A low-cost, high-throughput DNA quantification system using light pipe arrays for parallel fluorescence measurement

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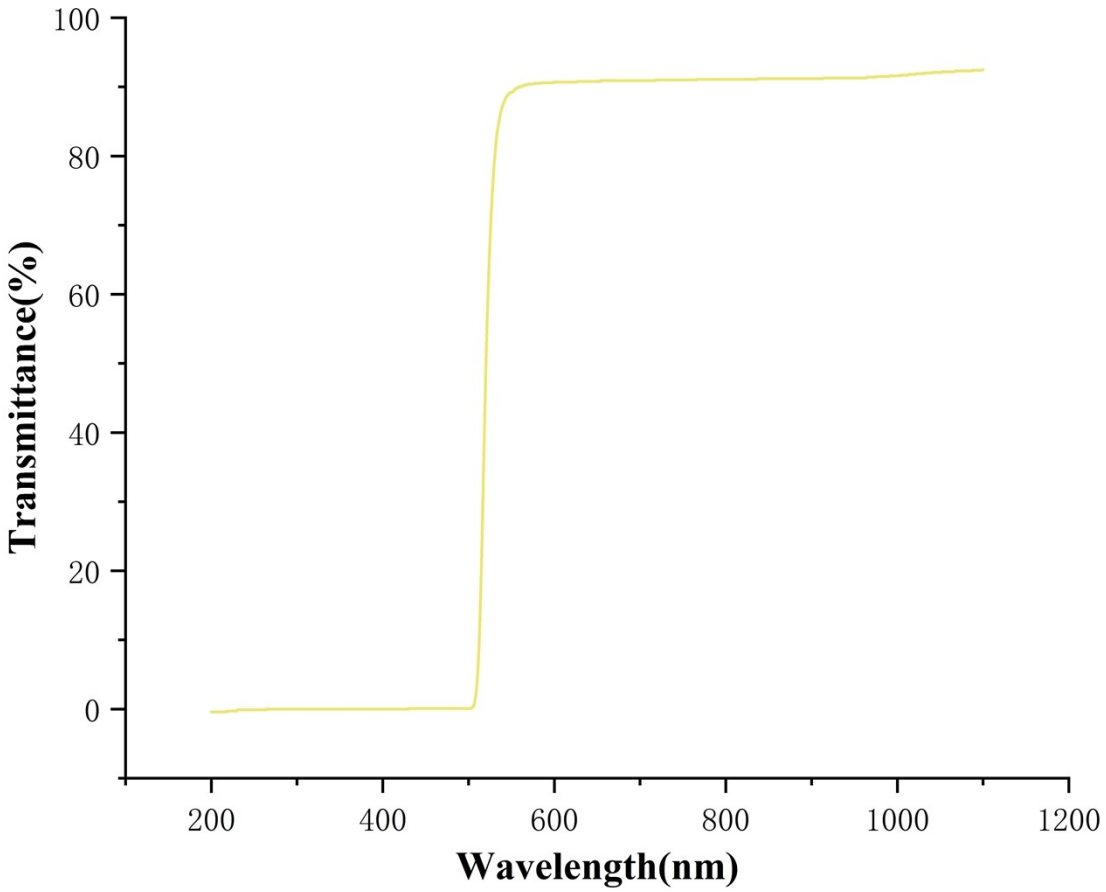

Fig.S1 The transmittance rate of the optical filters used for SYBR Gold, SYBR Green I .

