Exploring how facial age estimation improves the self-checkout experience

Global retail report - February 2023

With age verification accounting for between 40 - 50%[1] of interventions at self-checkouts, there are a number of operational challenges when it comes to checking ID.

The overwhelming majority of people are clearly old enough to purchase age-restricted items, but still need to wait for assistance to proceed with their purchase, which negatively impacts their self-checkout experience. Retail staff need to spend time accurately checking the ID of younger shoppers, which places a great strain and pressure on retail staff. Furthermore, when customers are asked to show proof of age, it can be one of the most common triggers of violence and abuse towards retail staff. It is estimated that more than 1 in 5 violent attacks on shop workers are triggered by age-restricted sales.[2]

To help solve these challenges, nearly four years ago we integrated our facial age estimation technology into retail self-checkouts. Since then, it has been trialled by retailers in the US and Estonia, with further pilots taking place in Germany, Poland and Czech Republic. And last year UK supermarkets - including Asda, Morrisons, Tesco and Co-op - tested the technology as part of a Home Office regulatory sandbox. The aim of the sandbox was to trial digital age verification for the sale of alcohol under the UK Licensing Act (2003).

During the sandbox, around 46% of customers who purchased age-restricted products opted to use the age estimation and age verification technology - demonstrating that customers are open to trying this new technology. Of the 99,800 customers that used the technology, there were no reported sales of underage customers purchasing age-restricted items.

Detailed reports from the Home Office and the supermarkets who participated in the sandbox are due to be published. But in the interests of transparency, we have shared our own insights from both the Home Office trials and our wider learnings of how our technology works in a retail setting. We hope this helps to answer common questions and dispel misconceptions, and build trust and understanding in this new approach to age verification, which can make the lives of retail staff easier and improve compliance rates.

[1] Percentage findings from NCR's Professional Services team following consultations with customers.

[2] 'It's not part of the job': Violence and verbal abuse towards shop workers.

Contents

Customers like the experience

“Customer exit interviews indicated that the vast majority of customers liked using Yoti, had no objections to having their photograph taken and would use the system again” - ASDA

To meet the UK Licencing Act (2003), the law currently states that a ‘responsible person’ must approve the sale of alcohol. So, in a busy retail setting customers have to wait for assistance from a colleague to carry out the age verification check. But this can lead to frustration and a less satisfactory customer experience or worse, abandoning their shopping basket and leaving.

Digital age verification has the potential to offer a quicker experience that customers like. This is particularly true for older shoppers who often get frustrated at having to wait for assistance, despite clearly being old enough to purchase alcohol. The demand for the technology is there, with 70% of people saying they would use it to prove their age when buying age-restricted goods at a self-checkout.[3]

With any new technology, some people will learn and adopt it quicker than others. If we think about the first time someone used contactless payments or even the self-checkout itself, it would’ve taken them longer compared with the third or fourth time. These technologies are now second nature to many people who use them quickly and efficiently on a daily basis. In fact, contactless payments accounted for almost a third of all payments in the UK in 2021, up 36 per cent compared with 2020.[4]

The same is true with facial age estimation. Some customers take longer the first time they prove their age this way; others pick it up quicker. As shoppers get used to the technology, it is likely to speed up their self-checkout experience when buying age-restricted goods.

During the Home Office sandbox, around 46% of customers who purchased age-restricted products opted to use the age estimation and Digital ID technology - demonstrating that customers are open to trying new technology.

The majority of shoppers who trialled the technology used age estimation. This was unsurprising given the majority of shoppers looked over the age threshold, and they did not need to do anything in advance. They could simply decide on the day to give it a go.

In comparison, shoppers wishing to use our Digital ID needed to set this up before they could use it at the self-checkout. Ideally we'd have advertised our Digital ID app ahead of time so that shoppers were more prepared, but the Home Office placed restrictions on marketing the app.

In the UK, over four million people have installed the Yoti ID or Post Office EasyID apps. Proving age is one of the primary reasons young people have told us they would like to use a Digital ID. We believe that many 16-24 year olds would create a Digital ID and use it to prove their age to purchase alcohol, if the Mandatory Licensing Conditions were updated.

[3] YouGov survey of 2,095 GB adults. Research undertaken between 31st October - 1st November 2022

[4] www.ukfinance.org.uk/news-and-insight/press-release/contactless-makes-third-all-payments-while-cash-use-falls-again-in

Retail staff support the technology and have more time to focus on other tasks

“With Yoti removing age checks from the Hosts, overall intervention volume is reduced for the Hosts (by 35,218), and subsequently overall intervention response times reduced (this equates to ~314 fewer Host managed Challenge 25 checks per day)” - ASDA

We understand there may be some who fear technology will replace the jobs of humans, but the Home Office sandbox demonstrated that the two go hand in hand - with the technology supporting retail staff in their role.

