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Smartphone app aids agencies in collecting road data

Smartphones have replaced several items we previously used in our daily lives as their technologies have improved, with the addition of various internal components such as Global Positioning Systems and sensors. Those internal advances also offer the potential for use in collecting and analyzing road performance data.

While a few such smartphone-based applications (apps) exist for that purpose, none have been tailored to meet the needs of Iowa county engineers. Until now.

Halil Ceylan, director of the Program for Sustainable Pavement Engineering and Research (PROSPER), and his research teams have spent the past few years developing tools that help local agencies perform pavement analysis of their roadways. Most recently that work has resulted in the CyRoads app.

“The insights and recommendations resulting from this research are expected to pave the way for enhanced measurement precision and efficiency, a broader scope of applications, and seamless alignment with extant pavement management information systems,” Ceylan said.

“These improvements can further enable Iowa's local agencies to adeptly collect data on road conditions and refine their maintenance and rehabilitation strategies.”

In addition to the CyRoads app, which is compatible with both Android and iOS platforms, the recently completed research project also developed a Raspberry Pi-driven smart box system that is a more cost-effective alternative than a smartphone. An appendix in the research report includes details on how to access and utilize the app and the smart box.

“The CyRoads app and smart box allow roadway roughness conditions to be surveyed more frequently and cost-effectively, helping Iowa's local agencies promptly identify problematic road segments and make informed maintenance decisions,” Ceylan said.

He added, “The state-of-the-art Python-based algorithm developed in this study for interpreting IRI data offers invaluable insights that can equip Iowa's local agencies with a deeper comprehension of roadway roughness conditions.”

Ceylan, with another research team, previously developed the Iowa Pavement Analysis Techniques (IPAT), an Excel-based automation tool that Iowa county engineers can use to estimate the project- and network-level pavement performance and remaining service life.

Smartphone app continued on page 3



CyRoads smartphone app

Acronyms and Abbreviations in *Technology News*

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
FHWA	Federal Highway Administration
ICEA	Iowa County Engineers Association
IHRB	Iowa Highway Research Board
InTrans	Institute for Transportation (at ISU)
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of County Engineers
TRB	Transportation Research Board

About LTAP

LTAP is a national program of the FHWA. Iowa LTAP, which produces *Technology News*, is financed by the FHWA and the Iowa DOT and administered by the Institute for Transportation at Iowa State University:

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From the Director: The Way of Deep Seeing

Last quarter in this column, I wrote about the “action of non-action.” How sometimes the best approach to a situation may be to do nothing. This subject made me think about how we (and other living things) communicate nonverbally. You may have heard, at some point, that over 90% of our communication is nonverbal. This statement is actually what I would call a simplification of the results from a 1967 research study. In this study, based on my non-expert understanding, participants were asked to listen to words being spoken and also to look at photos. These inputs were varied as part of the project. They were then asked to define the intention of the person. The results were that 7% of the participant judgement was based on the words spoken, 38% on tone, and 55% on facial expressions. One conclusion, when the verbal and nonverbal messages provided by a person don't match, is that people tend toward the nonverbal communication. Think of how people sometimes say “bless your heart,” for example, and you can see how this interaction can change what is communicated depending on their tone or expression.

The receiving and interpreting of nonverbal communications is a skill, especially when it is subtle. I'm far from an expert on the subject. Oh boy, am I not an expert. But, I would guess the process, at the very least, requires one to pay close attention to the speaker, have empathy for their emotions, and an understanding of as much situational context as you can gather. What this sounds like to me is active or deep listening—with the eyes. It is the act, according to my thinking, of being fully present and aware of what is happening during the conversation and regulating your own emotions, thoughts, and actions. Deep seeing, like deep listening, requires putting judgments aside and being open to the situation.

There are also nonverbal communications that people can't control or don't know they are doing. One example includes pupil dilation. It's been shown that pupil dilation means someone is interested in you or what you are saying (or that it's dark, of course!). Also, if someone raises their eyebrows for a split second when they are greeting you, it means they are happy to see you or attracted to you. There are even those that suggest a significance to which direction people are looking (although based my small review, there seems to be some debate about this one). There are many others, and also all kinds of variables that can “cross the wires” in interpreting nonverbal communication. At least I think so because it happens to me all the time.

This spring, LTAP is offering a lot of opportunities for training and recognition. Many people are taking advantage of our flagger training. LTAP staff is out on-site just about every day this time of the year. Registration is also open for a new webinar series on the basics of construction inspection, and also for on-site events like the Excavation Safety Workshops, Accessible Sidewalks and Curb Ramps: Design to Installation, and the County Engineers Research Focus Group. Registration should also open soon for Motor Grader Operator and the DOT Culvert and Bridge Backwater Program workshops. Note, however, our registration system has been experiencing a few glitches. If you run into anything unusual, please contact me to either correct the problem or check to see if your registration went through.

