

The Accuracy of Facial Recognition

New Mexico

Supercomputing Challenge

Final Report

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Executive Summary

In creating a facial recognition simulation, it was discovered that the procedures planned before-hand wouldn't work for beginners. The project was created on Starlogo nova instead, to create the amount of initial false facial identifications. We used three types of algorithms, which are: texture based, feature based, and appearance based. We got into specifics, using Geomertrical Features and Local Feature Analysis for Feature based algorithms. Independent Gabor Features and 2D-log Polar Gabor Transform and Neural Network was used for the Texture based algorithm. For Appearance based algorithms, we used Half-face based algorithm and Eigen-eyes based algorithm. Different variables were used as well, such as having hair covering the face, facial hair, wearing glasses, wearing a hat, wrinkles, and plain faces. Researching all the types of algorithms, it was found that in some situations the vital part that an algorithm uses can be covered, dragging down the effectiveness of an algorithm.

Body of the Report

Technology has been advancing in the world the past few years and will keep advancing as the years go by. One example of these advancements is facial recognition technology. The world relies on facial recognition, whether it be to unlock your phone or catch a criminal. Although, this technology with its advantages also has some drawbacks. According to recent studies, it is said that facial recognition is accurate 30-80% of the time. (Macdonald, 2016) But what about the remaining 20%? Based on those studies, facial recognition has many factors affecting its accuracy. (Watman, 2017) These factors include location of facial features and blockage of these features. With so many drawbacks, can we rely on facial recognition? If we are able to gather quantitative data on how these factors affect facial recognition, then we will find the accuracy of facial recognition as well as if it is reliable because facial recognition is relied on too much. In finding the accuracy of facial recognition, we hope to enhance this method for more accurate and reliable methods for the future.

In order to complete this project and get accurate results, we had to do lots of research. Facial recognition is a broad subject with many different methods and affecting factors. In doing research, we gained information of the different methods of facial recognition. In order to complete this project, we had to narrow it down to six: geometrical features, local feature analysis, independent gabor features, 2D-log polar gabor transform and neural network, half face based algorithm, and eigen-eyes based algorithms. The next limitation was our database used, Starlogo Nova, which limited how many factors we could incorporate into our project, it slowed down as we added more. Another limitation would be that we chose a complex topic, while being complete beginners. We had to learn about both how to code in starlogo nova as well as

learning about facial identification algorithms. We could only do so much within the amount of time we were given. The way we made the code was that we could only gather the initial false identifications, but we didn't have time to code the ability of the algorithm to re-check a face. So, the graph only increases, instead of providing the success results after seeing a face.

Coding the program, it performed an initial incorrect identification rate. We learned about different types of facial recognition algorithms, we chose ones that were easiest to understand. We also learned that each algorithm is very complex, each one having intricate equations. Starlogo nova didn't allow us to input the equations, so we used percentages from studies conducted in the past. Using the percentages of false identification rates, finding multiple for one variable, we averaged them out. After entering them in we found that some algorithms were worse than other algorithms, they had a steep line, which showed that they were wrongly identifying them more. In the end, we found that texture-based algorithms worked better than the other algorithms.

