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**ROVO: Firmware Generation and Visual Interaction  
Platform for Robotic Arm using IoT**

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## **Abstract**

The robotic arm is the most significant mechanical device used in the robotics field. Integration of robotics and IoT provides massive benefits for domestic and industrial utilizations. Even in dangerous human-related jobs, robotic arms are extremely useful. Nowadays, robotic arms are widely designed and built by everyone using 3D printers to control and monitor feedback. However, robotic arms not only have hardware parts but also firmware. Developing firmware for a robotic arm with a real-time monitor and control system is very time/cost consuming with lots of challenges.

The goal of this research is to identify the challenges in real-time monitoring and control systems, as well as to develop an IoT platform for the robotic arm that uses the no-code approach to generate firmware. Moreover, the platform achieved full-duplex and real-time communication using the MQTT and WebSocket protocols. Also, the firmware template was designed with low memory and power consumption in mind.

Based on IoT techniques and the literature survey, semi-structured interviews were conducted with domain and technical experts to identify the challenges and validate the hypothesis. The author developed the platform to ease the process of handling the robotic arms based on the requirements gathered. The platform was evaluated by experts. The evaluation feedback was positive.

**Keywords:** Internet of Things, Digital Twin, Robotic arm, No-Code firmware generator, Full-duplex and Real-time