

FileBridge: Unified Collaboration Platform

**Nikita Hatwar¹, Prashik Lamsoge², Tejal Borkar³, Vedant Kapgate⁴,
Anurag Yamnurwar⁵, Ashay Wanjari⁶**

^{1,2,3,4,5,6}Information Technology Department, PCE, Nagpur, India

Abstract

The "Unified Collaboration Platform" project introduces a sophisticated file management and collaboration platform that utilizes the Raspberry Pi for local hosting combined with cloud-based storage to optimize both performance and scalability. FileBridge serves as a local server for fast, secure file access within defined networks, while Firebase provides robust cloud storage, real-time synchronization, and comprehensive transaction logging. Aiming to improve team collaboration, FileBridge includes peer-to-peer (P2P) sharing functionality, enabling users to exchange files directly within the network, reducing dependency on centralized data pathways and enhancing access speeds. FileBridge's architecture incorporates essential features for collaborative work environments, including document version control and P2P sharing, allowing multiple users to edit and share files without data redundancy or version issues. By supporting a range of file types and formats, the platform maintains data integrity through detailed tracking of user interactions and modifications. Real-time updates and secure communication channels ensure that FileBridge supports seamless, dynamic collaboration in environments where both efficiency and security are crucial. Leveraging the adaptability and cost-effectiveness of the Raspberry Pi, along with Firebase's scalable cloud capabilities, FileBridge presents an advanced, flexible solution that operates efficiently within local networks while scaling to meet expanding data and user needs. The system effectively addresses the demands of modern, collaborative workflows, offering an innovative platform that enhances productivity, security, and ease of use for teams and organizations.

Keywords: Unified Collaboration Platform, FileBridge, Raspberry Pi, local hosting combined with cloud-based storage

Introduction

FileBridge is a unified collaborative file-sharing platform that combines the reliability of local hosting with the scalability and flexibility of cloud storage. Designed to support secure and efficient file sharing, FileBridge uses the Raspberry Pi as a local server to provide seamless access and control over files within a defined environment. By integrating Firebase for cloud storage, the platform facilitates real-time data updates and centralized storage management, allowing for organized, responsive collaboration. One of FileBridge's key features is version control, which enables multiple users to work on shared files without redundancy or data conflicts. This feature, combined with transaction tracking, ensures all user interactions and document modifications are recorded, providing full accountability and preserving document integrity. Built to accommodate a range of file types, FileBridge optimizes workflow processes, helping teams collaborate efficiently on critical documents.

The platform is designed to be both accessible and adaptable. The Raspberry Pi enhances local performance, ensuring secure access for teams working within the same network. Meanwhile, Firebase's cloud capabilities allow for seamless data synchronization and secure off-site storage, making FileBridge scalable and capable of supporting growing file volumes and user needs. By integrating local and cloud resources, FileBridge provides an affordable and powerful alternative to high-cost industry services, offering a streamlined and user-friendly environment for modern collaboration. Security is a cornerstone of FileBridge. With the use of the Raspberry Pi, sensitive files remain accessible only within a trusted local network, reducing risks associated with unauthorized access or breaches. For additional protection, Firebase ensures that data stored in the cloud is encrypted and safeguarded against external threats. This dual-layered approach ensures that the system provides both the security of localized hosting and the convenience of cloud storage. Another critical component of FileBridge is its intuitive user interface. The platform is designed to be user-friendly, ensuring that even users without advanced technical skills can navigate and utilize its features effectively. Clear navigation, real-time notifications, and an easy-to-use dashboard enhance the user experience, minimizing the learning curve while maximizing efficiency. Whether it's uploading, accessing, or modifying files, every interaction is optimized to save time and improve workflow.

FileBridge's collaborative tools also play a significant role in fostering teamwork. The real-time synchronization ensures that updates made by one team member are instantly reflected for others, eliminating delays and confusion. The platform's ability to handle multiple file types—ranging from documents and spreadsheets to multimedia files—ensures that it can cater to a variety of industries, including education, healthcare, software development, and creative agencies.

