

Episode Title: What's Happening with Automated Driving Systems on Rural Roadways

Topic: Rural Roadway Safety

Summary: Omar Ahmad, Deputy Director of the Driving Safety Research Institute at the University of Iowa, discusses his recent project focused on automated driving systems (ADS) in rural America. This episode discusses the challenges of deploying automated vehicles (AVs), particularly in rural areas. Omar highlights issues like software bias towards urban environments, sensor malfunctions in poor weather (especially ice), and difficulty with irregular intersections and high-speed traffic in rural areas. While AVs show promise for safety and mobility in general, this conversation identifies that the technology is not yet ready for widespread autonomous deployment in rural settings.

Expert: Omar Ahmad, Deputy Director of the Driving Safety Research Institute, University of Iowa

Episode Quote:

"We really wanted to do something very unique, that was a little bit more specific to Iowa—the four seasons, the rural roadways, the non-sort of nice roadways that you see in an urban area or on an interstate."

— Omar Ahmad

Transcript

00:10 E Ritchie

Welcome to the *FarmSafe* Podcast brought to you by the Great Plains Center for Agricultural Health. In the blink of an eye, an injury can change your life and your farm forever. During each episode, we share first-hand stories and real-life tips for making safer and healthier decisions while on the farm.

Omar Ahmad is the Deputy Director of the Driving Safety Research Institute at the University of Iowa. He has just finished a project that was funded by the US Department of transportation to understand the unique needs of rural roadways present to automated driving systems, commonly called ADS. While we may have read stories and watched reels about urban self-driving cars, questions about how well these systems can address road conditions out by our rural farms have not been explored.

E Ritchie

Omar, can you introduce yourself and your organization?

O Ahmad

My name is Omar Ahmad, and my role is Deputy Director at the Driving Safety Research Institute. We're part of the University of Iowa and we're located on the Research Park.

We've all heard about automated vehicles, or I think in the media they like to call them "autonomous vehicles" or "self-driving vehicles." They're coming. They're going to be here any day. And there is a lot of testing that we hear about that's taking place around the country. When you look at the actual testing that's being done, a lot of that testing is centered in urban areas such as San Francisco and Phoenix for instance. Typically, this testing involves the use of low-speed vehicles, shuttle vehicles that travel at speeds of about 18 miles an hour, at most, and are really boxes on wheels. We don't quite know how these vehicles will hold up in an actual crash when people are standing in them. But the testing that's being done is in what I call event parking type areas where you're moving from one parking lot to another. And in the rare instance that these vehicles are actually on the roadway, they're typically on a dedicated lane or on a lane where they have little or no interaction with like what I consider, what I call real traffic.

So, another thing that I wanna point out is that a lot of this testing is taking place in warm weather states, even when it's taking place in a winter state, the testing is only done in the warmer seasons. When we were applying for the grant back in 2018 and 2019, this is

what we saw. And we really wanted to do something very unique that was a little bit more specific to Iowa, but specific to Iowa in only the way that I described, like, the four seasons, the rural roadways, the non-sort of nice roadways that you see in an urban area or on an interstate.

E Ritchie

So why do you think it is important to look at automation in places like "Rural Iowa"?

O Ahmad

Folks who live in rural areas have typically little or no access to public transportation. And we have a lot of older folks that choose to live in rural areas. And we are an aging country. And being able to move from one location to another is basically independence and freedom. And as people age, they need transportation options of which rural areas don't have a lot.

So, if we have automated vehicles one day that are running around in rural areas, we might have a really fantastic way to take people from one location to another. And one of the cases that I'm personally very interested in is rural access to healthcare. And how do you get folks in rural areas to their appointments in regional healthcare centers, such as the University of Iowa Hospital and Clinics? One of the things that I didn't mention is traffic fatalities and when we look at rural areas-while a small segment of the population lives in rural areas, half of all traffic fatalities occur on rural roadways. So that's something to think about.

And automation has this potential to improve safety for all of us, right? And so, we want to see that impact taking place in rural areas as well, not just in urban areas. And one of our biggest worries is that if you test in urban areas only and you develop products for urban areas, right? Then you can have solutions that work well in urban areas. And maybe those solutions won't work well in rural areas. And we will have this further divide. I mean, we already have this growing divide within rural and urban areas and it's just going to make it greater.

