Hospital Management System for Medical Personnel

Bahadir Erkam Bakoglu

Ahmed Farhat
Konstantin Kapinchev

BSc H COMPUTER SCIENCE
University of Greenwich
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Abstract

Hospital Management System is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operations, such as medical, administrative, financial, and legal issues and the corresponding processing of services. Hospital Management System provides a secure, safe, and efficient system for managing the workflow of the hospital, which is necessary to maintain the quality of care and patient safety. Hospital Management System is a web-based solution, which enables the hospital to manage the patient records, keep track of the resources, services, and staff, and streamline the processes involved in the management of the hospital. This paper presents a comprehensive overview of the Hospital Management System, which is a specialized system designed to help medical personnel manage the daily operations of a hospital. The Hospital Management System is designed to provide a comprehensive view of the hospital's operations and to facilitate improved efficiency and quality of care. The system is designed to handle the core functions of a hospital, such as patient registration, medical records and medical staff management. Additionally, the system provides the ability to track patient treatments and outcomes. Furthermore, the system provides medical personnel with a better understanding of the hospital's operations, enabling them to make informed decisions and improve patient care. This system involves databases as a repository of information that is useful in managing the hospital. In addition to the storage, various tools are needed to build a reliable system for establishing a stable host-client connection will be described in this paper.

1. Preface

I noticed during my previous studies that I wanted to learn a more diverse collection of programming languages. This year I wanted to approach this project differently, by choosing a subject that required skills I did not yet mastered. During the development of this project, I have worked with unfamiliar server systems and tools, programming languages and server-client relationships. I have also gained more experience with programs I was already familiar with such as JavaScript, HTML, CSS. Also, I have learned that the struggle of designing and creating something is a very satisfying outcome of the development process. Therefore, this project has taught me valuable lessons both professionally and personally.

2. Acknowledgements

3. Introduction

Healthcare technology is constantly evolving, and hospital management systems are no exception. Hospital management systems are designed to help medical personnel better manage the process of providing healthcare services (Balaraman and Kosalram 2013). These systems streamline and simplify the tasks associated with managing a hospital, such as patient and staff records management. This helps to create a more efficient and cost-effective healthcare system. It also allows medical personnel to focus more of their time and energy on providing the highest quality of care possible. As a result, patients benefit from shorter waiting times and improved access to care (Demirel 2017). Additionally, hospitals are able to better manage their resources and reduce costs, leading to increased profitability. This improved efficiency leads to better overall outcomes for both parties and a more successful healthcare system (Mazumder and Braje 2016). In addition to improving efficiency, improved patient satisfaction and better health outcomes are also the result of improved efficiency.

The development of the hospital management system can be divided into two sections: back-end development and front-end development. Both of the development sections have their own challenges and limitations (K. Liu et al. 2017). The back-end of the Hospital Management System consists of multiple programming languages and databases for storage of any related information about the hospital staff and patients. There are a variety of tasks associated with building and maintaining a functional back-end system, and each of these tasks comes with its own unique obstacles. The most common challenges involve the architecture of the system, the complexity of the code, and the integration of different components. It is important to understand each of these challenges in order to make sure that the back-end system is up to date and meeting the demands of the application. Databases are vital components of many establishments, providing a secure and organized way to store and access large amounts of data. Unfortunately, databases can also be a source of significant challenges for businesses. From managing user access to ensuring data accuracy and reliability, database systems can present a number of challenges that need to be addressed (Sadeghian, Zamani, and Abdullah 2013).

As for the front-end section of the development cycle, the front-end development is an essential part of software engineering, allowing users to interact with applications through the web browser. However, it is not without its challenges. As the technology continues to evolve, front-end development must be up-to-date with the latest tools and techniques, as well as keep up with the ever-changing expectations of users to be able to achieve success. In addition, there are complexities associated with the compatibility of different browsers, devices and operating systems, as well as the difficulty of creating a consistent experience across users (Aubry and Floricel 2022). Furthermore, there is the challenge of creating a website or application that is both visually appealing and functional while keeping it up-to-date. Finally, front-end development must also take into consideration the need for optimization, speed, and security. All these challenges, when taken together, make front-end development a complex and time-consuming process.

