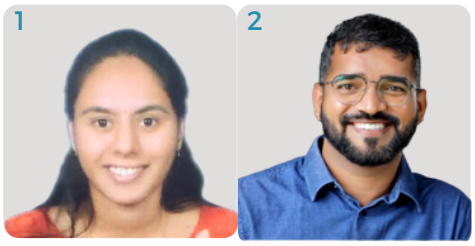
Performance Evaluation of an Intersection Conflict Warning System at an Unsignalized Intersection for Developing World Traffic



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Unsignalized intersections are identified as critical locations due to the higher number of road accidents at these locations. In India, 24% of road crashes occur at intersections, out of which 19% of crashes taken place at unsignalized intersections, resulting in serious injuries or fatalities (MoRTH, 2021). An intelligent transportation system application known as an Intersection Conflict Warning System (ICWS) is one approach that acts as the solution to reduce crashes at unsignalized intersections. ICWS consists of four components: sensors, communication subsystem, computer processors, and driver interface. Sensors installed on major and minor road detect the location, time, and speed of a vehicle approaching the intersection and is transferred through wired or wireless communication to the central processor. In the central processor, algorithms are developed to identify the gaps at the intersection and determine the unsafe gaps obtained from sensor data. Driver interface conveys time and appropriate information to minor and major road vehicle drivers (**Figure 1**).

This situation results in reduced conflicts as drivers get alert about the possible approaching vehicle, resulting in lower intersection approach speeds and improved driver gap acceptance.

Our research mainly focuses on designing and evaluation of the intersection conflict warning system installed at an unsignalized intersection for Indian driving conditions. A passenger car (Renault Triber) instrumented with video box was used for collecting the data (**Figure 2**). Scenarios were designed to evaluate the effectiveness of ICWS towards major road drivers. Drivers kinematic and video data was considered for analysing the effectiveness of ICWS. Further, a questionnaire was prepared to assess the effectiveness of the warning system in aiding drivers to cross the intersection safely.