Additionally, FileBridge includes customization options that allow teams to tailor the platform to their specific needs. Features such as user permissions, role-based access control, and custom file organization enable users to configure the system according to their workflow preferences. For instance, administrators can restrict access to sensitive files while granting full permissions to team leaders, ensuring that information is shared responsibly and securely. In terms of scalability, FileBridge is designed to grow with the needs of its users. Startups and small teams can rely on the basic functionality of the Raspberry Pi to manage files locally, while larger organizations can benefit from Firebase's advanced cloud storage capabilities to handle increasing volumes of data. As the needs of the organization evolve, FileBridge remains adaptable, allowing users to upgrade their resources without compromising on performance or usability. Integration capabilities further enhance FileBridge's functionality. The platform can be linked with third-party tools such as project management software, calendars, and communication platforms. This creates a cohesive ecosystem where files and workflows are seamlessly integrated, boosting productivity and reducing the need to switch between multiple applications.

By prioritizing affordability and performance, FileBridge provides an innovative solution for teams that want to collaborate effectively without incurring the high costs associated with enterprise-grade file management systems. Its ability to combine the reliability of local storage with the versatility of cloud technology ensures that it meets the demands of modern teams in a competitive and fast-paced environment. In conclusion, FileBridge represents a robust and efficient file-sharing platform that balances security, collaboration, and scalability. Its emphasis on version control, transaction tracking, and real-time synchronization addresses the core challenges of teamwork in the digital

age. By offering an affordable, secure, and user-friendly solution, FileBridge empowers teams to collaborate with confidence, ensuring that their evolving needs are met without compromise. Whether it's a small team working on a shared project or a large organization managing critical documents, FileBridge adapts to the scale and scope of its users, making it an indispensable tool for modern collaboration.

Literature Survey

The research papers collectively emphasize the Raspberry Pi's wide-ranging applications and technological advancements, underscoring its utility in numerous fields. The Raspberry Pi 5 marks a significant leap forward, featuring a 2.4GHz Arm Cortex-A76 CPU and an 800MHz VideoCore VII GPU, which enhance processing power and make the board highly suitable for AI tasks, edge computing, and robotics. The new design includes efficient thermal management and accessories like an Active Cooler and a 27W USB-C Power Supply. Ideal for AI applications, the Pi 5 supports robotics, edge computing, home automation, and educational initiatives, providing a robust platform for prototyping and real-time solutions. The device's support for PCIe connections and advanced thermal management further expands its usability in real-time applications, particularly in educational and prototyping scenarios.[1]

A comprehensive review of the Raspberry Pi's development traces its growth from a tool for computer science education to a staple for developers, hobbyists, and researchers. The paper explores its ARM-based architecture, extensive GPIO connectivity, and robust open-source software support, while acknowledging limitations like performance constraints in high-demand applications. It highlights the advantages and constraints of using the Raspberry Pi while exploring its promising role in the future of embedded systems and educational initiatives.[2]

The study on a personal cloud storage system addresses traditional cloud storage issues, such as limited data control and security vulnerabilities. By implementing OwnCloud on a Raspberry Pi 3, the system offers enhanced security with SSH access, password protection, and real-time alerts using LINE Notify. Users can expand storage easily by adding external devices without incurring extra fees. Emphasizing user-friendliness, the design prioritises security and offers convenient remote access, delivering a cost-effective and customisable cloud storage solution.[3]

The research on a low-power Network Attached Storage (NAS) system showcases the Raspberry Pi 3 Model B as a viable alternative to conventional NAS devices. With the implementation of Samba server software and energy consumption of only 1.99W per second, the system is not only energy-efficient but also capable of seamless data sharing across multiple operating systems. This method provides a sustainable and customizable solution for users prioritizing efficiency. Performance testing indicates that the system functions reliably and efficiently for real-time data sharing, offering a cost-effective and customizable alternative to traditional NAS systems.[4]

