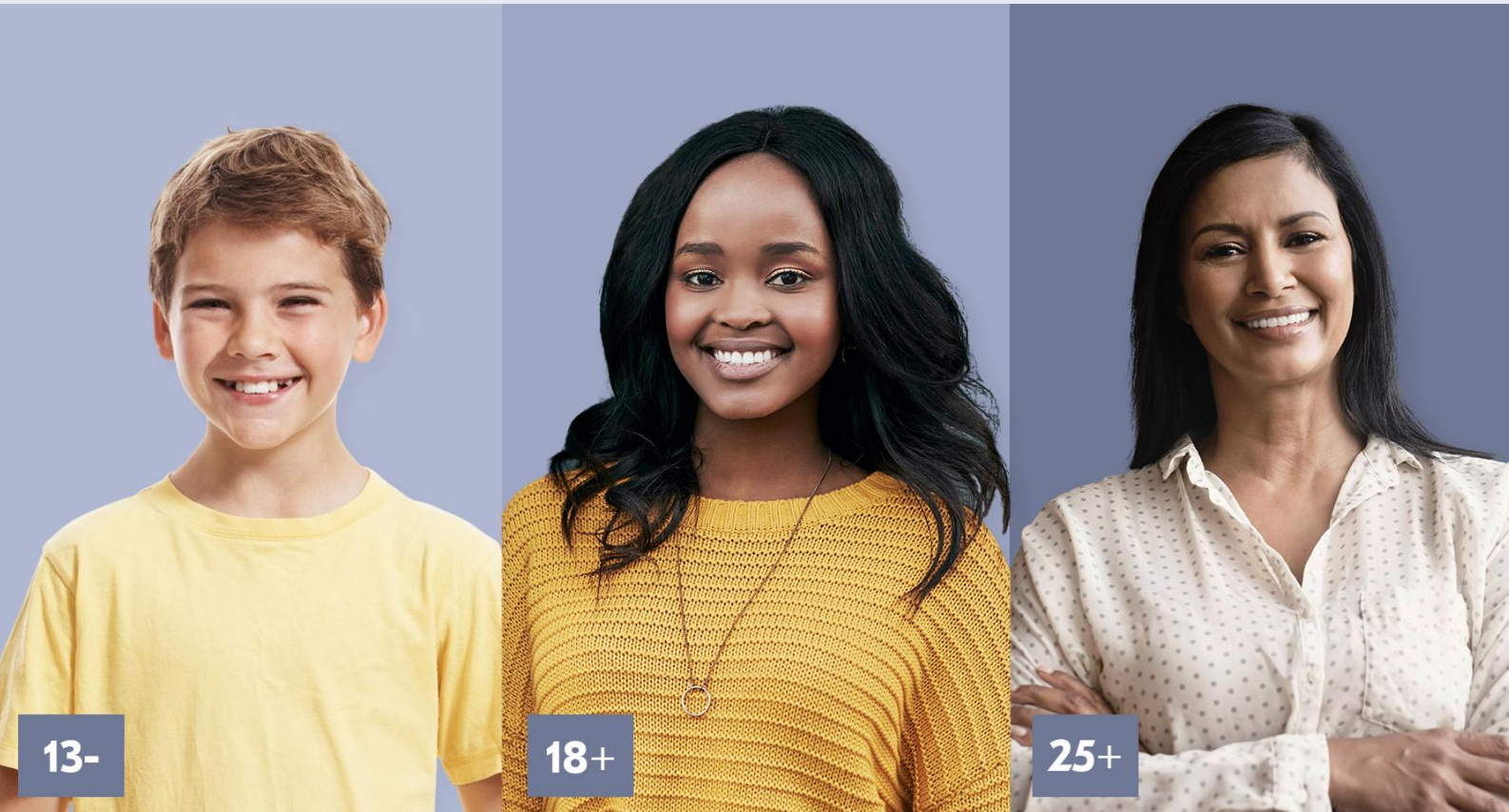




Yoti Age Estimation

White Paper | Full version



OCTOBER 2021

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 based on 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 1.28 years and it is 1.55 years for 13 to 19 year olds. These are the two age ranges regulators are most focused upon. 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 is our first algorithm that estimates the age of under 13s, using anonymous images of children that are provided by parents who have given consent for the images to be used for age estimation training purposes.

