

Digitalization of malls: A comprehensive online mall management system for business spaces and e-mall services.

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1. Abstract

The title of the project has been tossed as *“Digitalization of malls: A comprehensive online mall management system for business spaces and e-mall services”*. Mall Management System is an online system that aims to provide information and management of business spaces and other services to people on one click.

The project broadly caters the market with an enhanced opportunity to unite and operate over a common platform, where the business concerning retail store renting becomes much easier. The website shall provide a common interface, promoting the idea of Smart Malls, where the interested potential vendors get an indirect (virtual) yet direct access to have a preview of retail stores or services establishments for rental purposes, which will a bridge the gap between vendors and mall committee [1].

The whole concept is integrated using an online website developed with technologies like Java [2], Angular, Hyper Text Markup Language (HTML) and Cascaded Style Sheets (CSS). We are using the pivotal foundations like Spring Framework which shall further exploit the mechanisms of Java annotations and provides business logic implementation for website designing, Angular Framework for dynamic and materialistic webpage designing for a better and smooth user experience [2]–[4].

The parameters like first contentful paint (FCP), speed index, largest contentful paint (LCP), time to interactive (TTI), total blocking time (TBT), cumulative layout shift (CLS), central processing unit (CPU) utilization and bandwidth are used to evaluate the performance of the proposed system with online web analyzer tools [5].

2. Keywords

- 2.1. Mall management system
- 2.2. Online Marketing
- 2.3. Digitalization of Malls
- 2.4. Web-development
- 2.5. India

3. Introduction

The pages seen over the internet (World wide web) or intranet (private network) are known as web pages. The technology used to develop these pages is called web development. The practice of web development is used to develop singular or multiple web pages which includes not only simple static plain text but complex data algorithms as well [6]. There are several applications of web development, out of which a few are: e-commerce development, client/server-side scripting, web designing, client liaison etc.

There are usually two aspects of web site making, as illustrated by web professionals, namely, design and non-design. Non-design aspect of website development is included in web development i.e., scripting markup & programming. Even a programmer with basic technical knowledge can use content management skills to ease the content change process [7].

The proposed system shall be used to merge the real estate market i.e. buying, selling, or renting of retail-stores and service-establishments; with the e-commerce domain concerning e-marketing and promotions via Internet

domains [8]. The practical implementation of this project has been powered by Integrated Development Environments like Spring Framework (practicing the concept of Java Annotations) and Angular Framework which assists in building web-based client applications using HTML/CSS and TypeScript [3], [4], [9].

At last, the proposed system shall ultimately promote the ideology of **DIGITAL INDIA** [10], by indigenously providing our Indian markets with this auspicious initiation on the grounds of e-marketing. An initiation like this, shall generate employment, empower *Smart-Malls* concept [11], and hence help the society's economy to grow by promoting the small vendors to quest for stores those may fit their respective budgets; bridging up the gap between for an efficient marketing, which shall benefit both – the interested vendor and mall association by maintaining the transparency between interested potential vendors and the mall association which shall provide easy, virtual and convenient access to a common portal/interface where the bookings and consultancies over vacant stores can be arranged.

4. Theoretical Background

4.1. Mall Management System

This website is an online electronic system which mitigates the heavy burdening work of the mall management staff. It consists of features like business space listing for renting/leasing, available dates for a shop to rent, live touring of the mall, product listing of each and every shop, online shopping and home delivery from various outlets in the mall, extending their lease, virtual payment etc. The main of the website is to increase the mall utility, ease customer service, maintain customer satisfaction, paperless environment and provide excellent service. This website will cover all the major areas if the mall i.e. administrative, finance and management.

4.2. Current Status

However, the mall management requires a complex software, still, many researchers believe that once it is brought into action by the Indian market, it will be a huge success and its graph will rise upward exponentially. India, being a developing country, has very high probability of advancement because of its rapid technology boom, increasing government interest in investing into technology, adequate electricity and high-speed internet connectivity. Also, the software used in maintaining the website is cost effective as well, thus making it accessible to almost all categories of malls.

