A Production Support and Monitoring System on Mobile Application*

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***Abstract*—This paper proposes a production support system designed to assist human operators in industrial environments. The proposed system integrates easily with existing industrial automation equipment thanks to the used industrialPI4 computer provides simplicity of use through its mobile application interface. The industrialPI4 computer uses the Open Platform Communications Unified Architecture (OPC UA) protocol to connect as an edge device to industrial controllers allowing it to perform control and data acquisition operations. It synchronizes the data with a real-time database. The user can access and modify the data from the mobile application. This system facilitates the interaction with industrial processes, allows near-real-time and continuous remote monitoring and control of industrial processes. Test results of the system demonstrate its stability, agility, robustness while remotely controlling a real industrial process.**

***Index Terms*—Mobile application, Remote monitoring and control, OPC UA, Industry 4.0, Industry 5.0, Industrial systems.**

I. Introduction

The rapid digital transformation of industrial production has reshaped manufacturing environments into highly interconnected ecosystems where physical equipment, embedded devices, cloud services, and intelligent applications collaborate to support efficient and flexible operations. While Industry 4.0 established the foundation for digitalization through automation, connectivity, and data-driven decision-making, the emerging Industry 5.0 paradigm extends these concepts by promoting human-centric, resilient, and sustainable manufacturing systems. In this context, automation technologies are expected to optimize industrial processes and enhance collaboration between operators and intelligent machines, enabling greater flexibility, and responsiveness across production environments [1], [2]. Despite these technological advances, many industrial monitoring solutions continue to rely on proprietary, closed, inflexible, and monolithic Supervisory Control and Data Acquisition (SCADA) platforms that present limitations in terms of cost, adaptability, and intuitiveness [3]. These constraints motivate the development of a lightweight and open system capable of supporting real-time industrial communication while enabling remote access through modern digital technologies. Low-cost embedded computing platforms, together with cloud databases and cross-platform mobile applications, provide a practical alternative for extending industrial monitoring and control beyond conventional control rooms.

This paper presents a remote control and monitoring solution based on an industrialPI4, Firebase real-time database, and a mobile application, the former operates as an OPC UA client [4]–[6] directly interacting with PLCs in real time, the database enables secure cloud data storage and synchronization, while the latter provides operators with intuitive remote monitoring and control capabilities. By facilitating continuous access to production information from handheld devices, the proposed solution contributes to the human-centric vision of Industry 5.0, empowering operators with greater mobility, situational awareness, and interaction with industrial processes.

II. System Architecture

The system is designed to provide real-time and secure monitoring and control of industrial production lines. The PLC remains the main field-based controller of the equipment and the device responsible for security and safety in the industrial environment. The industrialPI4 computer is the only added hardware, it acts as an edge device responsible for data processing and synchronization between the PLC and the database. Firebase is the real-time cloud database service used to store the data of the supervised system and synchronize it between the different human operators. The cross-platform mobile application developed using Flutter is the user interface made available for the operators on their different mobile devices or on other screens, it is designed to facilitate the user's interactions with the equipment, data display, and historical data tracking. It is also responsible for allowing only the authorized users to make modifications to the system. Figure 1 shows this architecture and the communication between each part of the system, the PLC is the OPC UA server allowing secure access to its data. The IndustrialPI4 is the OPC UA client and also the bridge between the PLC and the database. Firebase is the database system that synchronizes data between all the users and enforces security rules. The mobile application is the human-machine interface of the

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system that also includes the organization of the users and their tasks.

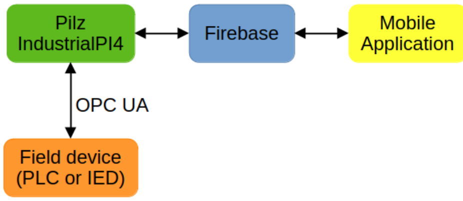
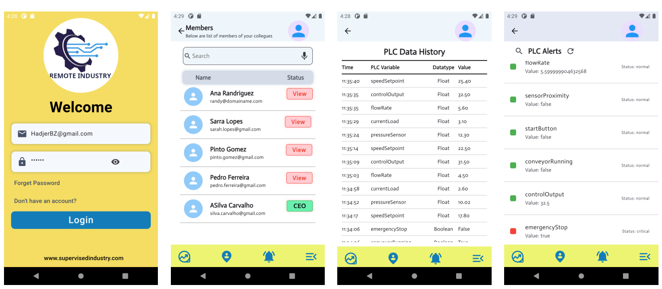


Fig. 1: The proposes system architecture.

A. Mobile Application

The application is developed in Flutter. It provides real-time visualization of the PLC data and the ability to send control commands back to the PLC thanks to the instantaneous data synchronization by Firebase in the cloud and by the industrialPI4 in the field through the OPC UA protocol. Figures 2 and 3 present the developed application. It is designed to ensure intuitive navigation and monitoring of the process data, and an easy remote manipulation of its control endpoints for authorized users. These figures show the user-friendly design of the application and highlights its effectiveness in continuous monitoring and in rapid intervention scenarios. Figure 2a displays the login page, Figure 2b shows the different users of the same equipment as team members and messaging between them. Figure 2c shows the PLC data, and Figure 2d shows system alerts and notifications. Figure 3 shows data display and control modes that can be chosen by the user.

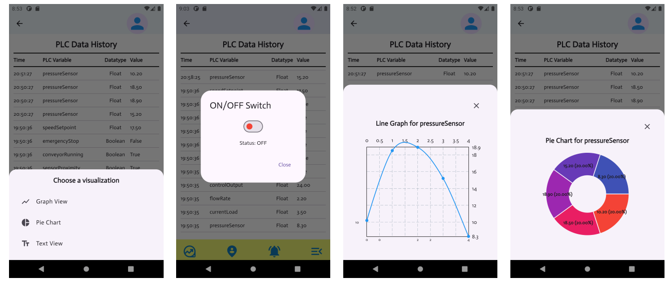


(a) (b) (c) (d)

Fig. 2: Login (a), Industry team members (b), PLC Data (c) and Notifications (d) pages.

III. Results and Discussion

We run a test case using a Siemens S7-1500 PLC by uploading a test program and configuring it as an OPC UA server, and using a Raspberry PI 3b as a data processing computer and internet gateway synchronizing data with the database. The mobile application was running in a smartphone, displaying the data viewing page to monitor data transfer between the PLC, the Raspberry Pi, the database, and the mobile application. After several tests, we obtained an end-to-end network latency average of $3ms$ and a maximum value of $7ms$.



(a) (b) (c) (d)

Fig. 3: Data visualization types (a), Equipment control (b), Graphics data plot (b), and Pie chart (b) plot pages.

IV. Conclusion

This research presents a scalable, adaptable, open, and cost-effective industrial IoT system that allows users to easily monitor and control industrial processes from a mobile application. The system is stable has a low latency, and guarantees secure communication and usage intuitiveness. Performed tests show the system's responsiveness and reliability.

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