Simulation-Based Traffic Optimization at Clock Tower Junction, Bapatla Using Ptv Vissim

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***Abstract*—In many growing towns across India, rapid urbanization has led to increased traffic congestion, especially at unsignalized intersections. The Clock Tower Junction in Bapatla, Andhra Pradesh, is a critical intersection experiencing frequent traffic chaos due to the absence of traffic signals and organized flow control. This project aims to analyze and optimize traffic movement at this junction using PTV VISSIM. The objective is to create a virtual model of the existing conditions, evaluate current traffic performance, and propose a signal-based solution to improve vehicular flow and reduce delays. Traffic data will be collected through field surveys, including vehicle counts and movement patterns during peak and non-peak hours. The collected data will be used to simulate two scenarios in VISSIM, the existing unsignalized condition and a proposed signalized model. By comparing key metrics such as average vehicle delay, queue length, and traffic throughput, the project will identify the most efficient traffic control strategy. The results are expected to support the implementation of smart traffic solutions in Bapatla and serve as a model for similar towns facing unmanaged traffic intersections.**

***Index Terms*—PTV VISSIM, Traffic Simulation, Unsignalized Intersection, Traffic Signal Optimization, Urban Mobility, Traffic Flow Analysis**

I. INTRODUCTION

Rapid urbanization and the continuous increase in the number of vehicles have led to serious traffic congestion problems in many towns and cities. Intersections are the most critical points in a road network where traffic streams from different directions meet, often resulting in delays, conflicts, and reduced roadway efficiency. In smaller urban areas, many important junctions still operate without proper traffic control systems, causing irregular vehicle movement and congestion during peak hours.

Clock Tower Junction in Bapatla is one such important intersection that experiences frequent traffic congestion due to the absence of effective traffic management measures. The junction connects major roads and carries a mixed flow of traffic including two-wheelers, cars, auto-rickshaws, buses, and heavy vehicles. During peak periods, the uncontrolled traffic movement at this intersection leads to longer delays, queue formation, and increased chances of conflicts between vehicles and pedestrians.

To improve traffic operations at such intersections, simulation-based traffic analysis has become an effective and economical approach. Traffic simulation software allows engineers to model real-world traffic conditions, analyze traffic behavior, and evaluate alternative control measures without disturbing actual road operations. Among the available tools, PTV VISSIM is one of the most widely used microscopic traffic simulation software packages for modelling urban traffic systems. It enables detailed analysis of vehicle interactions, traffic delays, queue lengths, and the effectiveness of traffic control strategies.

In this study, PTV VISSIM is used to analyze the existing traffic conditions at Clock Tower Junction, Bapatla, and to evaluate the effectiveness of introducing a signalized traffic control system. The current unsignalized condition and the proposed signalized model are simulated and compared using performance parameters such as average delay, queue length, and traffic flow characteristics. The objective of the study is to identify an efficient traffic control solution that improves intersection performance, reduces congestion, and enhances road safety.

II. METHODOLOGY

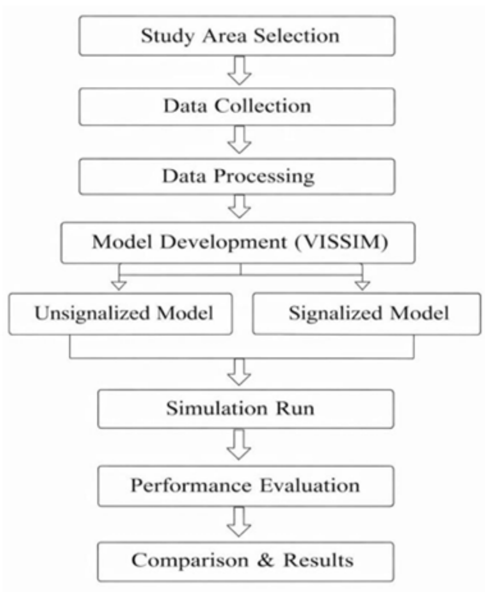


Figure 1: Flow Chart

III. EXPERIMENTAL WORK

The experimental work for this study was carried out to understand the traffic conditions at Clock Tower Junction, Bapatla, and to examine how traffic performance could be improved using PTV VISSIM simulation software. The main aim was to compare the existing unsignalized traffic condition with a proposed signalized system and evaluate the benefits of traffic signal control.