4.3. Organizational structure

The adoption of a shopping mall management system depends to a large extent on organizational factors, including the size of the shopping mall, business space, senior management support and financial resources. Other researchers emphasized the impact of infrastructure and senior management support. The support of senior management personnel is an important factor in determining the importance of management system innovation for managing services related to large shopping malls, listing, renting and leasing business spaces without manual intervention; it refers to the adoption of management systems and the importance of senior management.

The support of senior management has had a significant impact on changing the organization's attitude towards adopting management system innovation. The attitude, knowledge and experience of senior management to IT, as well as the understanding of the advantages and disadvantages of IT innovation, can help organizations adopt management system innovation.

Senior management support provides a positive environment for the adoption of shopping mall management systems. The support of senior management is a key factor in adopting a shopping mall management system.

Financial resources are essential to provide the infrastructure, installation, and all daily expenses during the use of the shopping mall management system, including hosting fees, website domain name registration, server fees and website maintenance fees. The necessary funding will affect the adoption of innovations. Therefore, shopping malls need to ensure IT budget and resources to implement the shopping mall management system.

4.4. Technological domain

In recent years, this technology has made tremendous progress. Therefore, companies are forced to adopt new technologies. Due to the increasingly fierce competition among malls, the operating costs of shopping malls are now a concern. Therefore, relative advantage refers to obtaining a mall management system, which helps to

reduce the operating cost of malls. Improved mall management system will provide better approach to list, book and manage different business spaces [11] with renting and leasing options as described:

1. Business space owners listing the business spaces will be handled online securely and offer transparency between owner and mall authoritative body.
2. Multiple language support to make interface more reachable to all sections of society and to every individual [12].
3. Online shopping options provided to users with home delivery feature [13].
4. User can visit the website online to start a business in a mall with options:
 - a. Business Spaces available for leasing – These spaces are targeted for the people/user who can afford spaces based on leasing (12 months contract).
 - b. Business Spaces available for renting – These spaces are targeted for the people/user who can afford spaces based on renting (1 month contract) like Ice-cream vendors, pop/sweet-corn vendors, toy-shop owners, etc. [14].
 - c. Spaces for advertising agencies available with per square-foot (sqft) option for banners.
 - d. Business meeting halls and atriums with hour-wise options for flexibility inside the malls.
 - e. If a business space is booked, user will be provided with the expected next available date.
 - f. Live touring of a particular business space with video conferencing and AR/VR accordingly [15], [16].
 - g. Online secure payments for business spaces booked [17].
5. Registered users will be provided with the customizable dashboards with options:
 - a. Extend the booked dates for auto-renewal of business space for next month/year accordingly.
 - b. Change (upgrade/degrade) to any business space available in the mall.
 - c. Registering for complaints related to business spaces like plumbing, electricity [18], etc.
 - d. Mall authoritative bodies will be provided with the options to check revenue generations of mall and information about business spaces present in the mall.

The proposed system involves website development, server development and maintenance and database management which includes an IT support team including software engineering experts to handle complex architecture of the system and make it stable and functional.

5. Method and ideology

The purpose of this research is to investigate and understand the use of mall management systems. In order to complete the task, the proposed system is constructed using the technical process shown in Figure 1.0

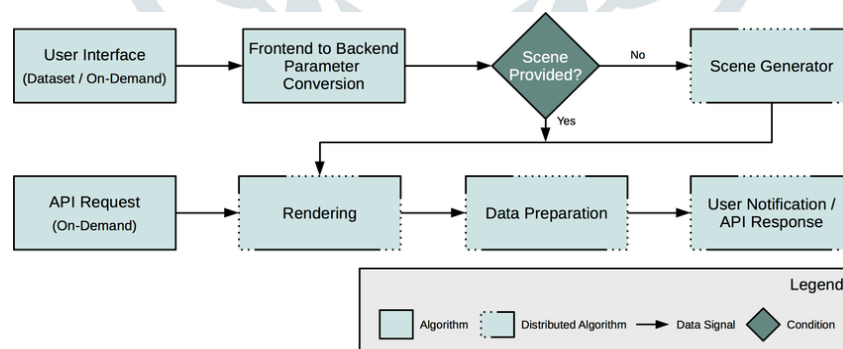


Fig 1.0

The technological stack used to develop the proposed system has involvement of technologies listed as:

