

Customer sentiment toward the use of cameras at Dutch supermarket self-scan checkouts

Dennis S. Vlaar
Master Applied AI
University of Applied Sciences
Amsterdam, Netherlands
dennisvlaar@gmail.com

Abstract—Self-scan checkouts have increased the speed of the payment process in supermarkets tremendously. The use of cameras and facial recognition could potentially speed up this process more by facilitating as an age checker for alcohol control. The use of facial recognition in public spaces is a privacy sensitive subject, and the question is if customers are comfortable with the presence of these technologies in the supermarket. A survey has been conducted and the results show that a majority of Dutch supermarket customers is not comfortable with these technologies. There is no correlation found between age and sentiment toward these technologies.

Keywords—Machine vision, Face-recognition, Customer sentiment

I. INTRODUCTION

According to Liftin and Wolfram self-scan checkouts have increased the speed of the payment process for supermarket customers tremendously (Liftin & Wolfram, 2009). Customer can now scan products with a portable hand-scanner while shopping. The use of facial recognition can speed up this process even more by facilitating age-verification for when customers buy alcohol. This technology also has the potential of improving the quality of age-verification and mitigate false-positives. The use of cameras in public spaces, and the use of facial recognition software is a loaded topic and raises concerns regarding privacy. This research is focused on customer sentiment towards the use of cameras at self-scan checkouts in supermarkets.

This paper stems from a machine vision project at the University of Applied Sciences. During this project two ideas were proposed which use facial recognition software at the self-scan checkouts in supermarkets. The first idea consists of using facial recognition software to estimate a customer's age. Using this technology no image data needs to be saved, the age-estimation will be done real time using a video feed. This first idea raises the first research question:

Research question 1:

“What is the sentiment of Dutch supermarket customers toward supermarkets using face recognition for age estimation?”

The second idea consists of using facial recognition software to identify a person. This technology requires image data of a person. A person will put his face in a database once, then the age of the customer will be verified manually and will be linked to his biometric face. This second idea raises the second research question:

Research question 2:

“What is the sentiment of Dutch supermarket customers toward supermarkets saving faces for age verification?”

The goal of this research is to get insights in the opinion of the Dutch public toward the use of above mentioned technologies.

This will help Dutch supermarkets/retailers to make an informed decision to either implement or not implement these technologies.

II. RELATED WORK

A. Beyond face value: public attitudes to facial recognition technology. (Ada Lovelace institute)

Facial recognition technology is now widely employed in several industries in the UK. It has been used at airports since 2008 at ePassport border security gates, and Heathrow Airport has ambitions to replace check-in and passport checks with it. The financial services hub Canary Wharf is exploring implementing facial recognition technology throughout its 97-acre property, and central London's Kings Cross shopping and commercial sector has been monitored using CCTV cameras with facial recognition capabilities.

The morality of facial recognition technology is a hot topic in British society right now. While reports concerning the use of face recognition in key London neighborhoods and shopping centers drew regulatory investigation and political censure, police trials of the technology in public locations in London and Wales were met with outcry and legal challenge.

In light of this, the Ada Lovelace Institute engaged YouGov to conduct the first survey of its kind to ascertain public opinion in the UK about the burgeoning use of face recognition technology in both the public and private sectors. A nationwide representative sample of 4109 persons from the UK are included in the poll. It records the initial reactions of the UK public to a variety of scenarios explaining particular uses of face recognition technology in various fields and for a range of objectives.

The report summarizes six key findings from the survey, the top four findings that are related to the research questions of this paper the most are:

1. Although there is a high level of awareness about facial recognition technology, little is actually known about it, especially in terms of the technology's limits.
2. Nearly half of the population expresses the opinion that individuals should be able to refuse to use or consent to facial recognition technology, indicating that consent is a crucial safety measure for many people.
3. The majority of people support facial recognition technology when there is a demonstrable public benefit and appropriate safeguards in place, which justifies greater investment in testing and articulating the potential public benefits of such technologies.
4. Further discussion between the public, business sector, and policymakers is required in order to comprehend and address the public's lack of faith in

the private sector's ethical use of face recognition technology.

B. Has facial recognition technology been misused? A public perception model of facial recognition scenarios. (Lai, X. & Patrick Rau, P. L.)

In this study, a model of the public's perception of facial recognition technology (FRT) is constructed. This study used a questionnaire with 704 participants to examine people's familiarity with, trust in, and attitudes concerning FRT scenarios. The research then used hierarchical cluster analysis to segment public opinions of several FRT scenarios and looked at how familiarity, trust, and attitude related to each FRT scenario. Four major conclusions were found, the two conclusions that are related to the research questions of this paper the most are:

1. Different FRT scenarios generated different public views, which could be categorized into four groups based on a shared level of familiarity, trust, and attitude.
2. In each FRT scenario, attitude was primarily influenced by trust, not familiarity, while demographic factors and trust propensity had no discernible influence on public perception.

