

# **TEKNOFEST**

## **AEROSPACE AND TECHNOLOGY FESTIVAL**

### **SMART TRANSPORTATION COMPETITION**

#### **PROJECT DETAIL REPORT**

**TEAM NAME: THE RISING STARS**

**PROJECT NAME: CASCADE SIGNALS**

**APPLICATION ID: 61174**

**PROJECT CONTENT: HIGHWAY**

## Project Detail Report

### 1. Project Summary:

Traffic congestion has become a major issue not only in Pakistan but also in many developed countries due to sustainable economic development. It has been caused by a signal failure, poor law enforcement, and inadequate traffic management; it also has a tremendous impact on the life of people, especially people living in metropolitan cities. It increases stress and frustration among motorists and often leads to road mishaps and hence injuries.



*Fig. 1: Flow of traffic on a typical four-way junction*

Several systems exist to control the traffic as there is always a possibility to break the signal, resulting in an accident. One such innovative method using a retractable spike strip system on every traffic signal termed as “**Cascade Signals.**” Road spike system uses Intelligent Transportation Systems (ITS) to control traffic according to vehicle density present on road. It is an automatic system that applies advanced communication, information, and electronics technology to solve transportation problems by helping people obey the traffic rules, reducing the workload of traffic police officers, and minimize the ratio of road accidents nearby four-way junctions. The system is completely automatic, it can be run without any help from traffic cops. This system can be manufacture in Pakistan and it will be the source of income for many people that working on daily wages in factories.

### 2. Problem/ Issue:

According to a WHO 2020 report, over 1 million people die or sustain injuries each year as a result of road crashes at a four-way junction. Between 20 and 50 million more people suffer non-fatal injuries, with many incurring a disability as a result of their injury. These crashes cost most countries 3% of their gross domestic product (GDP). These losses arise from the cost of treatment as well as lost productivity for those killed or disabled by their injuries and for family members who need to take time off work or school to care for the injured.



*Fig. 2: Accident near a traffic signal.*

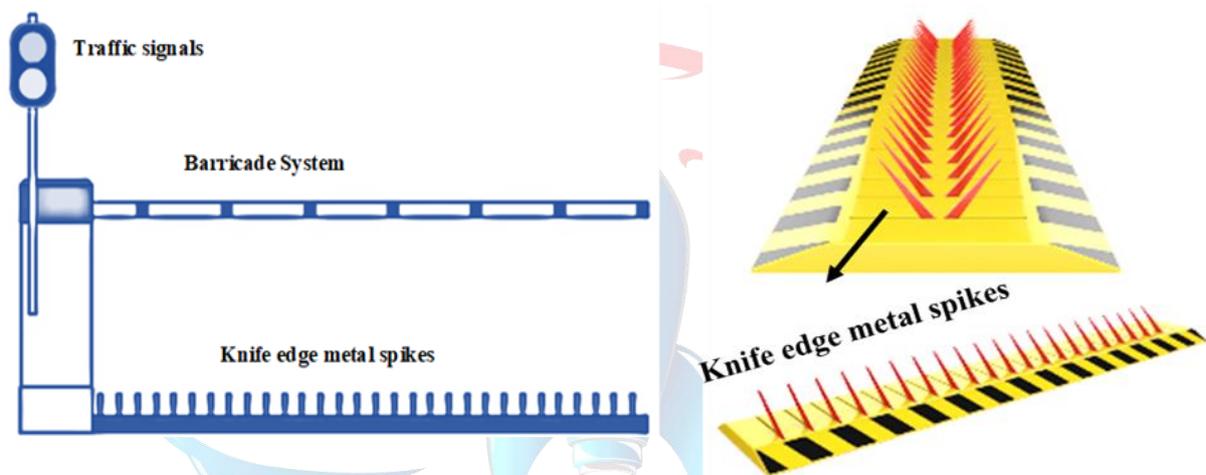
Vehicle use has risen dramatically in the modern world. As the number of cars on the road grows, so does the amount of traffic. There are many traffic accidents as a result of this phenomenon. Traffic takes a lot of time, energy, and patience. Traffic rules are set in place for the safety of drivers and pedestrians alike, thus it is all-important to follow them, but unfortunately, people are not following these rules, which is risky. In many countries all over the world, there are advanced and highly equipped systems that are installed to control fatal accidents. Traffic signals help a lot to manage and control the traffic influx but despite it, many people break signals by jumping red light which is the main issue that causes many accidents and serious injuries. This does not only harm the respective driver or car but may also take the lives of other innocent citizens [1].

