Designing an Artificial Intelligence System to Document Code Automatically

An Analysis of the Impact of Government Regulations on the Tech Industry

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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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The Role of Documentation in the Tech Industry

General Research Problem

What is the importance of government regulations and advancing technology being mutually interdependent?

Wall-E, a romantic love story between two lonesome robots, was also an alarming look into what the future could hold for our beloved planet: A dystopian land covered in trash, yet everyone is still living their "best" life codependent on technology. While the mounds of trash surely seem to be on track as the movie depicts, is everyone truly happy in this reality surrounded by technology.

As a society, we have begun to part ways with our material goods at a much faster rate than in the past. The lifespan of electronic goods like cell phones has been on a decline. The current average for cell phones sits around 2.5 years while researchers have found that the technologies in today's devices have the potential of lasting users up to at least 5 (ComputerCare, 2022). Many attribute this as the direct result of planned obsolescence, an unethical practice where manufacturers deliberately design products to fail prematurely. Whether this shortcoming is fueled by marketing efforts or planned obsolescence is to be determined. What is known are the detrimental impacts of these rapid upgrade cycles, specifically on underprivileged communities and their working and living conditions.

The issue of planned obsolescence can partially be blamed on the lack of tech documentation but also artificial limitations on repair placed by large tech giants. Companies choose to restrict access to board schematics and find ways to keep consumers out of their devices. While unethical, do they have the power to do so or should consumers have complete rights over the devices they purchase? Similarly, documentation in code makes it easier to look

at how various code snippets perform and contribute to the overall functioning of an application. This benefits future developers as it gives them a better understanding to be able to build on top of existing platforms. However, a lack of time and money makes this a difficult endeavor as well.

Maintenance institutes a large portion of the information technologies industry. So far the only example I have provided is cell phones, but every tech product needs maintenance to achieve its complete lifespan. On a slightly larger scale, farmers across America are running into issues keeping farming equipment up and running. Companies like John Deere are among the biggest providers of farming equipment but do not allow owners to repair tractors and other tools on their own accord. Farmers today are looking to buy older equipment so that they can repair it themselves and not have to take it to authorized dealers (Matsakis, 2022). These dealerships are often very expensive and have long delays which can lead to farmers missing crucial deadlines on the delicate harvest cycle. Right to repair has a ripple effect on all kinds of people, therefore, just like the farming community, in the paper I will explore the other less talked about communities that face descrimination from companies that restrict access into their products.

Technological growth is simultaneous with society. This interdependence poses the question, how should governments interact with technology? What should be the extent or limitations of these overall interactions. More specifically I would like to dive into how society should regulate technologies and when does the government have the right to intervene. I would like to explore the repercussions of such policies and look into areas such as which communities are impacted most. Alongside, I will be exploring whether withholding documentation leads to unnecessary waste and if consumers should even have the right to repair the products they buy.

Designing an Artificial Intelligence System to Document Code Automatically

Can Artificial Intelligence be utilized in a manner to help document code?

Documentation of code has been an issue in the tech industry for a long time. Reading code requires an understanding of the overall processes of the entire application and can sometimes assume knowledge that readers don't possess. In certain situations, researchers have found that “the cost of the documentation may outstrip its value” (Newhall & Schrader, 2010). This is discouraging to developers as they may find it expensive and time-consuming and therefore not worth it. Documenting helps with the longevity of the code as it is easier to maintain and utilize in other applications.

The preferred solution to the lack of documentation would be to have software developers start documenting their code. The benefits of this approach are clear as they are the individuals most knowledgeable about their work. The potential downside of this is the time commitment it requires as one is essentially writing the code to create a functioning program and then rewriting the entire process in a natural language. This is a very mundane task for developers that also takes time away from other tasks which may have higher priority. Implementation of new features and fixing bugs have higher priority since they are much more important to the functioning of the overall project. Especially for companies that are smaller in size, they may not have the human capital available to let developers spend company time extensively documenting code.