The purpose of this paper is to present a description of the development process of the hospital management system for medical personnel. Furthermore, a literature review and analysis will be presented to provide a context for the project as well as to give a background to the research. It will then be followed by an indication of the requirements specification of the system. After that, a review of the development process of the project as well as areas that can be improved in future will be performed in order to evaluate the potential improvement areas. The final part of the report will include a conclusion that examines the results of the project.

4. Literature Review

4.1. Database Utilities in Hospitals

Hospitals are places of immense importance, where people's lives are in the hands of the medical staff. As such, it is essential for hospitals to have efficient systems in place to ensure the best possible care for their patients. Database systems play an integral role in this, as they are used to store, manage and retrieve information (Mathur et al. 2014). Database systems are particularly important in hospitals because they allow medical staff to access vital information quickly and accurately. For example, a hospital may use a database system to store patient medical records, as well as records of treatments and medications administered. This information can then be easily accessed and accessed quickly by medical staff, allowing them to make more informed and faster decisions (Bezin et al. 2017). Database systems are also important in hospitals to help manage their resources efficiently. For instance, they can be used to track the availability of medical supplies, such as drugs, medical equipment, and other materials. This information can then be used to ensure that the hospital has enough resources to meet the needs of its patients.

4.2. Front-end Development

Front-end development is an essential part of web development, as it is responsible for the design and presentation of a website. It is the part of the website that users interact with, and it is essential to ensure that the customer experience is a positive one (Schrauder et al. 2018). Front-end development is responsible for providing an interface between the user and the server. This includes the coding of HTML, CSS and JavaScript to create the design and layout of the website. Front-end development can also include programming languages such as PHP, Ruby and Java. Front-end development is important for creating an attractive and easy-to-use website. It can also help to improve the navigation and user experience of the website. It ensures that the website is easy to use and that users are able to find the information they need quickly and easily (Brand et al. 2021). In addition, front-end development is important for ensuring that the website is secure and compliant with web standards. It is also important for ensuring that the website is accessible to users with disabilities and that it meets the requirements of the search engines.

4.3. Back-end Development

Back-end development plays a crucial role in the success of any website or application. It is the unseen engine that powers the front-end and ensures that the user experience is smooth and seamless. Put simply, back-end development is the foundation of any website or application and is essential for it to function correctly. Back-end development involves programming and writing code to bring a website or application to life. A back-end developer is responsible for creating the server-side components of a website or application such as user authentication, databases, and application logic. This enables the front-end of the website or app to be displayed correctly in the browser. Back-end development is essential for creating websites and applications that are secure and reliable (Z. Liu and Gupta 2019). By writing code that is secure and efficient, back-end developers can help protect user data, improve the performance of a website or application, and make sure that it is accessible to all users, regardless of their device or location. In addition, back-end development is the key to creating a website or application that is scalable. As usage grows, back-end developers can ensure that the website or app can handle the increased demand and traffic.

4.4. Database Systems

Database systems are critical for businesses, organizations, and individuals to store, manage, and analyze data. They provide an efficient and secure way of efficiently storing and retrieving data, which can be used for a variety of purposes. Database systems are used for the collection, storage, and management of large amounts of data and information. In addition, databases enable businesses and organizations to store, query, and manipulate data in an organized and efficient manner. Databases allow users to quickly access, analyze, and process data, which can then be used to inform decisions and strategies. Furthermore, databases enable users to access data from multiple sources and to easily share data across multiple systems. Furthermore, database systems can also be used to access and analyze large amounts of data in a secure and efficient manner. These systems provide users with tools to organize, sort, and analyze data, as well as generate reports and other visualizations. This data can be used to gain insight into trends, patterns, and correlations in the data, which can then be used to develop strategies, inform decisions, and improve processes.

4.5. Prevalence of Hospital Management Systems

Hospital management systems are computer systems used to manage the operations of a hospital. These systems are used to track patient care, hospital administration, and financial information. They are also used to monitor medical staff and manage patient records. The use of Hospital management systems is becoming increasingly widespread due to advances in technology and the need to improve patient care (Mathur et al. 2014). Hospital management systems can help streamline hospital operations by providing access to patient data, reducing paperwork, and improving communication between staff members. In addition, Hospital management systems can also help hospitals to improve patient safety by providing real-time information about cur-

rent patient conditions and treatments. The prevalence of hospital management systems are growing rapidly due to the growing demand for better healthcare. According to a survey conducted by the American Hospital Association, over half of all hospitals in the United States now use a hospital management system (DesRoches et al. 2013). This is a significant increase from just 30 percent in 2011. The growing trend is expected to continue due to the increasing demand for better patient care and the need to reduce costs.

