Thesis Project Portfolio

Binary Classification of Hand Motions as Door Opening/Non Door Opening

(Technical Report)

Understanding Reputation and Accusation: A Case Study of Chess Cheating

(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

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Spring, 2024

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Executive Summary

In modern society, accusation is one of the most powerful tools to transform lives. Even without conviction, an accusation with loose evidence is enough to cancel a celebrity's career. Canceling is a modern phenomenon that describes ruining one's reputation, thereby severely impacting the opportunities they have. Once canceled, a celebrity may lose advertising, movie, and other public-facing roles. However, celebrities have been canceled without confirmation of accusations, which begs the question of how accusations should function in modern society. Another effect of modern society has been the advent of smart technologies, which use sensors to allow people to interact with their environment. Smart watches already exist that can track a person via GPS, accelerometer, gyroscope sensors, and more. With the advent of smart homes, or homes designed with these sensors in mind, there has been a need to detect human behavior, such as door opening, to trigger various smart home features.

The STS research paper investigates how accusations have affected a community in the specific case of the chess community, which has recently dealt with cases of cheating via artificial intelligence and cheating accusations. The paper used two case studies of high profile cheating accusation incidents – the Carlsen-Niemann and Kramnik controversies – analyzing how accusation played a part in the rise and fall of reputations of these members. Both controversies stemmed from underdetermination, whereby chess play and other evidence is not enough to conclude that a player is cheating. Results from these case studies were compared against existing literature surrounding accusation. It was ultimately found that the changes in reputation by the community members did not align with existing literature. The details by which accusations are made and handled affect resulting reputations more than initial reputation. In the Carlsen-Niemann debacle, Carlsen's deference to cheating authorities helped his case much more

than Kramnik, whose usage of statistics despite his lack of statistical background resulted in a faulty argument. Simply making accusations cannot be enough to determine one's resulting reputation in a community.

The technical project developed a machine learning (ML) based on smartwatch sensor data that can be leveraged to detect if a door is being opened. Developing this solution required a machine learning tool: WEKA, a smartwatch sensor tool: WADA, and python & java scripting skills involving data analysis and manipulation. This class project employed the aforementioned tools to develop three ML models – random forests, J48, and SVMs – to utilize smartwatch sensor data and detect door opening. Of the models built using the three methods, the random forest classifier performed the best, with a 96.1% accuracy. In the future, more and a larger breadth of smartwatch data would be useful in validating the models. Results from this experiment indicate a high probability that, in the future and with more development, live smartwatch sensor data can be used to operate smart home functionality.

While reaching tangible results, the research done has many avenues for future exploration. The STS paper could be expanded by investigating more cases of cheating and cheating accusations within the chess community. Another high profile incident relates a tournament in which grandmaster Wesley So accused grandmaster Tigran L. Petrosian of cheating in a team tournament, inciting various discussions within the community. One low profile example is in 2012, where a player named Clark Smiley cheated using an AI hidden in an electronic notation device. In the two given case studies, interviews could have been conducted with influential chess players, cheating authorities, or chess authorities, to get firsthand accounts of how the chess scene has changed as a result of cheating scandals. Obtaining more accounts and more cases would give a better picture of the chess community and more data about

accusation within the community. As a result, there could be more findings and tangible results to generalize for the greater world.

The technical project was limited by time and resources. In the future, more processes would be required to bring the classifier to the market, as the project was more of a proof-of-concept. Advances, such as more training data, larger classifier networks, and other training methods could be made to make the classifier more stable and more accurate. With these changes, I am confident that the door opening classifier and similar models would be viable to be used in conjunction with a smart home or some other cyber physical system.