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Appendix
Version 10 June 2026

for the paper entitled

Practical evaluation of sensor-based technologies on pig fattening farms

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Table A1: Summary of types and number of performed interventions for all investigated sensor systems. The table contains raw data, i.e. not-normalised, thus not accounting for varying sensor count. The number of sensors (n) was provided in parentheses. The performed interventions were additionally grouped into three categories into 1) software-related issues, 2) hardware-related issues, 3) external issues, not direcly related to the system (e.g. power outage, internet connectivity issues), and 4) unknown causes.

Category	Climate sensor board (n = 6)		SAMBa (n = 6)		Water flow meter (n = 6)		Cough monitoring system (n = 3)		Optical pig weighing system (n = 3)		RGB camera (n = 12)		Climate measurement suite (n = 6)	
Software-related issues	Restart computer and software	2	Update automated data backup routine	1	Restart computer and software	14			Reopen software	11	Reopen software (due to computer auto restart)	55	Reopen Software	18
	Reopen Software	1			Configuration of water flow meter	1			Restart computer on-site	9	Not necessary, error message due to auto restart of camera	10	Reconnect to server	8
									Restart computer and software	4	Restart computer on-site	10	Restart computer on-site	6
									Contact support	3	Minor software maintenance	3	Restart computer and software	3
											Reopen software & start recording	1	Contact support	2
											Restart computer and software	3		
											Software maintenance and configuration	1		
Hardware-related issues	Clean Lux-Sensor	5			Replace broken water flow meter	1	Move gateway closer to sensor (weak signal)	2			Replace broken cable	3	Clean connections, replace cables	9
					Replace cables	1	Replace faulty switch	1			Clean cameras	2		
											Contact with support, replace broken cable	1		
											Replace faulty switch	1		
											Replace broken camera	1		
External issues	Communication	1			Network connectivity issue	1			Communication	3	Not necessary, error message due to temporary connection loss	30		
									Repair faulty network components	3	Internet connectivity issue	2		
Unknown							Unknown, self-solved	5						

Table A2: Results of the exploratory cluster analysis for k = 3 at a silhouette width of 0.36 (weak clustering). The table contains the number of sensor failures, all interventions, remote interventions, on-site interventions, and resulting data gaps for the investigated systems for all systems as well as averages for the three clusters.

Cluster	Sensor system	Cluster group	Failures	Interventions	Remote	On-site	Gaps
1	Water flow meter	1	36	24	18	6	34
	Climate sensor board	1	16	16	4	12	16
	SAMBa	1	2	2	2	0	0
	Cough monitoring system	1	32	28	0	28	32
	average	**1**	**21.5**	**17.5**	**6.0**	**11.5**	**20.5**
2	RGB Cameras	2	122	39	22	17	71
	Climate measurement suite	2	94	48	24	22	34
	average	**2**	**108.0**	**43.5**	**23.0**	**19.5**	**52.5**
3	Optical pig weighing system	3	64	60	50	10	64
	average	**2**	**64.0**	**60.0**	**50.0**	**10.0**	**64.0**

For k = 3, in comparison to k = 2, the only change in clustering is the optical pig weighing system being grouped in a separate cluster (cluster 3). The “low effort” cluster 1 thereby keeps the lowest average failures, overall interventions, remote interventions and resulting data gaps, although the amount of required on-site interventions is now second to highest. The separation of the optical pig weighing system produces two contrasting clusters: Cluster 2 can be described as a “high on-site effort” cluster, having the highest documented failures and required on-site interventions, as well as moderately high total and remote interventions, and resulting data gaps. Cluster 3, which consists only of the optical pig weighing systems, can be best described as a “high remote effort” cluster, being characterised by a moderately high number of documented failures, and the highest number of resulting gaps and of both total and remote interventions, although displaying the lowest number of on-site interventions. No further clustering was performed for k = 4, 5 and 6, since the clustering at k = 3 already resulted in a low silhouette width (0.36), attesting to only weak clustering.

Table A3: Summary statistics of the regression analysis on the normalised number of monthly sensor failure reports. Note that there was only one reported failure for the SAMBa system, thus no meaningful analysis could be performed.