4.6. Benefits of Hospital Management Systems

The primary benefit of hospital management systems is improved efficiency. By automating administrative tasks, staff are able to focus on providing quality patient care. Additionally, the system can provide real-time updates on patient care, helping to keep hospital staff informed. Another benefit is data accuracy and consistency. Hospital management systems enable hospitals to store and access patient information quickly and accurately, ensuring that all patient records are up-to-date and secure. This helps to reduce errors and improve patient safety (Mathur et al. 2014). Hospital management systems also improve communication between healthcare providers. By enabling providers to securely access patient data, they can better coordinate care and share important information. This helps to ensure that the patient gets the best possible care.

4.7. Limitations of Hospital Management Systems

Hospital management systems are essential tools for hospitals to remain organized, efficient, and compliant. However, there are some limitations to these systems that must be taken into account. One of the major limitations is the cost of implementation and maintenance. Hospital management systems can be expensive to purchase and implement, requiring a significant investment of resources (Zhang et al. 2016). Additionally, they require regular maintenance, which can be costly and time-consuming. Another limitation is the lack of flexibility. Hospital management systems are designed to provide standard services, which may not be suitable for all hospitals. Furthermore, they can be difficult to modify and customize, making it difficult to create a system that meets the specific needs of a hospital. A third limitation is the lack of compatibility with other systems. Many hospital management systems are not compatible with other systems, such as electronic health records, making it difficult for hospitals to integrate different systems (Parker 2021). Finally, hospital management systems can be difficult to use. Many systems require extensive training for users to understand and use, which can be a time-consuming and expensive process. Additionally, the user interface can be complex, making it difficult for users to navigate and use the system effectively.

5. Main Chapters

5.1. Analysis

Hospital management systems are a vital component of running a successful medical organization. They enable healthcare providers to effectively and efficiently manage their resources, personnel, and operations. The purpose of this project is to explore some of the previous systems that have been developed in the healthcare field. This will lead to the development of an improved system that will be able to cover the mistakes made by the existing system and the features that are missing. It is necessary to create a more efficient and easier-to-use system for enhanced user experience and patient care. In addition to providing better results and better patient experiences through the improved system, the system should also provide better performance outcomes.

First, it is important to note the many advantages that hospital management systems offer. By providing comprehensive information about patients, personnel, and other resources, these systems can help healthcare providers make informed decisions. Additionally, they can help streamline processes, such as billing, patient care, and scheduling. By automating tedious tasks and providing real-time information, hospital management systems can help providers quickly respond to changing conditions and improve the quality of care.

A second key benefit of hospital management systems is the increased accuracy they provide. By recording data in an organized, uniform way, these systems can help reduce mistakes and miscommunication. They also enable providers to easily store and retrieve data, ensuring that important information is quickly and accurately available. Furthermore, hospital management systems can provide data analytics to help providers better understand their operations and identify areas for improvement.

In addition to the benefits of hospital management systems, it is also important to consider their potential drawbacks. Security is a major concern, as these systems store sensitive information about patients, personnel, and other resources. Furthermore, installing and maintaining a hospital management system can be costly. Additionally, these systems are only as good as the people who use them, and any errors or oversights can lead to miscommunication and inaccuracies.

5.2. Requirements Specification

The hospital management system is a comprehensive, integrated information system designed to manage all the core aspects of a hospital's operations, such as medical and administrative issues and the corresponding processing of services. It supports day-to-day operations and also helps in providing quality care to patients. It is a computerized system that helps to maintain and manage the records of

the hospital, including patient history, staff information, and other operational data. In addition, the maintenance of confidentiality of patient, staff, and administrative data must also be accompanied by appropriate security measures. Furthermore, to be able to use the system more efficiently, the security measures should be adopted to ensure the integrity of the system and to ensure its efficient use.