Road safety is required to control the accident ratio of the vehicles by using Intelligent Transportation Systems (ITS). Because of the increase in motor cars in last 10-15 years traffic is rising day by day. So there is necessary to build a proper traffic management rule on road to reducing the pollution, saving fuel, control the traffic, reduce the ratio of accidents or traffic rule violation. For this purpose, we need to innovate a system named “CASCADE Signals”. The purpose of this system/ project is not only to reduce the ratio of deaths caused by traffic rule violation but also to reduce the work of Traffic Police officers.

There are several methods available for traffic management such as video data analysis, infrared sensors, inductive loop detection, wireless sensor network, etc. All of these strategies for smart traffic control are effective. However, the issue with these systems is that the installation time, as well as the cost of installation and maintenance, are extremely expensive [2]. Hence a new method named “CASCADE Signals” is most innovative and new technology which will require less time for installation with lesser costs as compared to other methods of traffic congestion management.

### 3. Solution

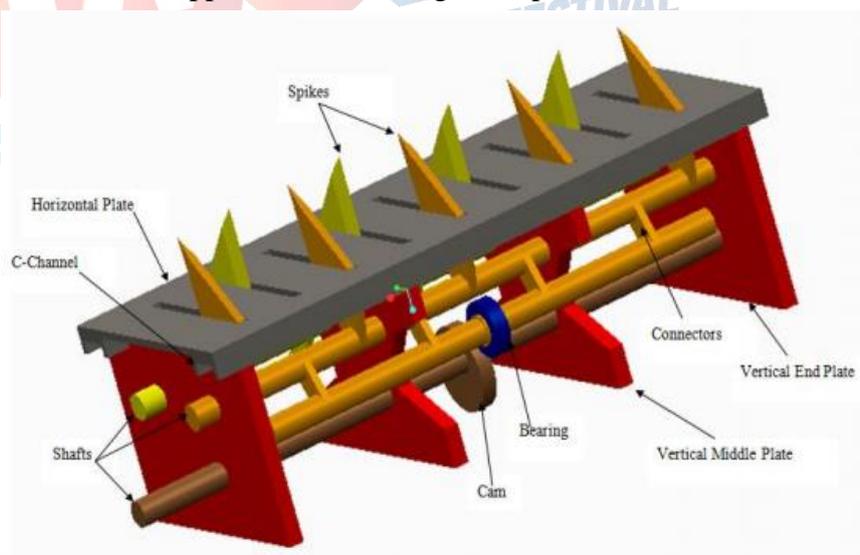
The cascade signals is an innovative method that use retractable spike strip system installed at the front of each lane before the zebra crossing. The system aims to puncture the tires of vehicles that try to jump signals; hence, it makes people wait till the signal turns green, or else the consequence will be immediate. The retractable spike strips before the zebra crossing are integrated with the traffic lights and the cycle time accordingly. The system consists of the knife-edge elements made up of metal, will automatically come out when the traffic lights turn red on the respective lane where traffic movement has to be stopped, and will retract when the traffic signal turns green. This system will help reduce accidents & improve commuters' traffic sense, especially when they disregard lanes, jump signals, & violate other traffic rules [1].



*Fig. 3: Diagram of a retractable spike strip synchronized with a traffic signal.*

### 4. Method

The experimental setup illustrated in the diagram is made up of numerous elements such as a spike system, a microcontroller, and a stepper motor. The figure depicts the situation. If the signal is red, the computer sends a command to the stepper motor to rotate at a specific degree, then the spike is opened. If the green and yellow lights are turned on, the microprocessor sends an instruction to the stepper motor, which causes it to return to its original position [3]. Materials were required to build "CASCADE Signals" are Screw Jack, MS Sheet Metal and Hollow pipe,



*Fig. 4: Assembly diagram of Road spike system*

Motor, Battery 12V 7.5 amps, Ball Bearing, Microcontroller, Solar Panel. Spikes are fixed on a shaft and comes with a spring for speedy responsiveness. It will be driven by a motor in response to the input motion. The spikes are constructed of high-quality steel [4]. The spike system is used for a variety of applications depending on the situation, such as traffic management, Bus rapid transit (BRT) systems, and one-way road directions, and it ensures that traffic regulations are followed correctly [1]. Metal spikes can be manufactured in different ways or lengths depending on the purpose of the need. The whole process is controlled by the control unit. The motor is arranged under the road as shown in the drawing. If the gate model is closed the spikes are come up with help of the bevel gear setup. Any car that attempts to cross the signal when the gates are closed will have its tire punctured. Limit switches are used to control the motor's rotation. After the car has been inspected, the motor is reversed, the gate opens, and the road spikes are lowered to allow vehicles to pass through [5]. The mechanism that rotates the spikes from the horizontal to the vertical position and back again must be work within seconds [6].

