Case Studies // Industry // Technology



Automating Structural Problem-Solving

How Galvia Digital Revolutionised Data Logging for McFarland Consulting



At a glance

McFarland Consulting, specialising in structural problem-solving across the UK and Ireland, faced challenges managing data from diverse, high-end sensor devices with proprietary protocols. These devices required on-site visits or manual processes to interpret and unlock the data, impacting time and resources. Seeking to automate data collection and analysis, but lacking the in-house capabilities, the company required assistance as they wanted to scale the business without expanding its developer team.

Galvia Digital provided practical solutions including analysing sensors, reverse-engineering protocols, and the development of a Python application for a Raspberry Pi that connected the sensors to the cloud without manual intervention. These steps resulted in the seamless connection of sensors and data processing, partnered with the creation of a self-service portal for clients to make data-driven decisions regarding their building structures. This scalable and flexible solution facilitated streamlined data transmission to the cloud, enhanced business operations and improved service reliability.

Client Company Introduction

McFarland Consulting analyses, monitors, and extends the lifespan of structures using an innovative and intelligence-led methodology. They provide services for a wide range of damaged and deteriorating structures throughout the UK and Ireland.

The team places sensors on building walls, equipped with fibreglass rods, to gather readings over time and detect structural damage and stress, including cracks and weak points. The captured data is compiled into Excel sheets for report generation.

These data-driven insights advise clients on necessary actions to improve their buildings' safety and integrity, addressing existing issues or taking proactive measures to prevent future problems. By analysing the data, McFarland Consulting can also predict trends in structural damage, allowing clients to manage safety concerns before they escalate.

Challenges

McFarland Consulting faced challenges in managing data from its various high-end sensor devices as they communicated through different cloud vendors.

• Specific sensors could only connect to a laptop through a data logger without internet access, requiring staff to log in remotely to retrieve data.

- Specific sensors could only connect to a laptop through a data logger without internet access, requiring staff to log in remotely to retrieve data.
- Each sensor device used its own unique, proprietary communication protocols, making data integration and management difficult due to the lack of standardisation. This process was not streamlined, leading to inefficiencies and labour-intensive operations.
- The lack of a cohesive system hindered the company's ability to provide a seamless service, frequently necessitating extensive time, travel, and resources to obtain data from clients' premises.
- The client company required a solution to advance its business processes by integrating a system capable of automatically collecting, analysing, and compiling data into a self-service portal for clients.
- The company lacked the technical skills to independently implement these requirements but wanted to avoid expanding the team, leading them to seek our expertise.



Solutions

First, we analysed the two different sensors McFarland Consulting used across multiple sites as each data logger had an independent method for sending data from sensors to the laptop. We then implemented solutions to ensure all sensors communicated seamlessly with the cloud and transferred data to a central location. Previously, the devices didn't communicate with each other, requiring staff to log in remotely to retrieve data and manually complete reports for clients, negatively affecting operating procedures.

Reverse-Engineering Protocol:

Leveraging our expertise, we reverse-engineered the protocol for each data logger to understand how they transmitted data, allowing us to decode the communication methods and data formats used.

This helped us analyse and understand the underlying rules and structures that govern how the data was transmitted and received without having access to the original design specifications.

Python Application and Raspberry Pi:

Our skilled team developed a Python application that runs on a Raspberry Pi. This device connects to the data loggers through an Ethernet port, eliminating the need for remote desktop login to retrieve data. The Raspberry Pi collects and processes data from the sensors automatically.

Data Logger Software:

In response to the client's needs, we introduced Data Logger Software to collect the decoded data and send it to the cloud for processing. Automatically collecting, recording, and storing data from various sensors over time.

The software runs on the Raspberry Pi, and communicates with the sensors to gather structural data in real-time or at specified intervals.

The collected data is then organised, decoded, and processed for further analysis or reporting. Data logger software helps manage large volumes of data, ensuring accuracy, consistency, and reliability in data collection and processing.