The hospital management system offers a number of features that have been incorporated into the system's back-end and front-end, which include various elements that have been developed for both. There are several key features that make up the back-end of the hospital management system that include the ability to create, connect and modify databases by medical and administration personnel. In addition, a server have been set up to provide system users access to the database created. The system database will then be able to be edited and added to, which will allow users to add data to the system. In terms of the user interface, it is very intuitive, easy to navigate, and the user experience is very pleasant on the whole. In addition to providing all of the necessary options and features, it has a visually appealing design and a simple user interface. To ensure the safety and integrity of the system, an authentication and login system has been implemented. This system requires the user to enter their credentials, such as username and password, to access the system. Any unauthorized access attempts are detected and blocked to protect the system from potential threats. The authentication system also provides additional security features, such as user authentication according to clearance level, to further protect user accounts. Furthermore, the system has adopted additional protective measures against various types of malicious activities that may harm the system integrity and data confidentiality, such as brute-force and SQL injection attacks.

There are both hardware requirements as well as software requirements in order for the hospital management system to perform optimally. There are two types of hardware components that are part of the hospital management system: computers and servers. In terms of software, the hospital management system must be integrated seamlessly with existing systems to function optimally. For best performance, it is recommended that the hospital management system be installed on a server with an Intel Xeon processor, 8GB of RAM, and a large hard drive to ensure best performance. Additionally, the server should have access to a reliable internet connection and a secure network. The hospital management system should also be backed up with a secure off-site server in case of emergencies. This ensures that data is secure and can be recovered quickly in case of an outage. The system should also be regularly maintained and updated to ensure that it stays secure and up-to-date. Software should be updated regularly to ensure all systems run at their peak performance.

5.3. Design

Designing a hospital management system for medical personnel is a challenging task that requires a thorough understanding of both the medical field and the technology used to develop the system. An effective system should be tailored to the specific needs of the medical personnel and the hospital it is being used in. It should also be able to integrate with existing systems, such as electronic medical records, to provide a comprehensive solution.

When designing a hospital management system, it is important to consider the user experience of medical personnel. The user interface should be intuitive and easy to navigate. It should also be on theme by making use of thematic colors of a hospital such as white or blue. It should also provide a secure environment for sensitive data, such as patient records. It should also have multiple safeguards to ensure that data is only accessed by authorized personnel, and that any changes to the data are logged and tracked. Additionally, it should have backup systems in place to ensure that data is not lost in the event of a disaster. It should also have encryption capabilities to protect data from being accessed by malicious actors.

The system should also enable medical personnel to easily access patient records and other information. This can be achieved through a range of features, such as search capabilities, visualisations, and reports. These features should be user-friendly and intuitive to ensure that medical personnel can quickly and accurately access the information they need. Additionally, the system should be secure to protect the confidentiality of patient data.

In addition, the system needs to be capable of providing medical personnel with information and data related to the patient. They will be in a better position to make informed decisions and improve patient outcomes. The system should also allow for monitoring patient health over time, so that any changes can be quickly detected and addressed.

Overall, the design of a hospital management system for medical personnel is a complex task that requires a thorough understanding of both the medical field and the technology used to develop the system. It is important to consider the user experience of medical personnel, as well as ensuring that the system is able to integrate with existing systems and provide real-time data. By taking all of these factors into consideration, a hospital management system can be designed that is tailored to the specific needs of the medical personnel and the hospital it is being used in.

5.4. Implementation

Implementation of the hospital management system is an incredibly complex and nuanced process, as it requires integrating a wide range of technologies and protocols to ensure

optimal performance. The system must be able to store and access patient medical records and track personnel details. The system must also provide real-time data to help hospital administrators make decisions quickly and accurately.

Implementation of the hospital management system commenced with the designing and creation of the front-end features, the visuals, and the user interface of the system. This involves creating user-friendly forms and menus that allow users to quickly and easily enter or retrieve data. The user interface makes use of colors such as white and blue so that the user feels as though they are in the hospital as they use the system, which is very important to convey an impression of healthcare to the user. The use of colors are used in moderation. Too many colors can be distracting and interfere with the user's ability to focus on their task. Additionally, the user interface is designed to minimize visual clutter and easy to navigate. Furthermore, additional features have been developed to provide the created user interface with some ease of use functionalities that does not involve the server or database usage. The client side features of the hospital management application include error messages for empty user name or password fields on the login screen. The system also has a "Remember Me" feature that allows users to stay logged in for a certain period of time. Moreover, sorting capabilities for columns, search bars and pagination are implemented in the data tables when displaying patient and user data. The application also allows users to customize their view by setting a number of rows per page, selecting the columns to be displayed and choose which page to display in the data table.