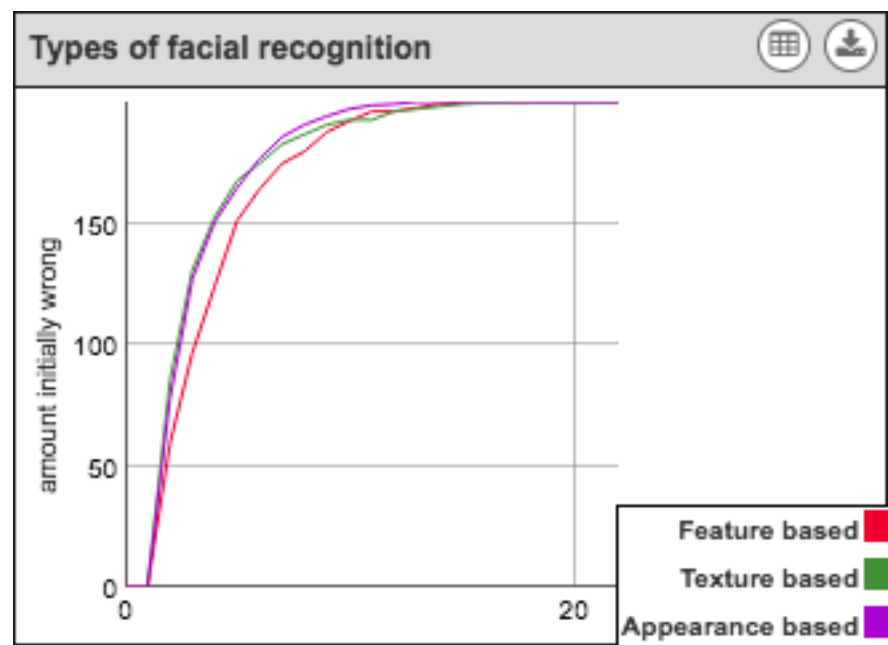
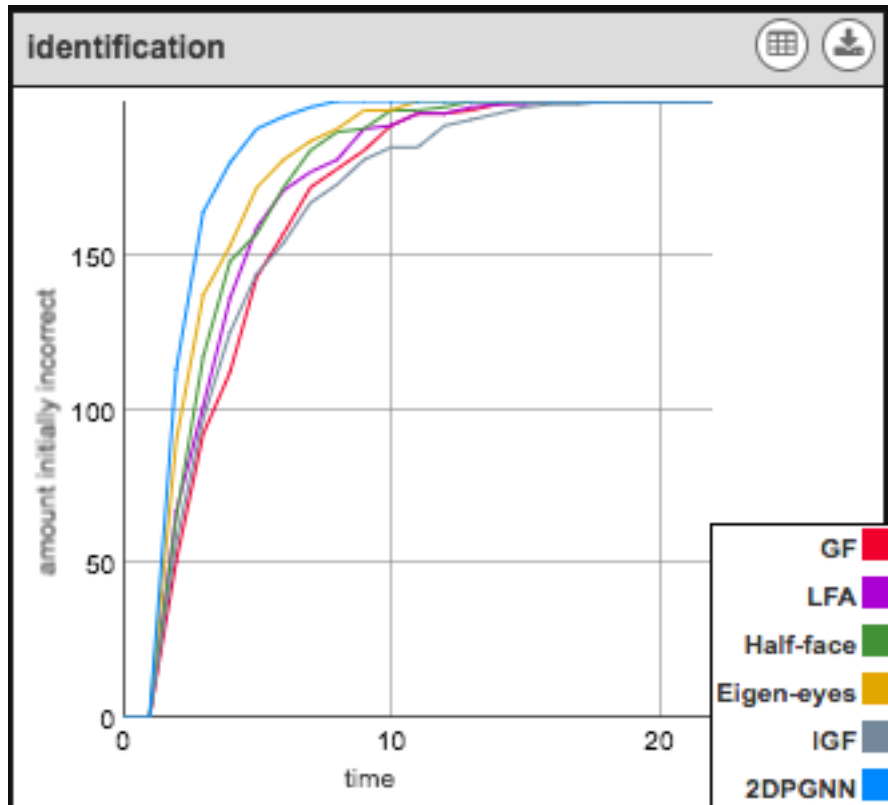
The conclusion we got was that for the initial false identification rate was that texture – based algorithms, specifically Independent Gabor Features, worked the best. Overtime, it worked better because the amount of initial wrongs rose slowly. Meaning that it would get things wrong less than the rest of the ones we tested. While we began the simulation IGF remained accurate, being the lowest to the bottom. Having lower incorrect identifications rates from the variables that we tested, we discovered that for facial recognition Independent Gabor Features works best.

Based on the limitations of our project, we have ideas on what we can do better. Instead of using Starlogo nova, we could use a more complex program, such as Python. Learning about

Python over the summer, then beginning a project would be easier because we would be already informed about how to perform commands and run the code. For the types of facial identification algorithms, there are hardly any articles that give the kind of data we want, but as long as we begin looking for resources over the summer as well we could find reliable information. Finally, for using Python and coding problem we could ask someone that specializes in Python for help. Starlogo nova slowed down as we added more factors until we were able to minimize the amount of commands we used, at the possibility of Python also lagging, we should have a Python mentor to help keep lag to a minimum.