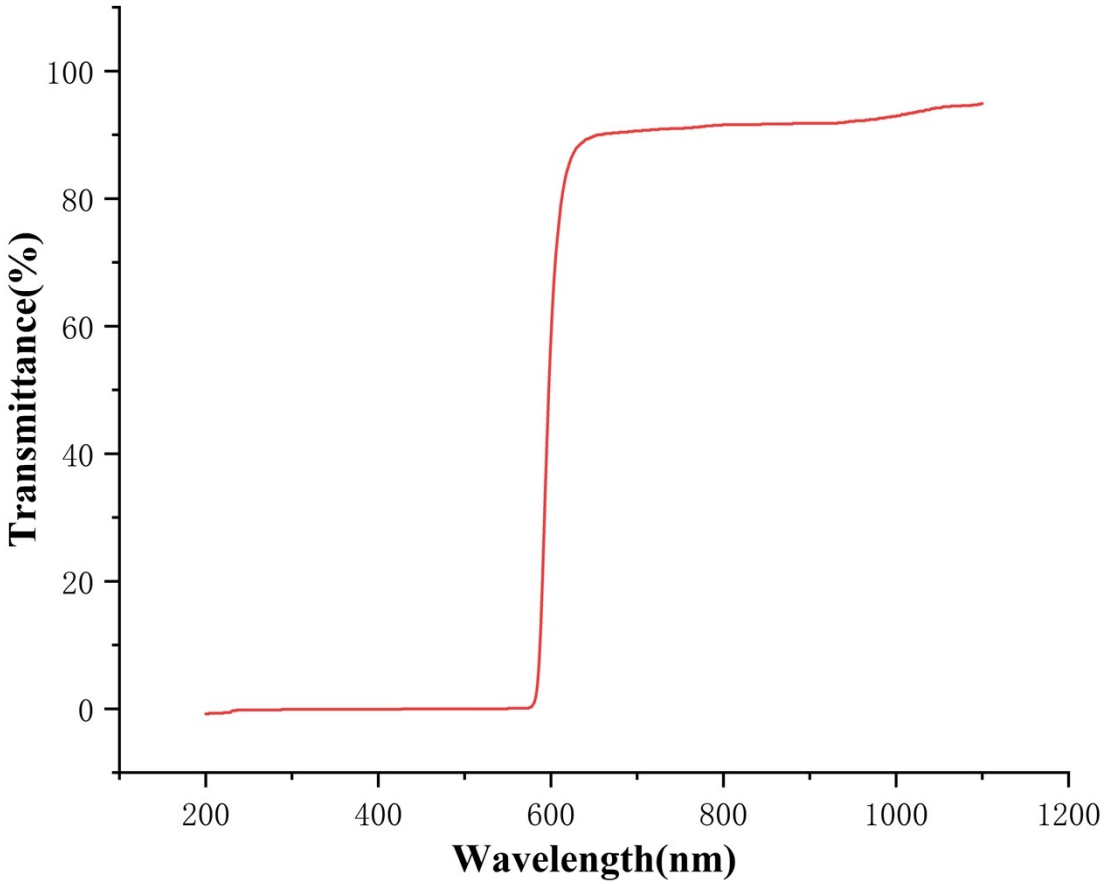

Fig.S2 The transmittance rate of the optical filters used for GelRed.