The Renewable Energy Monitoring System (REMS) leverages IoT technology and Raspberry Pi to monitor decentralized photovoltaic systems. The integration of Analog/Digital Converter Embedded System (ADCES) and cloud-based data platforms allows for real-time data acquisition, firmware updates, and flexible sensor support. REMS reduces costs compared to traditional monitoring setups and enhances the flexibility of renewable energy projects. REMS enables remote firmware updates and facilitates data accessibility through a web-based monitoring platform, making it scalable and customizable for different renewable energy installations.[5]

A motion detection-based surveillance system employs a Raspberry Pi Model B+ with a 5MP camera module to optimize storage by recording only when motion is detected. The system offers real-time streaming capabilities via web browsers and mobile devices, proving effective in minimizing storage requirements and providing high-quality surveillance. The camera stream can be accessed in real-time through any web browser, including on mobile devices. Experiments demonstrate effective motion detection and low latency performance. Future improvements include enhancing the algorithm for more accurate detection of slow-moving or small objects.[6]

A study on IoT-based wireless communication details using the Raspberry Pi as a file server with Samba, facilitating secure data transfer through Wi-Fi and ZigBee networks. The research outlines the system's setup, including Python scripts and XCTU software, and demonstrates its reliability and cost-efficiency for energy-conserving communication solutions. The results demonstrate the reliability and potential of Raspberry Pi in developing low-cost, energy-efficient wireless communication systems for various IoT applications.[7]

These studies collectively highlight the Raspberry Pi's transformative impact across sectors, focusing on energy efficiency, real-time monitoring, cost-effective cloud solutions, and the board's continued potential in emerging technologies.

Modelling and analysis

Components : The main components used in our Unified Collaboration Platform are as follows:

Hardware Used: Technologies and Tools Used in the Development of FileBridge

Firestore Purpose: Firestore serves as a cloud storage and real-time database solution. It is used to store user data securely and provide synchronization capabilities across devices. This ensures seamless backup and remote access for users, allowing them to retrieve and share files effortlessly.

Figma Purpose: Figma is a collaborative design tool that simplifies the process of creating and prototyping website interfaces. It allows real-time design sharing among team members, making it an ideal choice for user interface (UI) design and development.

Usage:

- Create wireframes and mockups for the FileBridge interface.
- Build interactive and clickable prototypes to visualize the user journey.
- Ensure the web interface offers a smooth and intuitive user experience through iterative design testing.

Visual Studio Code (VS Code) Purpose:

VS Code is a versatile code editor tailored for web development. It supports multiple languages like HTML, CSS, and JavaScript and provides an extensive library of extensions to enhance productivity.

Usage:

- Write, debug, and test both the front-end and back-end codebase of FileBridge.
- Integrate Firestore for cloud storage and manage local hosting functionalities efficiently.
- Streamline development processes by leveraging built-in debugging tools and extensions.

Version Control and Transaction Logging Software Used:

Git: For version control, allowing collaborative coding, tracking file modifications, and maintaining multiple code versions.

Custom Python Scripts: For implementing additional transaction logging mechanisms to monitor file activities and maintain an audit trail.

Purpose:

- Track all changes made to files, ensuring proper version management.
- Maintain a comprehensive log of file transactions for transparency and rollback capabilities.

Technologies Used: The core technologies used in the FileBridge development process are:

1. HTML

Purpose: The backbone of the FileBridge web application, HTML structures the content displayed on the website.

2. CSS

Purpose: Provides styling to the web application. CSS ensures that the user interface is visually appealing and responsive across devices.

3. JavaScript

Purpose: Adds interactivity to the FileBridge application. JavaScript powers dynamic functionalities like file uploads, real-time data updates, and user input validation.