Digital age verification technology provides an opportunity to reduce the number of physical age interventions at self-checkouts. This gives retail staff more time to complete other tasks, such as observing and supporting customers, particularly to spot ‘walkaways’. This is when a customer has walked away from a self-checkout without making payment, either accidentally or deliberately. During busier periods, it can be challenging for retail staff to spot ‘walkaways’, but the Home Office trials demonstrated a decrease in the number of walkaways.

The technology could also help reduce potential conflict between retail staff and customers. According to the BRC’s most recent crime survey, retail staff face over 1,300 incidents of violence and abuse every day. One of the most common triggers is when staff ask customers for proof of age when buying alcohol. Retailers have a duty of care to keep their staff safe, so giving shoppers more choice in how they prove their age will hopefully reduce potential conflict, creating a more positive experience for customers and retail staff.

Accessibility and inclusivity

Facial age estimation is more inclusive because anyone who looks over the required age threshold can prove their age in seconds, without needing to show a physical ID. This is particularly impactful for customers who may not feel comfortable showing ID, or who do not own a driving licence or passport. They simply look at a camera on the self-checkout and our technology estimates their age. The image is instantly deleted once the customer receives their estimated age, making it a privacy-preserving solution.

Prior to the sandbox trials, we worked with a number of charities to ensure the technology caters for people who often find themselves locked out of accessing digital solutions, whether that's because they do not have access or because technology has not been designed with minority or vulnerable groups in mind. There are clear benefits of our technology for both customers and retailers, so we acknowledge that it's even more important for us to work with charities who might otherwise struggle to benefit from technology.

We believe that anyone who wishes to use the technology should be able to, so retailers need to be mindful of wheelchair accessibility and customers who may be below a certain height. During the Home Office sandbox trials, customers at or below 1.5m in height were excluded from using this technology due to the angle at which the self-checkout cameras were installed. This included customers in wheelchairs.

Some supermarkets have self-checkouts positioned at a lower height to ensure they are accessible for all who wish to use them. It could also be beneficial for retailers to consider voice prompts for customers with visual impairments, again to ensure the technology is inclusive for all.

Our free Digital ID app provides another privacy-preserving way for shoppers to prove their age. Using the free Yoti or Post Office EasyID app, shoppers just scan a QR code on the checkout screen and share a verified age attribute. For adults who either do not want to use facial age estimation or younger looking adults who may be estimated below the age threshold, they have another way to prove their age, without needing to show an ID document or wait for assistance.

Giving customers more choice

The introduction of new technology shouldn't exclude or discriminate against those that don't wish to use it. We believe there should always be an alternative for those who still want to prove their age by whichever way feels familiar and comfortable to them.

During the trials, customers who did not wish to use digital age verification had the option to ask a staff member to come and approve them and if required, show their ID to a colleague instead.

Digital age verification

Staff member

Facial age estimation is more accurate than humans at determining age

“Yoti achieved a 100% rejection rate, in relation to the independent test purchases carried out “ - ASDA

Whilst some people are good at estimating age, others struggle, and this variability can frustrate customers, particularly young people, who are asked to provide physical proof of age. Additionally, the rising quality of fake and counterfeit IDs makes it increasingly difficult for retail staff to check the age of customers accurately. This puts increasing pressure on retail staff.

We believe that, when presented with a clear facial image, our technology compares very favourably with human abilities. Humans tend to systematically underestimate the ages of older people, and overestimate the age of those younger, and our ability to estimate accurately tends to decrease as we ourselves get older. A number of factors affect the ageing process, such as quality of diet and nutrition, adverse environmental conditions, use of narcotics, physical labour, stress and lack of sleep. All of this makes it difficult for humans to accurately estimate the age of another person.

Given our facial age estimation is more accurate than humans, it reduces the risks of incorrectly estimating the age of shoppers. During the sandbox trials, of the 99,800 customers that used the technology, there were no reported sales of underage customers purchasing age-restricted items.

Independent test purchases by two retailers, using 18—19 year olds, demonstrated a 100% rejection rate using Yoti. One retailer set the minimum age threshold at 28 years - meaning individuals had to be estimated as 28 or over. All 20 test purchases were correctly rejected because individuals were below the age threshold. The second retailer set the minimum age to 30 and carried out 30 test purchases — all were correctly rejected.

Additionally, the technology does not get fatigued on a long shift, and it cannot show favour to personal friends, or bias against individual customers. The technology also increased compliance performance for all ID checks. Any customers who were estimated below the age threshold were asked to prove their age another way; either by using our free Digital ID app or by showing their ID to a member of retail staff. Retail staff, therefore, knew which customers needed to show ID - and could spend time accurately checking these IDs

We continue to invest in improving the accuracy of our technology to ensure it works fairly for different skin tones, ages and genders. We have been regularly and transparently publishing the accuracy rates in our facial age estimation white papers since January 2019.

