The Impacts of Autonomous Systems and How it Affects Society

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On my honor as a University Student, I have neither given nor received unauthorized aid on this
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STS Research Paper

1. Introduction

      Autonomous systems are a rapidly growing industry, ranging from autonomous cars to autonomous machines that make cars, this leading industry promises a lot of benefits, promoting a system where safety, efficiency, and quality of life features are of the top quality. However with more technological innovations and advancements coming out as time passes by, There are discussions to be made on how society will be affected by it. Multiple people in society have been wondering how jobs will be affected, how safe it is to trust autonomous systems, and many more have made an argument over how this industry will pan out in its application, some leaning over the fact that AI will take over jobs. According to a report by Pew Research, Alex Howard, a writer and editor based in Washington, D.C., stated, "I expect that automation and AI will have had a substantial impact on white-collar jobs, particularly back-office functions in clinics, in law firms, like medical secretaries, transcriptionists, or paralegals" (Pew Research, 2014, para. 16). Jonathan Grudin, principal researcher for Microsoft, concurred, asserting, "Technology will continue to disrupt jobs, but more jobs seem likely to be created" (Pew Research, 2014, para. 7). These perspectives have generated considerable debate surrounding autonomous systems. Supporters argue that such systems enhance work efficiency, reduce human error, and facilitate job tasks. However, critics contend that they displace human workers, pose privacy concerns, and may not operate as safely as advertised, leaving the decision to adopt them unresolved.

      Having this much controversy, it is important for one to be informed about autonomous systems and the ongoing situation with it, which has led us to the goal of this paper, this paper aims to deep dive into the complex world of autonomous systems, taking in perspectives from multiple faucets of education and analyzing the disciplinary steps that are taken in the operation of it. By going through the challenges and successes in autonomous systems, we can understand more about autonomous systems and inform readers of the importance of having awareness of them and how to deal with the rapid pace of adoption.

2. Background and Significance

Autonomous systems, which are often associated with Artificial Intelligence, are machines or systems made to be capable of doing tasks without human supervision, these systems or machines can range from autonomous vehicles which are the most prominent topic of discussion right now, all the way to drones or personal assistants. The development of autonomous systems comes from multiple faucets of engineering and computer science. According to the U.S. Department of Transportation (2019), substantial financial backing from multiple sectors, including government agencies, has propelled the advancement of autonomous technology. The Department highlights significant investments, such as the allocation of approximately $60 million in the Automated Driving Systems (ADS) Demonstration Grant (U.S. Department of Transportation, 2019). This funding initiative aims to incentivize research and development efforts focused on improving autonomous driving capabilities, demonstrating a broader commitment to advancing this technology.

Here we focus on the importance of analyzing and studying the social impacts of autonomous systems. Usually one would focus on the technological aspects more, but people don't realize that if society isn't prepared to react to autonomous systems properly, there will be a lot of dismay amongst them. To do this we highlight the benefits and risks of introducing autonomous systems into society, with the first being having the advantage of increased efficiency, safety, and convenience. According to Krnlegal (n.d), citing research from The Insurance Institute for Highway Safety, current self-driving technology has the potential to reduce accidents by approximately 34%; however, autonomous vehicles still encounter challenges in avoiding, planning, deciding, and executing driving tasks (Krnlegal, n.d). This observation extends to various instances of autonomous systems, demonstrating their potential to address societal concerns regarding safety and efficiency. They also have other benefits that can be highlighted in detail even more such as: accessibility, economic impact, sustainability, and many more as demonstrated by Yeruva (Forbes, 2022), which all revolve around the concept of increasing the safety and efficiency of society. However the biggest issue still lies on the risks and the disadvantages that autonomous systems bring which is mainly based on how it impacts the people using it. This consists of

