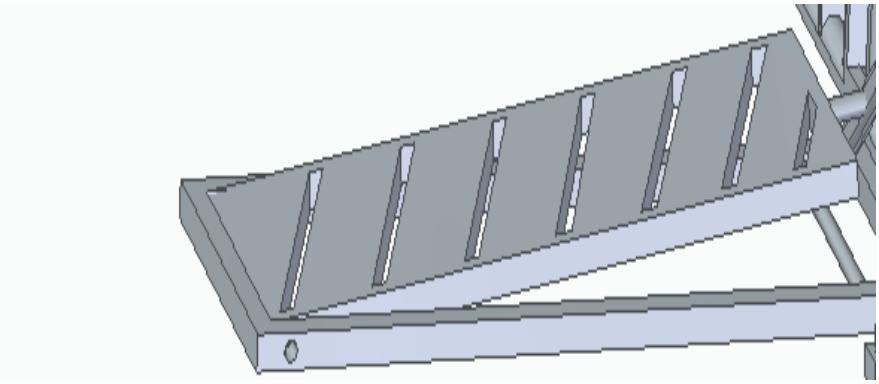

Figure 3: Base plate

The required load calculation of Pulley $T=\frac{(E+Z)}{n} \times S$

T=load carrying capacity.

E=dead weight of transport unit. Z=maximum addition load. n=number of castor wheel S=factor of safety 1.5

$T=\frac{(110+325)}{1} \times 1.5$

T=652.5 Kg.

which is the load carrying capacity for single Pully

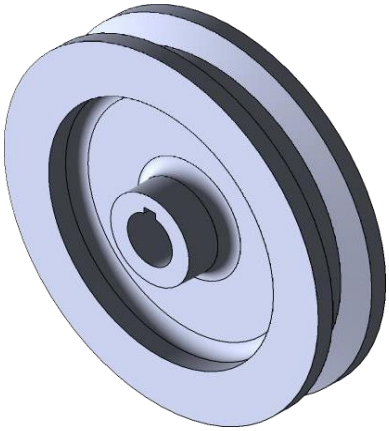

Figure 4: Pulley

6 2D MODEL

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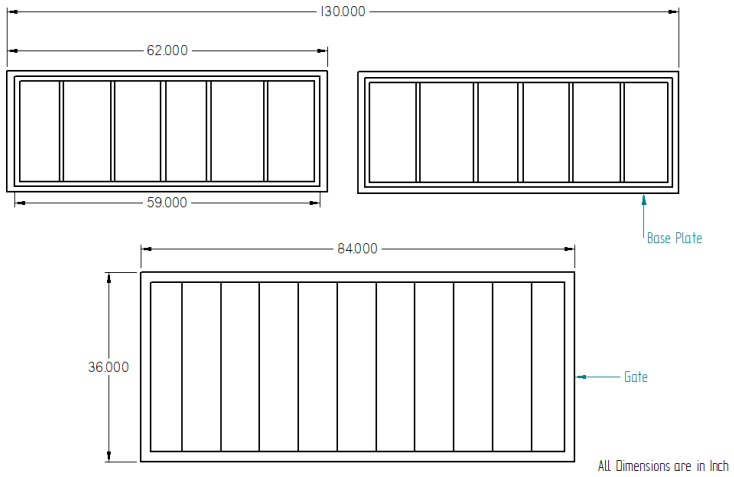

Figure 5: 2D Views

7 3D MODEL

The 3D view of the mechanically operated gate system, created using SolidEdge software, showcases a detailed representation of the gate mechanism. This digital model provides a comprehensive visualization of the gate structure, including its components and how they interact.

Figure 6: 3D View

8 FABRICATED MODEL

The fabricated model of the mechanically operated gate system is a physical representation of the design created using SolidEdge software. It provides a tangible demonstration of the gate's structure, components, and functionality, allowing for hands-on examination and evaluation before implementation in real-world settings.