Our May 2022 white paper was independently verified, including our accuracy rates and measurement approach. Additionally, the Age Check Certification Scheme (ACCS) carried out an independent evaluation of the white paper, and concluded:

"The training, testing and results reporting presented in the whitepaper have been independently validated by ACCS, who have certified that Yoti have deployed appropriate methodologies to analyse the performance of their Age Estimation algorithm, including ensuring appropriate separation of machine learning training data, testing data and validation data."

Configured to work with age thresholds

Facial age estimation can be configured to work with different age thresholds. Businesses can set the most appropriate threshold so as not to irritate older customers or let younger people through. The size of this buffer also depends on the level of accuracy required by the business, or any regulatory requirements.

Many countries use Challenge 25 as a guide and this is something retailers and customers are already familiar with. Therefore, Yoti recommends setting an age threshold of 25 years if businesses are looking to detect under 18s.

As the technology becomes more accurate and improves further, age thresholds could be lowered. This would allow more people to use age estimation in a retail setting.

Anti-spoofing can help prevent underage sales and fraudulent activity

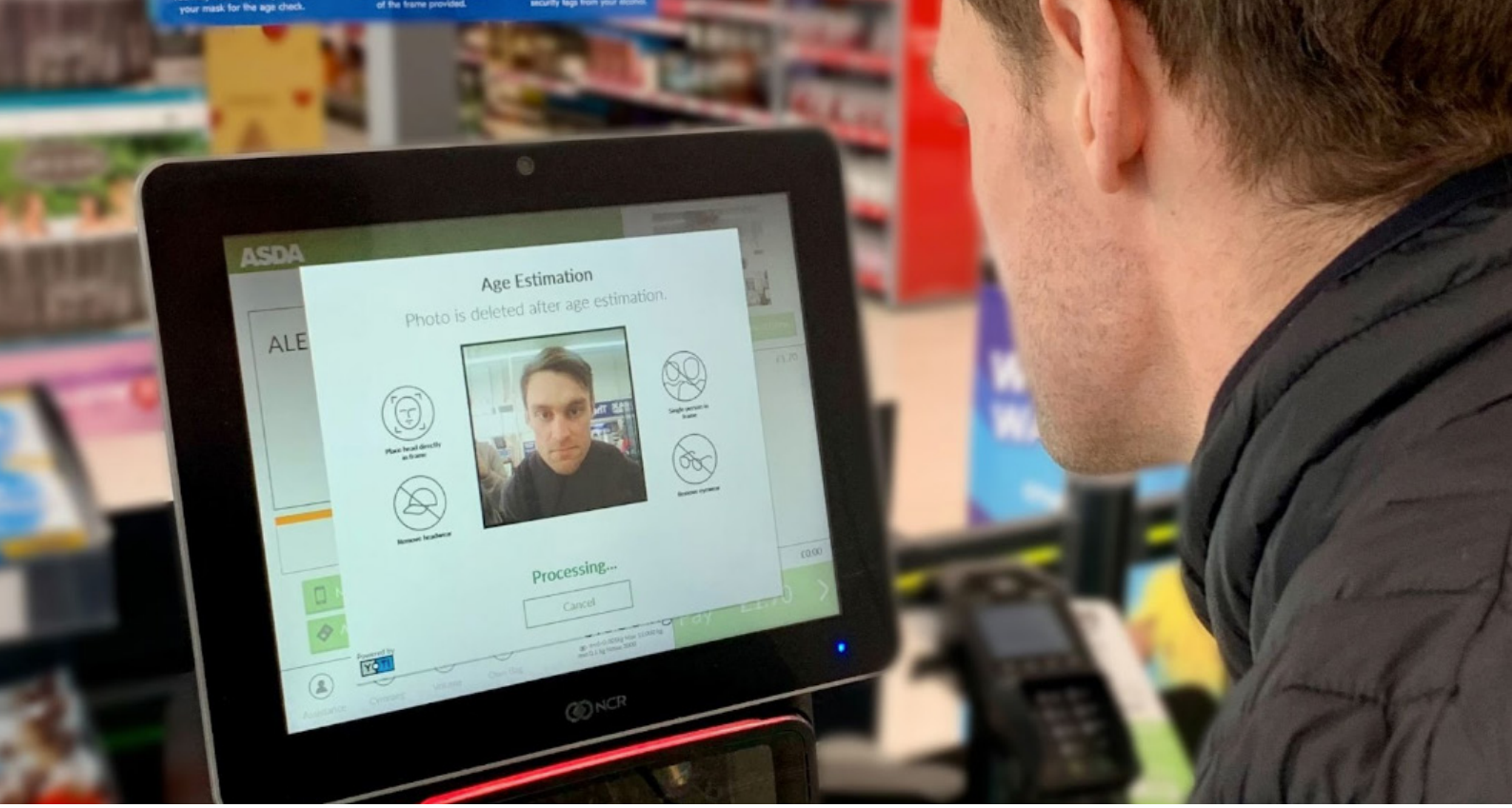
“We believe the biggest impact of Yoti is the potential to reduce the sales of alcohol to children.” - ASDA