The first step involved collecting traffic data from the junction through field observations during peak traffic hours. The number of vehicles entering the intersection from each approach was counted and classified into categories such as two-wheelers, auto-rickshaws, cars, buses, and heavy vehicles. Turning movement data was also collected to identify how vehicles moved through the junction in different directions. In addition to traffic volume, details of the road geometry such as road width, number of lanes, and junction layout were recorded to accurately represent the actual site conditions.

After collecting the required data, the intersection was modelled in PTV VISSIM. The existing traffic condition was first developed as an unsignalized intersection model, where vehicle movement depended on driver judgment and priority rules. This model was simulated to observe traffic behavior under current conditions. Important parameters such as vehicle delay, queue length, number of stops, and traffic flow efficiency were noted to assess the performance of the junction.

To improve the traffic movement, a signalized intersection model was then created for the same junction by introducing traffic signals with suitable timings. The signal phases and cycle times were designed based on the observed traffic volume and movement patterns. This model was also simulated under the same traffic conditions, and the same performance measures were recorded.

The results obtained from both models were compared to evaluate the effect of signalization on traffic performance. The comparison showed the changes in delay, queue length, and overall traffic movement, helping to determine whether the proposed signal system could provide better traffic control and reduce congestion at the junction.

IV. RESULTS

Simulation Model (3d View of Intersection)

1. Unsignalized Intersection Model

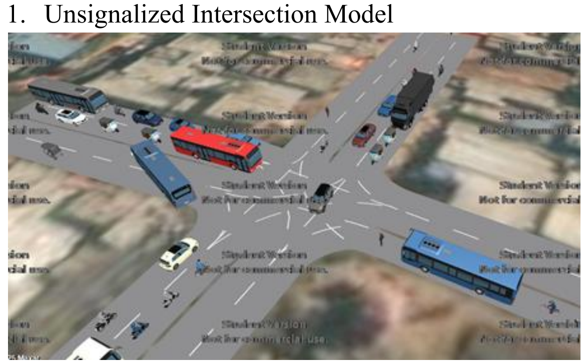


Figure 2: 3D View of Unsignalized Intersection Model

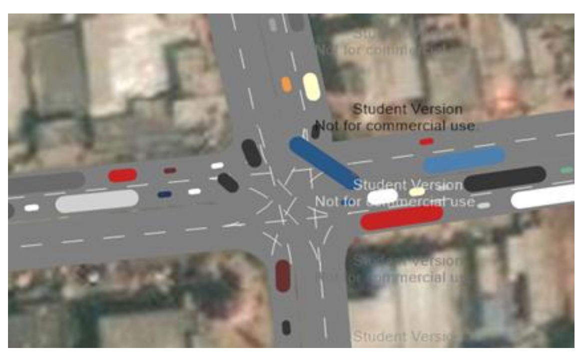


Figure 3: 2D View of Unsignalized Intersection Model

Figure 2,3 shows the unsignalized intersection at Clock Tower Junction, where traffic movement is uncontrolled and depends on driver judgment, resulting in higher conflicts, irregular flow, delays, and congestion under mixed traffic conditions with weak lane discipline and frequent merging, especially during peak hours.

