Thesis Project Portfolio

Machine Learning: Determining Fruit Ripeness from Visual and Auditory Data

(Technical Report)

From Virtual Assistants to AI: Data Privacy Issues in the Digital Age

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

William Tan

Spring, 2023

Department of Computer Science

Table of Contents

Sociotechnical Synthesis

Machine Learning: Determining Fruit Ripeness from Visual and Auditory Data

When it comes to determining ripeness, many customers simply resort to their own senses as well as folk wisdom, such as knocking on the fruit. This approach can be unreliable and cause the customer to waste money by spending it on unripened, unsatisfactory fruit. The technical report proposes a solution using a machine learning approach, which can provide accurate and precise determinations on fruit ripeness. The approach involves developing a mobile phone application that can utilize the phone's camera and microphone. While previous approaches remain fixated on using single features such as appearance, sound, aroma, and other characteristics, our approach is to combine two of the most commonly-used features: visual appearance and sounds from knocking. The camera can capture images of the fruit and use computer vision to analyze its appearance, while the microphone can process the sound of the user knocking on the fruit via signal processing. By combining these two data sources, the application can render a determination on ripeness.

This proposed approach should to be accurate for most types of fruits, with the exception of those that can vary greatly in size, hardness, and color, which are more complex and could result in a loss of accuracy or confidence in the method’s results. However, this method should be expected, when sufficiently trained, to outperform humans at making determinations on ripeness. The application would provide better information on fruit ripeness to customers, leading to more informed decisions and potentially reducing food waste. However, further work may be needed to expand the range of fruits and vegetables that the application can accommodate, as well as the

amount of variation within each type, which can likely be done by making the method consider additional features. Overall, this approach has the potential to greatly improve how we determine fruit ripeness and promote more informed and sustainable consumption.

From Virtual Assistants to AI: Data Privacy Issues in the Digital Age

In recent years, the issue of data privacy has become increasingly prominent in discussions surrounding technology and society. As individuals continue to rely on digital platforms and services for a wide range of activities, from communication and entertainment to education and work, the amount of personal data being collected, processed, and stored has grown exponentially. This has raised concerns about the ways in which this data is being used and the potential for it to be misused or abused. My research paper examines this issue from the perspective of a social contract framework, which emphasizes the importance of informed consent and the right to exit. In this framework, individuals are seen as active participants in the creation and maintenance of the social structures and systems that govern their lives, and their consent is required for these structures to operate justly and effectively. Additionally, individuals have the right to opt out of these systems if they feel that their interests or values are not being represented or respected.

However, my examination of the digital world today reveals that these two primary concerns of informed consent and the right to exit are being violated in an alarming fashion. As people become increasingly interconnected and use both virtual assistants and artificial intelligence, the amount of personal data and information they unknowingly surrender can be staggering. While

concerns arose over the early pioneers of virtual assistants, such as Siri and Alex, these issues have only become more pronounced as the years go by, as demonstrated by controversy after controversy. Users' data is often collected without individuals' knowledge or consent and used for a variety of purposes, including targeted advertising, surveillance, and even political manipulation, as documented in the cases of Clearview AI and Cambridge Analytica. Their data can even fall into the wrong hands in data breaches, giving bad actors an ability to do significant amounts of damage.

Furthermore, even when individuals are aware of the data being collected and have the option to opt out, the process can be complex, confusing, and time-consuming. This can effectively limit their ability to exercise their right to exit, particularly for those who lack the resources or technical knowledge to navigate the complex digital landscape. Overall, my research paper highlights the urgent need for a renewed focus on the principles of informed consent and the right to exit in the digital age. By prioritizing these principles and ensuring that they are upheld in practice, we can work towards creating a more just and equitable digital society that respects the privacy and autonomy of all individuals.