C. Resistance to facial recognition payment in China: The influence of privacy-related factors. (Liu et al.)

China is regarded as a pioneer in cashless payment transactions as a result of the worldwide digital payment trend. Because mobile payment options are so common, 40% of Chinese citizens believe they do not need to carry cash when they are on the go. However, since 2019, facial data leaks in China have resulted in an increase in financial market disputes and civil lawsuits, which may cause consumers to delay or even refuse to adopt FRP.

This study investigated users' reluctance to accept facial recognition payments within the context of China's innovation resistance and privacy calculus. This research uses three key components of the users' own privacy perception (privacy concerns, perceived privacy risk, and privacy control) as well as two essential components of the characteristics and factors related to FRP (perceived benefits and the perceived effectiveness of privacy policy) in order to look into potential relationships between the antecedents and the outcome variable of resistance.

A total of 1200 valid observations were gathered, including both individuals who had used face recognition payment systems previously and those who had not.

The findings demonstrate that privacy control, privacy risk, and perceived advantages are just a few of the factors in the privacy calculus model that are significantly impacted by how effective a privacy policy is regarded. In that the perceived effectiveness of privacy policies has a positive effect on privacy control while having a negative effect on privacy risk, they agree with a prior study.

This study also reveals evidence that the perceived effectiveness of privacy policies has a negative influence on users' resistance to facial recognition technology. It is important to note that the perceived effectiveness of privacy policies has a significant impact on all path coefficients of resistance. It suggests that users' reluctance to choose FRP has

lessened when the platform's bioinformation privacy policy was made public.

D. A Study on the influence of customer characteristics on innovation resistance and intention to use in face recognition payment system. (Zhang et al.)

The findings of this study indicate that consumers' perceptions of risks and their views toward prior goods have a favorable influence on innovation resistance, whereas customers' motivation and self-efficacy have a negative influence. Additionally, research demonstrates that customer resistance to innovation will negatively affect usage intentions.

On the basis of the findings of this study, the following conclusions can be made:

First, the study discovered that customer innovation had no discernible influence on innovation resistance during the innovation and diffusion of the face recognition payment system. This is due to the fact that using facial recognition to confirm identity is not a novel use of biometrics. Customers are used to using some physical features for identity verification.

Secondly, according to the findings, customers' capacity for risk perception has the biggest influence on innovation resistance. Biometrics is specifically tied to the customer themselves. Customers are concerned about how successfully privacy and personal information can be maintained in the age of big data because to the vast gathering and utilization of biological data. The ability to employ facial recognition and simple payment for a long time will therefore depend on the formulation of authoritative large data collecting rights, usage rights, and forgetting rights.

III. METHODS

A. Survey

To answer the two research questions, a survey was conducted. The survey consisted of three parts and is shown in Appendix A. The first part contains demographic questions and general question on the use of self-checkouts at the supermarket. The second part focused on outlining a scenario related to the first research question, and the third part focused on outlining a scenario related to the second research question. First the scenarios were introduced, then the participants had to indicate how comfortable they would be in these scenarios. Lastly the participants had to substantiate their answer.

B. Reliability

The survey was distributed in two ways. An anonymous link was distributed to friends and family of me and a classmate. Also a QR-code was distributed through campus. This has led to more response from people aged under 25. The distribution in age can be seen in figure 1 below. The distribution of gender can be seen in figure 2.

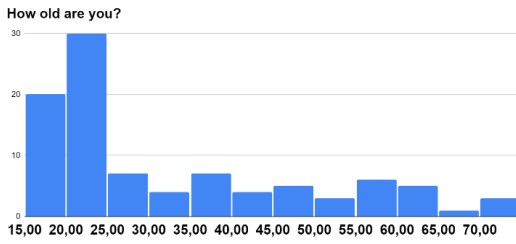


Figure 1. Age distribution of survey participants.

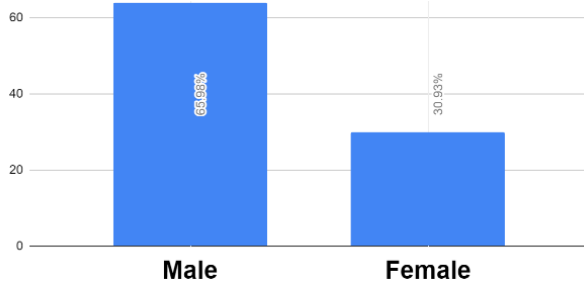


Figure 2. Gender distribution of survey participants.

