

# **Hybrid Humanoid Robot**

(Technical Reports)

## **Autonomous Insights: Shaping Policy through Advanced Autonomous Vehicles Research**

(STS Research Paper)

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By

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On my honor as a University student, I have neither given nor received unauthorized aid  
on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## **Introduction:**

Autonomous vehicles (AVs) are shaping the future of transportation by removing the requirement for human control. Autonomous vehicle implementation offers the potential to improve traffic efficiency and road safety (Litman, 2023). The significant shift from human control vehicles to AVs in driving behavior has placed the policymaker at the forefront of applying research findings to the development and implementation of progressive policy. Autonomous vehicles have not only been implemented into cars on the road but the range of places that AVs have surface is everywhere. It can be the airports, hospitals, shipyards, and even inside the ship helping the workers. In my capstone project, I am working on an autonomous humanoid robot. This humanoid robot will be implemented into the navy ships where it will be able to interact in a human environment and help around the ship. With the robot being placed into the workplace they will be able to do jobs that are too dangerous for the human to do. Since robots will do dangerous jobs around the ship, the policies on safety concerns can be updated accordingly. The policies will keep on changing to best fit the situation.

With the AVs now being placed on the roads where they will be able to interact with other AVs and make decisions with that information, new policies are likely to follow these changes. Since there is a lot of research regarding how AVs work and how they will be able to drive on the roads with other cars, the policymaker should use this information from the researchers and use it to update the policies according to the changes that will come with the implementation of AVs. There are a lot of factors that the policy maker should consider when making these changes to the policies. Policy makers should actively engage with researchers, industry experts, and the public to develop policies that address the challenges and opportunities presented by the

implementation of AVs. By staying informed about the latest research findings and technological developments, policy makers can create a regulatory framework that fosters safe, efficient, and responsible integration of AVs into transportation systems. There are a lot of factors that makes AVs interesting to test and see affect of those progression on the policy making for AVs. Policy makers can work with researchers to understand the impact of AVs on traffic patterns and use this information to develop policies that encourage the adoption of AVs and manage traffic in mixed AV and human-driven environments. The research group from International Journal of Environmental Research and Public Health stats that, “Existing literature in this regard suggests that noticeable emission benefits of AVs at the network level can be achieved at penetration rates ranging between 30% and 50%”(Massar, p.12). AVs also have the potential to reduce greenhouse gas emissions through improved traffic flow and the potential for electrification. The most intersecting aspect that keeps on changing with AVs is their safety feature. It can have a massive impact on the shape of the future policy making and policy make needs to account for all the research and adapt to the changes.

Safety regulation is one of the policies that changes as there are new updates to autonomous vehicle are made. During the Google Self-driving car project between 2014 and 2018, there has been notably high accident reports when driving the car in autonomous driving mode in comparison to conventional manual-mode driving. Autonomous driving mode caused 63.3% of the accident reported while conventional manual driving only caused 36.7% of the 128 accident reported (Wang, Zhang, Huang, & Zhao, 2020, p.6). With the constant improvement of the AVs it has been noted that In a more recent report from California Department of Motor Vehicles, “It is also interesting to find that only a small portion (around 6.3%) of the total accidents is caused by the AVs, while 93.7% of the accidents are caused by the other

parties, including pedestrians, cyclists, motorcycles, and conventional vehicles” (Wang, Zhang, Huang, & Zhao, p.8). This has caused more companies to invest their time into testing AVs. With the constant improvement of AVs and increasing automation, it has been predicted that the road accident could be reduced by 50% by 2050 and completely reduced by 2070 (Winkle, 2016). Autonomous vehicles have the potential to enhance road safety, primarily by reducing human errors, which are a leading cause of accidents. Policy makers can utilize research findings to set safety standards, testing procedures, and certifications for AV manufacturers.

In my STS research project, I'm studying how safety policies for Autonomous Vehicles (AVs) have changed. I'll investigate updates based on testing and overall improvements in AV safety and how have those changes affected the policies made by policy maker. This research aims to understand how regulations are adapting to advancements in AV safety.

### **Technical Topic: Hybrid Humanoid Robot(HHR)**

Hybrid Humanoid Robot (HHR) is to be implemented into the Navy ships where it should be able to work in a human centric environment without hindering human work. Moniz states that robot and human are becoming co-workers, “With the increased involvement of humans and autonomous systems, or coworking scenarios, the robots and humans must cooperate to fulfill a common goal” (Moniz, 2013). The main objective of our CAPSTONE project is to make it so that the Hybrid Humanoid Robot has no trouble navigating around the Navy’s ships. It shouldn’t run into any obstacles such as climbing the ladder or opening watertight doors. There are many customer needs for the HHR but we were able to simplify just a couple of the problems that we need to find the solutions to. The HHR needs to be able to

Compliant wheel/foot mechanism where the tire can inflate and deflate according to the needs of the terrain. Compliant mechanism is a type of flexible mechanism that accomplishes the transmission of force and motion by relying on the deformation of its elastic body. When the robot is on a flat surface the tire can inflate so it can use its wheels to navigate around the ship more effectively. The tire should deflate when it encounters obstacles such as ladders or a step to open the watertight door. When the tire deflates, the HHR should be able to use its foot to navigate. This helps the HHR be efficient on both even and uneven floors.