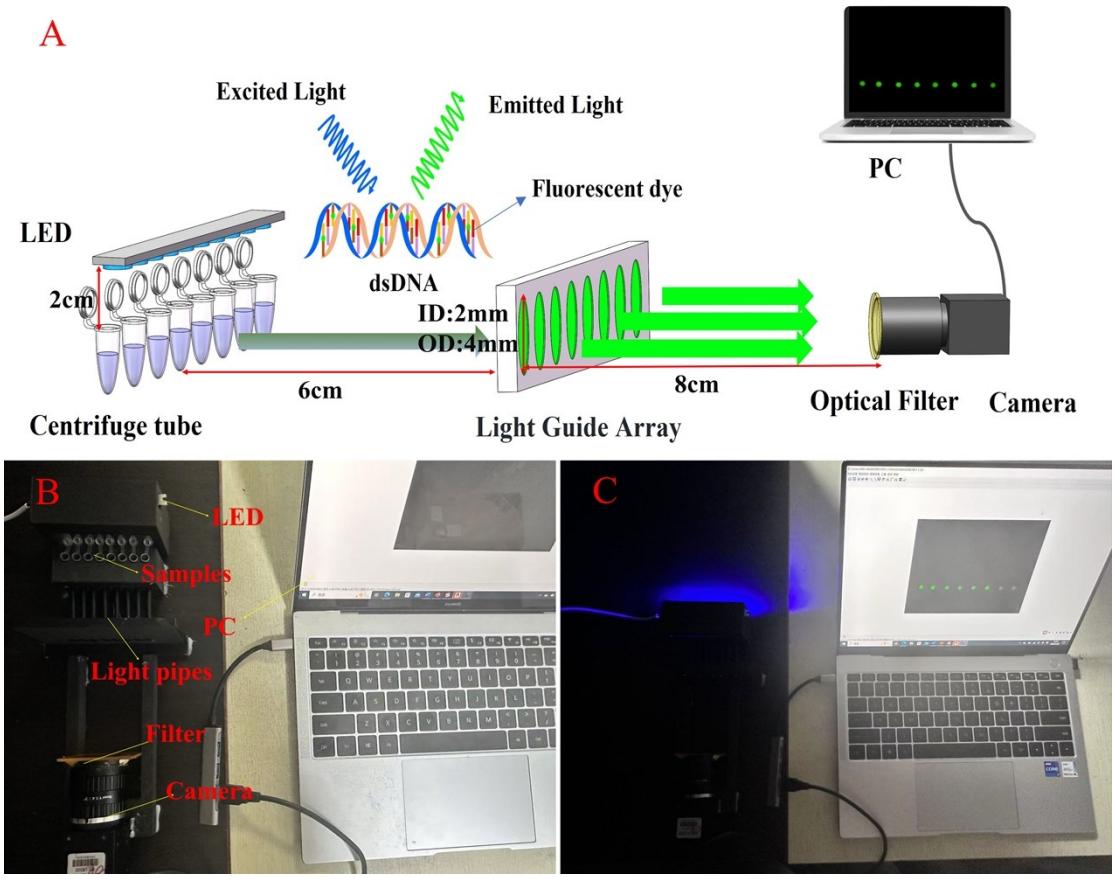

Fig.S3 (A) The sketch of self-built DNA concentration measurement system. (B) The photo of the self-built DNA concentration measurement system. (C) the photo of the self-built system when it worked.

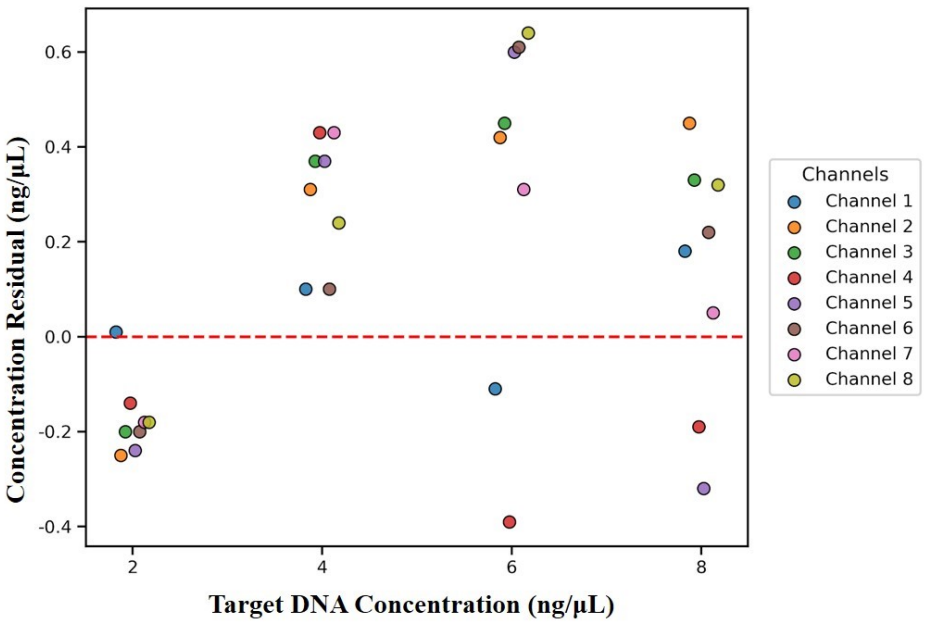

Fig. S4. Cross-channel concentration residual analysis for SYBR Green I. The absolute concentration residuals were calculated based on the mean measured results presented in Table S3.