Key takeaways

- Mean Absolute Errors (in years) are 2.79 for 6-60, 1.55 for 13-19 & 1.28 for 6-12.
- Yoti facial age estimation always forgets a face.
- Users are not individually identifiable.
- Training data collected in accordance with the UK GDPR.
- Independently tested and certified.
- Gender and skin tone bias minimised. Our best MAE (1.18) is for 6-12 year olds with darkest skin tones (V & VI).
- Yoti facial age estimation is highly effective at helping young people to stay safe online.
- 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.

Mean Absolute Error by age

Age	Gender								All
	Female				Male				
	Skin Tone (based on the Fitzpatrick Scale)								
	Type I & II	Type III & IV	Type V & VI	All	Type I & II	Type III & IV	Type V & VI	All	
MAE	MAE	MAE	Average MAE	MAE	MAE	MAE	Average MAE	Average MAE	
6	1.35	1.61	1.22	1.40	1.06	1.79	1.35	1.40	1.40
7	1.36	1.37	0.90	1.21	0.76	1.06	1.20	1.01	1.11
8	0.93	1.00	1.87	1.27	1.02	1.40	1.15	1.19	1.23
9	1.10	1.02	0.90	1.01	1.54	0.89	0.70	1.05	1.03
10	0.96	0.88	0.72	0.85	1.09	0.88	0.81	0.93	0.89
11	1.34	1.80	2.00	1.71	2.21	1.04	1.32	1.52	1.62
12	2.08	2.33	1.57	1.99	2.01	1.56	0.80	1.46	1.72
13	2.36	3.01	2.40	2.59	1.74	2.38	2.06	2.06	2.33
14	1.69	2.11	2.53	2.11	1.46	1.98	2.21	1.89	2.00
15	1.22	1.54	1.79	1.52	1.09	1.36	1.50	1.32	1.42
16	1.00	1.08	1.27	1.12	0.86	1.22	1.17	1.08	1.10
17	1.13	0.94	1.03	1.03	0.94	1.19	1.05	1.06	1.05
18	1.46	1.18	1.12	1.25	1.23	1.57	1.32	1.37	1.31
19	1.91	1.67	1.40	1.66	1.52	1.82	1.55	1.63	1.65
20	2.27	2.13	1.96	2.12	1.96	1.92	2.13	2.00	2.06
21	2.63	2.47	2.22	2.44	2.02	2.22	2.28	2.18	2.31
22	2.70	2.62	2.93	2.75	2.33	2.11	2.40	2.28	2.51
23	2.82	2.95	3.35	3.04	2.25	2.18	2.17	2.20	2.62
24	2.64	2.77	3.69	3.03	2.29	2.22	2.38	2.30	2.67
25	2.67	3.06	4.14	3.29	2.20	2.23	2.40	2.27	2.78
26	2.63	3.17	3.82	3.21	2.19	2.20	2.26	2.21	2.71
27	2.64	3.10	4.68	3.48	2.25	2.37	2.35	2.32	2.90
28	3.07	3.23	5.06	3.78	2.39	2.43	2.57	2.46	3.12
29	2.76	3.47	4.43	3.55	2.51	2.88	2.87	2.75	3.15
30	3.02	3.23	5.02	3.76	2.44	2.75	3.11	2.77	3.26
31	2.81	4.38	5.05	4.08	2.61	2.42	2.84	2.62	3.35
32	3.19	4.21	5.20	4.20	2.64	2.83	2.95	2.81	3.50
33	3.44	3.88	4.40	3.91	2.80	3.23	3.31	3.11	3.51
34	3.54	4.12	5.28	4.31	2.86	3.14	2.99	2.99	3.65
35	3.22	3.48	5.64	4.11	2.75	2.97	2.95	2.89	3.50
36	3.14	3.57	2.38	3.03	2.99	2.69	3.19	2.96	2.99
37	3.14	3.80	3.70	3.55	2.63	2.96	3.41	3.00	3.27
38	3.48	2.42	4.73	3.54	2.67	3.06	3.34	3.02	3.28
39	3.52	4.11	3.75	3.80	2.82	2.56	3.59	2.99	3.39