1. Website frontend designed with Angular and HTML/CSS.
2. Website Backend designed with Spring Framework and MVC architecture.
3. Communication between frontend and backend is done with Rest APIs
4. PostgreSQL is used as database for storing mall related information.

5.1. Angular and HTML/CSS

Technology has widened its scope to unsaid dimensions in the past few decades, and, building web applications for different electronic devices has been a major part of it. In the past few years, there have been many innovations

which led to the development of responsive mobile & user-friendly applications. It is even possible now to have a singular code-base for the applications used over different OS platforms (like, android & iPhone) or different devices itself (like, mobile & laptop). The competition between the companies in the technology sector has grown so much that they adopt vast measures to stay ahead of their competitors by giving out naïve technology devices at cheaper rates [3].

The web pages are designed using a language called Hyper Text Markup Language, abbreviated as HTML. HTML has many versions, ranging from Tim-Berners-Lee invented www, in 1989, to W3C Recommendation: HTML 5.2, in 2017. However, HTML5 is the most commonly language for building web pages along with Cascading Style Sheets (CSS) and JavaScript, to build modern web-based applications.

AngularJS is a toolkit used for creating the framework largely apt for app-development. it's absolutely protrusile and works well with different libraries. Each feature can be improved or recast to suit distinctive development advancement. It is commonly used for making single-page applications, wherever some parts of the page (sub-views) are changed or updated as a result of the user 's actions or information being sent from the server. Different options embrace two-way data-binding, reusable parts, deep linking, and constitutional services for backend communication and localization support. Mobile Angular is another User Interface (UI) framework that's engineered on AngularJS and Bootstrap for mobile-friendly application development.

AngularJS, is the antecedent of Angular, which open-source and is prolonged by Google. Even after being an expansion of AngularJS, web applications of Angular can also be developed by Dart or typescript. Angular was built to simplify the function of building custom components. These custom components are then added to the code-base of the web applications in order to implement logic. Extensive data binding is practiced by Angular. It also offers routing mechanism, along with dependency injection module and modularization support. However, unlike the AngularJS, which was MVC-based, Angular is not. Also, Angular has a drawback of not including the UI components.

5.2. MVC Architecture

In software package design connectors are considered software package parts for delivering information and management in a very computer code. they're the software package module for describing the dependency of parts and providing a channel to link parts along. significantly, the connectors play a major role in distributed system. during this paper, we tend to consider the planning of connective in Model-View- Controller (MVC) distributed design. Model-View-Controller (MVC) design divides a system into 3 kinds of modules: Controller, Model and think about. significantly, it's vital that read is separated from system organization. Controller is enforced as a separate part or it combines with read. In Brubeck's analysis, the essential idea of Model-View-Controller (MVC) is shown: The Model deals with the logic and information of application, and it's additionally answerable for change the knowledge of read and receiving the commands from the Controller; the read is answerable for the presentation; the Controller is answerable of input from users as well as the keyboard or mouse events, and notifies Model victimization events.

MVC design assists in separating application phases into logical units [19]. Making the appliance more practical and pragmatic. It caters a novel entity; it might be one object or even a structure. There's a singleton relationship with the entity and also the object's information. Moreover, it also responds to requests coming back from the user-end. During this means, the process of information occurs solely within the model, which ensures internal information consistency and continuity. The read is employed to give the graphical visualization of the interface. It may separate some pointers concerning the model or highlight others. The input and output information is feasibly laid onto an interface victimization numerous parts like pushbuttons, menus, dialog boxes, etc. To examine the standing of the appliance objects, the read pops up the issues to the model through the controller. It further provides the link between the interface (view) and also the application process logic (model) [2]. It uses the model ways to extract information concerning the appliance object, to alter the standing of the article and to tell the read concerning this variation. Hence, the controller allows a user to make changes and see results, page (or different document) from the view; the model exists entirely on the server.