There is a fine balance between usability and security. Digital age verification needs to be easy for customers to use but include protections to prevent underage shoppers from tricking the system.

Anti-spoofing is therefore a difficult challenge but key to the success of digital age verification. There are different types of anti-spoofing available, and additional protections can be put in place, but these will impact the experience of using the technology. For instance, active liveness requires the individual to perform an action, such as to nod or turn their head from left to right. But do shoppers really want to stand at the self-checkout doing this?

During the Home Office sandbox, despite a member of retail staff being present throughout, appropriate anti-spoofing was also used. We continually tested the service to find the right level between usability and security. We found that our passive anti-spoofing was needed for optimum results, so we upgraded the anti-spoofing during the trials.

Yoti’s proprietary NIST-certified passive liveness technology, MyFace, confirms it is a real person at the self-checkout, and not someone holding up a photo or video of another person. This liveness technology has been tried and tested in unobserved scenarios, i.e. with no person present.



Camera quality and environmental impact on success rates

As you would when taking any photo, you need to make sure the lighting is right and there isn't any glare on the camera. We've seen that facial age estimation works best with high quality cameras and good lighting so that it can capture a clear image of the person (which is then deleted as soon as their age has been estimated).

We have invested in the technology to ensure that it also works well with lower quality cameras and smaller image files, to ensure the technology is available and accurate for different retailers. During the Home Office sandbox, some self-checkouts carried out hundreds of age estimation transactions each week and successfully recorded an age estimation in over 90% of cases, despite relying on low quality cameras and small image sizes.

The positioning and setting of the self-checkout can also have an impact on success rates. For instance, if self-checkouts are positioned too close together, there might be other shoppers in the background which can make it harder for the technology to capture an image and estimate the age of the individual shopper.

We hope that this report has shed some light on how facial age estimation works in a retail setting. We will publish an updated report when more trials have been completed and more retailers are using Yoti's facial age estimation and Digital ID solutions on the self-checkouts.

Appendix

What is facial age estimation?

Our facial age estimation technology accurately estimates a person's age based on a selfie. We built it to give everyone a secure way to prove their age without sharing their name or ID document. This privacy-friendly approach doesn't require any personal details or ID documents, and all images are instantly deleted once someone receives their estimated age — nothing is ever viewed by a human. It can't link a name to a face or identify anyone. This is the difference between facial analysis and facial recognition.

The technology simply estimates an age and that's it. It never knows the person's name, identity or buying habits. It is not recording what the person is buying - it just checks their age.

How does it estimate age?

The technology has been trained to estimate age by looking at facial features in an image. To the technology, the image is simply a pattern of pixels, and the pixels are numbers. Our facial age estimation technology has been trained to spot patterns in numbers, so it learns 'this pattern is what 18 year olds usually look like', or 'this is the pattern for a 6 year old', and so on.

How does facial age estimation work at a self-checkout?

Shoppers purchasing alcohol look at a camera on the self-checkout and age estimation technology estimates their age. A privacy-preserving solution, it doesn't require any personal details or ID documents, and all images are instantly deleted once an age has been estimated. If the system detects the shopper looks younger than the set age threshold, customers are asked to use an alternative method to prove their age.

How accurate is facial age estimation?

We continue to invest in improving the accuracy of facial age estimation and we will soon be releasing an updated model with improved accuracy across all skin tones and gender for those aged 6-70.

The accuracy of the technology when estimating the age of an 18 year old has a Mean Absolute Error (MAE) of 1.22. Businesses using age estimation can use a threshold, like Challenge 25, to have greater confidence that someone under the age of 18 would not be able to buy an age-restricted item.

Another way to measure the accuracy of age estimation is using a True Positive Rate (TPR). This is the probability that an actual positive will test positive, for example, an 18 year old is correctly estimated to be under 23. The TPR for 13-17 year olds correctly estimated as under 23 is 99.65%. This gives regulators and businesses a very high level of confidence that nobody underage will be able to access age-restricted goods or services.

Further information on the accuracy of facial age estimation can be found in our white paper.

If you have any further questions about our technology, please get in touch at www.yoti.com/contact/business/