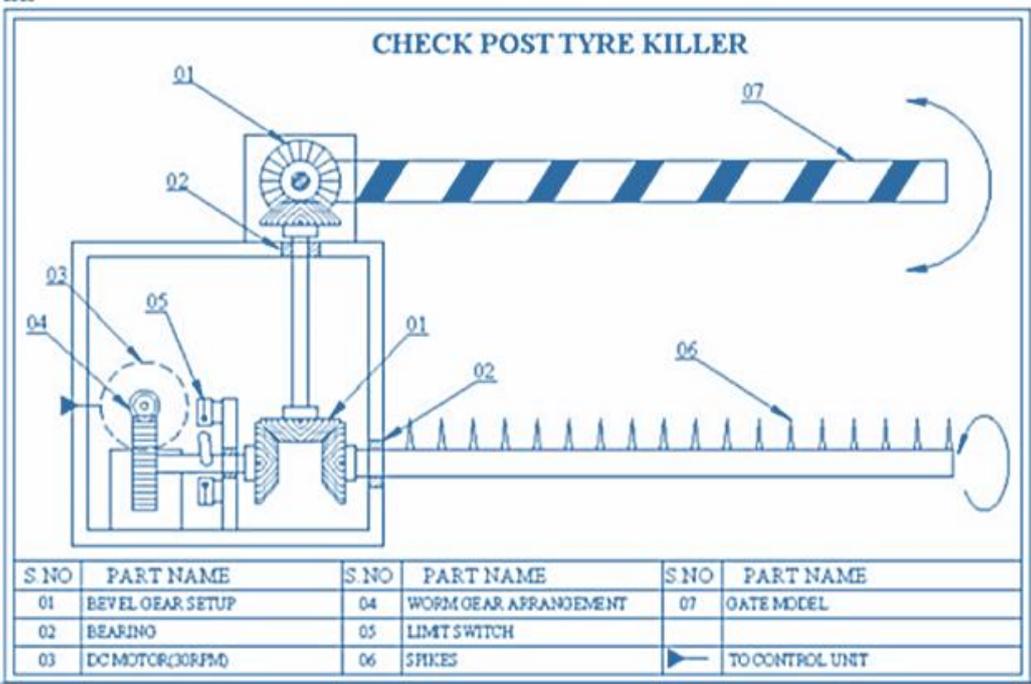


Fig. 5: Design of Check post tire killer type Cascade System

5. Innovative Aspect

“CASCADE Signals” project is one of the best, innovative and advanced idea for the betterment of society. The innovative aspect of our project is using the project in such an efficient and effective way that works so quickly on the traffic rule signal. This project is different from existing products and projects in design, parts, or tools, reliable, easy to maintain, and inexpensive. The whole system of Cascade Signals and metal spikes which will be installed will be directly connected with the traffic signal pole. No damage occurs to passing vehicles until the spikes are activated and most importantly cascade signals do not cause any damage or instability to any vehicle passing over it while metal spikes are down. In case of any case which will occur the nearest traffic police station or police car will receive the signal automatically,

so that they may reach the spot and manage the situation rapidly to avoid any disturbance to the whole traffic. This project can be “Made in Pakistan” with Pakistani products, tools, and techniques. Because we do not need to purchase any tools or parts of the project from a foreign country to pay a high amount of taxes. If we buy such system from foreign countries we need to pay high custom duties, if any problem occur in system we need to call Company’s Engineers to resolve the problem and it takes alot of time. So to avoid such problems and taxes we’re developing such method that is easy to use, eco-friendly and inexpensive.

This project is made with some pre-planning, which provides flexibility in operation. This innovation has made them more desirable and economical. This project is being developed with the hopes of being both cost-effective and beneficial to defense, reduces road accident ratio due to high-speed nearby signals and also it reduces the workload of the traffic cops. This project helped us to know the periodic steps in completing project work. Thus we have completed the project successfully.

