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Optimizing Traffic Flow with Hydraulic Engineering Innovations

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ABSTRACT: This study introduces a hydraulic footpath traffic reduction system utilizing hydraulic jack mechanisms to alleviate traffic congestion. Currently, footpaths along roadsides serve a mono-functional purpose, reserved exclusively for pedestrians. We propose a design modification for these footpaths, enabling dual functionality for both pedestrians and vehicles. The system employs hydraulic jacks and pre-stressed concrete slabs to facilitate vertical movement, allowing the footpath to be raised for pedestrian use and lowered to serve as an additional traffic lane. This approach aims to significantly reduce traffic congestion by effectively providing an extra lane. The paper focuses on mitigating severe traffic congestion by employing this innovative footpath system. Data was collected during peak hours on a working day using a videography survey method. Traffic volumes were analysed in the morning and afternoon, categorizing vehicles and calculating queue lengths at congested intersections.

Our findings indicate that the hydraulic footpath system can reduce queue lengths by approximately 60% compared to traditional footpaths. This reduction is achieved by providing additional space at signalized intersections, thereby increasing service volume and enhancing overall traffic flow. The study concludes that hydraulic footpaths are a viable solution for improving traffic conditions in metropolitan areas, especially at signalized intersections where congestion is most acute. The Hydraulic Footpath Traffic Reducing System employs a hydraulic jack mechanism to alleviate traffic congestion. Presently, footpaths on the road edges are mono-functional, designated solely for pedestrians. To mitigate traffic congestion, we propose a modified footpath platform designed for dual use by both vehicles and pedestrians. This system utilizes hydraulic jacks and pre-stressed concrete slabs to facilitate the upward and downward motion of the footpath. By raising the footpath, it serves pedestrians, and by lowering it, it functions as an additional lane for vehicles, thereby significantly reducing traffic by creating extra road space.

This paper focuses on addressing severe traffic congestion by analyzing traffic volume and patterns. The survey was conducted on a working day, during peak hours. Additional data were collected and analyzed during morning and afternoon periods. The study aims to introduce the modified footpath traffic reducing system in the study area to ensure smooth traffic flow. Vehicular traffic is a major issue in metropolitan cities, where congestion at signalized intersections leads to chronic conditions, especially in dense downtown areas. We adopted a hydraulic mechanism to minimize traffic problems. Hydraulic machines lift objects vertically to a specific height. Our objective is to develop a mechanism that lifts the footpath at signalized intersections up and down, particularly during high traffic periods. This study demonstrates the efficacy of the hydraulic footpath traffic reducing system in mitigating traffic congestion and improving traffic flow, particularly at critical intersections.

KEYWORDS: Traffic congestion, Footpath, Emergency Vehicle, Hydraulic system etc.

I. INTRODUCTION

The population on Earth is expanding at a very rapid pace. As every individual opts to travel by their own vehicles instead of public transportation due to greater comfort and time efficiency, the number of vehicles is increasing, leading to traffic congestion. This congestion occurs because the number of vehicles on the road exceeds the road's capacity. If traffic is not properly managed, it will lead to conflicts, particularly for emergency vehicles such as ambulances and fire trucks, which will be unable to reach their destinations on time. The primary problem is that emergency vehicles cannot travel as quickly as necessary due to the presence of other vehicles on the road.

Nowadays, a significant number of deaths are attributed to traffic congestion, and emergency vehicles are ineffective because they cannot move fast enough through traffic jams. Even in the absence of congestion, emergency vehicles are often delayed by traffic lights, resulting in loss of life. Additionally, many people do not make an effort to give way to these vehicles. The lack of footpaths in many areas forces pedestrians to walk on the edges of the road, causing further traffic issues. Our proposed solution aims to regulate traffic flow by creating an extra lane through the use of modified footpaths, which will expedite the flow of traffic and reduce the latency of emergency vehicles. Generally, traffic is defined as the movement of persons or goods between locations, including pedestrians, herded animals, and other conveyances. There is no universally accepted definition of traffic congestion. This is primarily due to two perspectives on congestion: a physical phenomenon, which describes how vehicles hinder each other's progression as the demand for limited road space approaches full capacity, and a relative phenomenon, which relates to user expectations regarding road system performance. Both operational and personal perspectives are crucial in understanding congestion and its impact. The goal of this study is to address these issues by implementing an efficient traffic management system, particularly for emergency vehicles, through the modification of footpaths to create additional lanes.

II. RELATED WORK

Traffic Condition in India: India, the second most populous country in the world, also boasts the second largest road network globally, following the United States. Indian roads span 5,903,293 km, including 1,583 km of expressways, according to the 2017-18 annual report by the Ministry of Road Transport and Highways, Government of India. Maintaining this extensive network is a significant challenge, particularly due to the increasing number of private vehicles and the overburdening of roads in major cities such as Nagpur, Mumbai, and Delhi. These cities experience medium to high levels of traffic congestion. Poor roadway conditions, non-uniform roadways, inadequate lane discipline, improper bus stop locations and designs, a variety of vehicle types and operating conditions, and uncontrolled on-street parking all contribute to this congestion.