Figure 7: Fabricated model

Figure 8: Testing

9 Literature Review:

[1]. Design and Construction of an Automatic Gate [1] taken from the journal ABUAD journal of Engineering Research and Development (AJERD), volume 2, Issue 2, 123131 by Onyinye Florence IKPEZE, Emmanuel Chidiebere, Kola Michael Kareem published on 31/12/2019. The automatic gate is one of the best instruments for usage in companies, industries, academic institutions, and universities. Because they save time, reduce the energy required of humans to open and close manual gates, and shield gate operators from the health risks associated with opening and closing manual gates in bad weather, automatic gates are essential and very helpful. The construction and design of the automatic gate at the main entrance of Afe Babalola University Ado- Ekiti, Ekiti State, Nigeria, was made possible by the control unit, power supply unit, and gate. Other responsibilities included developing and implementing the control and power supply units in addition to designing, manufacturing, and mounting the gate.
A long time ago, gates were Human force was being used to unlock gates

[2]. Automatic gate control using IOT taken from journal International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), Volume 5, Issue 1 by Nitin patil , Mr. Shubham Shirude and Mr. Pradip Gavali published on 1/05/2021. The project's objective is to offer an inexpensive automatic gate system for residences, structures, collages, etc. An automated gate that opens to the house with ease is one of the nicest characteristics of the house. There are three types of automatic gate mechanisms: sliding below ground, screw drive piston, and swing cubic. There are just three types of designs that are currently available. The items available on the market are very costly, even before installation and maintenance expenses are taken into consideration. Imported items make up the bulk of the merchandise sold in our country.

[3]. Automatic Sliding Gate taken from journal International Research and closing of Institute Main Gate, Volume 7, Issue 06 by Dhiraj R. Ahire, Aavesh R. Attar, Kunal P. Katare, Chaitanya N.Hake published on June 2020.. An automatic gate is among the most useful tools for use in companies, enterprises, colonies, colleges, and educational settings. Among other mechanisms, a sliding screw, rack and pinion, rotary, piston, or chain sprocket can be used to operate a gate. While there are designs for a wide range of tasks, these designs also come at the highest cost. Costs associated with setup and maintenance have not yet been considered. Most of the products we use in our country are imported from abroad. This work aims to investigate, assess, and develop a novel mechanism that is inexpensive, secure, easily accessible, and simple to install. Several mechanisms are used to operate the gate in this instance.

[4] Automatic Gate opening and closing using IR sensor June 2022 authors: ALIMUL RAHEE We have planned this venture entitled "Programmed entryway opening and closing framework utilizing IR Sensor with a basic plan. The most proverb of this extend is to utilization of sensor with of inserted hardware for the entryway opening systems' we portray the plan and usage of programmed controller for the door' The entryway opens when any human development is identified close the entryway it recognizes the development and sends a flag to the transistor, in turns gives hinder flag and the entryway and near the door' which is driven by a engine IC, The hinder signals can be utilized to halt power to the engine within the occasion of bolted condition A chip controlled programmed entryway opener counting implies for recognizing the speed and heading of travel of the entryway. The micro-controller assesses recognized changes in either the speed or course of travel to decide the cause, and either inverts entryway travel course or disregard the location. The settings of the entryway are put away within the memory of the chip. The microcontroller will direct the opening and closing speed and the heading of entryway travel depending upon a modified grouping. The entryway control mechanism is able to distinguish these between these inside variables and outside obstacles.

[5]. Automatic gate opening system for vehicle with password Prajapati Dipali K, Raj Roshani D, Patel Komal C., Hilali Marhaba [5] A. The principal aim of this project is to enhance security within a company by restricting access to the secure area to only authorized individuals. The authorities prioritize the security of any company. Both intellectual property and tangible property are under risk. Because of this, access to the secured areas is restricted to authorized individuals in possession of valid RFID tags. An integrated circuit in this tag is used to process and store data as well as modulate and demodulate the radio frequency signal that is being broadcast. As a result, the

moment the user presents the RFID tag to the card reader, the data on the tag is scanned and compared to the data on the microcontroller. A relay that is driven by the microcontroller's output will turn on the load when the data it contains matches that in the microcontroller. The system indicates "AUTHORIZED" if a valid tag is swiped; otherwise, it displays "UNAUTHORIZED" and prevents access. In addition to the LCD screen, an indicator lamp is employed. An additional way to improve this project is to interface it using GSM technology. An SMS can be used to alert security staff to any attempt at unauthorized access.