2. Signalized Intersection Model

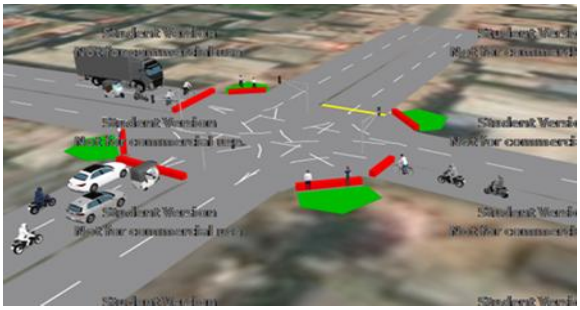


Figure 4: 3D View of Signalized Intersection Model

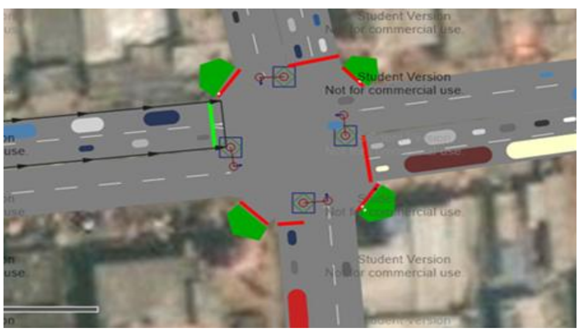


Figure 5: 2D View of Signalized Intersection Model

Figure 4,5 shows the signalized intersection at Clock Tower Junction, where traffic movement is controlled through signal phases, resulting in systematic flow, reduced conflicts, improved safety, and enhanced overall traffic efficiency, especially during peak hours.

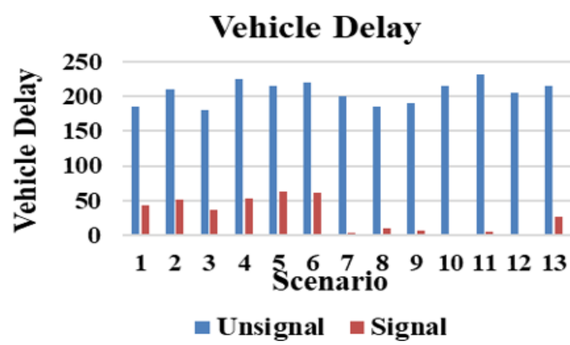
V. Comparative analysis

Table 1: Comparison of Traffic Characteristics

Parameter	Unsignalized Model	Signalized Model
Average Delay	Moderate to High (≈25–45 sec)	Variable (≈2–60 sec)
Queue Length	High (up to ~80 m)	Controlled (up to ~60 m)
Traffic Flow	Irregular and uncontrolled	Organized and systematic
Level of Service (LOS)	LOS C to LOS E	LOS A to LOS E
Vehicle Stops	Frequent and random	Controlled at signals
Conflicts	High (vehicle–vehicle & pedestrian)	Reduced due to signal control
Pedestrian Safety	Poor	Improved with dedicated phase

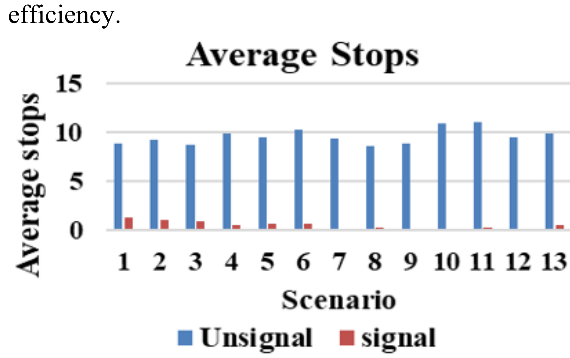
Table 1 shows that the signalized model performs better than the existing unsignalized condition. It reduces queue lengths, delays, and vehicle stops, leading to smoother traffic flow. The signal system regulates movements efficiently, minimizes conflicts, and improves safety. Overall, it ensures better traffic organization, operational control, and improved Level of Service (LOS), especially during peak hours.

Model Comparison



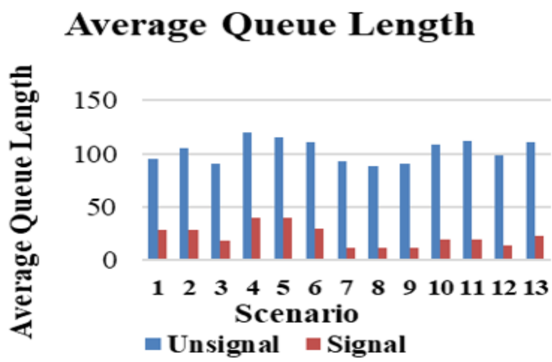
Graph 1: Average Vehicle Delay (Signalized Vs Unsignalized)

Graph 1 shows that vehicle delay is significantly higher at the unsignalized intersection (about 180–240 seconds), indicating severe congestion and poor traffic control. In contrast, the signalized intersection exhibits lower and more controlled delays (about 10–60 seconds). This reduction reflects improved traffic regulation and fewer vehicle conflicts. Overall, signalization enhances traffic flow and intersection efficiency.