Sensor	Estimate	Standard error	p-value	Overdispersion coefficient	Model type
Water flow meter	0.002	0.001	0.15	0.18	Quasi-Poisson
Climate sensor board	-0.005	0.002	0.15	0.27	Quasi-Poisson
SAMBa	NA	NA	NA	NA	NA
Cough monitoring system	0.011	0.005	0.14	0.55	Quasi-Poisson
RGB Cameras	-0.001	0.001	0.57	1.77	Negative binomial
Climate measurement suite	-0.003	0.002	0.08	1.64	Negative binomial
Optical pig weighing system	0.004	0.002	0.10	0.91	Poisson

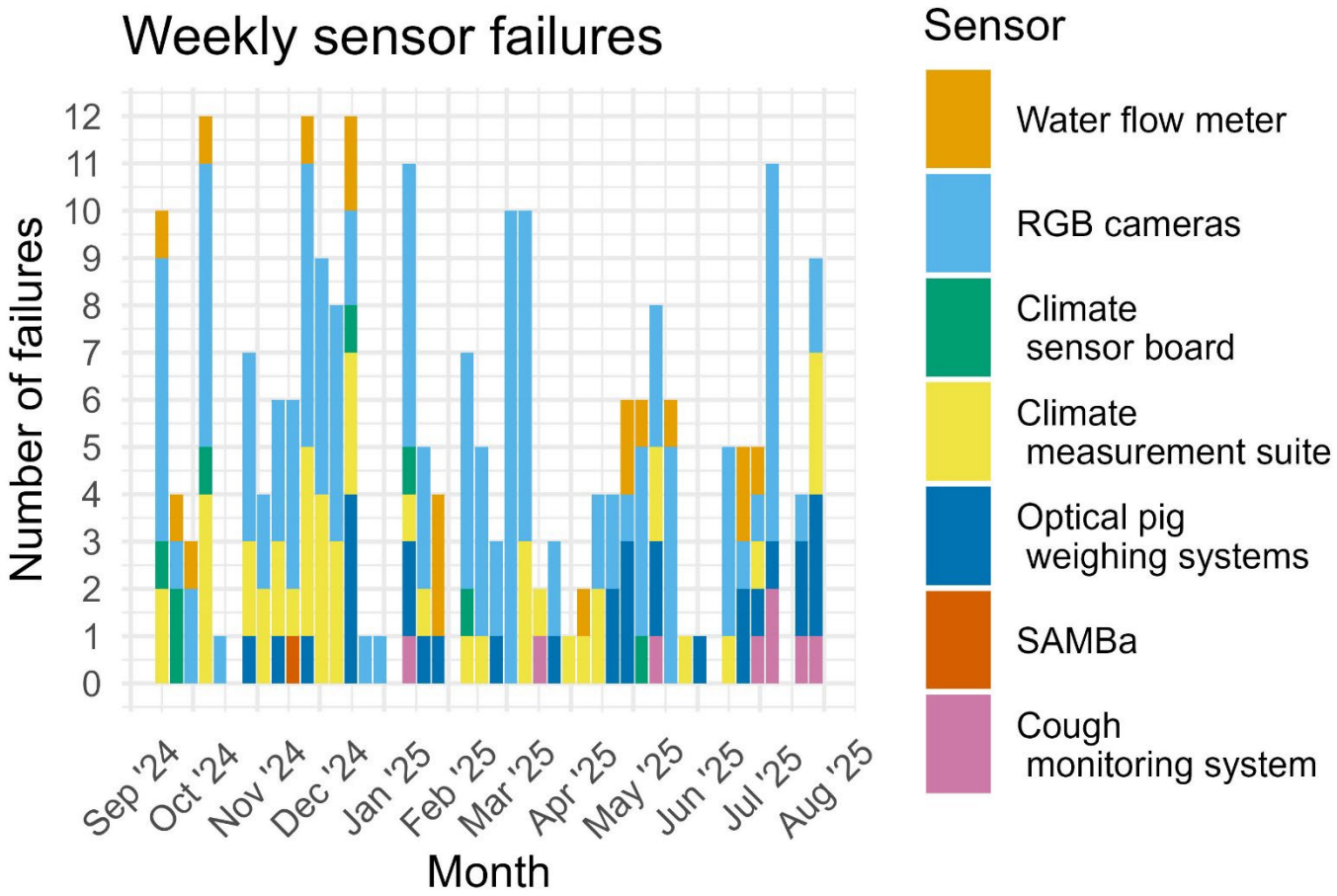

Figure A1: Weekly reported normalised counts of sensor failures for all seven sensor systems across the entire survey period.