E Ritchie

These are both really important issues for our listeners. The fact that our aging rural farmers and farm families may not have had access to healthcare or even feel comfortable driving into urban areas to get healthcare is a concern, for sure. And knowing that rural roadways are where half our traffic fatalities occur does help us understand that an automated driving system could help improve safety overall, and that is worth investigating. What are the key differences in rural areas that you wanted to consider when you design the study?

O Ahmad

One of those is that rural roadways, while the average speed might be lower than on an interstate, the diversity of speeds that vehicles that travel at on that roadway is huge. You can have vehicles that are driving at 55 or 60 miles an hour, but they share that exact roadway with horse buggies that are crawling along or ATVs or bicycles or just a slow-moving vehicle, such as a farm implement. This is a very common thing in Iowa, but it's also a common thing in practically any other state, once you go out into a rural area.

In rural areas, there's fewer uncontrolled intersections. And even intersections are not, you can pretty much get on and get off at any point in the rural areas. Once again, think about harvest season. Tractors come on and off the rural roadway at almost any location and with little or no warning. These are the challenges, and these urban vehicles that we're seeing that are being tested in these urban areas, they're never gonna be able to really deal with these types of challenges. That's the motivation behind the proposal that we put together. And there was a very special opportunity from the US Department of Transportation that was providing funds to test ADS technologies.

So, we created this route. It's a 47-mile route. And we tried to include on this route as many different classes of roadways as possible and as many different types of roadway surface conditions as possible. So, of course we have interstates on it.

O Ahmad

And we have two-lane highways on it that are really well marked with lane markings, but we also have roadways that were paved with worn lane markings and paved without any lane markings whatsoever. And then gravel roadways as well. And we had four stops on this route that theoretically represented places where people might want to go. We had stops at the Iowa City Marketplace, the Hills Community Center, the Riverside Casino and the Kalona Library. They each had sort of their own parking situation that made them unique.

This was the route that we came up with, 47 miles of roadways, different types of intersections. And we drove this route over and over, over a course of two years and in all four seasons. And we drove it during the day, we drove it in the morning, we drove it late at night because we really wanted to see whether this automated vehicle would function differently depending on the time of day or depending on the surface condition or the weather.

E Ritchie

So, you had a route that had all sorts of typical rural conditions, including weather. Did you use a car that was already designed as an automated driver for this project?

O Ahmad

The vehicle that we utilized, it was purpose-built. We reached out to a technology partner in Illinois, and they took this vehicle, which is essentially a Ford F-350 cutaway. And there was a company that does the upfitting to make it ADA compliant. Then this other company in Illinois installed all the sensors on this vehicle.

O Ahmad

There's different kinds of sensors and the sensors were chosen to support the software that we had chosen to run this vehicle. We weren't really able to work with any companies like Google or GM or Tesla because these companies will never put their technology in the hands of a public institution. And certainly not in a way that we would have any hope of understanding what are the inner workings of their software or their technology. So, we decided to use an open-source automation software. And believe it or not, there are a couple out there that you can download and use. The one that we chose is called Apollo. And we chose it because given what we were trying to do it was, at that time anyway, but again, back in 2019, the best software out there. Apollo, by the way, is a software written by a company called Baidu, which is based in China. This company installed the sensors for us and then they put all the computing equipment inside, and we installed the software and then we started testing. We tested our vehicle driving different types of roadways on that 47-mile route, at different times of the day, encountering different types of situations. We did 80 full drives over a course of two years. And we collected a ton of data, data from all the sensors, video data, forward view, back view.

One thing that I haven't yet explained to you guys is that we also recruited people to ride in the vehicle. And so, we asked those people to wear wristbands that would record physiological data. And so, we have their physiological data at different points in the drive. Now, we did surveys to look at their trust and perception. And so, we gave them surveys before their drive and after their drive to see if their trust increased.