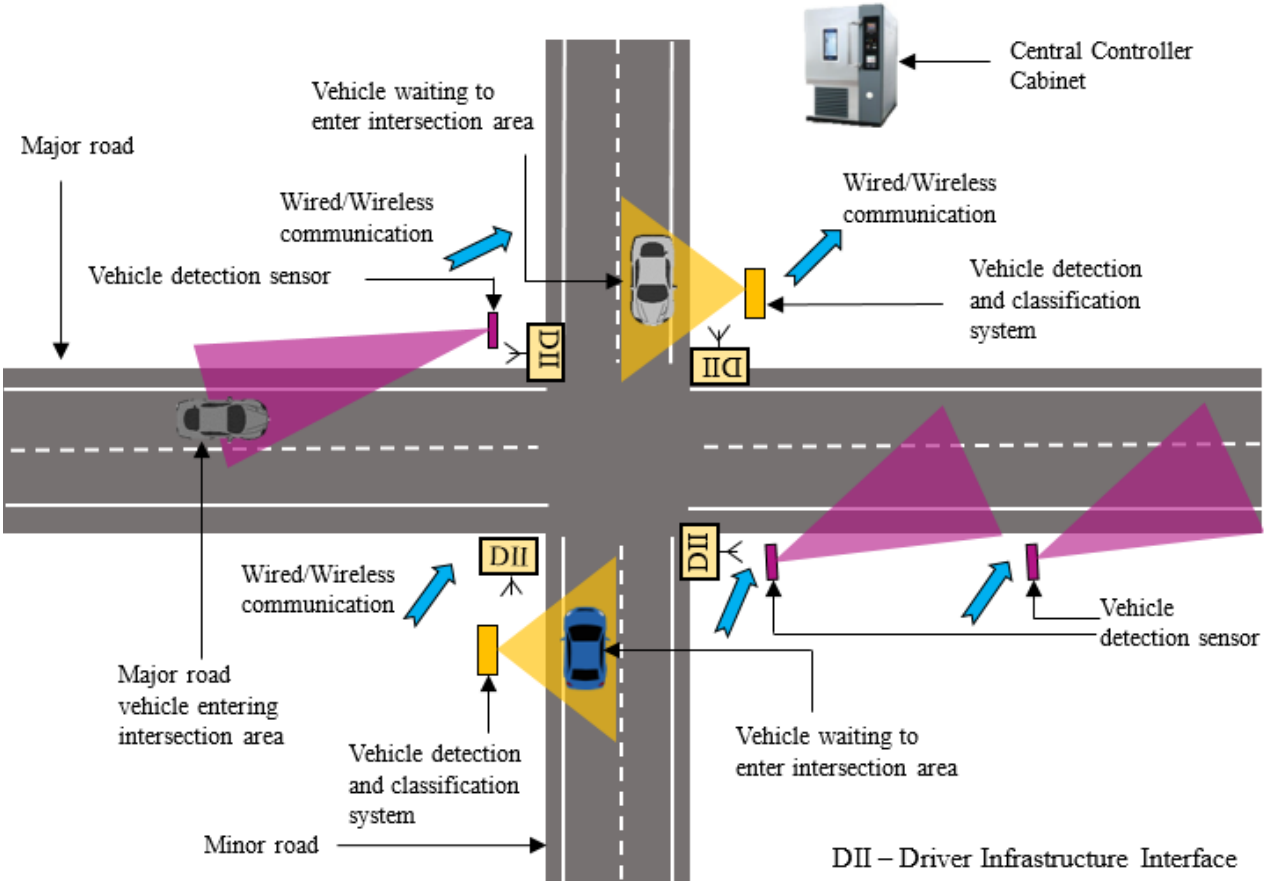

Figure-1: Schematic diagram of unsignalized intersection with different ICWS component

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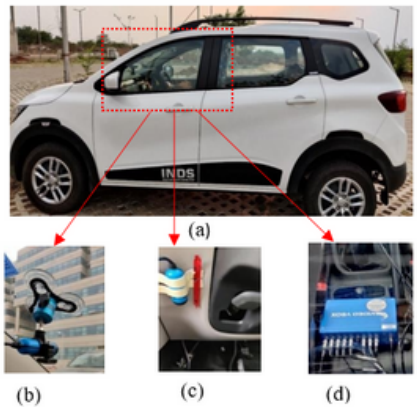

Figure-2: (a) Indian Naturalistic Driving Study (INDS) vehicle (b) Front camera (c) Camera facing towards driver brake movements (d) GPS data logger.

Conclusion:
The findings of the research suggest that drivers with activated ICWS had a lower mean speed, shorter response time and longer speed reduction time compared to those without ICWS condition (i.e., signboard not activated). It indicates that when ICWS is activated, drivers are able to apply brakes earlier and reduce their speed prior.

Thus evade collision at the intersection, since they have been provided with a piece of information in advance about the presence of vehicle on the adjacent side of the intersection.

Further, the questionnaire results exhibit a positive response from the participants, describing that the conflict warning system was found to be helpful in crossing and reducing collisions at the intersection.

The insights from the research would be helpful for transportation engineers and highway safety authorities to design and deploy the intersection conflict warning system at several unsignalized intersections for developing world traffic. This research acts as a key initiative towards designing and evaluating the ICWS for Indian driving conditions.

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Something to do with wrinkles and cracks on the pavement surface?

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The wrinkles and cracks seen on the pavement surface are certainly not the artistic work of a Civil Engineer. Ever wonder why these cracks and wrinkles are seen on roads? The roads are generally designed to resist traffic loads for a certain number of years, referred to as the design life of a pavement. Due to heavy usage or temperature variation (of course one can blame it on climate change effects) and seasonal moisture fluctuations due to summer and monsoon periods, these pavements undergo huge internal stresses. Needless to say, any stress would cause strain in a body…these excessive strains (tensile) would eventually crack the bituminous layers to show fatigue cracking on the surface, as seen in **Figure 1**.

As discussed, there are various reasons for them to develop further and deteriorate the pavement. So the next question is 'Do we have a face pack to cover it up?' Yes, we do have several options, the simplest being asphalt overlay, a thin asphalt layer (20 – 30 mm) covering all these cracks to improve the ride quality, and of course the user perception! You know, we spent about INR 1,400 Cr during 2021-22 just to repair such cracks. So, more sustainable ways are always explored for controlling these cracks. **One such solution is to introduce polyester or glass fiber grids as interlayers in the bituminous layers. A small study demonstrates that the cracks have moved laterally instead of vertical direction because of the presence of interlayers.**

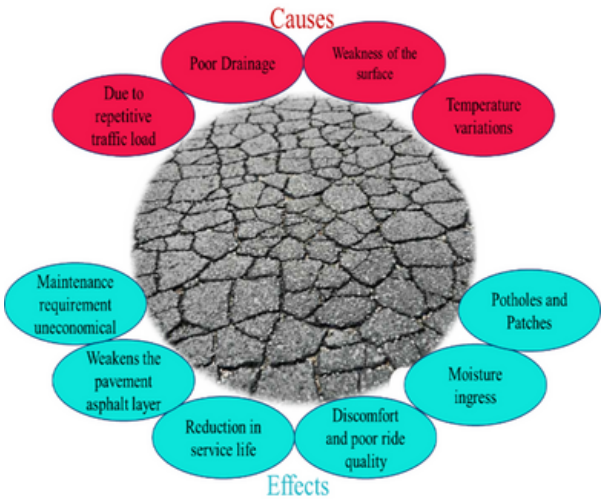

Figure-1: Causes and effects of fatigue surface cracks on asphalt pavements