

Automation and Real-Time Data Integration for Magnetic Field Testing in Magmeter Manufacturing

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Abstract - In modern industrial testing environments, accurate measurement, real-time monitoring, and secure storage of instrument data are critical requirements. Manual recording of test results often introduces errors, delays, and inconsistencies in data management. This research presents the design and development of a semi-automated instrumentation and real-time data logging system using LabVIEW for industrial measurement applications.

The BGM101 Gaussmeter forms the core of the proposed system, connected to a host computer through a USB-COM port and accessed via a manufacturer-supplied DLL integrated into LabVIEW. Raw magnetic flux readings are processed within LabVIEW to extract DC mean, peak, and range values, which are then written into a MySQL database with automatic timestamps.

The developed system eliminates manual logging, improves measurement consistency, reduces operator intervention, and provides a scalable architecture for future industrial automation. Experimental results demonstrate reliable real-time acquisition, visualization, and database storage of measurement parameters, validating the effectiveness of the proposed approach.

Key Words: LabVIEW, Industrial Automation, BGM101, MySQL, Data Acquisition, Serial Communication, Real-Time Monitoring.

1. INTRODUCTION

Industrial measurement systems demand high accuracy, repeatability, and efficient data management. Conventional measurement techniques often rely on manual recording, which can lead to data inconsistency, operator dependency, and increased processing time. With the advancement of industrial automation, integrating measurement instruments with software-based monitoring systems has become essential.

Among graphical programming environments, LabVIEW stands out for its hardware interfacing capability, built-in signal processing functions, and real-time data visualization. The present work builds on these strengths to develop a system where the BGM101 Gaussmeter feeds live magnetic field data into LabVIEW, which processes it and pushes results directly into a MySQL database — removing manual recording entirely from the testing workflow.

The objective is to automate real-time measurement, parameter extraction, visualization, and database storage while minimizing manual intervention and improving overall testing efficiency.

2. LITERATURE REVIEW:

This section reviews work done across four areas that directly relate to the proposed system: LabVIEW as a data acquisition platform, gaussmeter design and magnetic field measurement, serial and DLL-based instrument interfacing, and database integration in industrial settings.

Zhang et al. developed a real-time monitoring system built on LabVIEW capable of data acquisition, processing, display, storage, and over-limit alarm generation. The system demonstrated LabVIEW's suitability as a virtual instrumentation platform for continuous industrial monitoring with a user-friendly human-machine interface. However, the work focused on a single environmental parameter and did not address multi-instrument integration or structured database logging with timestamps.

Liu et al. presented a LabVIEW-based motor state monitoring and fault diagnosis system that collected multi-dimensional signals including vibration, rotational speed, temperature, current, and voltage using NI cDAQ hardware. The system incorporated cloud-based data backup for further statistical analysis. While this work demonstrates multi-channel acquisition and cloud storage, it relies on dedicated NI hardware rather than a DLL-based

proprietary instrument interface, which is a distinct challenge addressed in the present work.

Konovalov et al. proposed an Industry 4.0-oriented LabVIEW-based industrial condition monitoring network using Modbus TCP fieldbus protocol combined with wireless and wired sensor nodes for preventive maintenance applications. The system used a bespoke graphical user interface for real-time data capture and control. The work highlights the growing relevance of LabVIEW in IIoT-ready manufacturing architectures, but does not address direct integration with open-source relational databases such as MySQL.

Pelegri-Sebastiá et al. designed a DC digital gaussmeter capable of measuring magnetic fields up to ± 1000 G using Hall-effect sensor ICs, a PIC18F4550 microcontroller, and a LabVIEW-based PC interface over USB. The instrument demonstrated accurate DC magnetic field measurement with remote control capability. While the hardware design is relevant, the work does not incorporate automated data logging, database storage, or integration with manufacturing test workflows — gaps directly addressed in the present system.