Another option used in the industry is to hire a company, usually freelance writers, to do code documentation for them. This is often expensive and again cannot be utilized by smaller startups as they may not have the profit margins at the time to support outsourcing work.

For this project, I will design a piece of software that assists developers in the documentation of code. The first iteration would be a sort of standardized automated testing protocol. This could run through the code and see what parameters are being used by specific methods, what's being outputted, and also what's being obtained from other methods referenced within the code. While this would be helpful, it may not give enough information regarding the overall purpose of the code.

To take it this step further I would like to use Artificial Intelligence to transform code into natural language, basically trying to describe the functionality of the code in layman's terms. There is much to explore in the link between natural language and programming language. Using an engine that bridges the two it may be possible to convert between languages such as Python into English. I do not know the feasibility of such software but would like to do more research into it. I have found a couple of companies that work with auto-documenting code for developers. There are open-source projects like Docly which have attempted to take on the problem of documentation using AI. I could build upon what has been done before and take the project in my own direction. I recognize that I will not be able to build an entire ML engine by myself but by using existing resources I could achieve something close to what I am looking for. I will measure the success of the program by using examples of already well-documented code. I would remove the documentation and pass the program through the application to cross-reference the output. For this, I would serve as a moderator to see if the results of my application were similar to the human-made documentation.

Documentation is usually put on the backburner and is a very small part of the development cycle. My goal is to build something that documents code well but also I would like to raise awareness of the importance of documentation. Documentation helps keep the

community thriving as everyone works together instead of leaving people struggling to understand specific applications. Besides code, even the documentation of physical technologies has also been found to be a little lackluster.

An Analysis of the State of Underprivileged Communities Under Current Regulations

What impact has similar legislation to Right-to-Repair had on relevant actors in the past?

Right to repair is the ethical idea that consumers own the products they purchase. Despite intellectual property, this level of ownership grants consumers the right to open and tinker with everything they own. On this belief different views have sprung up regarding what this entails and whether or not it should even exist. The increased public support has resulted in proposed government legislation that would allow consumers the ability to repair and modify the products they purchase. The legislation has been a topic of debate for a wide variety of industries, most notably the automobile industry. In 1996, The Supreme Court ruled that it was illegal to withhold information regarding the manufacturing of vehicles. To help independent repair shops diagnose and repair faults, the OBD port was required to be a standardized protocol (Barreto, 2020).

This introduces some of the overarching actor groups I will be referencing throughout my research paper: manufacturers, consumers, and the government. Whether cars or cell phones the idea is similar, the government stepped in to allow consumers to repair cars increasing their lifespan and boosting the second-hand market. Historically, the US government has had to catch up to technological advancements, and once again they may be falling behind.

Since I will be referencing the government I will look to government reports/publications and old court cases to analyze and assess the history of repair laws. I will also look at

governments across the globe to see if there are perhaps nations that are more proactive and have seen better consumer protection or do they also suffer from similar issues.

In 1975 congress passed the Magnuson-Moss Warranty Act which was an instrumental change in consumer protection. The law governed product warranties requiring manufacturers to provide clear and detailed warranty information making it easier for consumers to seek a remedy for breach of warranty in court. However, today we see this act falling apart. The growing public concern states that the act no longer holds up to the rapid technological developments leading to challenges for people in the repair industry. This leaves independent repair shops dealing with "designs that prevent repair", "software locks", and overall "unavailability of parts and documentation" (FTC, 2021, 7).

While these restrictions are a hindrance to all consumers, the individuals that suffer the most are usually already underprivileged as the "burden tends to fall on communities of color and lower-income communities"(FTC, 2021, 4).

