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Bi-Annual Report for MassDOT & City of Boston

H1 2024

Background

Since its inception in 2020, Motional has been dedicated to making driverless vehicles safe, reliable, and accessible. Supported by shareholders of Aptiv and Hyundai Motor Group, Motional has made significant strides toward this goal.

In recent years, Motional introduced the all-electric IONIQ 5 robotaxi, the world's first fully-integrated Level 4 autonomous vehicle ("AV"), mass-produced with a smart, flexible cell-based production system. The IONIQ 5 robotaxi is also among the first autonomous vehicles certified under U.S. Federal Motor Vehicle Safety Standards. Motional has established industry-leading partnerships with major ride-hail companies, including Uber and Lyft, to deploy AVs on their networks. The company has introduced driverless technology to the public, completing over 100,000

autonomous rides in Las Vegas and thousands of autonomous food deliveries in Los Angeles, solidifying its position as a leader in the AV industry.

Recently, Motional announced the closing of a \$475 million funding round from Hyundai Motor Group ("HMG"), underscoring HMG's belief in the strategic importance of autonomous technology and confidence in Motional's market potential.

However, large-scale driverless deployment will not occur overnight. Autonomous vehicles will enter the market when the technology has matured and the business case for deployment is clear. While Motional is pleased with its technical progress and initial commercial deployments, large-scale deployment remains a future goal.

In collaboration with its shareholders, Motional has updated its strategic plan to focus on the continued development and generalization of core driverless technology, while de-emphasizing near-term commercial deployments and ancillary activities.

Motional remains confident in its mission to transform personal mobility through driverless vehicles, with the potential to improve roadway safety, reduce emissions, and enhance the overall transportation experience.

Testing activity

Our testing efforts continue to focus on the Hyundai IONIQ 5 platform, which includes more advanced hardware and technical capabilities compared to our previous vehicles. This vehicle incorporates passenger experience features for ride hailing, including a passenger display that shows ride information, remote control assist button to help passengers connect with a representative, and external displays and lights that help passengers identify their vehicle.

Operational Design Domain (ODD)

Our AVs are designed to operate in low-speed, urban environments in various conditions. We validate vehicle performance using simulation and bench tests and in a closed-course setting before operating on public roads. To date, we have experience testing on public streets with a variety of road actors, including heavy vehicle traffic, emergency vehicles, construction, cyclists, and pedestrians. Additionally, we have operated our AVs safely in daytime and

nighttime, and windy, rainy, and snowy conditions in closed-course and public road environments.

Amount of testing

AV testing in Boston, MA on public roads and private test track was paused at the start of 2024. There are no immediate plans to restart testing.

Takeover procedure

Our vehicle operators can take over and manually control the vehicle in any situation in which they feel uncomfortable or unsafe. Planned takeovers are also done when finishing a mission or approaching situations that are not within the outlined testing environment.

A examples of typical takeovers include the following:

- When emergency vehicles are in active operation (e.g., sirens and lights activated) on the roadway;
- When law enforcement officers are manually directing traffic in intersections through which our AVs are traveling;
- When construction vehicles are obstructing our lane of travel;
- When oncoming vehicles or bicycles violate lane boundaries;
- When weather conditions deteriorate rapidly; and,
- When other vehicles are exhibiting erratic behavior near our AVs.

A vehicle operator's decision to take over manual control in a given situation does not necessarily indicate that continued autonomous operation in that situation would be unsafe. Because we instruct our vehicle operators to err on the side of caution, we expect that takeovers will occur in many cases in which the AV would have handled the situation without incident.

Description of ADS system failures

We did not experience any unanticipated failures or disruptions while driving in autonomous mode. As we explain above in greater detail, in specific traffic scenarios, our vehicle operators take over manual control because of known limitations of the current state of AV software.

Goals for future testing

New goals will be outlined when testing activities resume in Boston.