The next step in the implementation of the hospital management system is to develop the back-end of the system. As part of this process, the server must be installed and a connection needs to be established between the server side and the client side of the system. There are various methods to set up a server. However, in this project, a server tool Xampp has been used to set up an Apache server. After that, an additional SQL server has been created for the purpose of storage of data which will be the backbone of the system. Next, a database and several tables for storing the patient and staff information has been created inside the SQL server. Then, the connection between the client and server has been created:

```
$servername = "localhost";
$username = "root";
$password = "";
$database = "Hospital_db";

// Create connection
$connection = new mysqli($servername,
                         $username,
                         $password,
                         $database);

// Check connection
if ($connection->connect_error) {
    die("Connection failed: "
    . $connection->connect_error);
}
```

The main reason for using an Xampp server is because of the responsiveness of the server tool and the ease of use of the control panel of the server. In this way, it is possible to decrease the time required for development by making test procedures and other modifications easier to perform. In addition, Xampp is a free open source server that can be accessed and downloaded from anywhere. Due to this, the software is both reliable and flexible at the same time.

After setting up the server and the connection, it is essential to add SQL statements inside the forms in the user interface while also setting up a session. The sessions are a way of storing information that can be used in multiple pages in HTML. In this case the patient ID can be stored in the session for the users of the system. It is possible for a doctor, for example, to display data related to the patient and to make changes to the patient's data with the specific ID associated with the patient. This process doesn't require the users of the system to manually enter any IDs since the ID of the patient will be retrieved manually once the related table row is clicked. Once the ID of the patient is retrieved the user is taken to a form page where they will see the patient information and apply changes to the existing data. However, it is of utmost importance that the malicious actors can not damage the integrity of the system by any means (Lawal, Sultan, and Shakiru 2016). A way to achieve this secure user inputs is to use SQL prepared statements. It is especially useful to use prepared statements when protecting against SQL injections (Qian et al. 2015). This is because parameter values, which will be transmitted later via a different protocol, do not need to be properly escaped. An SQL injection cannot take place if the statement template that is used in the original statement is not derived from external input.

```
$sql = "UPDATE em_patient SET
            `Complaint`=?,
            `Medical History`=?,
            `Physical Examination`=?,
            `Diagnosis`=?,
            `Decision`=? WHERE
            `ID`='".$_SESSION['ID']."'";

$stmt = mysqli_stmt_init($connection);

if (!mysqli_stmt_prepare($stmt, $sql)) {
```

```
385        die(mysqli_error($connection));
386    }
387
388    mysqli_stmt_bind_param($stmt,
389                           "sssss",
390             $Complaint,
391             $Medical_History,
392             $Physical_Examination,
393             $Diagnosis,
394             $Decision);
395
396    mysqli_stmt_execute($stmt);
397
398
399
```

After that, it is necessary to setup different types of users who will have access to different sections of the system. To authenticate every login, each user in the database has a user name, password, and type. The users can log in to the system if they enter the correct user name, password and user type and leave none of the fields empty. It is important to set error messages if a user either enter a wrong credential or leaves an area empty. However, it is important to not expose any crucial details about the error. For instance, if a user enters the user name incorrectly but the password is correct, the error message should not state "Incorrect user name". In a situation where the person attempting to log in is not a member of the staff but a malicious actor performing brute-force attacks on the system, it may be easier for them to gain access now that they know the password is correct and they only need to crack the user name.

The key part of the project is to combine different programming languages into one cohesive working system. In the client side of the system, a number of client-side languages are used, including HTML, CSS, and JavaScript. As for the back-end of the system, on the other hand, it is made up of server-side programming languages, such as PHP and SQL, as well as the Xampp server tool, which enables integration with the system.

5.5. Testing and Integration

There has been thorough testing of the system to ensure that it will work as intended. Every feature of the system has been tested by a group of volunteers who have an understanding of hospital management systems. For testing purposes the database has been populated with artificial data. The tests have been carried out by different browsers including Firefox, Google Chrome and Microsoft Edge. The computer processing power of the testers' computers varied between Intel i5 to i7. The system retrieves and posts data to the database in real time. The testers have recorded that in some of the older devices Xampp server tool causes a slight delay on the computer, however, this does not affect the application's operations, it affects the Xampp tool itself.