These communities will serve as a primary actor group throughout my research paper since they are disproportionately affected as a lot of them are small black-owned repair/manufacturing businesses. Since these businesses have no protection they face the threat of going out of business by the bigger and more well-established tech giants who prefer to keep all kinds of repair work within the network. Not only are they able to upcharge customers but also entice individuals to pay more to upgrade to newer devices for even small and simple repairs like cracked screens. Besides just business owners the overall communities face discrimination altogether as the inability to repair creates a monetary surge in the second-hand market. Recent events magnified this instability. With the prompt shift to online programs alongside the global shortage of computer chips, what little was available was being sold at astronomically high

prices leaving individuals of these communities without the necessary tools to perform in this virtual work environment.

On behalf of these discriminated communities, another actor group takes the role of standing up for them, the advocates for the right to repair. These individuals argue that if passed, this legislation could be incredibly beneficial for the planet helping reduce the depletion of natural resources. “Extending the life of a phone by just one year would result in a decrease in emissions equivalent to taking hundreds of thousands of cars off the road”(Gulserliler, 2022, 2). This decision essentially falls entirely in the hands of these manufacturers who ignorantly choose to cut the life of products short.

These advocates continue to argue for reform circling back and bringing light to the unfortunate circumstances of underprivileged communities. Most of our waste is exported to third world countries where workers work in inhumane conditions to recycle these devices, the pollutants affect the workers and also eventually find their way into the livestock the communities eat. This deteriorates the health of the entire community with research showing that residents living near e-waste recycling facilities suffer from “high incidence, headaches, vertigo, nausea” as well as “ cancer, diabetes, hypertension, cardiovascular disease, and fertility problems”(Turiel, 2021, 8).

The primary groups besides general consumers pushing for the right to repair are different bloggers and volunteer advocacy groups. There are numerous YouTube documentaries by different internet celebrities like “Louis Rossmann” who reveal the deceitful actions of large tech companies. In his opinion these companies make an effort to appear environmentally friendly but in fact are making mostly absurd claims since there are usually other ways of achieving the same results without sacrificing repairability. One of the major companies that

documents products for public use is ifixit.com. They focus on physical technologies like phones and laptops and post teardown guides on the internet for people to use. This allows common folk to open up and repair their devices without having to go to the big corporations like Google, Apple, and Microsoft. There are a lot of research papers written on investigating the environmental impacts of throwaway culture and quick device upgrade cycles. I hope to use them to see the overreaching effects the decisions these companies make on recycling efforts. For other supporting material I will have to utilize content on internet blogs and general discussion posts to get a picture of both sides of the argument and why people fighting for the right to repair believe they deserve it.

With everything said so far the argument becomes very one-sided, and with a research paper I do not want to argue for a particular side but present all the information relevant to my subject. Therefore I will be looking into publications from different corporations and business analytics reports describing the consequences of having the right to repair. I will need to explore the idea of intellectual property and copyrights to ensure that any proposed legislation does not breach existing contracts. It will also be beneficial to include the economics behind why companies may not support the right to repair and how profits might not be as high if the legislation is approved. This means potential money that typically would be put back into salaries and research of new products would no longer be available.

Companies also argue from the technical side, claiming the right to repair would lead to a hindrance in technological growth. They claim that the design, practicality, and efficiency of a device comes first as those are its primary objectives, however this can sometimes come at the expense of its repairability. In the process of making products elegant and smaller, they become harder to get into and internal components have to be stacked and placed in harder to reach areas.

On this basis, I would like to explore the different rationales that companies use to justify the limits they impose and perhaps some expert opinions from technicians to see what they think about the matter.

Conclusion

I hope to address everything discussed in this introductory actor analysis covering all the communities mentioned. With all these different groups we can see how interconnected the system is, the actions of one group impact the entire system in either intended or unconscious consequences. In current writing, there is an overall lack of completeness in the sense that everything only focuses on one specific issue and usually does not consider the entire branching network of that issue. Through my research, I hope to give a bigger picture of what's going on with issues that are less talked about but still relevant in the debate on repair. I would also like to demonstrate the importance of documentation in not only tech but also software projects through my plan to create an auto-documenter for engineers to utilize.

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