Traffic Condition at Signalized Intersections: Transportation is pivotal to civilization's progress, yet it presents considerable challenges worldwide. Countries strive to resolve transportation issues within their capabilities and resources. Traffic volume, defined as the number of vehicles passing a section of roadway within a specified time, remains steady. At signalized intersections, vehicles form queues, where the distance from the first to the last vehicle is known as queue length.

Pedestrian Traffic at Intersections: A pedestrian is defined as an individual walking along a road or development area. Traditional public transfer station designs rely on established guidelines, considering constant situations but not the varying needs of pedestrians, such as elderly people or parents with children. Factors affecting pedestrian walking speed include age, gender, size, health, trip characteristics, and pedestrian volume.

Footpath: A footpath is a designated area of the road or public space for pedestrian use. According to the World Health Organization (WHO, 2013), pedestrians are individuals walking for at least part of their journey. Walking offers economic, environmental, social, and health benefits, enhancing the quality of life. Footpaths, provided by the government, are essential in urban life for promoting healthy and pollution-free mobility.

Reasons for Traffic Congestions:

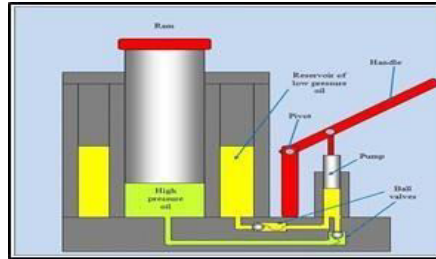
Rapid Increase in Population: As the population grows, so does the demand for transportation services, resulting in an increased number of vehicles and subsequent traffic congestion.

Deficiency of Traffic Police: Inadequate traffic police presence, leads to improper vehicle direction and traffic entrapment.

Increase in Private Transport: The lack of comfort and efficiency in public transport drives people to purchase private vehicles, overwhelming the current road capacity.

Behaviour of People: Human behaviour significantly impacts traffic conditions. Mental disorders, depression, anxiety, and emotions can affect vehicular flow and contribute to congestion.

Hydraulic Jack: A hydraulic jack is a device that lifts loads by applying force through a hydraulic cylinder. It operates based on Pascal's principle, using compressible fluid, usually oil, to push a piston in a cylinder. Hydraulic jack oil, typically low viscosity, is essential for the system's efficiency.



Objectives:

- Minimizing traffic in unstable conditions
- Accelerating traffic flow
- Utilizing footpaths as extra lanes during emergencies
- Reducing traffic congestion for smoother traffic flow

Advantages of Hydraulic Traffic Reducing System:

- Hydraulic systems are accurate and easy to use, with simple controls for starting, stopping, accelerating, or slowing down
- They deliver consistent power regardless of speed changes
- Leaks in hydraulic systems are easy to locate
- Integrated oil systems lubricate and protect essential areas
- Hydraulic systems can exert significant force using small, flexible cylinders and hoses

III. METHODOLOGY

Working Principle: The concept is based on a hydraulic jack system that operates on the principle of Pascal's law. Pascal's law states that "for a closed container filled with incompressible fluid, if pressure is applied at one end, it will be equally transmitted in all directions. In simple terms, under hydrostatic conditions, the pressure applied is the same in all directions. The hydraulic jack has one end connected to a power source and the other end connected to the modified platform, filled with incompressible fluid. When force is generated by the power source, it creates pressure on the smaller side, which is equally transmitted to the larger side of the hydraulic jack connected to the modified footpath platform. Since the pressure is equal on both ends, but the area on one end is larger, a substantial amount of force is generated, enabling the jack to lift heavier loads.

System Design: Develop a conceptual design of the hydraulic traffic reduction system based on the identified traffic congestion issues and analysis. Determine the placement of hydraulic actuators at strategic locations, such as intersections and bottleneck areas. Design the control system architecture to integrate with existing traffic management systems and receive real-time data inputs.

Simulation and Optimization: Utilize computer simulations or traffic modeling tools to simulate the behavior of the hydraulic traffic reduction system. Apply optimization techniques, such as predictive modeling and machine learning algorithms, to determine optimal configurations for the hydraulic actuators. Evaluate different scenarios and control strategies to optimize traffic flow, minimize congestion, and improve travel times.

Implementation: Install the necessary hydraulic actuators and associated infrastructure at identified locations within the study area. Integrate the hydraulic traffic reduction system with existing traffic management systems, such as traffic signals and surveillance cameras. Calibrate and fine-tune the system based on real-world conditions and feedback.