job displacements, privacy, and dependency issues, as far as anyone is concerned these are the primary issues that gets brought up when discussing autonomous systems. Job displacement is arguably the biggest issue here as it directly impacts a lot of people's lives, implementing autonomous systems will automatically cut a big number of human operated jobs with the McKinsey report saying that AI is expected to replace 2.4 million US jobs by 2030, with an additional 12 million occupational shifts. An expected 400 to 800 million people will also lose their jobs due to AI (Hypotenuse, 2023, para. 5). The next main issue we have is privacy and security, since a majority of the population will be using autonomous systems by the time it is implemented, we will be seeing an absurd amount of data being collected by these systems and companies, which leaves the concern to how companies handle this data, even now already people are already complaining about how companies like Amazon, Google, and more are collecting our data and using them without our given permission, the addition of autonomous systems will most likely increase the volume of this data breach, resulting in privacy breaches and potential harm to people if misused by people who have malicious intent, an example of this can be seen recently when Oxen Tech writer, Kelle White stated that T-Mobile revealed that 37 million of its customer's records were stolen in a breach that began in November 2022. According to the company's AI analysts, the threat actor used an application programming interface or API equipped with AI capabilities and could secure unauthorized access, which shows how the misuse of AI can harm people's privacy issues (White, 2024). The last and final issue that gets talked about a lot is dependency issues, with the implementation of autonomous systems and how efficient it will be, it will be natural that society grows attached to these autonomous systems and becomes overly dependent on them, this will cause humans to lose most of the skills that people would have now and pose a risk that humans may be able to lose their control over things and lose their decision making capabilities as they will be too reliant on these systems, Writer Jannik Lindner from Gitnux brings up very revealing data about our society, mentioning that by 2024, more than 50% of user interactions will be augmented by AI-driven algorithms with 77% of society relying too much on technology to succeed, indicating an over-dependence on technology. It is also important to note that 48% of the world's population owns a smartphone (Lindner, 2023, para. 3). While

it may seem as if the last issue isn't necessarily an issue, I would say that these systems won't make us lose control entirely as long as handled properly, but to that I present society nowadays and how they are too reliant on their phones or devices, sure not everybody is attached to their phone, however the majority is and the majority will affect society in the biggest way possible just by sheer volume. After presenting the advantages and disadvantages of autonomous systems, it is easier to see why understanding the basics and the cultural impact this can bring is very important for people to know as it may come in the near future.

3. Methodology

The approach taken for this research question was mainly on how good are autonomous systems and how it could be built upon even further for society to not only accept it better but also to give them the accessibility to handle the implementation of autonomous systems better. In order to research this the information gotten from research has been filtered into either useful, not useful, and could be useful given more time was put into it. This section will also include the struggles and mishaps that are gone through during the research process. The analytical framework that was chosen for the research is the Actor Network Theory (ANT), Lolha (Medium, 2022) describes it as the theory where both humans and non-humans, or what we called actants, hold an equal role in generating network assembly, in other words this framework includes all the stakeholders in question, giving us an more in depth analysis and research of how society is being impacted by autonomous systems in general. This results in analyzing the implementation and adoption of autonomous systems and the impacts or consequences that result from having autonomous systems put in society. With all things into consideration, the exact methods will involve researching multiple sources and using the information filter, using interviews, important documents, and observations of the world and how political figures will come into play in society.

4. Literature Review

If we want to know about what the public perception is towards autonomous systems, we can look into numerous writings that were made by people who are well known in the industry or people who have been known to represent the general masses properly. With this being said there are a few articles