We would like to acknowledge our mentors, Mrs. Geizi Dejka and Mrs. Dena Burgert. They helped us throughout this project, from giving advice to pushing us to finish this project. We would also like to acknowledge Dr. Cameron Cooper who took time out of his day to teach us more about facial recognition. Lastly, we would like to thank Ms. Jennifer Cordova for giving us advice and resources to enhance our project.

Appendixes



Bibliography

- Acquisti, A. (2013, June). *What will a future without secrets look like?* [Video file]. Retrieved from https://www.ted.com/talks/alessandro_acquisti_why_privacy_matters
- Braje, W. L., Kersten, D., Tarr, M. J., & Troje, N. F. (n.d.). *Illumination effects in facial recognition*. Retrieved from <https://pdfs.semanticscholar.org/2550/5b4deae99554fb5d5103cf18d115f9699bc7.pdf>
- Calistra, C. (2015, February 13). The effects of glasses on facial recognition. Retrieved from Kairos.com website: <https://www.kairos.com/blog/the-effects-of-glasses-on-facial-recognition>
- Clover, J. (2017, September 14). Apple's face id feature works with most sunglasses, can be quickly disabled to thwart thieves. Retrieved from MacRumors.com website: <https://www.macrumors.com/2017/09/14/face-id-works-with-sunglasses-thwarts-thieves/>
- Davis, Wendy N. "Face Time: Facial recognition technology helps nab criminals - and raises privacy concerns." *ABA Journal*, Oct. 2017, p. 16. *General OneFile*, http://link.galegroup.com/apps/doc/A517442345/GPS?u=nm_s_sanjuanchs&sid=GPS&xid=bf461dca. Accessed 14 Dec. 2017
- Divyarajsinh N Parmar et al ,Int.J.Computer Technology & Applications,Vol 4 (1),84-86
- Facial Recognition. (2014). Retrieved December 15, 2017, from Find Biometrics website: <https://findbiometrics.com/solutions/facial-recognition/#identifier>
- Geitgey, A. (2016, July 24). Machine learning is fun! Part 4: Modern face recognition with deep learning. Retrieved from Medium.com website: <https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78>
- How facial recognition software works. (n.d.). Retrieved November 17, 2017, from Norton website: <https://us.norton.com/internetsecurity-iot-how-facial-recognition-software-works.html>

- Huma, Z. E. (2017, September 6). Samsung fails to improve facial recognition in Note 8, you can unlock Note 8 with low quality image [Blog post]. Retrieved from TechStunt website: <https://techstunt.com/samsung-fails-to-improve-facial-recognition-in-note-8/>
- Macdonald, C. (2016, June 24). Facial recognition is not reliable: Massive test using a million faces finds controversial technology is not as accurate as claimed. Retrieved June 25, 2016, from DailyMail.com website: <http://www.dailymail.co.uk/sciencetech/article-3658797/Facial-recognition-ISN-T-reliable-Massive-test-using-million-faces-finds-controversial-technology-not-accurate-claimed.html>
- Manjunath, B. S., Chellappa, R., & Malsburg, C. V. D. (n.d.). *A feature based approach to facial recognition*. Retrieved from https://vision.ece.ucsb.edu/sites/vision.ece.ucsb.edu/files/publications/92CVPR_0.pdf
- Marques, I. (2010). *Face recognition algorithms*. Retrieved from <http://www.ehu.es/ccwintco/uploads/e/eb/PFC-IonMarques.pdf>
- McCullom, R. (2017, May 17). Facial recognition technology is both biased and understudied. Retrieved from unmark.org website: <https://undark.org/article/facial-recognition-technology-biased-understudied/>
- Office of the Privacy Commissioner of Canada. (2013). *Automated facial recognition in the public and private sectors*. Retrieved from https://www.priv.gc.ca/media/1765/fr_201303_e.pdf
- Orcutt, M. (2016, July 6). Are facial recognition systems accurate? Depends on your race. Retrieved from MIT technology review.com website: <https://www.technologyreview.com/s/601786/are-face-recognition-systems-accurate-depends-on-your-race/>
- Richa Singh, Mayank Vatsa and Afzel Noore (2008). *Recognizing Face Images with Disguise Variations, Recent Advances in Face Recognition*, Kresimir Delac, Mislav Grgic and Marian Stewart Bartlett (Ed.), ISBN: 978-953-7619-34-3, InTech, Available

from: http://www.intechopen.com/books/recent_advances_in_face_recognition/recognizing_face_images_with_disguise_variations