## **6. Applicability**

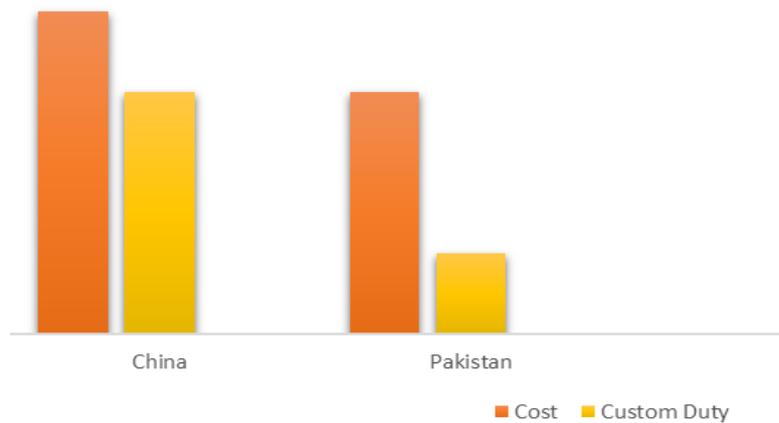
The applicability of our project in daily life is that it will help people to reach their destination safely, fewer injuries will occur and even people will be aware that if they break signal so the tires of their vehicles will be punctured so by this, they will follow traffic rules. It also can be applied in the big cities with congested, heavy traffic cities of the world. Furthermore, it will be first rectified by the traffic police department and law enforcement departments that which locations have the dire need of this controlling system. Accordingly, the retractable spike system will be installed and the respective officials will be given training on how to utilize it efficiently [7]. This system can be implemented commercially in all the areas of the city such as hospitals, highways, schools, office parkings, warehouses, factories, residential areas, and shopping malls. Implementation of this project requires the support of the government and law enforcement departments.

## **7. Estimated cost and Project Scheduling**

The estimated cost of this project will be around 900\$ (141030.00 PKR) regardless of paying high custom duties. This cost would include all the materials, supply chain, assembling, installation, and testing of the system. The project would be scheduled as follows:

- The required material and resources will be purchased by different vendors in Pakistan.
- Upon completion of purchasing the inventory/ material of the project, all the parts would be properly assembled before installing on the targeted traffic signal.
- The concerned technicians or experts would then install all the material properly in their respective places under the supervision of traffic cops.
- All the wiring or cables or any wireless device will be connected with the traffic signal. The system's full controlling command will be given to the traffic police department.

The city's local government or traffic police department will sustain and manage the retractable spike system simultaneously.



*Fig. 6: Cost comparison of the project in China & Pakistan*

➤ **Estimated Timeline of Proposed Project**

Activity	April 21		May 21		June 21		July 21		Aug 21		Sept 21	
	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2
Literature Review	[Blue bar spanning April 21 Q1 to Sept 21 Q1]											
Proposal Write-up	[Green bar spanning April 21 Q1 to May 21 Q2]											
Material selection & Total Cost			[Orange bar spanning May 21 Q1 to July 21 Q2]									
Design & Construction of a Cascade Signal					[Grey bar spanning June 21 Q1 to Sept 21 Q2]							
Final Project Report Write-up							[Blue bar spanning July 21 Q1 to Sept 21 Q2]					
Conclusion and Recommendation									[Red bar spanning Aug 21 Q1 to Sept 21 Q2]			

**8. Target Group of the Project Idea (Users):**

The target group of the project are all the people traveling on the roads both in urban and rural zones of the country. These include motorist, bicyclist, pedestrian, etc. It is an automatic system that can prevent the violation of traffic rules, minimize the ratio of road accidents nearby four-way junctions, fast alert system to near police stations & provide option for ambulance.

## 9. Risks

“CASCADE Signals” system is one of the best, innovative and advanced ideas that use modern technology which is beneficial for society. This project has the lowest possibilities of risk because it can be implemented to serve mankind, but the following risks can be considered:

In case if the system punctures any vehicle's tires and it is not quickly removed or managed by the police then this may occur disturbance to the whole traffic.

- If the system is not timely managed and updated it may cause bad or wrong signaling putting innocent drivers at risk.
- Proper maintenance of the system must be done on monthly basis to increase the lifetime of the system like maintenance of metal spikes or control of the automatic system.
- The shape of metal spikes can be changed or broken by continuous work of puncturing tires of vehicles. Metal spikes can also become corrode by the action of Oxygen which is present in environment.

## 10. Resources and Report Layout

1. Bhansali, S. N. Development of Mechanism for Road Spike System.
2. Khaire Trupti, H., Student, U. G., RcYeola, S. N. D. C. O. E., Patil Bhagyashree, K., Thorat Ankita, S., Patil Rohit, E., & Shaikh, I. R. (2019). Traffic Signal Automation using Spike Road Block. *Traffic*, 3(11), 817-819.
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7. Abu-Lebdeh, G., & Benekohal, R. F. (2003). Design and evaluation of dynamic traffic management strategies for congested conditions. *Transportation Research Part A: Policy and Practice*, 37(2), 109-127.