and pieces of literature that discusses autonomous systems that help us fit the broad picture in perspective. The first article is titled "The Social Dilemma of Autonomous Vehicles" by Tim Urban on Wait But Why (Urban, 2015), this article explains the bare bones of autonomous vehicles which have been discussed previously in our background and introduction as it tries to educate people who might not have been aware of it and tries to elaborate the ethical and societal implications that comes with autonomous systems. The piece also dives further into the complex social dynamics that comes with the introduction of autonomous vehicles mainly the politics side of it, which is also discussed a lot in a policy report titled": "Preparing for the Future of Artificial Intelligence" by the National Science and Technology Council, Executive Office of the President of the United States (National Science and Technology Council Committee on Technology, 2016), this document is a policy update of how the government plans on tackling the advancement of Artificial Intelligence (AI) whilst also explaining its societal impacts. The main points that were made mainly consisted of how the big parts of society (government, industry, academia, etc.) should work together in ensuring that AI develops in the way that makes everyone safe and in harmony. Most of the points that are brought up in these pieces emphasize on the responsibility that comes with developing AI or autonomous systems, which is to be expected as it is extremely important that this part of technology develops properly for society to not go into disarray. Andrew Ng, a leading researcher of AI and a co founder of Google Brain, discussed the potential that AI has and its transformative features that it has to society, he also then emphasizes that the handling and development of it needs to be enacted responsibly. In order to understand why this technology needs to be dealt with responsibly, we can create a hypothetical situation in which the worst case scenario happens. Autonomous systems can be mishandled in numerous ways, either we develop it to the point it gets too good and it starts being very hostile towards humans (extreme case), or it becomes so good that it replaces the need for human jobs to exist and creates a massive economic gap, and theoretically there are many more situations that can occur but for now we will go with the second one as it is the most realistic and impactful in an economical sense. If we develop AI to the point where it replaces every trivial job, and even more advanced one, naturally the need for humans will drop, causing a significant amount of jobless

citizens and people, resulting in people unable to afford everyday living, this scenario will directly result in people protesting and causing riots as they will not have a choice. Considering that was one of many scenarios in which AI and autonomous systems can go wrong, this shows how important it is to develop it responsibly and why there needs to be so many people on board in order to ensure that AI and autonomous systems actually contribute to society properly.

5. Discussion and Results

In order to understand how far deep the development of AI and autonomous systems has gone, we need to look at data and trends in order to see how realistic and close we are to being in the situation explained by the pieces of writing or interviews from our credible sources. In an interview conducted by Rishi Sunak, Elon Musk, CEO of X, Tesla, and Space X gives his broad thoughts on AI technology and how it will impact society, Musk acknowledges the potential AI has yet also understands how much it can disrupt the job market, he also delved in deeper on how Open Source vs Closed Source AI development could pose a big argument, but ultimately Musk advocates for the government to get very involved with the development of AI, stating that it needs to be properly regulated and that its potential as an educational tool is tremendously large. In another interview conducted by the channel, 60 Minutes on youtube, host Scott Pelley asks Geoffrey Hinton, a British AI pioneer, questions about how he thinks AI will impact society. Hinton's views were generally similar to Musk's, in which he acknowledges both benefits and risks AI provides, Hinton also presses on the uncertainty surrounding AI's future and how it could cause a world treaty to mitigate the potential risks of it. Overall from both of these interviews, it is clear that both benefits and risks are plausible with AI and that the uncertainty factor is the problem with it, whether it be uncertainty with jobs, uncertainty with behavior, the potential of AI on affecting our society is large, whether it be good ro bad. According to Amanda Russo from the World Economic Forum, a data report of 2024 revealed that automation will have replaced 85 million jobs globally by 2025 (Russo, 2020), which is very close and indicative of how close we are to full automation, in percentages, this means that 30% of jobs will have been replaced by automation which is an alarming number of jobs as the job market for technology services are already at a low as of right now. The same web blog also

mentioned that 70% of tasks that are done in human jobs currently can easily be automated, the only question we have about this is when does automation get affordable enough to the point where business executives and directive boards start taking the option over the human workforce, once that kicks in, the 30% could easily skyrocket up to 50-70% depending on how widespread and ready society is for it. It seems very inevitable that automation replaces most jobs within the next 10 years and that nobody can stop the power of automation as it is too lucrative of an option to not consider, the only one who can stop it? Ourselves really. But what does that really mean, if the public reception to AI and automated systems ends up being very negative, politicians who want to appeal to the public would naturally fight against AI, now in my personal opinion, AI and automated systems are inevitable, eventually most things in our lives will be automated and done by machines, however socially it might be possible to not stop but slow it down to match the pace of the world in a way that everybody can be prepared to face it. This all depends of course on how things actually pan out and how society actually responds to it, it also needs a lot of moving parts to go well as we know that big corporations have a way with influencing political decisions especially when it comes to votes.