O Ahmad

We always had a safety driver in the vehicle. We always had a co-pilot in the vehicle because we were doing some real-time logging. And then we had a research assistant that would sit in the passenger area with the research participants. They would give them the surveys and just make sure that their needs were taken care of. All of this data was collected, and it is being shared publicly. That was one of the key requirements of the grant was that the data be publicly shared. Once again, companies don't publicly ever share their data.

E Ritchie

And after you built the device and programmed things for the automatic driving systems, what did you learn about their ability to drive on rural roads in Iowa?

O Ahmad

One of the lessons that we learned is that automated vehicles are programmed to be conservative. And the reason why is because the slower you go, the bigger the chance that you're gonna be able to avoid a crash. Typically, they have a *maximum* speed that's governed in the case of those boxy shuttles that look very sexy, but, you know, operate with these little, tiny wheels in in parking lots of their max speed generally is around 18 miles an hour. If you're gonna drive a shuttle at 18 miles an hour on a rural highway, I mean, you're asking for trouble in my opinion, particularly in bad weather. We knew that our vehicle had to go a lot faster. Initially it had a speed limit of 54 miles an hour, which was okay for rural highways, but it was actually horrible for interstates because we were constantly being passed by other vehicles on 218.

And as vehicles would pass us and cut in front of us, the vehicle would get spooked and then slow down even more. So, before we knew it, we were like going 35 miles an hour on an interstate, which is essentially illegal, right? You're supposed to go at least 40 miles an hour. So, they exhibit conservative behavior. And I'm calling out max speed because, even today, very little testing is being done with high-speed vehicles. To operate in a rural area, you need high speed vehicles. You can't do slow speed.

E Ritchie

What about speeds at intersections in rural Iowa?

O Ahmad

They're very slow to start from stop. So, generally when they come to an intersection, a red light or a stop sign, they stop. And then there's this pause for like five seconds, right? Which would somebody who lives in that area that's used to kind of pseudo rolling through the stop sign that annoys people like you wouldn't believe. And we got honked at all the time. And so, we worked, we tried to tweak the software to have that pause time not be five seconds, but have it be more like two seconds. But nevertheless, would just, once it started rolling, it would be very slow.

E Ritchie

What about driving on gravel roads? How did the vehicle do?

O Ahmad

Generally software engineers live in town. And certainly, unless somebody has written a specific piece of software to deal with a gravel road, the vehicle is going to drive the gravel road like it's on a paved road and what does that mean? It's going to drive on the right edge of the gravel road. Well, if you drive on the right edge of the gravel road, that's where all the loose stuff is, right, and when the weather bad and it's slimy out there, I mean that that could literally pull your vehicle off the roadway. And the fact is that bad weather or not most people drive the gravel road drive in the middle of the road and then you only move over when somebody's approaching you because it's not that often that somebody approaches you. That's not how an automated vehicle drives on a gravel roadway. And so, we tried to kind of change that behavior, but it was tough. It was very tough. And so out of the box, you are going to find that automated vehicles are going to have a tough time with this type of situation.

E Ritchie

What about the weather? Your study was unique in that it looked at all seasons. What did you learn?

O Ahmad

We have all these sensors on our vehicle that helps the vehicle see what's going on around it, right? So, we have radars, we have lidars. It's essentially a laser that shoots out from this device. It's gonna pick up, if the laser hits a tree, it's gonna pick that up. If it hits a stop sign, it's gonna pick that up. If it hits an animal, it might pick it up, or another vehicle or a human being. And then there's a piece of software that takes all this information and then tries to classify what each object is. That's what an automated vehicle is doing.

It's surveying the environment and it's classifying the object. And once you've hopefully accurately classified the object, then you'll be able to better predict, based on which way the object is heading, like how fast it's moving, where it's gonna go, so on and so forth. But mainly you're just trying to figure out is there anything you're gonna hit, right? And if so, we're gonna break for it. When this technology works well, it works pretty well. It picks up almost everything. I mean, we've saw it pick up bicyclists, pedestrians.