Hejtmanek and Roubal investigated noise optimization in a gaussmeter with a Hall probe for 3D magnetic field mapping, employing synchronous detection via a lock-in amplifier to suppress electromagnetic disturbances and improve signal quality. This work establishes the importance of signal integrity in magnetic field measurement environments. The present system builds on this understanding by implementing DC mean calculation and statistical parameter extraction within LabVIEW to improve measurement reliability.

Chen et al. designed a LabVIEW VISA-based continuous data acquisition system for the Fluke PM6306 RCL meter, demonstrating serial port communication configuration, optimized acquisition rates, and structured data storage. This work provides a validated framework for VISA-based instrument interfacing in LabVIEW, relevant to the serial communication architecture employed in the proposed system. However, the work addresses only a single instrument and does not extend to MySQL database storage.

Bozkurt et al. examined data synchronization and loss in PLC-based automation systems, comparing four database backends — MSSQL, MySQL, MongoDB, and Apache Cassandra — for real-time industrial data storage. The

study demonstrated that MySQL provides reliable timestamped storage suitable for industrial automation with millisecond-level synchronization accuracy. This validates the selection of MySQL as the database backend in the proposed system and confirms its suitability for real-time measurement logging.

Table -1: Comparison of existing systems with proposed system.

Parameter	Zhang et al. [7]	Liu et al. [8]	Pelegri et al. [10]	Chen et al. [12]	Proposed System
Instrument Interface	NI Hardware	NI cDAQ	USB/ LabVIEW	VISA Serial	DLL + VISA Serial
No. of Instruments	Single	Multi	Single	Single	Multi (2)
Real-Time Monitoring	Yes	Yes	Yes	Yes	Yes
Database Logging	No	Cloud only	No	No	MySQL with timestamp
Automated Parameter Extraction	No	Partial	No	No	Yes (DC mean, peak, range)
Manual Intervention Required	Yes	Partial	Yes	Yes	Minimal
Proprietary DLL Support	No	No	No	No	Yes (BGM101)

Gap Analysis: Taken together, the surveyed works show that LabVIEW is a mature platform for industrial monitoring, but most implementations rely on standard NI hardware with conventional serial or VISA interfaces. No work was found that combines a proprietary DLL-based gaussmeter with automated MySQL logging under a single LabVIEW framework. That specific gap — DLL interfacing plus relational database storage for magnetic field testing — is what this project targets.

3. METHODOLOGY

The BGM101 Gaussmeter is the sole measurement instrument in this system, connected to the host PC via USB through a virtual COM3 port. Rather than using standard serial polling, the instrument exposes a set of callbacks through its BGM.dll library — specifically ConnectionFound, ConnectionLost, SerialNumber, and Results — which LabVIEW invokes using the Call Library Function Node. This event-driven approach means data arrives in LabVIEW only when the device has a new reading ready, avoiding unnecessary CPU overhead.



Fig -1: LabVIEW Block Diagram

Fig. 1 shows the LabVIEW block diagram implementing this architecture. Once a Results callback fires, the raw measurement cluster is unpacked and passed through a mean calculation block configured for 25 samples per cycle at 100 ms intervals. The output parameters — DC mean, DC min, DC max, AC, low peak, high peak, and range — are wired both to front panel indicators for live display and to an SQL INSERT node that writes the DC mean value into the bgm_data MySQL table with a system-generated timestamp.

Database connectivity is handled through the NI Database API over an ODBC connection configured with the bgm_mysql DSN. Each successful write produces one timestamped row in the database, creating a sequential measurement log that persists beyond the LabVIEW session.

4. SYSTEM ARCHITECTURE:

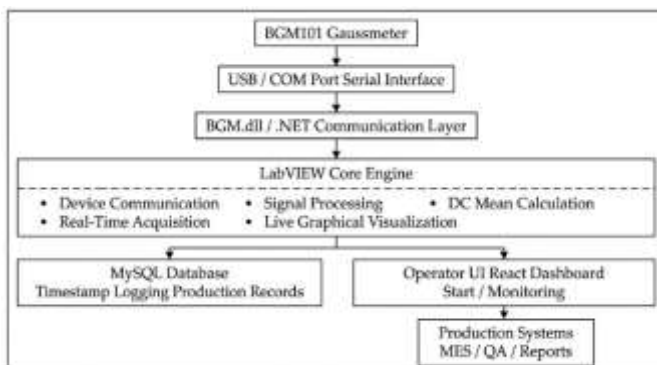


Fig -2: System Architecture of the Proposed Semi-Automated Instrumentation and Real-Time Data Logging System.