6. Conclusion

In conclusion, with the rapidfire growth of AI, it is important to handle and develop it responsibly, as the amount of lives that it can impact is insurmountable and happening in the very near future, so it is important to not only be educated in the matter, but also understand the implications that may come with it. The most critical part of this entire topic is how will the adoption be handled, as public perception is king, it is important to present AI and automated systems in a way that will not be received negatively by the public, we as citizens also need to understand how fast we want this development to be and how it perhaps will not necessarily impact us in the most positive sense. One wrong move and the whole technology industry and AI will never have a good reputation in the public's eyes, as even right now it already is pretty negative considering how they think it will take over everything. I recommend that in the future when the adoption of AI and automated systems actually take place, that the stakeholders and politicians heavily take into consideration how much this piece of technology will

impact our lives, as it is perhaps harder to see this from the eyes of someone directing a multibillion dollar company or someone in politics who's too old to even care of the implications of AI and autonomous systems, however this pans out, I believe it is important that people both accept AI and also understand that the world needs to be ready for the adoption of AI before it can be fully integrated.

References

AI, H. (2024, March 15).

The robopocalypse cometh: What jobs will AI replace by 2030?. What Jobs   Will AI Replace

by 2030? - Hypotenuse AI.

https://www.hypotenuse.ai/blog/what-jobs-will-ai -

replace#:~:text=According%20to%20the%20McKinsey%20report,tasks%20are%20the%20most

%20vulnerable.

Automated Driving System Demonstration Grants. U.S. Department of Transportation. (n.d.).

https://www.transportation.gov/av/grants

Lindner, J. (2023, December 16).

Dependence on technology statistics [fresh research] • gitnux. GITNUX.

https://gitnux.org/dependence-on-technology-

statistics/#:~:text=By%202024%2C%20more%20than%2050,world%27s%20population%20own

s%20a%20smartphone

Self-driving car accident statistics. Kisling, Nestico & Redick. (2023, April 20).

https://www.knrlegal.com/car-accident-lawyer/self-driving-car-accident-

statistics/#:~:text=The%20Insurance%20Institute%20for%20Highway,and%20execution-

related%20driving%20errors.

Smith, A. (2014, August 6).

Ai, robotics, and the future of Jobs. Pew Research Center.

https://www.pewresearch.org/internet/2014/08/06/future-of-jobs/

White, K. (2024, March 6).

Real-life examples of how AI was used to breach businesses. New.

https://oxen.tech/blog/real-life-examples-of-how-ai-was-used-to-breach-businesses-omaha-

ne/#:~:text=Early%20this%20year%2C%20T-

Mobile,and%20could%20secure%20unauthorized%20access.

Yeruva, V. (2022, October 12).

Council post: Autonomous Vehicles and their impact on the economy. Forbes.

https://www.forbes.com/sites/forbestechcouncil/2022/02/14/autonomous-vehicles-and-their-impact-on-the-economy/?sh=21ee67f360de

Preparing for the future of Artificial Intelligence. (2016, October).

https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf

Rishi Sunak. (2023, November 3). Rishi Sunak & Elon Musk: Talk AI, Tech & the Future [Video]. YouTube.

https://www.youtube.com/watch?v=WQdLDMLrYIA

60 Minutes. (2023, October 9). "Godfather of AI" Geoffrey Hinton: The 60 Minutes Interview [Video]. YouTube.

https://www.youtube.com/watch?v=qrvK_KuIeJk

Recession and automation changes our future of work, but there are jobs coming, report says. World Economic Forum. (2020).

https://www.weforum.org/press/2020/10/recession-and-automation-changes-our-future-of-work-but-there-are-jobs-coming-report-says-52c5162fce/