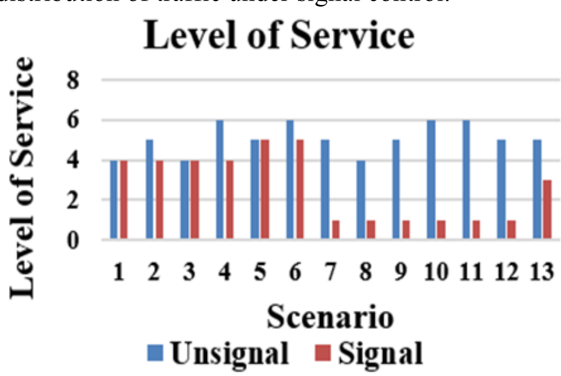
Graph 2: Average Number of Stops

Graph 2 shows that the unsignalized intersection experiences a higher number of vehicles stops due to congestion and lack of control. In contrast, the signalized intersection has fewer and more regulated stops under signal phases. This results in smoother traffic flow and better operational efficiency.



Graph3: Average Queue Length Comparison

Graph 3 shows that queue lengths are significantly higher at the unsignalized intersection (up to ~190 m), indicating severe congestion and poor traffic flow. In contrast, the signalized intersection maintains shorter and more controlled queues (up to ~60 m). This reflects improved traffic management and better distribution of traffic under signal control.



Graph 4: Level of Service (Los) Comparison

Graph 4 illustrates that the unsignalized intersection operates under poor conditions with LOS ranging from D to F, indicating severe congestion and unstable traffic flow. In contrast, the signalized intersection shows improved performance with LOS ranging from A to E, with several movements operating at better levels (LOS A–C). This demonstrates enhanced traffic efficiency under controlled conditions.

VI. INTERPRETATION OF RESULTS

The unsignalized model exhibits severe congestion, irregular vehicular movement, and increased traffic conflicts due to the absence of control mechanisms, resulting in high delays, unpredictable traffic flow, and longer queue formation. In contrast, the signalized model ensures systematic traffic movement through regulated signal phases, thereby reducing conflicts and improving overall intersection discipline. Although delay varies across movements due to signal waiting time, the overall traffic flow becomes more organized and efficiently managed. Furthermore, the provision of a dedicated pedestrian phase significantly enhances pedestrian safety by minimizing vehicle–pedestrian conflicts. Overall, the signalized model demonstrates superior performance in terms of traffic organization, safety, and operational efficiency compared to the existing unsignalized condition.

VII. CONCLUSION

1. The study evaluated traffic performance at Clock Tower Junction, Bapatla using PTV VISSIM by comparing unsignalized and signalized intersection models based on field data.
2. The unsignalized intersection exhibits poor performance during peak hours, with very high average delay (≈180–240 s), excessive queue lengths (up to ~190 m), and Level of Service (LOS) ranging from D to F, indicating severe congestion and unstable flow.
3. The absence of traffic control leads to irregular vehicular movement, frequent stopping, and increased vehicle conflicts under unsignalized conditions.
4. The signalized intersection improves traffic organization through controlled signal phases, resulting in smoother and more systematic flow with reduced and better-managed queue lengths (up to ~60 m).
5. Under signalized conditions, vehicle delay is significantly reduced (≈1–62 s), along with improved pedestrian safety due to regulated movement and a dedicated crossing phase.
6. The Level of Service improves to a range of LOS A to E, with several movements operating under better conditions (LOS A–C) compared to the unsignalized case.

7. Overall, the analysis confirms that signalization is more effective, and PTV VISSIM is a reliable tool for traffic simulation and decision-making in urban intersections.

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