Fig. 2 shows the five-layer architecture of the proposed system. At the hardware layer, the BGM101 Gaussmeter captures DC magnetic flux density through its Hall-effect probe. A USB cable carries this data to the PC, where Windows assigns it a virtual COM port.

Above the transport layer sits the BGM.dll and .NET communication layer. Instead of the system actively requesting readings, the DLL fires callback events whenever new data is available. LabVIEW listens for these events through the Call Library Function Node — a passive, interrupt-style design that keeps the acquisition loop lightweight.

The LabVIEW Core Engine forms the central processing layer of the architecture. Within this layer, five key operations are performed simultaneously: device

communication management, real-time data acquisition, signal processing, DC mean calculation across configurable sample windows, and live graphical visualization of magnetic flux density trends on the front panel waveform graph.

From the LabVIEW Core Engine, the architecture branches into two parallel output layers. The first output layer is the MySQL Database, which receives processed DC mean values via the NI Database API over an ODBC connection. Each record is stored with an auto-populated timestamp, creating a structured log of production measurement records for traceability and future analysis.

The second output layer is the Operator UI React Dashboard, which provides a monitoring interface for production personnel. The dashboard enables operators to initiate acquisition, view live readings, and access historical measurement records without direct interaction with the LabVIEW environment. Both output layers feed into the Production Systems layer, supporting MES reporting, quality assurance workflows, and production record management.

The proposed architecture ensures modularity, scalability, and real-time operation, providing a reliable and extensible foundation for magnetic field testing in industrial magmeter manufacturing environments.

5. RESULTS:

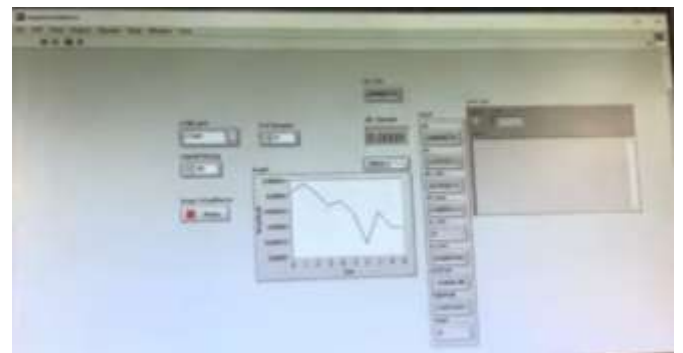


Fig -3: LabVIEW Front Panel Showing Real-Time DC Mean Measurement, Waveform Graph, and Extracted Signal Parameters.

To validate the system, the BGM101 was connected and run continuously while LabVIEW recorded measurements and pushed them into MySQL. The test focused on confirming three things: that communication stayed stable, that computed parameters were accurate,

and that every reading landed in the database with a correct timestamp.

A. Real-Time Data Acquisition

Communication was established on COM3 with 25 samples per cycle and a 100 ms request interval. The BGM101 sent readings continuously without any dropouts during the test run. On the front panel visible in Fig. 3, the DC LIVE field updated with each incoming result, and the waveform graph scrolled in real time showing the magnetic flux trend.

B. Extracted Signal Parameters

For each acquisition cycle, the system automatically extracted and displayed the following parameters on the LabVIEW front panel:

The DC mean value recorded during experimental validation was consistently in the range of 0.000919 T to 0.000922 T, confirming stable magnetic field conditions in the test environment. The AC component was measured at 3.27472E-5 T. The DC minimum and DC maximum values were recorded as 8.21054E-6 T and 0.000935 T respectively, while the low peak and high peak values were -0.0006138 T and 0.0013393 T respectively. The measurement range was recorded as 4, indicating the active range setting of the BGM101 instrument during the test.

