Yoti Age Estimation

White Paper | Executive summary

MAY 2022

Executive summary

Yoti's facial age estimation is an effective, secure age-checking service that can estimate a person's age by looking at their face. There is no need for a physical check of documents or human intervention.

Yoti's facial age estimation is built in accordance with the 'privacy by design' principle in the UK GDPR. No individual can be identified by the model and it encourages data minimisation because it only needs a facial image. Yoti immediately deletes all images of users. The model cannot infer anything else about a person nor can it uniquely identify a person.

Yoti's facial age estimation is performed by a 'neural network', which we have trained to be able to estimate human age by analysing a person's face. Our technology is accurate for 6 to 12 year olds with a mean absolute error (MAE) of 1.36 years and of 1.52 years for 13 to 19 year olds. These are the two age ranges regulators are most focused upon in order to ensure that under 18s do not have access to age restricted goods and services.

Our True Positive Rate[1] (TPR) for 13-17 year olds being correctly estimated as under 23 is 99.65%. This gives regulators a very high level of confidence that nobody underage will be able to access adult content. Our TPR for 6-11 year olds being correctly estimated as under 13 is 98.91%. Our solution is configurable to meet any regulations that requires prior consent before age estimation is used.

At Yoti, we take our ethical responsibilities as a company developing new technology very seriously. All the data (face image and month and year of birth only) used to **train** the algorithm is obtained by Yoti in accordance with the UK GDPR during the onboarding process for the Yoti apps or using consented data collection exercises. See page 20, Appendix Data used to build the model, for details.

This May 2022 release is our first algorithm that estimates the age from 6–70, using anonymous images that have been given consent to be used for age estimation training purposes. We are pleased to report the algorithm continues to show improvements in accuracy on this iteration. Some small deviations in this trend are best explained by demographic changes in the underlying training and testing data (see page 31 for a detailed discussion).

We are delighted to announce that Yoti's Facial Age Estimation technology has now been approved by the German regulator, KJM, for the highest level of age assurance. This means it can now be used, alongside the Yoti digital ID app, to check the age of German located individuals accessing 18+ adult content.

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1. True Positive Rate - the probability that an actual positive will test positive, such as an 18 year old is correctly estimated to be under 23.

Expanding the data set & improving accuracy

Our first white paper, published in December 2018, contained accuracy across age ranges of 13-60. Since September 2021 we published our 6-12 data for the first time, and we now include data for age range 60-70 From the outset we have built the data for 6-12 year olds with a balanced ratio of data across skin tone and gender.

We are pleased to report the algorithm continues to show improvements in accuracy on this iteration. Some small deviations in this trend are best explained by demographic changes in the underlying training and testing data (see page 27 for a detailed discussion).

Key takeaways

- Mean Absolute Errors (in years) are 2.96 for 6-70, 1.52 for 13-19 & 1.36 for 6-12.

- Users are not individually identifiable

- Helps organisations to meet Children's Codes or Age Appropriate Design Codes

- Does not result in the processing of special category data

- Gender and skin tone bias minimised.

- TPR for 13-17 year olds correctly estimated as under 23 is 99.65%.

- TPR for 6-11 year olds correctly estimated as under 13 is 98.91%.

- Training data collected in accordance with the UK GDPR.

- Independently tested and certified.

- A secure, privacy respecting solution that protects individuals.

- Yoti liveness and age estimation is very hard to 'fool'.

- Over 500 million checks performed worldwide.

- Solution is fast and scales to tens of millions of checks per day.

- Deployments: 'Lite' model on device and full model on premise (law enforcement).

Mean Absolute Error by age band

Gender	Female				Male				All
Skintone	**Tone 1**	**Tone 2**	**Tone 3**	**All**	**Tone 1**	**Tone 2**	**Tone 3**	**All**	
6-12	1.31	1.38	1.58	1.42	1.25	1.34	1.30	1.30	**1.36**
13-17	1.41	1.72	1.91	1.68	1.22	1.46	1.64	1.44	**1.56**
18-24	2.43	2.31	2.52	2.42	2.04	1.96	2.08	2.03	**2.22**
25-70	2.94	3.37	4.79	3.70	2.73	3.24	3.77	3.25	**3.47**
6-70	2.59	2.92	3.97	3.16	2.38	2.76	3.16	2.77	**2.96**

Yoti facial age estimation accuracy — Mean estimation error in years split by gender, skin tone and age band

Skin tones

For skin tone, our research team tagged the images using a scheme based on the widely used Fitzpatrick dermatological scale. Fitzpatrick uses six bands, from Type I (lightest) to Type VI (darkest). For the present, we have presented our data in three bands (based on Fitzpatrick Types I & II, Types III & IV, and Types V & VI).

Skin tone scale

Tone 1   Tone 2   Tone 3

About 'Mean Absolute Error'

Yoti facial age estimation can make both positive and negative errors when estimating age (that is, it can estimate too high, or it can estimate too low). By taking 'absolute' values of each error we mean ignoring whether the error is positive or negative, simply taking the numerical size of the error. We then take the average (or 'arithmetic mean') of all those absolute error values, producing an overall 'MAE'.

A table of MAE by year can be found in the appendix on pages 26-28.

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With age estimation, once you know you're dealing with a child you can…

Turn off excessive notifications.

Minimise the data you collect - don't store it.

Set geolocation to off but give the child the ability to turn it on if needed.

Shield their data. It shouldn't be used for things not in their interest.

Provide age-appropriate content.

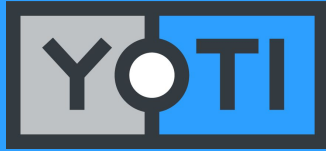Use child-friendly language to explain platforms.

Be certain the online community is within the same age threshold.

Always be sure to treat a child like a child.

Be certain the online community is within the same age threshold.

To find out more visit **yoti.com**