Shaughnessy, Andy. "But the face rings a bell. (Back Page)." *Printed Circuit Design*, Feb. 2002, p.

32. *General OneFile*,

go.galegroup.com/ps/i.do?p=GPS&sw=w&u=nm_s_sanjuanchs&v=2.1&id=GALE%7CA103990111&it=r&asid=dfc9d5273a3d1dbcbbae6729a790065e. Accessed 26 Oct. 2017

Singh, R., Vatsa, M., & Noore, A. (n.d.). *Face recognition with disguise and single gallery images*.

Retrieved from iiidd.edu.in website: <https://www.iiitd.edu.in/~mayank/Disguise-IMAVIS.pdf>

Smith, S. M. (1997). The feature-based approach. Retrieved

from <https://users.fmrib.ox.ac.uk/~steve/review/review/node2.html>

Solon, O. (2017, March 27). Facial recognition database used by FBI is out of control, house committee hears. Retrieved from theguardian.com

website: <https://www.theguardian.com/technology/2017/mar/27/us-facial-recognition-database-fbi-drivers-licenses-passports>

Stergiou, C., & Siganos, D. (n.d.). Neural networks. Retrieved

from https://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/report.html

Sydell, L. (2016, October 25). It Ain't Me, Babe: Researchers Find Flaws In Police Facial Recognition Technology [Blog post]. Retrieved from npr

website: <https://www.npr.org/sections/alltechconsidered/2016/10/25/499176469/it-aint-me-babe-researchers-find-flaws-in-police-facial-recognition>

Takehara, Takuma, et al. "Dynamic facial expression recognition in low emotional intensity and shuffled sequences." *North American Journal of Psychology*, vol. 19, no. 2, 2017, p.

359. *Academic OneFile*,

go.galegroup.com/ps/i.do?p=GPS&sw=w&u=nm_s_sanjuanchs&v=2.1&id=GALE%7CA496085833&it=r&asid=19deda2e142b4b795d93c933201efb7b. Accessed 26 Oct. 2017

- Thakkar, D. (n.d.). False acceptance rate and false recognition rate in biometrics. Retrieved from bayometric.com website: <https://www.bayometric.com/false-acceptance-rate-far-false-recognition-rate-frr/>
- Tian, et. al, Y.-L. (2001, February 23). Recognizing Action Units for Facial Expression Analysis. Retrieved November 16, 2017, from NCBI website: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4157835/>
- "The truth about law enforcement's use of facial recognition technology." *American City & County*, 9 May 2017. *Business Collection*, go.galegroup.com/ps/i.do?p=GPS&sw=w&u=nm_s_sanjuanchs&v=2.1&id=GALE%7CA491448831&it=r&asid=d6c8f012c7ff128528618d9fabe4b708. Accessed 26 Oct. 2017.
- Vincent, J. (2016, November 3). These glasses trick facial recognition software into thinking you're someone else. Retrieved from The Verge.com website: <https://www.theverge.com/2016/11/3/13507542/facial-recognition-glasses-trick-impersonate-fool>
- Waddell, K. (2016, October 19). Half of american adults are in police facial recognition databases. Retrieved from The Atlantic.com website: <https://www.theatlantic.com/technology/archive/2016/10/half-of-american-adults-are-in-police-facial-recognition-databases/504560/>
- Watman, A. (2017, April 4). Facial recognition is increasingly common, but how does it work? Retrieved from TheConversation.com website: <https://theconversation.com/facial-recognition-is-increasingly-common-but-how-does-it-work-61354>