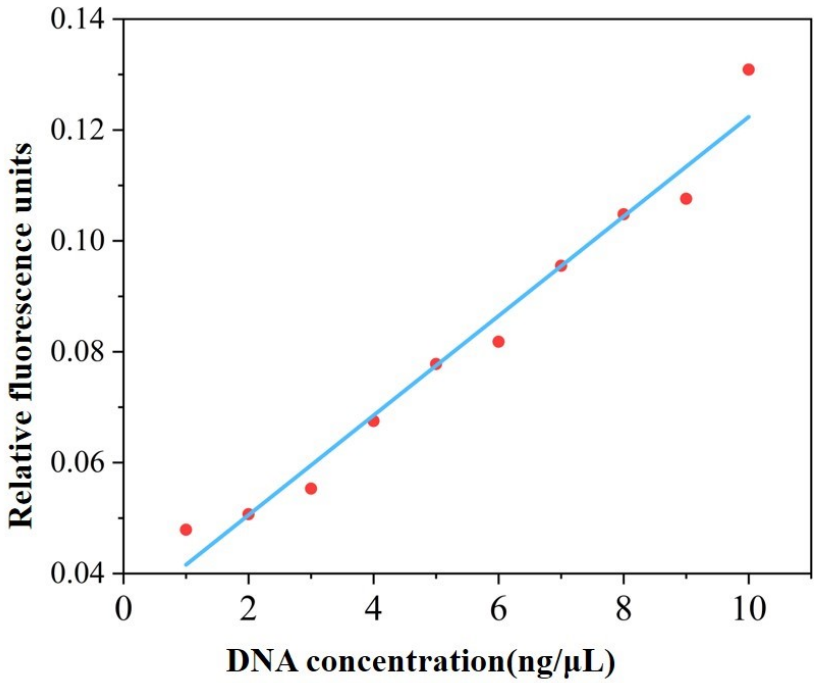

Fig. S5. Linear standard curve for DNA quantification measured by the commercial TECAN Spark microplate reader. The fluorescence intensity was obtained using SYBR Green I with standard DNA concentrations ranging from 1 to 10 ng/μL.

Table S1. Detailed Bill of Materials for the self-built DNA concentration measurement system

Material	Price($)	Supplier
CMOS camera	46	MindVision
Lens	21	MindVision
Optical filter	15	Guanshida Technology
LED	1.8	Shenzhen Tianrui Optoelectronics
Light pipe	0.9	Hengyue Technology
3D printed product	1.3	Creality K1 Max

Table S2 The parameters corresponding to Fig.5

Channels	Different dyes	Slope (k)	Intercept (b)	R
A	GelRed	7.25±0.52	16.35±3.18	0.955
	SYBR Gold	16.12±0.53	3.79±4.34	0.99
	SYBR Green I	23.39±0.48	-14.65±3.03	0.996
B	GelRed	8.47±0.50	19.27±3.08	0.968
	SYBR Gold	16.77±0.67	19.00±5.71	0.985
	SYBR Green I	26.58±1.20	-21.08±4.98	0.982
C	GelRed	9.26±0.46	19.69±2.76	0.978
	SYBR Gold	18.71±1.04	5.78±7.21	0.972
	SYBR Green I	22.80±0.72	-5.94±4.18	0.99
D	GelRed	8.25±0.63	23.65±4.35	0.949
	SYBR Gold	18.29±1.51	6.97±8.35	0.941
	SYBR Green I	24.58±0.88	-13.03±5.36	0.988
E	GelRed	9.07±0.59	20.89±3.11	0.963
	SYBR Gold	15.77±1.18	15.65±8.79	0.951
	SYBR Green I	26.90±2.27	-2.07±13.66	0.972
F	GelRed	7.61±0.48	23.02±3.12	0.964
	SYBR Gold	15.73±1.51	15.42±10.05	0.922
	SYBR Green I	26.01±1.2	-7.3±8.1	0.981
G	GelRed	8.4±0.72	11.54±4.94	0.937
	SYBR Gold	16.54±1	7.29±5.81	0.967
	SYBR Green I	21.17±0.77	5.83±5.57	0.988
H	GelRed	7.4±0.6	11.21±3.86	0.943
	SYBR Gold	13.08±1.86	17.67±9.11	0.927
	SYBR Green I	18.28±0.7	-0.14±5.25	0.986

Table S3 Comparison of DNA concentration measurements (2, 4, 6 and 8ng/μL) with a commercial instrument (Qubit 3.0).