Monitoring and Control: Establish a centralized control system to receive real-time data from traffic sensors and adjust the hydraulic actuators accordingly. Continuously monitor traffic conditions and make real-time control decisions based on the collected data. Implement adaptive control mechanisms that respond dynamically to changing traffic patterns and congestion levels. Monitor and evaluate the performance of the hydraulic traffic reduction system in terms of traffic flow improvements, congestion reduction, and travel time reductions. Gather feedback from users, stakeholders, and the public to assess the system's effectiveness and address any concerns or issues. Identify areas for improvement and optimization through iterative refinement of control strategies and system parameters.

Pedestrian Traffic at Intersection: A pedestrian is defined as an individual walking along a street or development area. Public transfer stations have traditionally been designed on the basis of established guidelines, which outline passenger behavior in the depot. However, these guidelines only consider constant or static situations. Different types of pedestrians, such as elderly people or parents with children, require varying transfer times. Factors affecting pedestrian walking speed include age, gender, size, health, trip characteristics, and pedestrian volume.

IV. EXPERIMENTAL RESULTS

Hydraulic Machine: Hydraulic machines are powered by the force of a liquid fluid. A common example is heavy construction equipment. Hydraulic fluid is pumped through the machine to various cylinders and hydraulic motors, where it is pressurized in response to resistance. The fluid is transported by hoses, cylinders, or lines, and control valves either directly or indirectly control it. Pascal's law, which states that any pressure applied to a fluid within a closed system is transmitted equally in all directions, forms the basis of both hydraulic and pneumatic systems. Hydraulic systems use incompressible fluid instead of a gas, enabling significant force to be transmitted through small cylinders and flexible hoses.

Hydraulic Jack Operating Principle: The operation of a hydraulic jack is governed by Pascal's Law, which states that any change in pressure at one point in an enclosed incompressible fluid causes the same change in pressure at all other points. This principle applies to the hydraulic jack press and common vehicle braking systems. Pascal's Law explains that pressure is the force divided by area. Consequently, force equals pressure multiplied by area. The law and the operation of hydraulic jacks are illustrated by the increase in force as area increases while pressure remains constant. An individual operates a lever to lower the plunger, causing a pressure change. This pressure is transmitted to the larger hydraulic chamber, applying the same rate of pressure to the ram cylinder. Due to the ram cylinder's larger surface area, a greater lifting force is distributed, lifting the load above the ram cylinder. The plunger must travel a greater distance than the ram cylinder to raise the load to a reasonable height. Inside a hydraulic jack, there is one larger platform area and a smaller platform area, both attached to pistons. These platforms are filled with a uniform, non-compressible fluid. Applying force to the smaller piston exerts pressure uniformly throughout the platform, transferring the same pressure to the larger platform, causing it to move upward.

Improvement of Traffic: Two lane highway experiences high congestion during peak hours. Introducing the modified platform here can increase the number of footpath lanes by two. Thus, after implementation, the number of lanes will become four, potentially reducing traffic congestion by 25%.

V. CONCLUSION

These strategies can be broadly categorized into two measures: regulatory and economic. Regulatory measures encompass access management and parking management, while economic measures include pricing policies. Implementing these mechanisms is crucial in addressing and alleviating congestion problems.

Our study concludes that the integration of a hydraulic jack system into footpaths is an innovative and effective solution in the construction sector. This system requires minimal construction area, eliminates the need for specialized construction, and significantly reduces construction costs while conserving land.

The hydraulic jack system proves particularly beneficial during emergencies such as road accidents and traffic jams. Upon the completion of our mega project, we determined that this road construction system effectively manages heavy traffic, especially under adverse conditions such as heavy rain, accidents, and rallies. The system's operation can be adapted to remote or time-based control, offering flexibility and efficiency in traffic management.

In conclusion, the hydraulic jack system in footpaths is a cost-effective, innovative solution capable of significantly improving traffic flow and managing emergency situations with ease. Implementing this system will play a crucial role in reducing traffic congestion in the future.

