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Title:	An intelligent cloud monitoring system for multiple 3D printers based on IoT
Authors:	Xie, Y (/browse?type=author&value=Xie%2C+Y) Yang, Q (/browse?type=author&value=Yang%2C+Q) Liu, W (/browse?type=author&value=Liu%2C+W) Sun, X (/browse?type=author&value=Sun%2C+X)
Keywords:	Internet of Things;internet software;production engineering computing;industrial applications of IT;manufacturing systems;three-dimensional printing;inspection and quality control
Issue Date:	4-Oct-2024
Publisher:	The Institution of Engineering and Technology (IET)
Citation:	Xie, Y. et al. (2024) 'An intelligent cloud monitoring system for multiple 3D printers based on IoT', IET Conference Proceedings, 2024 (12), pp. 1208 - 1215. doi: 10.1049/icp.2024.3605.

Abstract: In the Industry 4.0 era, 3D printing has become a cornerstone of intelligent manufacturing, necessitating precise real-time monitoring and control to ensure efficiency and quality. This research developed an IoT-based cloud monitoring system for 3D printers to enhance remote monitoring and control capabilities. The system collects real-time sensor data on parameters such as temperature and humidity, along with live video feeds. These multimodal data are pre-processed at the edge and further analyzed in the cloud. Users can monitor the 3D printing status via a custom visual interface and adjust parameters based on data analysis to optimize printing quality. To evaluate the system's effectiveness, experiments were conducted to explore the relationship between process parameters and surface roughness and to optimize the printing process and quality using the Taguchi design of experiments. Five factors were considered: nozzle temperature, bed temperature, printing speed, layer height, and ambient temperature. The significant printing process factors were identified, and optimal factor levels were determined to enhance print quality. The experimental results demonstrated that the system can significantly improve the quality and response speed of 3D printing process monitoring. Additionally, it enhances the reliability and user experience of 3D printing.

URI: <https://bura.brunel.ac.uk/handle/2438/30886> (<https://bura.brunel.ac.uk/handle/2438/30886>)

DOI: <https://doi.org/10.1049/icp.2024.3605> (<https://doi.org/10.1049/icp.2024.3605>)

ISBN: 978-1-83724-195-8

Appears in Collections: Department of Mechanical and Aerospace Engineering Research Papers (</handle/2438/8625>)

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