O Ahmad

Even on occasion small animals. But here's the challenge. When you're driving in bad weather, ice can form on these sensors. And when ice forms on the sensor, the laser goes out. It essentially is blind. It doesn't see anything. Here's the challenge. The software doesn't know whether the LiDAR sensor has ice on it or not. And this happened on a wintery mixed day in Iowa. You know, we always do these safety checks before we start driving. The safety checks were fine, but within 20 minutes we had ice on the sensor, and the vehicle started to do some very strange things.

E Ritchie

Since your study was designed to identify these risks, it seems you identified some pretty important limitations for technology to have to overcome to be useful in the Midwest. Anything else that found out when driving your rural path with your test vehicle?

O Ahmad

If the geometry of the intersection is weird, we saw it pick up the wrong signal head. So, we might have been in a lane that was red, but it picked up the signal head from a lane that was green, and it would start to go; and vice versa. It had issues with, it was basically programmed to respond to red, yellow and green, but it didn't know what a flashing red was, and it didn't know what a flashing yellow was. And so, it would do weird things when it would see those types of situations. And once again, the more regular the intersection, the better the chances that it was going to work well.

O Ahmad

A lot of regular intersections tend to be in cities. Sometimes not. Maybe in the eastern cities you get weirder intersections. But right now, most of the testing was being done on the west coast and in the southwest. But in rural areas, the intersection may be really weird. It may be that the roads aren't quite at 90 degrees. They're kind of diagonal. And then there are situations in which you can't pick up traffic at all just because it's coming at the intersection in such a weird angle.

E Ritchie

Given all that you learned, do you still think that this technology might be useful in rural environments, particularly to meet the needs of older rural residents needing some form of public transportation or to help improve safety on rural roadways, both of which motivated your study?

O Ahmad

My sort of two cent summary of what we did is that automated vehicles, ADS vehicles specifically, have amazing potential. They really do. And they can improve safety and offer broad mobility options for everybody, but they're not ready for prime time. I mean, based on what we learned, they're not ready to be let loose and set out into the world by themselves. Now, are they ready for deployment if a safety driver is there? Yeah, potentially. And that's where we need really well-trained safety drivers. So, we can't have a safety driver that doesn't know anything about the limitations of automation. They would need to be trained on the limitations of automation, just like our safety drivers were.

O Ahmad

And there are going to be many times when the technology breaks, where a computer shuts down, where whatever happens. And so, you, in these deployments, you're going to need really, really close cooperation with your technology partners, right? Because the deployments ideally should be done by the transit providers, but they're going to be dependent on these technology corporations.

And so, they really need to be working very, very closely. I see it as an iterative process. We do something on a smaller scale and then we figure out what's going on and we make it better. But in every case, safety is the number one thing. You cannot put people, whether they're inside that vehicle or outside, at risk. Minimizing that risk is so important, and to minimize that risk, you really need to understand the limitations of the technology.

E Ritchie

If you want to see more about this study, we will post a link to Dr. Omar Ahmad's project page, which has videos and a link about how to access data generated from this study.

While these automated driving systems may not be ready for prime-time in rural America, we anticipate that more of the technology developers will take the time to understand the unique hazards of rural roadways and to bring technology to help our rural communities and farm families.

E Ritchie

Current testing, largely in urban areas with slow-speed vehicles, fails to address the unique challenges of rural roads. These challenges include a wider diversity of speeds, from high-speed vehicles to horse buggies and tractors, more prevalent uncontrolled intersections, and a greater irregularity in roads and road markings. For example, paved vs gravel roads. Omar noted the absence of testing during all four seasons and the potential impact of automated vehicles on rural transportation needs, including healthcare access for a growing and aging rural population. A significant point highlighted was the surprisingly high percentage of traffic fatalities occurring on rural roadways despite this area hosting less of the population.

E Ritchie

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We want to hear from you. Share your stories about health and safety issues on the farm, about injuries that made you change the way you work, or about the ways you keep yourself and others safe on your farm. Also let us know if there's questions you have or topics that you want to hear about on the air. You can visit our website, gpcah.org, or email us.

Original music for the *FarmSafe* podcast was written and performed by Ben Schmidt.

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Episode Resources

- [Omar Ahmad's Project page](#)
- [Traditional roadway hazard study on roadway crashes: Farm vehicle crashes on public roads: Analysis of farm-level factors](#)

Photo