C. Database Logging Results

Every computed DC mean was automatically pushed into the bgm_data table. Seven consecutive records from the test run are shown in Table II. The timestamps increment by exactly one second per row, which confirms the logging rate held steady throughout.

Table -2: Sample DC Mean measurements logged in MySQL Database

Record ID	DC Mean (T)	Timestamp
1	0.000919	2026-04-27 14:25:59
2	0.000919	2026-04-27 14:26:00
3	0.000921	2026-04-27 14:26:01
4	0.000919	2026-04-27 14:26:02
5	0.000920	2026-04-27 14:26:03
6	0.000921	2026-04-27 14:26:04
7	0.000922	2026-04-27 14:26:05

The MySQL database schema consisted of three fields: an auto-incremented integer primary key, a double-precision

dc_mean field, and an auto-populated timestamp field using the DEFAULT current_timestamp attribute. This structure ensures complete traceability of every measurement with minimal manual configuration.

D. System Performance

The system ran without interruption for the full test duration. No dropped readings or database write failures occurred. As Fig. 3 shows, the waveform stayed within the 0.00091 T to 0.000935 T band throughout, which matches the manually verified field conditions at the test site. The combination of stable communication, consistent parameter extraction, and reliable database writes confirms the system is ready for production floor deployment.

6. DISCUSSION:

Moving from manual observation to automated logging had a clear practical impact in this implementation. Operators no longer need to watch the Gaussmeter display and transcribe readings — the system captures, computes, and stores every measurement without human involvement between readings.

The choice of an event-driven DLL interface rather than timed polling proved important. Polling-based designs risk reading stale values if the poll fires before the instrument updates; the callback architecture used here means every value written to the database reflects a genuine new measurement from the BGM101.

MySQL was selected over simpler options like CSV logging because it supports concurrent reads — meaning a separate dashboard or reporting tool can query historical data while acquisition continues, without file-locking issues. The timestamp field, auto-populated at insert time, gives each record a reliable chronological anchor for traceability.

Challenges during development centred on the ODBC connection configuration — specifically matching the 32-bit LabVIEW runtime to a 32-bit MySQL ODBC driver and System DSN — and on correctly mapping the DLL callback signatures to LabVIEW data types. Both were resolved through driver reinstallation and type-mapping adjustments in the Call Library Function Node configuration.

The React-based operator dashboard builds on this foundation by reading from the same MySQL database,

giving production staff a browser-accessible view of live and historical readings without any LabVIEW licence requirement on their machines.

7. CONCLUSION

This paper described the design and testing of a semi-automated magnetic field data logging system built around the BGM101 Gaussmeter and LabVIEW. The core contribution is the integration of a proprietary DLL-based instrument interface with a relational database backend — a combination not widely reported in existing literature for this class of instrument.

Experimental runs confirmed one-second logging intervals, zero communication failures during testing, and DC mean values stable in the 0.000919 T to 0.000922 T range under consistent field conditions. The MySQL database accumulated records with accurate timestamps throughout, validating the end-to-end data path from instrument probe to stored record.

Future work will extend the system to include threshold-based pass/fail logic directly in the LabVIEW VI, automated report generation from the MySQL data, and full deployment of the React operator dashboard on the production floor at Krohne Marshall Pvt. Ltd.

ACKNOWLEDGEMENT:

The authors express sincere gratitude to the Department of Electronics and Telecommunication Engineering, Progressive Education Society's Modern College of Engineering, Pune, for providing the facilities and support required for this project. The authors extend special thanks to Krohne Marshall Pvt. Ltd. for sponsoring this project and providing access to the BGM101 Gaussmeter and industrial testing environment. The authors are deeply grateful to Mrs. Vaishali Shahapure and Mr. Hitesh Nikam from Krohne Marshall Pvt. Ltd. for their invaluable industry guidance, technical inputs, and continued support throughout the project. The authors also thank the project guide Mrs. A. A. Kasangottuwar for her valuable academic guidance and mentorship.

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