Also, don't forget to submit your Mousetrap ideas by May 10. You get free training registrations and food if you win.

Gratefully,
Keith ■

Smartphone app continued from page 1

Another of Ceylan's teams developed the Pavement Structural Analysis Tool (PSAT), a Microsoft Excel, macro, and Visual Basic for Applications (VBA)-based automation tool that local agencies can use to estimate the structural capacities of in-service pavements for three different pavement

types. It also analyzes up to 10 pavement layers by using the equivalent layer theory, where multilayered pavement systems are converted into three-layered systems

For more information about the CyRoads app development research

and to access the research report, visit the project page at <https://intrans.iastate.edu/research/completed/development-of-a-smartphone-based-road-performance-data-collection-tool/>. ■

“The CyRoads app and smart box allow roadway roughness conditions to be surveyed more frequently and cost-effectively, helping Iowa’s local agencies promptly identify problematic road segments and make informed maintenance decisions.”

—Halil Ceylan, PROSPER director

In brief: Lasting LTAP impacts

The Iowa LTAP continues to expand its Equipment Loan Program. A pavement marking retroreflectometer has been added to the collection and will soon become available for free loans.

In August 2022, the FHWA published a final rule adding provisions for maintaining minimum levels of pavement marking retroreflectivity to the MUTCD. Incorporated into the then-current 10th edition (2009) of the manual, they are also included in the 11th edition (2023). The MUTCD also provides several methods to track and manage pavement marking retroreflectivity, including direct measurement.

These new minimum retroreflectivity levels refer broadly to high-speed, high-volume roadways (35 to 70+ mph, 6,000+ vehicles per day). Although the majority of local agency roads do not fall under the MUTCD minimums, the Iowa LTAP wanted to provide local agencies with the option of measuring marking retroreflectivity, if desired. LTAP's recent acquisition of a DELTA LTL3500 pavement marking retroreflectometer serves that purpose.

The device works similar to a sign retroreflectometer. After turning the device on, it is placed on the pavement marking location that will be measured, and the user presses a button to collect the measurement. Measurements are collected in dry, daylight conditions, as the unit is designed to block out ambient light and mimic vehicle headlights. Data is stored electronically within the memory of the device for later download and review in the office. The unit is lightweight and has an extendable handle, allowing the user to collect measurements while walking along a roadway without having to stoop down to pavement level.

LTAP staff would like to answer one commonly asked question regarding the measurement of pavement marking retroreflectivity:

Q: Can I use a sign retroreflectometer to collect measurements?

A: No, as the light angles of a sign retroreflectometer are aimed to mimic vehicle headlights hitting a sign face, and these differ from the angles of light hitting a pavement marking.

Once available to loan, more information on how to request the DELTA LTL3500 pavement will be available here: <https://iowaltap.iastate.edu/equipment-loan-program/>. As always, the entire collection is available to loan, free-of-charge. Don't forget to check out the currently available equipment and share your impact story with us! ■



Pavement marking retroreflectometer

Iowa LTAP Mission

To foster a safe, efficient, and environmentally sound transportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer, thus improving the quality of life for Iowans.

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Technology News to transition to all-electronic edition

LTAP plans to publish final print copy in December 2024, seeks subscriber emails

After more than 40 years of printing a regular *Technology News* edition, the Iowa LTAP is planning to transition to an all-electronic newsletter by the end of 2024.

While staff are still solidifying details of the transition, we're announcing early and hoping readers will want to continue to hear from us after the printing ends.

For those who **already receive** the electronic edition of *Technology News* or who already receive our Iowa LTAP Biweekly Resource newsletter, you have been **automatically added** to our electronic edition.

For those **not currently subscribed** to our electronic editions but would like to continue to receive *Technology News* after printing ends, **join the electronic newsletter** edition by going to the Iowa LTAP home page (<https://iowaltap.iastate.edu/>), clicking on the *Subscribe to Our List* link, and filling out the requisite information.

During this transition time period, please reach out to Director Keith Knapp (kknapp@iastate.edu or 515-294-8817) with any feedback or thoughts. We appreciate input on everything Iowa LTAP does, and we thank you in advance for bearing with us during this time.

Background on the transition

Within three months of the Iowa LTAP being established at ISU in 1983, the staff had put together and printed its first *Technology News* newsletter, a publication that has been printed on a regular basis ever since.