Results

Raspberry Pi for Data Logging:

Our effective solution automated data collection from the sensors, eliminating the need for staff to visit sites or log in remotely to retrieve data. By using Raspberry Pi, McFarland Consulting gained a cost-effective and scalable method to gather and manage data from multiple sites into one system. This approach revolutionised their data management process, saved significant time and resources, and allowed the company to provide enhanced and reliable services to their clients. Additionally, the flexibility of the Python application enables dynamic updates and modifications to accommodate new sensors or protocols, ensuring long-term adaptability.

Decoding Packet Frames, Reverse Engineering and Creating a Schema:

By understanding the client's requirements, we decoded the packet frames used in network communication through trial and error and reverse-engineered the devices, creating a schema that describes the information consistently, regardless of the device. This ensured that all data was uniformly structured and more straightforward to analyse, streamlining data processing and integration for the company. We enhanced data accuracy, simplified troubleshooting, and boosted overall system reliability, ultimately saving the company time and improving resource allocation.

CI/CD Process and Installation Process:

We implemented a successful CI/CD process to build the data logger code and ensure its reliability, along with an installation process for the system. Using an automated installation process made deployment faster and easier. Our approach reduced the risk of errors, sped up development, and simplified maintenance, ultimately leading to advanced operations and improved system performance for the company. We guaranteed the quality of the data logger software by following these standard procedures and ensuring all steps were met through automation.

Trial Deployment:

Our next step was to deploy a strategic trial with customers, using data transmitted to the cloud via an MQTT broker. This process validated the solution's effectiveness in real-world conditions, ensuring reliable data transmission and providing flexibility in connectivity options. Conducted over an entire month, the trial helped mitigate risks by identifying bugs and potential issues early on, presenting feedback from users, and making necessary adjustments. Our approach ultimately led to a more robust and reliable system that meets customer needs and ensures a strong product market fit.

TSSL Certificates Installation and Process Deployment:

We installed SSL certificates on every data logger for secure authentication and established a process for deploying these certificates. Our solution enhanced operational efficiency, enabling McFarland to provide its clients with a more reliable and scalable service. Importantly, we secured data transmission, protecting sensitive information from unauthorised access. This approach builds customer trust and supports the company's growth and expansion efforts.

Centralised Self-Service Portal:

Our creation and connection of a centralised portal provided McFarland Consulting with a seamless and dynamic way to manage data and reports, compared to the original process of manually extracting and analysing data into Excel sheets. This portal refined data organisation and accessibility for both staff and clients. With all data consolidated in one place, staff can quickly retrieve and analyse information, optimising their workflow and reducing time spent on administrative tasks.

The centralised portal improves clients' accessibility to detailed and understandable building reports. We have now empowered users to log in at their convenience to review structural data, trends, and insights without waiting for manual structural reports. This transparency and ease of access enhanced customer satisfaction, as clients felt more informed and in control of their building's maintenance and safety.

Additionally, the portal's streamlined access to data facilitated quicker decision-making, enabling clients to address potential issues proactively. Our solution not only scaled McFarland Consulting's operations but also optimised the quality of service and customer experiences.

GalviaDigital

galviadigital.com

Conclusion

Galvia Digital successfully completed the project within the agreed timelines, scope, and budget. Integrating our solution offered numerous benefits to McFarland Consulting. We automated the data collection and analysis process, eliminating the need for site visits and remote desktop login, saving considerable time and resources through the introduction of the Raspberry Pi and Data Logger Software. The reduction in on-site visits and manual data handling also led to lower operational costs for the company and leveraged efficiency.

Additionally, the creation and connection of a centralised portal allowed seamless access to data and reports, improving data organisation and accessibility for both staff and clients. Our solution's ability to handle multiple devices and cloud vendors ensures scalability as the company grows. Clients can now easily access and understand their building reports, enhancing customer satisfaction and service quality.

Aiming for excellence, we elevated the client's results by upskilling and developing the team's expertise in automated data analysis and report generation, strengthening the company's technical capabilities and providing a competitive edge in the market.

"Galvia Digital's expertise has enabled McFarland Consulting to seamlessly collect and analyse complex, high volume data resulting in a reduction of time spent on site which in turn lowered operational costs. Additionally, we now have the option for clients to view their structural health data directly, enhancing our customer experience and creating further trust in their structural assets." Bobby Weir, McFarland Consulting