Before looking into a hybrid humanoid robot that has a wheel/foot mechanism, we need to research Wheeled Humanoid Robots and Bipedal Humanoid Robots. ATHENa (Adjustably Designed Torque-controlled Humanoid for the Environment of NAavy) has been one of our biggest influences on the Bipedal Humanoid Robots where we essentially will be producing the same interface when it comes to the foot mechanism side of the robot. (Sifat, 2018) We need to use similar methods to find the center of gravity of robots and be able to control them using a Robot Operating System. This will help the robot find its center of gravity when climbing the ladder without losing its balance. Wheeled Humanoid Robots are used because convenience of wheeled design allows simple translational commands to be given for the robot.

HHR needs to be autonomous for it to work properly around the ship without needing any extra help from humans. There has been a lot of research around autonomous robots where the robot has been able to work in a human-centric environment without interfering with other humans at work. Husky by Clearpath Robotics has been a great example of autonomous robots which have been put to work. It uses a software called OutdoorNav: The Clearpath article states, “OutdoorNav allows unmanned ground vehicles to navigate outdoor environments with

high precision, accuracy, and safety ”(Munir, 2023). It also uses thermal sensors to see any obstacles so it would be able to work around them. Thermal sensors and other software will be used in HHR so it will be able to detect obstacles such as ladders so it can form into its foot mechanism and vice versa. “The future of robots continues to be predicted by many experts. One of the most worrying problems for humans is that robots will completely replace human workers in the future”(Khang, Rani, and Sivaraman, 2023, p.116). This statement allows the government to be worried about the future and to take action to implement new policies to keep the autonomous vehicles in control.

### **STS Topic: Shaping Policy through Advanced Autonomous Vehicles Research**

Fast paced changes of the autonomous vehicle lead the policy makers to use the research done on autonomous vehicles to make updates on the policies to best accommodate these changes. How has the safety policy for autonomous vehicle has changed through the years since the first implantation of AVs to the AVs that’s on the road? I will be focusing on the safety policy are ensured by National Highway Traffic Safety Administration otherwise known as NHTSA. NHTSA is a US government agency that focuses on ensuring the safety of motor vehicles and road users through regulations, research, and education. According to the NHTSA driver error is believed to be the main reason behind over 90% of all crashes. Errors such as speeding, aggressive driving, overcompensation, inexperience, slow reaction times, inattention and various other driver shortcomings(National Highway Traffic Safety Administration, 2008). Autonomous vehicles plans to get rid of human errors and make the vehicle fully automated where accidents are less likely to occur. This is the case for the future and it still has a long way to go before AVs are fully reliable on automated driving. For now NHTSA has to enforce

policies on the semi autonomous vehicles so there are any mistakes on the road due to mistake that can be made by AVs. Since they are not fully automated, they should be some kind of tracking system where it tracks that the driver is still paying attention to the road. As noted by the International Research Journal of Engineering and Technology about how Tesla went about this problem, “Drivers must keep their hands on the steering wheel, as they claim it hasn’t yet reached full autonomy”(Ingle & Phute,2016, p.372). NHTSA should enforce a policy that makes the driver be the person that still control the driver now and then instead of relaying on the automation fully.

Autonomous vehicles have made so that it would be able move through traffic safely and smoothly if is made properly. The more integration of AVs into traffic the faster the traffic will be able to move because they would be able to communicate with each other according. According to the Science of Total Environment, “when considering mixed scenarios with conventional and autonomous vehicles, pollution decreases as the presence of AVs in the traffic flow increases” (Silva, 2022, p.8). To encourage the adoption of autonomous vehicles and amplify these positive impacts, government policies should provide incentives for their purchase. Such incentives would likely drive increased consumer interest and contribute positively to environmental sustainability. As these vehicles evolve, regulations must adapt to ensure the safety and efficiency of their integration into existing traffic systems. Regulations should not only address safety concerns but also navigate the complex landscape of data privacy and environmental impact.

Autonomous vehicle have a long way to go to be fully automated and not make any mistakes on the road. According to the Forum written by the Policy Forum, it states, “ AVs are still having trouble identifying road hazards and potential obstacles reasonably expected to be in

the driving path. The lack of regulation has allowed these unproven vehicles onto our roads”(Claybrook & Kildare, 2018, p.36). Without NHTSA moving forward and putting in place a policy where it makes it so that AVs are not getting integrating into road without passing a test. A test where it would be able identify any unusual hazards on the roads and be able to move through traffic without causing much problems. It should not make mistakes that would put the driver or the passengers in danger.

### **Conclusion:**

As autonomous vehicles become more integrated into our society and become more integral parts of our transportation, NHTSA face challenges to maximizing the benefits and addressing potential pitfalls. Similarly, the integration of Hybrid Humanoid Robots (HHR) into various environments, such as navy ships, present both opportunities and challenges for policy makers. Regulations and policies must adapt to ensure safety, efficiency, and sustainability as technology advances NHTSA has a lot of resources on the how the safety policy for autonomous vehicle have changed throughout years and discussion on how they will be perusing new policies in the future. I will be research on how they are planning to move forward with this and predicting what will come in the future of autonomous vehicle.



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