From a high of about 3,000 print subscribers in 1999, *Technology News* still goes out to nearly 1,300 readers each quarter. However, new subscription requests during the past nearly 5 years skew toward preferring an electronic copy of the newsletter (82% prefer either electronic or both electronic and physical, just 17 percent only want a physical copy).

Additionally, since the COVID-19 pandemic required Iowa LTAP to take all of its efforts online and necessarily increase its electronic mailings, we now have a strong mailing list and a reader base accustomed to hearing from us online and in a timelier manner.

Iowa LTAP staff have been discussing this possible transition from print internally and with the advisory board for about the past 5 years, and put simply by Director Keith Knapp, "It's time." ■



Technology News newsletter looks through the years, in 1989 (left) and 1995 (right)

Iowa LTAP's resources now includes webpage on CDL regulations

Regulations related to entry-level drivers seeking to obtain their commercial driver's license (CDL) took effect in February 2022. The Entry-Level Driver Training (ELDT) regulations and associated Training Provider Registry were mandated under the Moving Ahead for Progress in the 21st Century Act (MAP-21) of 2012.

The training requirements (including theory and behind-the-wheel training) under the ELDT apply to those seeking the following licenses:

- Obtain a Class A or Class B CDL for the first time
- Upgrade an existing Class B CDL to a Class A CDL
- Obtain a school bus (S), passenger (P), or hazardous materials (H) endorsement for the first time

Note that per the Federal Motor Carrier Safety Association (FMCSA) that oversees the new regulations the requirements are not retroactive, meaning individuals who were issued a CDL or an S, P, or H

endorsement prior to February 7, 2022, are not required to complete training for the respective CDL or endorsement.

The Iowa LTAP is committed to providing technical assistance to Iowa's local governments, which includes providing resources to help these agencies navigate federal regulations. The webpage available under the Resources dropdown menu on the Iowa LTAP home page (<https://iowaltap.iastate.edu>) or directly at <https://iowaltap.iastate.edu/cdl-resources>. One resource available on the site that looks pretty great is Ohio LTAP's CDL training for local public agencies page, which includes a video on how to set up a program: <https://www.transportation.ohio.gov/programs/ltap/technical-assistance/cdl-training>.

The links and details provided on the webpage aim to provide comprehensive information about the training requirements and opportunities available. However, if there's more information we can provide, please don't hesitate to reach out.

The resources include links to the FMCSA's overview pages and its Training Provider Registry page, the Iowa DOT's CDL page for Iowa-specific information, Ohio LTAP theory training modules (noted above), and Clear Roads' project page providing resources for maintenance equipment operators. Additionally, the page includes links to two Iowa LTAP webinars that have previously been held related to the topic. This topic is also regularly included on agendas at ICEA and APWA meetings and conferences.

The most recent Iowa LTAP webinar included a panel of city representatives (from Des Moines, Cedar Rapids, Ames, and Iowa City) who weighed in on their implementation efforts. The Iowa Public Works Service Bureau (PWSB) also has a forum topic related to ELDT open to members (membership is free), and those with additional questions about the topic can continue the conversation. Find out more about the Iowa PWSB at <https://iowapwsb.org>. ■

Iowa LTAP now accepting applications for Mousetrap contest

Competition deadline is May 10

It is the people on the front lines who often discover the latest and best practices, whether through new gadgets that improve the quality and safety of a project or innovative processes that reduce costs and improve efficiency.

Each year, Iowa LTAP sponsors a statewide Build a Better Mousetrap (BABM) Competition that provides a great opportunity for local agencies to share their new ideas with others.

We are looking for submissions from Iowa's local public agencies (e.g., cities and counties) that have created new solutions to problems or found ways



Clay County's Type 3 barricade weight

to work more effectively. The top three winners are recognized statewide and are offered free workshop registrations.

Local agency employees can learn more about the competition and submit an entry at <https://iowaltap.iastate.edu/iowa-babm-competition/>. The deadline to submit an innovation is May 10, 2024.

Entrants must provide a photo of their invention, details on its cost and savings/benefits to the community, and offer background as to why and how the solution was developed. Videos of the equipment or innovation are strongly encouraged. The entries will be judged on cost savings/benefits to the community, ingenuity, ease of transferability, effectiveness, and video demonstrations.

Clay County won the 2023 Iowa competition for its inventive barricade weights.

More details about previous Iowa winners are available here: <https://iowaltap.iastate.edu/iowa-innovations/>. ■

CP Tech Center publishes reduced carbon guide



Concrete production plant

Transportation agencies across the nation are striving to quantify the environmental impacts and carbon emissions of their pavement materials as part of their overarching endeavor to construct and maintain sustainable pavement systems.