C. Validity

To ensure the survey measures what it is intended to measure the survey was made together with a classmate who had a similar research topic. Also, the survey is peer reviewed by four other classmates who provided feedback.

IV. RESULTS

This chapter discusses the results of the survey given in Appendix A.

A. Results. Sentiment toward face recognition for age estimation.

Scenario 1: "Supermarkets will be using facial recognition at self-checkouts to estimate a customer's age. This will only be done when the customer gives consent."

Respondents could rate their comfortability with this scenario on a scale of zero to ten. The results are shown in table 1.

How comfortable are you with this scenario?										
0	1	2	3	4	5	6	7	8	9	10
7	11	4	5	4	7	7	9	5	8	4

Table 1. Comfortability of supermarket customers with scenario 1.

Table 1 shows that the majority of the respondents are not comfortable with scenario 2. 63.4% of the respondents scores a 6 or lower in comfortability with this scenario. Only 36.6% of the respondents are reporting to feel a 7 or higher in comfortability with this scenario.

When asked why respondents are not comfortable with this scenario, the answers that were chosen the most are: It is an invasion of my privacy (18.1%), I do not trust them to use the technology ethically (13.7%), it will normalize surveillance (12.6%), it will be misused or hacked (9.3%).

When the respondents who are comfortable with this scenario were asked why, these were their most answered responses: It will reduce delays (18.5%), It's convenient (16.3%), it will not affect me personally (16.3%), I trust them to use the technology ethically (13%).

When a test for correlation is done between age and comfortability of scenario 1 the result is an r value of -0.111

with a p-value of 0.365. This means there is no significant correlation between age and comfortability of scenario 1.

B. Results. Sentiment toward saving faces to database.

Scenario 2: "Customers of supermarkets will have the option to get age verification one time. A picture of their face will be taken and saved to a database. The next time a customer doesn't need manual ID check, but will be verified using face recognition technology."

Again, respondents could rate their comfortability with this scenario on a scale of zero to ten. The results are shown in table 2.

How comfortable are you with this scenario?										
0	1	2	3	4	5	6	7	8	9	10
8	11	1	5	3	5	7	8	6	1	2

Table 2. Comfortability of supermarket customer with scenario 2.

Table 2 shows that the majority of the respondents are not comfortable with scenario 2. 70.2% of the respondents scores a 6 or lower in comfortability with this scenario. Only 29.8% of the respondents are reporting to feel a 7 or higher in comfortability with this scenario.

When asked why respondent are not comfortable with this scenario, the answers that were given the most are: It is an invasion of my privacy (18.1%), I do not trust them to use the technology ethically (14.3%), it will be misused or hacked (14.3%), it will normalize surveillance (11.2%).

The respondents who are comfortable with this scenario report the following reasons: It's convenient (15.2%), it will reduce delays (13.6%), it's reliable (13.6%), it's accurate (13.6%), it will not affect me personally (12.1%).

When a test for correlation is done between age and comfortability of scenario 2 the result is an r value of -0.104 with a p-value of 0.444. This means there is no significant correlation between age and comfortability of scenario 2.

V. DISCUSSION

In this paper the following research questions have been addressed:

1. "What is the sentiment of Dutch supermarket customers toward supermarkets using face recognition for age estimation?"
2. "What is the sentiment of Dutch supermarket customers toward supermarkets saving faces for age verification?"

For the first research question the conclusion can be made that a majority of Dutch supermarket customers would not be comfortable with supermarkets using facial recognition to estimate age. The main reason for people to not feel comfortable toward the use of this technology are privacy concerns.

For the second research question the same conclusion can be made, and the results are more clear in this situation. A majority of Dutch supermarket customers report to have privacy issues with supermarkets implementing such a technology.

There seems to be no correlation in sentiment toward the use of both technologies for age. This means there is no significant

difference between how comfortable younger people are with the use of these technologies versus older people.

Based on the results of this research, I would advice supermarkets to not implement any facial recognition technology in their check-out systems. The survey suggests that the majority of Dutch supermarket customers are not comfortable with the use of facial recognition at self-scan checkouts. Implementation of these technologies will most likely reduce customer experience.