4. React

Purpose: A JavaScript library used for building the front-end. React ensures a modular, component-based approach to UI development, enabling reusable code and efficient rendering.

5. Node.js

Purpose: A server-side JavaScript runtime that facilitates back-end operations. Node.js handles tasks such as API requests, server-side logic, and Firebase integration.

Conclusion

The FileBridge project presents a modern, efficient, and secure solution to address the challenges faced by organizations in managing their documentation workflows. By utilizing the Raspberry Pi platform and integrating cloud storage through Firebase, FileBridge offers an affordable, scalable, and decentralized file-sharing system that simplifies file management and enhances collaboration. This project focuses on addressing the inefficiencies of traditional file-sharing methods, which often lead to delays, security risks, and data redundancy. A key feature of FileBridge is its version control system, which enables multiple users to work simultaneously on the same document without risking data conflicts or duplication. This functionality is essential for teams that need to collaborate effectively while maintaining the integrity of their work. Additionally, secure file transfer protocols ensure that documents are shared through encrypted channels, preventing unauthorized access and ensuring data privacy.

Another important aspect of the system is transaction tracking, which enhances accountability by logging every file access and modification. This provides transparency and makes it easier to track changes and identify potential errors, improving the overall reliability of the system. Designed for scalability, FileBridge can grow with an organization's needs, supporting a wide range of file types and increasing user demand without sacrificing performance. The decentralized structure reduces reliance on a single point of failure, which strengthens the system's reliability and security.

In today's fast-paced work environment, the ability to collaborate effectively is critical to success. FileBridge's real-time synchronization capabilities ensure that users always have access to the latest versions of their documents. This eliminates the confusion that often arises from outdated files and

manual updates. Teams can co-author documents, share insights, and resolve issues more efficiently, enabling them to focus on delivering results rather than grappling with logistical challenges. Moreover, the system's intuitive user interface, designed with modern tools like Figma, ensures ease of use for individuals at all technical skill levels. Employees can quickly adapt to the platform, reducing training time and promoting widespread adoption across the organization.

The decision to use Raspberry Pi as the backbone of FileBridge underscores its commitment to affordability. By leveraging the low-cost hardware capabilities of Raspberry Pi, organizations can deploy FileBridge without the need for expensive servers or extensive infrastructure. This makes it an ideal solution for small to medium-sized enterprises (SMEs) and educational institutions that may face budgetary constraints. Furthermore, Firebase's pay-as-you-go pricing model ensures that organizations only pay for the resources they use, minimizing waste and maximizing cost-effectiveness. In an era where data breaches are increasingly common, FileBridge prioritizes security through robust encryption protocols. The platform ensures that sensitive information is protected during both storage and transfer. Additionally, by maintaining detailed logs of all transactions, organizations can conduct audits, identify suspicious activities, and respond promptly to potential security threats. This proactive approach to data security helps build trust among users and stakeholders alike. As organizations continue to grow and evolve, so do their technology needs. FileBridge's flexible and modular architecture ensures that it can adapt to future advancements with minimal effort. The system is designed to integrate seamlessly with emerging technologies such as artificial intelligence (AI) and machine learning (ML), paving the way for intelligent document management and predictive analytics.

Ultimately, FileBridge offers a practical, cost-effective solution for offices and departments looking to modernize their file-sharing systems. By combining secure, real-time collaboration with a flexible, scalable architecture, FileBridge enables organizations to streamline documentation processes, increase productivity, and ensure data integrity, all while minimizing security risks and operational costs. This makes FileBridge a valuable asset for organizations of all sizes, especially those with limited resources. The combination of affordability, scalability, security, and user-centric design positions FileBridge as a groundbreaking tool in the realm of digital documentation and collaboration. Whether for small teams or large enterprises, it stands as a testament to how technology can simplify complex workflows while empowering users to achieve their goals more effectively.