However, before they can quantify their impacts, transportation agencies need tangible strategies to start their projects off successfully by reducing the carbon emissions of their transportation construction materials.

To help agencies reduce the environmental impacts incurred during the production of paving concrete before it leaves the concrete plant, the National Concrete Pavement Technology Center (CP Tech Center) recently published the *Guide for Reducing the Cradle-to-Gate Embodied Carbon Emissions of Paving Concrete*.

Cradle to gate describes the earliest portions of a product's life cycle, from initial material production—such as aggregate mining—through product manufacture at the concrete plant. Embodied carbon emissions are a measure of a material's cradle-to-gate global warming potential, which is estimated from the energy used to extract, process, and transport the raw materials as well as the emissions generated from the manufacturing processes.

The strategies presented in this guide can serve as an important early step in bringing attention to the need for broader carbon reduction during a pavement system life cycle, while implementing quantifiable change at the outset of a project.

Specifically, the guide presents five strategies that can be used separately or in combination and that can result in measurable reductions in the cradle-to-gate embodied carbon emissions of paving concrete. The strategies are summarized as follows and expanded upon in the guide:

1. Target the cementitious binder.
2. Target the concrete mixture to optimize binder content.
3. Reduce the cradle-to-gate embodied carbon emissions of aggregates.
4. Target mixture performance requirements.
5. Consider other factors.

Each strategy is accompanied by an Implementation Table that provides background information about the strategy, a high-level overview of how the strategy can result in lower embodied carbon emissions, and actions and steps that can be taken to implement the strategy. The guide also provides a detailed example method to estimate the embodied carbon emissions of paving concrete.

“Most of the strategies presented can be implemented immediately to produce positive short-term improvements while broader, longer term actions are planned,” reads the guide. “Early successes achieved during the production stage can be built upon to further reduce embodied carbon emissions in later stages of the concrete life cycle.”

The strategies outlined in the guide are well within the scope of the target audience. That is, the agency personnel involved in specifying concrete paving mixtures, their consultants, and contractors and concrete mixture designers can immediately implement these strategies as part of their concrete paving projects going forward.

However, agencies' ability to reduce the embodied carbon of concrete in a given location depends on existing practices and the availability of concrete-making materials, meaning in some cases more dramatic changes may be needed.

The guide was published with funding from and as part of the Federal Highway Administration (FHWA) cooperative agreement Advancing Concrete Pavement Technology Solutions.

This guide and other publications produced as part of the ongoing cooperative agreement are available at the project page: <https://cptechcenter.org/research/in-progress/advancing-concrete-pavement-technology-solutions/>. Additionally, a recent webinar focused on the topic is available on the CP Tech Center's Webinars and Videos page at <https://cptechcenter.org/webinars-and-videos/>. ■

Workshop and conference calendar

[Information current as of March 20, 2024] Iowa LTAP will continue holding both virtual and in-person events and trainings throughout the spring and summer.

For the most up-to-date information about in-person attendance requirements and additional upcoming virtual events, please check regularly at <https://iowaltap.iastate.edu/events/> and consider subscribing to our mail list at <https://iowaltap.iastate.edu/> for email updates.

2024	Event Name	Location	Contact
April			
4–5	APWA Iowa Chapter Spring Conference	West Des Moines	Beth Richards
16–25	Basic Construction Inspection Webinar Series	Webinar (12:00 p.m. CT)	Keith Knapp
23	Excavation Safety Workshops	Storm Lake	Paul Albritton
24	Excavation Safety Workshops	Webster City	Paul Albritton
25	Excavation Safety Workshops	Independence	Paul Albritton
29–10	Safety Inspection of In-Service Bridges – 2 Week – (NHI Course 130055)	Ames	Paul Albritton
30	Accessible Sidewalks and Curb Ramps: Design to Installation	Ames	Keith Knapp
30	Excavation Safety Workshops	Atlantic	Paul Albritton
May			
1	County Engineers Research Focus Group	Ames	Keith Knapp
1	Excavation Safety Workshops	Indianola	Paul Albritton
2	Excavation Safety Workshops	Fairfield	Paul Albritton
14	Motor Grader Operator Workshops	Cherokee	Paul Albritton
15	Motor Grader Operator Workshops	Clarion	Paul Albritton
16	Motor Grader Operator Workshops	Independence	Paul Albritton
21	Motor Grader Operator Workshops	Atlantic	Paul Albritton
22	Motor Grader Operator Workshops	Indianola	Paul Albritton
23	Motor Grader Operator Workshops	Ainsworth	Paul Albritton

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Event details and online registration

Watch for details and online registration information, by specific dates and events, on the Iowa LTAP Workshops page, iowaltap.iastate.edu/workshops/. ■

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