The testers have been given access to the server and asked to log in as every types of user and determine if the features work as intended. Various errors were found out by the testers during these tests. One of the errors was the inability to log in to. This has been fixed by modifying the SQL statements which select the row from the user table in the database to be compared to the user inputs. The issue was the SQL statements were using a "," instead of "AND" which caused them to not select the row correctly. Another issue was the problem with the page features loading. The fix for this was with connecting the computer to the internet. This problem occurred because the features of the data tables in the system is stored online. Thus, if there is no connection to the internet the features does not load. Final issue spotted was with the ability to edit users in the admin user type. The source of the issue was the mistyping of the SQL statements which are supposed to post the user inputs to the database. However, the declaration of the input types in the prepared statements were recorded as "i" which stands for integer instead of "s" which is for string. This issue caused the SQL connection to throw an unrecognized input error. After the issue has been spotted it has been fixed accordingly.

5.6. Product Evaluation

The system has been tested extensively and is proven to be reliable and efficient. The user interface of the system is intuitive and easy to use, making it easy for medical personnel to manage their patients and their records. The system also allows for quick and easy access to patient records, which is extremely important in ensuring accurate patient care. The system has adopted database security and access control measures to protect patient data. This ensures that only authorized personnel have access to sensitive information, ensuring patient privacy and confidentiality.

Based on the results of the evaluations, it has been demonstrated that the system has a high level of responsiveness. In addition, the evaluations have determined that the system performs well and fast. There have been a number of comments about the simplicity and appeal of the user interface by the testers.

The connection between the server and the client enables information in the database to be updated and retrieved in real time. This allows data to be synchronized instantaneously, ensuring that the users has the latest version of the data. It also allows users to quickly access the data without having to wait for a response from the server. This ensures that data is always up-to-date and accessible.

There has been a thorough testing of the security measures employed in the system against various cyber-attacks, such as brute force attacks and SQL injection attacks. During the tests, it was shown that the system is robust enough to endure attacks of the type that were performed.

6. Conclusion

In conclusion, the hospital management systems have been an invaluable tool for medical personnel in recent years. They have enabled hospitals to streamline their operations and provide more efficient patient care. By automating the management of patient records, hospital staff can quickly access the necessary information and provide better treatment. In addition, the system has allowed for improved communication between hospital staff and external stakeholders, as well as better communication between patients and care providers.

The implementation of a hospital management system has allowed for improved patient safety and satisfaction. By providing staff with the information they need, they can make informed decisions about patient care. The system also provides a platform for improved communication between patients and providers. Patients can access their records and communicate with their care team more easily, while providers can access patient records quickly and accurately.

Overall, the hospital management system has been an effective tool for medical personnel. It has allowed hospitals to become more efficient and provide better care to their patients. It has also enabled improved communication between patients and providers. By streamlining operations and providing accurate patient information, the hospital management system has been a valuable asset for medical personnel.

7. Future Work

The future of hospital management system for medical personnel is full of potential to improve the quality of care, efficiency of operations and scalability. The main structure of the system can branch out into different departments such as laboratory, storage and pharmacy. The system can be integrated with other healthcare devices in the laboratory to automate laboratory processes. In storage, lists of various medical equipment could be recorded and requested when a medical staff member is required. As for pharmacy, records of drugs could be listed and graphically presented. This would enable administrators to track which drugs are used more often and which drugs are running low.

One such development is the integration of artificial intelligence (AI) into hospital management system. AI will enable more accurate and efficient decision-making, allowing medical personnel to focus on patient care. AI-based technology can be used to improve diagnosis and treatment decision-making, identify hidden correlations in patient data, and automate routine tasks. AI has already been used in a number of healthcare applications, including diagnostics and drug discovery.

Finally, hospital management system can also be used to improve patient safety and reduce medical errors. By integrating technologies such as barcode scanning and RFID tags, hospitals can track patient medications and treatments more accurately. Additionally, these technologies can be used to alert medical personnel to potential errors and alert them to any changes in patient conditions.

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