Mean Absolute Error by year

Age	Gender								All
	Female				Male				
	Skin Tone (based on the Fitzpatrick Scale)								
	Type I & II	Type III & IV	Type V & VI	All	Type I & II	Type III & IV	Type V & VI	All	
	MAE	MAE	MAE	Average MAE	MAE	MAE	MAE	Average MAE	Average MAE
40	3.04	3.21	4.90	3.72	2.61	2.66	2.91	2.73	3.22
41	2.79	3.23	3.21	3.07	2.87	2.72	3.34	2.98	3.03
42	2.95	3.98	4.49	3.80	2.74	3.19	3.38	3.10	3.45
43	3.12	3.22	4.09	3.48	2.67	2.60	3.15	2.81	3.14
44	2.82	3.15	6.70	4.22	2.66	2.91	3.52	3.03	3.63
45	2.64	3.95	3.99	3.53	2.41	3.16	3.23	2.93	3.23
46	2.94	4.24	2.22	3.13	2.90	3.79	3.17	3.29	3.21
47	3.35	2.74	4.74	3.61	2.97	3.42	2.75	3.05	3.33
48	3.58	4.47	2.86	3.64	2.56	2.97	2.90	2.81	3.23
49	2.98	2.91	4.52	3.47	2.77	2.76	2.98	2.84	3.15
50	3.06	3.70	3.50	3.42	2.80	3.00	3.05	2.95	3.18
51	2.85	4.37	2.96	3.39	2.85	2.90	5.56	3.77	3.58
52	2.35	2.67	3.34	2.79	2.90	2.71	3.44	3.02	2.90
53	2.35	4.07	3.09	3.17	2.78	2.31	2.61	2.57	2.87
54	2.26	2.07	9.68	4.67	2.65	3.44	2.96	3.02	3.84
55	2.22	2.20	6.45	3.62	2.13	3.18	3.83	3.05	3.34
56	2.26	4.63	6.12	4.33	2.20	3.29	3.24	2.91	3.62
57	2.47	4.19	5.49	4.05	2.03	3.37	2.28	2.56	3.31
58	2.82	4.25	5.05	4.04	2.74	3.90	4.37	3.67	3.86
59	3.38	7.50	5.87	5.58	3.26	4.32	4.72	4.10	4.84
60	4.30	6.64	6.10	5.68	3.81	4.26	5.40	4.49	5.09
Avg¹	2.54	3.07	3.66	3.09	2.28	2.52	2.66	2.49	2.79

1. As of September 2021, we are giving equal weighting to each MAE year of age between 6 and 60, regardless of the overall volume of images tested across all ages. Refer to page 15 [Fair standardised measurement](#).

Table of Mean Absolute Error for 6-12 year olds

From the outset, we have built the data set for 6-12 year olds with a balanced ratio of data across skin tone and gender. The mean absolute error is 1.28.

It is also very encouraging to see that the darkest (V & VI) skin tone male and female 6-12 year olds are not disadvantaged - their MAE is lowest at 1.18. The relevant MAE for skin tone I & II is 1.34 and for skin tone III & IV is 1.33.

For a fuller explanation of the Fitzpatrick Scale, see page 23 of this white paper.

FITZPATRICK SCALE





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