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An interview with Allen Nejah, CEO of InfiniGear Robotics, Inc.

EV Gearheads: Thank you for joining us today. Can you introduce yourself and tell us a little about your background?

Allen Nejah: It's a pleasure to be here, thank you. I'm Allen Nejah and I've been an entrepreneur and high tech developer in Silicon Valley for over 25 years. I have founded multiple technology startups that have provided product and technology development for more than 400 customers, including Fortune 100 firms and government agencies. I architected and managed projects across industries including connected cars, aerospace, medical, semiconductor, consumer products and IoT.

I am now focused on our new venture, InfiniGear Robotics. This is particularly exciting because it has the potential for huge impact, both economic and environmental. Our engineering team has spent the last 5 years developing the technology for AI robotic transmissions. We believe these will revolutionize EVs and especially heavy vehicle mobility.

EVG: Before we hear more about how it works, what was the inspiration behind the technology?

Allen: This might surprise you, but the inspiration came when I stopped playing in a Division 1 soccer league due to multiple knee injuries. I picked up mountain biking as a new sport. Whenever I was climbing a steep hill and had the challenge of changing gears, I thought "there has to be a better way!" This question about gear changing kept running through my head while driving around and seeing big rigs struggle to slowly climb hills. A couple of months later, an idea popped into my head. Shortly after that, I wrote down the original concept of a telescopic gear mechanism, which became the heart of the iGear system.

EVG: It's funny how often small annoyances lead to big ideas. Before you tell us how you went from that "aha" moment to an AI robotic transmission, could you first briefly explain what a transmission does?

Allen: Absolutely. The automotive industry has relied on traditional transmissions for decades. A transmission, which is sometimes also called a gearbox, is a mechanical device which uses a gear set—two or more gears working together—to change and adjust speed and torque in a vehicle. Transmission systems, often having well over 1000 components, have been essential for vehicles ranging from motorcycles and passenger vehicles to semi-trucks and massive mining machinery. This is how a vehicle is able to generate torque and run at a variety of speeds or handle load when driving on different inclines.

EVG: Got it. So it sounds like transmissions were a great invention?

Allen: Despite their effectiveness, transmissions are complex and heavy, and require significant maintenance. The introduction of Continuously Variable Transmissions (CVTs) aimed to address some of these issues by offering a lighter, more efficient solution, though they introduced their own set of challenges, including reduced performance under load, new complex maintenance issues, and a poorer driving experience.

EVG: What about hybrid vehicles and EVs?

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Allen: With hybrids, to get more fuel efficiency, manufacturers needed to reduce weight and increase gearbox efficiency. The vehicle manufacturers went with the best transmission option available at the time: Continuously Variable Transmissions, or CVTs. CVTs introduced a belt and pulley system to continuously vary the gear ratio. This promised more efficient shifting and better fuel economy due to lighter weight. However, a slight improvement in efficiency came at a heavy cost of poor driver performance, slippage under load, and a new set of maintenance issues. Have you ever been in a hybrid that jerked when starting to go uphill? That's the CVT pulley slipping problem. CVTs also have known maintenance issues – manufacturers are not fans of the technology.

EVG: With the rise of electric vehicles (EVs), have transmissions evolved, and if so, what challenges have arisen, particularly for heavy vehicles?

Allen: EVs changed the game. With EVs, electric motors deliver power to the drivetrain almost instantly, making traditional transmissions seem obsolete for small passenger vehicles. However, there were challenges due to the limited range of the motor rpm and torque. This was not a big issue for small passenger vehicles, due to their lighter weight and lower torque requirements, but they still had performance issues. People were surprised that their car's battery charge dropped more quickly, and they had less range on the highway versus in-town driving. However, heavy vehicles, such as semi-trucks, suvs, vans and buses, presented a unique challenge. They must have gearboxes that provide gear ratios up to 10:1 to efficiently handle large payloads. Basically, the function of a transmission is essential for heavy vehicles.

The shift to electricified heavy vehicles necessitated a new transmission solution that could meet their specific load and efficiency requirements without compromising performance due to complexity, size and weight. EV semi-trucks and other heavy vehicles also experience poor battery life because what works well at low speeds does not work well at highway speed over long distances where the motors experience heat and stress. In response, EV semi-truck companies have tried to address this by adding multiple motors and batteries, which adds weight complexity and cost.

EVG: That brings us to AI robotic transmissions. Can you share how these work and some of their benefits?

Allen: AI robotic transmissions, employing our patented iGear system, leverage a highly efficient, simplified design. With fewer than 200 components, the design contrasts sharply with traditional transmissions which often have over 1000 components, so this is a lighter, more efficient alternative. The unique feature of the iGear system is the ability for continuous gear ratios that exceed the 10:1 gear ratios required by heavy trucks. We do this through a patented AI software-driven telescoping gear mechanism that allows for dynamic gear ratio adjustments and predictive linear shifting. The technology enables vehicles – heavy vehicles in particular – to operate at peak performance in any condition, significantly extending the range and reducing the environmental impact.

EVG: You mentioned AI. Can you tell us more about how the iGear system uses AI?

Allen: In addition to AI controlling the mechanical, robotic operation of the iGear system, additional AI has a big impact on the driving experience, safety, and energy consumption. We also are expanding the AI applications for safety, performance, and energy efficiency based on

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road conditions, traffic, weather, terrain, and more. The iGear system will communicate with multiple iGear systems within the vehicle, in addition to the vehicle sensor network.

EVG: That sounds remarkable. What makes the iGear transmission stand out in terms of efficiency and sustainability?

Allen: The iGear system is a superior approach because it offers the widest range of gear ratios compared to any current transmission. The transmission energy efficiency will meet or exceed existing technologies while being less complex, smaller, and lighter. Its design supports efficient operation of semi trucks at highway speeds, reducing heat stress on the motor and drivetrain.

The design not only increases the vehicle's range by 25-30% but also meets the higher torque requirements of heavy loads with seamless shifting. It's a green solution that significantly reduces energy waste and charging requirements. The streamlined gearbox design reduces the number and weight of batteries needed, leading to longer ranges or the possibility of using fewer batteries and enabling shorter charging times. This not only reduces operational costs but also minimizes environmental impact by lowering energy waste and charging requirements.

EVG: Where are you currently at with this technology?

Allen: We have a working prototype of the iGear system, both for a "half transmission" with one iGear, and for a full transmission, using 2 iGears. The system is designed to enhance efficiency, simplicity, and versatility in the automotive industry, especially for heavy vehicles.

EVG: Looking towards the future, what impact do you see AI robotic transmissions having on the transportation industry?

Allen: AI robotic transmissions represent a transformational technology for EVs especially the heavy vehicle industry. They offer the potential for semi-trucks and other heavy equipment to operate up to 30% more efficiently, transforming how goods and people move, reducing operational costs, and minimizing environmental impact. This technology is not just about improving vehicles; it's about reshaping industries and leading us towards a more sustainable, efficient future.

EVG: Lastly, what's next for InfiniGear Robotics and the iGear technology?

Allen: We are continuously refining the iGear system to handle even more gearbox applications and exploring partnerships to integrate our technology into various vehicle platforms. Our goal is to make AI robotic transmissions the standard for heavy vehicles, paving the way for a new, green era in heavy vehicle mobility. We're excited about the journey ahead and the impact we can make.

EVG: Thank you for sharing your insights and the exciting developments at InfiniGear Robotics. It's clear that AI robotic transmissions have the potential to redefine heavy vehicle mobility for a greener and more efficient future.

Allen: Thank you for having me. We're just at the beginning of this journey, and I'm thrilled about the possibilities ahead.