References

1. Bellows, J. "Comparing Linux Operating Systems for the Raspberry Pi 2," Department of Computer Science, Winona State University, Winona, MN, USA.
2. Fezari, M., and A. Al-Dahoud. "Raspberry Pi 5: The new Raspberry Pi family with more computation power and AI integration," Badji Mokhtar Annaba University, Dept. of Electronics, Annaba, Algeria, and Al-Zaytoonah University, Amman, Jordan, 2023.
3. Francis-Mezger, P., and V. M. Weaver. "A Raspberry Pi Operating System for Exploring Advanced Memory System Concepts," in MEMSYS '18: Proceedings of the International Symposium on Memory Systems, 2018.
4. Kopacek, P., et al. "Robot Retrofitting by Using LinuxCNC Complemented with Arduino/RaspberryPI," in Digital Conversion on the Way to Industry 4.0. ISPR 2020, N. M.

- Durakbasa and M. G. Gençyılmaz, Eds. Lecture Notes in Mechanical Engineering, Cham: Springer, 2021, pp. 225-235. doi: 10.1007/978-3-030-62784-3_19.
5. Maksimović, M., V. Vujović, N. Davidović, V. Milošević, and B. Perišić. "Raspberry Pi as Internet of Things hardware: Performances and Constraints," in Abstract—The Internet of Things (IoT) Ideology, vol. 24, pp. 1-10, 2015.
 6. Nguyen, H.-Q., T. T. K. Loan, B. D. Mao, and E.-N. Huh. "Low Cost Real-Time System Monitoring Using Raspberry Pi," Computer Engineering Department, Kyung Hee University, Yongin, South Korea.
 7. Nayyar, A., and V. Puri. "Raspberry Pi- A Small, Powerful, Cost Effective and Efficient Form Factor Computer: A Review," International Journal of Advanced Research in Computer Science and Software Engineering, vol. 4, no. 5, pp. 1-7, 2014. Available: www.ijarcsse.com.
 8. Oladimeji, L. A. "An Overview of Raspberry Pi," Department of Computer Science, School of Pure and Applied Sciences, Ogun State Institute of Technology (OGITECH), Igbesa, Ogun State, Nigeria, Jun. 2015.
 9. Pereira, R. I. S., I. M. Dupont, P. C. M. Carvalho, and S. C. S. Jucá. "IoT Embedded Linux System Based on Raspberry Pi Applied to Real-Time Cloud Monitoring of a Decentralized Photovoltaic Plant," Laboratory of Alternative Energies, Electrical Engineering Department, Federal University of Ceará, Fortaleza, Brazil, and LAESE Laboratory, Telematics, Federal Institute of Ceará, Maracanaú, Brazil.
 10. Rauf, F., M. Ithing, and Z. Adnan. "Personal Cloud Storage using Raspberry Pi," International Journal of Computer Applications, vol. 180, no. 22, pp. 5-9, Feb. 2018.
 11. Runia, M., and K. Gagneja. "Raspberry Pi Web server," Department of Computer Science, Southern Oregon University, Ashland, OR, USA, 2015.
 12. Srivastava, S., S. Agarwal, O. P. Singh, and S. Srivastava. "Low Power Network Storage Device Using Raspberry Pi 3 Model B," International Journal of Technical Research and Applications, e- ISSN: 2320-8163, Special Issue 42 (AMBALIKA), pp. 52-56, Mar. 2017. Available: www.ijtra.com.
 13. Youssfi, Z. "Making operating systems more appetizing with the Raspberry Pi," 2017 IEEE Frontiers in Education Conference (FIE), Indianapolis, IN, USA, 2017, pp. 1-4, doi: 10.1109/FIE.2017.8190736.
 14. Zhao, C. W., J. Jegatheesan, and S. C. Loon. "Exploring IoT Application Using Raspberry Pi," International Journal of Computer Networks and Applications, vol. 2, no. 1, pp. 27-34, Jan.-Feb. 2015.