

An aerial photograph of a yellow school bus driving on a road. The bus is positioned on the right side of the frame, moving away from the viewer. The road has white lane markings, including a solid line on the left and a dashed line on the right. The bus has "SCHOOL BUS" written on its front. The background shows a road with a crosswalk and some shadows from trees or buildings.

# Technology to Enhance School Bus Safety and Performance

**A new era in smart traffic enforcement.**

# Technology to Enhance School Bus Safety and Performance.

New technology empowers us to achieve things we never thought possible, and to solve problems that were previously thought to be too costly or difficult. For years, school districts and law enforcement agencies have struggled with the danger caused when motorists illegally pass school buses that are stopped, to either pick up students on their way to, or drop students off on their way home from school.

Recent advances in artificial intelligence and computer vision now make it possible to leverage the technology to protect children as they get on and off their bus. Artificial intelligence of things (AIoT) devices use mobile cameras mounted on bus exteriors, leveraging Hayden AI's patented deep learning platform to capture potential traffic violations. This new technology solution is fully automated, requiring no effort from the school bus driver to operate. The solution is highly accurate, capturing a greater number of prosecutable violations. Automated school bus stop arm technology is a valuable tool for school districts and law enforcement agencies seeking to enhance student safety and motorist awareness.

Passing a school bus with its stop arm extended is illegal in every U.S. state. Yet each and every school day, almost 100,000 drivers do so, putting children's lives at risk. According to a 2019 survey of approximately 27% of school bus drivers in the U.S., 95,319 vehicles illegally passed school buses in a single day – contributing to at least 17 million stop arm violations per year<sup>1</sup>. Even this number is only a fraction of annual violations, as not all school bus drivers participated in the survey.



The staggering number of illegal school bus passes leads directly to student deaths and injuries. According to the National Highway Traffic Safety Administration (NHTSA), on average seven school-age children were killed while crossing the street to or from school buses each year from 2009 to 2018<sup>2</sup> – a number increasing as child pedestrian fatalities in general skyrocket across the country<sup>3</sup>. In just a six-day period in 2018, six students were killed and eight students and two adults were injured by vehicles illegally passing school buses or crashing into people as they waited to board<sup>4</sup>.

As school districts and law enforcement agencies focus on increasing safety for students, automated school bus stop arm technology is an important tool to increase motorist compliance with laws requiring them to stop when the bus is stopped.



# Enhance Student and Driver Safety.

Children, the most vulnerable members of our community, are put in danger when vehicles illegally pass stopped school buses. In Indiana in 2018, a person driving a pick-up truck illegally passed a stopped school bus with its stop arm extended and hit four children as they crossed the street. One 9 year old and two 6 year olds were killed, and an 11 year old was seriously injured.

Following that tragic crash, the National Transportation Safety Board (NTSB) issued an in-depth report investigating measures to reduce instances of illegal school bus passing<sup>5</sup>. They found that automated enforcement cameras could significantly reduce violations based on multiple studies. Another study of a pilot program in North Carolina, which installed stop arm cameras and issued citations to violators, reduced illegal passing overall.<sup>6</sup> As a result of these findings, the NTSB formally recommended that every state and the District of Columbia should immediately pass legislation permitting the use of this technology, if they had not already done so.

In addition to the safety benefits of the technology itself, some states make additional safety improvements to sidewalks and crosswalks near school bus stops by dedicating revenue from school bus stop arm enforcement citations to fund that infrastructure. Hayden AI's automated school bus stop arm enforcement technology captures rich and robust violation data that unlocks previously unavailable insights, helping school districts and law enforcement agencies identify locations for improvements.



# Increase Law Enforcement Efficiency.

The National Highway Traffic Safety Administration (NHTSA) recommends that school districts make enforcement a fundamental part of their school bus stop arm compliance programs<sup>7</sup>. Until recently, the only way school districts could pursue this was through police enforcement and bus driver intervention. Yet limited police capacity diminishes the effectiveness of enforcement efforts. For a school district with many different bus routes, it is impossible for officers to enforce school bus stop arms at every bus stop every day of the school year. It is also unsafe for bus drivers to focus on capturing the license plate information of illegally passing vehicles and take any attention away from monitoring children during a stop.

Public awareness of ongoing enforcement is also essential to curb illegal passing of school buses, according to NHTSA. But the impossibility of catching and processing every violation reduces public perception of ongoing enforcement.



Automated school bus stop arm technology is an effective solution to this problem. A 2021 NHTSA study of automated school bus stop arm enforcement in three school districts across the country found that stop arm cameras catch as many as 35 times more violations than police officers and school bus drivers – and that these programs lead to a decrease in violations among drivers who have already received one violation<sup>8</sup>.

Other studies have found that 99% of drivers who received a school bus stop arm violation ticket do not receive a second ticket. This is a powerful finding that indicates that automated enforcement leads to a decrease in violations over time, and that receiving a ticket leads drivers to change their behavior – both of which increase safety. Hayden AI's advanced Automated School Bus Stop Arm technology ensures that the capture of this game-changing data is efficient, accurate, and secure.

# Ensure Privacy and Detection Accuracy.

For automated school bus stop arm enforcement to work, the detection camera must “watch” the street to capture potential violations – just like bus drivers and police officers look out for illegally passing vehicles. This enables the camera and processing equipment to create evidence packages for potential violations without any effort from the bus driver. These packages typically include a photo of the violation occurring, a photo of the license plate, and a short video. Understandably, this level of personally identifiable information (PII) collection raises privacy concerns.

Fortunately, automated enforcement technology exists that collects and shares only a tiny fraction of such sensitive data. This solution only collects data and creates an evidence package if a potential violation is detected. Rather than video continuously being collected and transmitted to the cloud or a server over the course of the day, the solution uses “edge processing” equipment installed on the bus itself to perceive potential traffic violations, capture them, and transmit only that information. That enables districts to significantly minimize data that is collected, shared, and stored.

Hayden AI's automated school bus stop arm enforcement technology is one of the only such technologies available that includes this edge processing technology.





# How Does It Work?

There are currently 12 states that have enabled school bus stop arm enforcement technology, and another 10 states with legislation pending. The enabling legislation typically includes language that permits local governments or school districts to implement camera enforcement and issue citations based on the evidence packages those cameras capture. Local law enforcement receives a potential violation evidence package, and determines if a violation has been committed. If it is determined that a violation occurred, the motorist is provided with various options to remedy the violation, including interaction with the judicial system.



# Why Hayden AI for School Bus Stop Arm Enforcement

Hayden AI is quickly becoming a world leader in smart enforcement technologies. The company was founded on the belief that by combining computer vision with artificial intelligence, we can help governments automate manual processes, thus making public agencies more effective. To that end, we are leveraging our patented deep learning platform in partnership with school districts and law enforcement agencies across the country to make students' journeys to and from school as safe as possible.

In addition to the enforcement benefits of our systems, Hayden AI technology captures valuable traffic data that can also be used to improve performance. By providing school districts with real-time insights into how their buses are operating, we are empowering them to make the best decisions possible with their students in mind.



# Sources

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