[6]. Design and development of low-cost auto gate system for house January 2016 Authors: Muhammad Ikhwan Razak University Malaysia Pahang This Project is to design and develop the low-cost auto gate system for house. The current auto gate is costly; this project will build an auto gate that is less expensive than the current auto gate on the market while maintaining the same level of safety. An automated door is a moveable, automatic barrier that is placed at the entrance of a room or building with the purpose of limiting access, making doors easier to open, or offering visual seclusion. A low-cost auto gate will be constructed during the project to be used as the house's backyard rear gate. This justifies the choice to use an intelligent gate controller system to protect sensitive areas from trespassers or groups of people who typically exploit lax security measures at the point of access. A smartphone with an Android app integrated is the controller that is being utilized. The Arduino program was the software utilized for this project. The hardware and software components are linked to the controller. Although the concept of Auto Gate is not new, the system's installation is pricey.

[7]. Design and Fabrication of an Intelligent Gate System ALBAGUL, A. TWAIERa, S. SALHEENa, O. KHALIFAb, Omer. SM Jomahc a Control Engineering, The Higher Institute of Electronics, Baniwalid, Libya, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia c Faculty of Electrical Engineering, Automatics, Computer Science and Electronics, AGH University of Science and Technology, Poland. The design and construction of an intelligent gate system that permits only specific vehicles or cars to pass through the gate are described in this paper. Creating an intelligent gate that regulates the flow of people and vehicles into the property is crucial. Only designated cars or vehicles should be able to pass through the gate, which should be controlled by the gate system. When the recognized vehicles are located, the gate will open. Should an unlawful vehicle attempt to pass, the gate will not open. The system is made up of electronic, mechanical, and electrical parts. It is a product of mechatronic engineering. Installing this intelligent gate system is appropriate for businesses and universities where only specific types of cars are permitted entry.

[8]. Automatic toll gate system SANGIVALASA, MANDAL, VISAKHAPATNAM DIST. (A.P) [10] This article will address automated toll gates that use image processing as a means of resolving traffic issues and preserving the toll collection system's transparency. Our goal is to use a Raspberry Pi system to create an automated, time-saving digital toll collection system that will also monitor and control vehicle entry and exit on highways. The vehicle's license plate is taken from the image captured by the toll gate camera at the entrance, and it is then cross-checked with the authorized registered plate number. The Raspberry Pi is linked to a database so that the image processing program OCR can verify registered data. The Raspberry Pi processes the authorization to allow entry-existing of the car if the verification process involving the comparison of the retrieved plate number and the registered data base is successful. The gate is operated by a DC motor that the system detects when an authorized vehicle passes through. In the event that the car is not authorized, a notification requesting manual payment will be sent.

10 CONCLUSION

With the successful design and construction of the mechanically driven gate system, a dependable and practical access control solution for residential driveways has been achieved. The materials, construction technique, and design criteria of the gate system were meticulously selected to guarantee robustness, effectiveness, and visual appeal.

The gate system provides a sturdy and long-lasting means of managing access to the property with the use of a pressure-treated timber panel, a heavy-duty sliding mechanism, and a steel frame. The gate runs well, giving inhabitants privacy and protection while facilitating easy access and departure. The research has shown that developing and building a mechanically driven gate system for home use is both feasible and practical. Moreover, the possible uses of the gate system go beyond driveways to a range of business, industrial, and residential environments, demonstrating its adaptability and versatility. Subsequent advancements may delve into automation functionalities to augment ease of use and accessibility, in addition to investigating substitute materials and building techniques to maximize economy and ecological soundness.

All things considered, the project successfully combines the concepts of mechanical engineering with manufacturing techniques to produce a workable solution for access control, with potential applications that could improve functionality and security in a range of settings.

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[3] Prajakta et al. "**Automatic Sliding Gate**" International Journal of Advanced Research in Science and Engineering,Construction of an Automatic Gate

[4] http:// hyclassproject.com//design-and-constriction-of-an-automatic gate opening- and closing-system-using-infrared." [Online].

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[7] ABAGULa et al. SMJ Control Engineering, The Higher Institute of Electronics, Baniwalid, Libya, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia c Faculty of Electrical Engineering, Automatics, Computer Science and Electronics, AGH University of Science and Technology, Poland. **Design and fabrication of intelligent gate system.**

[8] **Motor drop catch mechanism for vertical gate** JOHN R. HORN WIPO- Search international and national patent

[9] Swing type gate operator ACADEMIA**.** E D U

[10] Yawen Du et al. **Design and Fabrication of Smart Home with Internet of Things Enabled Automation System**

[11] **Design and Fabrication of Smart Home with Internet of Things Enabled Automation System**

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