Insights

Without testing in Boston in 2024, Motional has limited local insights to provide. However, advancements continue in Las Vegas, particularly with the perception system of the IONIQ 5 robotaxis. Las Vegas, with its iconic hotels, brightly lit billboards, and crowded sidewalks, offers a unique testing environment.

Navigating The Strip presents significant challenges for human drivers due to the sensory overload, but Motional's robotaxis are designed to focus solely on the driving

environment. These autonomous vehicles ignore distractions like casino promotions and concert advertisements, concentrating only on road and sidewalk activity.

With road accidents on the rise and distracted driving a leading cause, Motional views its robotaxis as a safer mobility option for tourists and residents. The National Highway Safety Administration reported over 19,000 vehicle-related fatalities in the first half of 2023. While this is a decrease from 2022, it represents a 27 percent increase since 2013, with distracted driving contributing to nearly 10 percent of fatal accidents in 2021.

Motional's AVs utilize a network of sensors, processors, and controllers to replicate human driving actions. The perception system, which identifies objects around the vehicle, relies on data from cameras, radars, lidars, and microphones to create a comprehensive 360-degree view. Advanced AI models classify objects such as vehicles, cyclists, and construction cones, to enable accurate navigation. Extensive data collection from testing in diverse locations, including Las Vegas, Boston, Pittsburgh, Los Angeles, and Singapore, enhances the system's performance.

Las Vegas offers unique challenges with its blend of video billboards, exotic cars, and crowded streets. Motional's perception system can distinguish real objects from distractions like high-resolution screen images, preventing errors in navigation. The system fuses data

from multiple sensors to maintain accuracy, filtering out irrelevant visual noise.

Motional's robotaxis are designed to provide safe, comfortable rides, unaffected by the glitz and glamor of Las Vegas. This rigorous testing environment not only ensures the technology's reliability but also contributes to the continuous improvement of autonomous driving systems, reinforcing Motional's commitment to transforming personal mobility.

Feedback for municipal and state transportation engineers, planners, and policymakers

Decisions regarding monitoring or communication devices for autonomous vehicles should be made within standards bodies that include diverse representation from industry, public sector, automotive hardware experts, first responders, and other relevant stakeholders. When design decisions, such as the specific method (visual, audio, etc.), are made in isolation by policymakers who consult only a few parties individually, achieving a safe and effective consensus becomes nearly impossible.

For example, in California, Assembly Member Ting is proposing a method for first responders to interact with an AV. The intention is commendable: if an AV is immobilized, first

responders need to feel safe approaching the vehicle, ensuring it won't start driving on its own during a crash scene. However, various proposals intended to address this issue have inadvertently introduced new problems. A remote override, for instance, poses significant cybersecurity and safety risks. A loud sound could conflict with best practices and be mistaken for sirens, while certain flashing or visual cues could also lead to confusion. Scrolling text can be distracting to other drivers.

Currently, companies like Motional invite first responders to learn about their vehicles and provide them with an interaction guide for situations involving an immobilized AV. Our competitors follow similar practices. However, there is no universally agreed-upon standard across the industry and first responders for handling these scenarios. Establishing such a standard requires the involvement of a body like SAE (Society of Automotive Engineers) or a similar organization, where diverse perspectives can be considered, and a consensus can be reached.

Relying on a policymaker to quickly devise a solution ahead of a legislative deadline often leads to incomplete and potentially unsafe measures. The process should involve thorough deliberation within a standards body, allowing for comprehensive evaluation and testing of proposed solutions. This collaborative approach ensures that all potential risks and benefits are thoroughly assessed, leading to safer and more effective

standards for AV interaction with first responders.

By engaging a wide range of stakeholders in the decision-making process, we can develop robust, well-rounded standards that enhance the safety and reliability of AVs. This collaborative method fosters innovation while ensuring that all parties' concerns are addressed, ultimately leading to safer and more effective integration of AVs into our transportation systems.