		MR (ng/μL)	RE (%)	MR (ng/μL)	RE (%)	MR (ng/μL)	RE (%)	MR (ng/μL)	RE (%)
GelRed	1	1.71±0.06	14.38	4.47±0.12	11.92	5.57±0.13	7.11	7.75±0.08	3.12
	2	2.08±0.04	4.06	4.34±0.03	8.51	6.31±0.15	5.30	8.11±0.05	1.38
	3	1.56±0.08	21.92	3.79±0.11	5.13	5.94±0.04	0.97	8.89±0.07	11.14
	4	2.02±0.10	1.00	3.81±0.08	4.53	6.04±0.06	0.81	7.49±0.16	6.32
	5	1.33±0.05	33.42	3.86±0.07	3.41	6.33±0.07	5.65	7.82±0.13	2.20
	6	2.25±0.06	12.54	3.77±0.04	5.51	6.24±0.06	4.14	8.27±0.17	3.40
	7	1.76±0.07	11.82	4.40±0.05	10.15	5.73±0.05	4.34	7.07±0.06	11.63
	8	1.72±0.08	14.00	3.80±0.01	4.89	6.14±0.07	2.43	6.73±0.01	15.88
SYBR	1	1.56±0.06	21.79	4.66±0.09	16.67	6.43±0.08	7.30	8.12±0.06	1.53
Gold	2	1.71±0.02	14.40	4.57±0.05	14.30	6.38±0.16	6.49	8.01±0.07	0.15
	3	1.80±0.03	10.00	4.42±0.04	10.59	6.63±0.02	10.50	7.74±0.03	3.21
	4	1.52±0.09	24.00	5.39±0.07	34.74	6.16±0.07	2.79	7.62±0.04	4.67
	5	1.57±0.03	21.08	5.05±0.16	26.34	6.45±0.06	7.51	8.08±0.12	1.00
	6	1.53±0.01	23.3	4.72±0.08	18.07	6.24±0.05	4.02	7.56±0.02	5.48
	7	1.67±0.06	16.73	4.72±0.01	18.07	6.24±0.13	4.02	7.56±0.08	5.48
	8	1.63±0.04	18.49	4.80±0.06	20.00	6.56±0.06	9.39	7.06±0.09	11.67
SYBR	1	2.01±0.11	0.32	4.10±0.11	2.43	5.89±0.05	1.92	8.18±0.11	2.24
Green I	2	1.75±0.06	12.51	4.31±0.08	7.80	6.42±0.07	6.96	8.45±0.06	5.65
	3	1.80±0.03	9.89	4.37±0.04	9.25	6.45±0.01	7.44	8.33±0.06	4.19
	4	1.86±0.07	6.87	4.43±0.05	10.76	5.61±0.08	6.44	7.81±0.07	2.38
	5	1.76±0.03	11.92	4.37±0.09	11.68	6.60±0.04	10.00	7.68±0.15	3.94
	6	1.80±0.06	9.89	4.10±0.02	2.41	6.61±0.06	10.11	8.22±0.11	2.73
	7	1.82±0.08	8.91	4.43±0.07	10.69	6.31±0.07	5.12	8.05±0.04	0.62
	8	1.82±0.02	8.81	4.24±0.06	6.06	6.64±0.03	10.71	8.32±0.08	4.04
Qubit		2.22±0.09	11.00	4.10±0.06	2.50	5.48±0.06	8.67	9.64±0.05	20.50

Note:MR: Measured Result (ng/μL); RE: Relative Error. From left to right, the four pairs of MR and RE columns correspond to the target DNA concentrations of 2.0, 4.0, 6.0, and 8.0 ng/μL, respectively.

Table S4 Quantification results and relative errors in the inter-channel crosstalk assay

	Channel	Result 1(ng/μL)	RE(%)
Self-built system	1	8.84	10.5
	2	2.30	8.5
	3	8.60	7.5
	4	2.14	16.5
	5	8.72	9.0
	6	2.26	13.0
	7	8.92	11.5
	8	2.17	14.5

Table S5 Comparison of DNA concentrations of the PEG-67 PCR amplicon measured by the self-built system, Qubit 3.0, and TECAN Spark

	Channel	Result 1(ng/μL)	Result 2(ng/μL)	Result 3(ng/μL)
Self-built system	1	4.21	6.05	7.30
	2	4.37	5.57	6.88
	3	4.64	5.72	7.07
	4	4.39	5.68	7.19
	5	4.48	5.91	7.32
	6	4.66	6.11	7.13
	7	4.35	5.83	6.97
	8	4.25	5.79	6.80
Qubit 3.0		4.66	5.87	7.28
TECAN Spark		4.49	6.13	6.97

Note: Result 1, Result 2, and Result 3 represent the parallel measurements of the identical PEG-67 PCR product diluted to 0.04×, 0.05×, and 0.06× of its original concentration, respectively.