SOURCES

1. Lai, X. & Patrick Rau, P. L. (2021). Has facial recognition technology been misused? A public perception model of facial recognition scenarios. *Computers in Human Behavior*, 124, 106894. <https://doi.org/10.1016/j.chb.2021.106894>
2. Litfin, T. & Wolfram, G. (2009). New Automated Checkout Systems. *Retailing in the 21st Century*, 189–203. https://doi.org/10.1007/978-3-540-72003-4_12
3. Liu, Y. L., Yan, W. & Hu, B. (2021). Resistance to facial recognition payment in China: The influence of privacy-related factors. *Telecommunications Policy*, 45(5), 102155. <https://doi.org/10.1016/j.telpol.2021.102155>
4. YouGov. (2019). Beyond face value: public attitudes to facial recognition technology. In <https://www.adalovelaceinstitute.org/report/beyond-face-value-public-attitudes-to-facial-recognition-technology/>. Ada Lovelace Institute.
5. Zhang, L. L., Zhang, Y. B. & Kim, H. K. (2021). A Study on the Influence of Customer Characteristics on Innovation Resistance and Intention to Use in Face Recognition Payment System. *Journal of Advanced Researches and Reports*, 1(3), 47–54. <https://doi.org/10.21742/jarr.2021.1.3.07>

APPENDIX A

General Questions:

Q1. How old are you?

Q2. What gender do you identify as?

- Male
- Female
- Nonbinary
- Other

Q3. Do you use the self-checkouts at the supermarket?

- Yes
- No

Q4. If your answer was yes: how often do you use the self-checkout?

- Not very often
- Often
- Always

Q5. Do you buy alcohol at the self-checkout in supermarkets?

- Yes

- No

Q6. If your answer was yes: Do you feel like the staff checks your age often and correctly

- Both
- Only often
- Only correctly
- Neither

Situation 1:

Supermarkets will be using facial recognition at self-checkouts to estimate customers' age. This will only be done when the customer gives consent.

Q7. On a scale of 1 to 10, where 1 is not at all comfortable and 10 is very comfortable, how comfortable are you with supermarkets using facial recognition in this way?

Q8. [Question when Q1 is 6 to 10.] You said that you are comfortable with supermarkets using facial recognition technology in this way, rating your level of comfort as [insert rating from Q1] out of 10. Which of the following are reasons why you are comfortable with this? Please select all that apply

- It's convenient
- It will reduce delays
- I trust them to use the technology ethically
- It will encourage good behavior
- It's reliable
- It's accurate
- It's indiscriminate e.g. by race and by gender
- It will not affect me personally
- It enhances existing security systems (e.g CCTV)
- I can opt out or consent
- It will not be misused or hacked
- Other (specify)
- Don't know

Q9. [Question when Q1 is 1 to 5] You said that you are uncomfortable with supermarkets using facial recognition technology in this way, rating your level of comfort as [insert rating from Q1] out of 10. Which of the following are reasons why you are uncomfortable with this? Please select all that apply

- It's inconvenient
- It will increase delays
- I do not trust them to use the technology ethically
- It will reduce freedom of behavior
- It's unreliable
- It's inaccurate
- It can be used to discriminate e.g. by race or gender
- It will affect me personally
- It will normalize surveillance
- I can't opt out or consent
- It will be misused or hacked
- Other (specify)
- Don't know

Situation 2:

Customers of supermarkets will have the option to get age verification one time. A picture of their face will be taken

and saved to a database. The next time a customer doesn't need manual ID check, but will be verified using face-recognition technology.

Q10. On a scale of 1 to 10, where 1 is not at all comfortable and 10 is very comfortable, how comfortable are you with supermarkets using facial recognition in this way?

Q11. [Question when Q4 is 6 to 10.] You said that you are comfortable with supermarkets using facial recognition technology in this way, rating your level of comfort as [insert rating from Q4] out of 10. Which of the following are reasons why you are comfortable with this? Please select all that apply

- It's convenient
- It will reduce delays
- I trust them to use the technology ethically
- It will encourage good behavior
- It's reliable
- It's accurate
- It's indiscriminate e.g. by race and by gender
- It will not affect me personally
- It enhances existing security systems (e.g CCTV)
- I can opt out or consent

- It will not be misused or hacked
- Other (specify)
- Don't know

Q12. [Question when Q4 is 1 to 5] You said that you are uncomfortable with supermarkets using facial recognition technology in this way, rating your level of comfort as [insert rating from Q4] out of 10. Which of the following are reasons why you are uncomfortable with this? Please select all that apply

- It's inconvenient
- It will increase delays
- I do not trust them to use the technology ethically
- It will reduce freedom of behavior
- It's unreliable
- It's inaccurate
- It can be used to discriminate e.g. by race or gender
- It will affect me personally
- It will normalize surveillance
- I can't opt out or consent
- It will be misused or hacked
- Other (specify)
- Don't know