REFERENCES

- [1] Darshan Shingane, Abhishek Targe, Sumeet Dhum, Prithviraj Phalke "Hydraulic Traffic Reduce System" Research in Science, Communication and Technology (IJARSCT) Volume 2 Issue 2 February 2022.
- [2] Faizan Y. Shaikh, Sagar U. Bawane, Sachin G. Nakade, Shubham S. Zore "Study On Hydraulic Traffic Reduce System" International Journal of Advanced Innovative Technology in Engineering (IJAITE) vol 6 may 2021
- [3] Anurag Teted, Ved Kale, Omakar Agivale, "Hydraulic Traffic Reduce System" International Research Journal Engineering and Technology (IRJET) vol 8 issue 5 | May 2021
- [4] Rohan Dhumal, Aniket Kumbhar, Umesh Thite, "Design and Fabrication of Hydraulic Lift" c in Engineering, Science and Management Volume-2, Issue-1, ISSN (Online): 2581-5792) PP 47-53 January 2019
- [5] Sumeet Sambhaji Pisal, Shantanu "Analysis Of Fluids For Hydraulic Lifts" Mosalakanti 2 Research Journal of Engineering and Technology (IRJET) International. Volume: 06 issue 07 July 2019.
- [6] M. Antony Maria Thomas Benny, U.S. Chavan "Design and Analysis of Piston Rod Joint in Hydraulic Cylinder for Industrial Implements" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 14, Issue 3 Ver. VII) PP 47-53. May - June 2017.

- [7] DR. Ramachandra C. G., Krishna Pawana, Shiuvraj Shet “Design And Fabrication of Automative Hydraulic jack system for vehicles” vol no. 6 2013
- [8] Dr. Ramchandra C G, Krishna Pavana, Shiraj Shet and Venugopal Reddy Virupaxappa B 2013, Vol. No. 6, Issue No. Vi, Dec Issn: 2231
- [9] CICI B., MARKOPOULOU A., FRIAS-MARTINEZ E., LAOUTARIS N.(2013). “Quantifying the Potential of Ride-Sharing using Call Description Records”.ACM HotMobile’13,February 26–27, 2013, Jekyll Island, Georgia,USA.
- [10] Dr. Ramchandra C G, Krishna Pavana, Shiraj Shet and Venugopal Reddy Virupaxappa B 2013, Vol. No. 6, Issue No. Vi, Dec Issn: 2231
- [11] CASAS, J., RUIZ DE VILLA, A., TORDAY A., (2012). “Framework for Traffic Pattern Identification: Required Step for Short-term Forecasting”. Australian Transport Research Forum 2012. Perth (Australia)
- [12] CASTRO-NETO M., YOUNG-SEON J, MYONG- KEE J, et al (2009). “Online-SVR for short term traffic flow prediction under typical and atypical traffic conditions”. Expert Systems with Applications, 36, 6164-6173.
- [13] ABU-LEBDEHA G., BENEKOHALB R.F. (2003). “Design and evaluation of dynamic traffic management strategies for congested conditions”. Transportation Research Part A: Policy and Practice Volume 37, Issue 2,pp 109–127
- [14] CHEN, H., GRANT-MULLER S. (2001) “Use of Sequential Learning for Short-Term Traffic Flow Forecasting”. Transportation Research Part C, Vol. 9, No. 5, pp. 319–336.
- [15] CUENA, J., HERNADEZ, J.Z., MOLINA M., (1995). “Knowledgebased models for Adaptive traffic management systems.”, Transportation Research, Part C 3 (5), 311–337
- [16] DAVIS G. A., NIHAM N. L., HAMED M. M., JACOBSON L. N. (1991) “Adaptive Forecasting freeway traffic congestion”. Transportation Research Record, 1287, 29-33.
- [17] DIA, H, (2001) “An Object-Oriented Neural Network Approach to Short-Term Traffic Forecasting”. European Journal of Operation Research, Vol. 131, pp. 253–261.
- [18] HAMED M. M., AL-MASAEID H. R., BANI SAID Z. M. (1995) “Short-term prediction of traffic, volume in urban arterials”, ASCE Journal of Transportation Engineering, 121(3), pp. 249– 254.
- [19] HEGYI A., DE SCHUTTER B., BABUSKA R, HOOGENDOORN S., VAN ZUYLENH., SCUURMAN H. (2000). “A fuzzy decision support system for traffic control centers”.
- [20] Cano, C., Galita, W., Samoranos, E.I. and De Leon, A.A., 2019. Design and Fabrication of a Hydraulic Motorcycle Lifter. Available at SSRN 3469969M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989
- [21] Thomas L Speer, TRAFFIC SIMULATOR APPARATUS @Ww-fee y Jan. 28, 1964 T. 1 SPEER 3,119,257 8William Neese, A. Aircraft hydraulic systems.
- [22] Dr. Pritesh Prajapati, Pragnesh H Prajapati -A Research Paper on Traffic Jam at Signal Cross Road They discussed about the various system used for controlling traffic congestion and problems it.
- [23] Chetan Gawali, Amit Bhongade, Amit Ramteke, Nilesh Landge- Effective Traffic Management System By Using Hydraulic Footpath
- [24] William Neese, A. Aircraft hydraulic systems.
- [25] Rajmohan G, Jazim Haris, Mohammad Shafin; Inbuilt lifting arrangements for heavy vehicles.
- [26] G. K. Patil Refrence No: 37s1373: A case study on implementation of hydraulic jack to heavy loaded vehicles



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