The constituents of MVC are as follows-

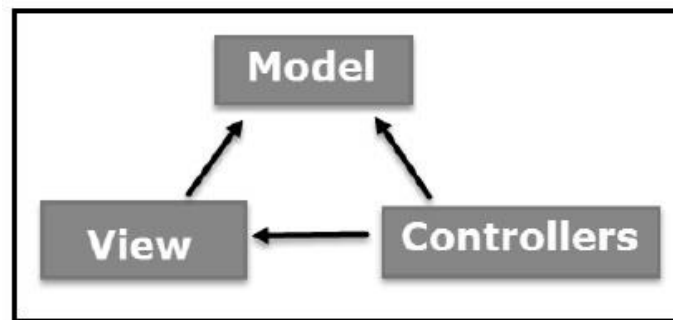


Fig 1.1

Model

The Model describes the data-related logic that the user works with. This could represent either data or information that's being send between the view and controller sections or the other business logic-related data or information. for example, a client entity can fetch the client details from the database, engineer it and recast it back to the database or use it to display details.

View

The view is employed for each and every user interface logic of the appliance. for instance, the client view can embody every user interface parts like buttons, navigation bars, etc. that the last client associates with.

Controller

Controllers act as an ally between Model and View sections to process every business logic and incoming requests, engineer data using the Model section and link with the Views to display the final output. For instance, the client controller will control all the associations and inputs from the client view and reform the database using the client model. The same controller will be used to display the customer information.

5.3. Spring Framework

The way an architecture is selected, it lays a significant role behind the productivity when compared to any other attribute of software development, it is because of the basic nature and mechanism of the software's architecture.

Recommendation of a simpler and basic architecture is always preferred as it lays the foundation of a highly prolific operation which covers all the basic requirements quoted by the client by still maintaining the streak to provide J2EE architecture [4]. The pivotal parts of any J2EE application are the presentation layer (User Interface, UI, tier), the business services layer (Middle tier), and the data access layer (Enterprise Information Systems, EIS, tier). Firstly, UI is MVC's (Model View Controller) concern. Secondly, Business service layer is led by "Business Methods" which can directly be used without to use any EJB APIs. The business objects are stateless session beans with local interfaces, running inside an EJB container, moreover, they even provide transaction management, thread management, and role-base security.

Ultimate concern is to set-up a web-application to the best version of it. To emphasize a number of objectives: simplicity, testability, and portability is an alternatively said ambition. Simpler it is cheaper it gets on pocket.

The spring framework is an associator in nursing web application design and framework of management instrumentality for the platform of Java. All the above stated objects use extensions of Java framework for constructing web applications over Java Enterprise Edition, however, the core features of the framework are versatile and can be used by any Java application [2].

5.4. APIs

An application programming interface (API) is a determined ally that outline interconnections linking numerous software mediators. It specifies the kind of calls or requests that can be made, how to create them, the data formats that should be used, the protocols to follow, etc. Application Programming Interfaces (APIs) were first documented in 2005 and saw a rapid popularity significantly. The evolution of APIs both private/managed and publicly accessible/open source to comply to the software architectural design standard called Representational State Transfer (REST) is entailed [20]. RESTful APIs have particular functions. The GET function can fetch data or information, the PUT function can revise current data or information, the POST function can create new data or information, and DELETE can delete data or information from the data source. The RESTful API (Representational State Transfer) standard circumscribe a lot of potential within the GET, PUT, POST, and DELETE functions. Also, structure that issue APIs as part of their service make a responsive effort to keep APIs extended and reposed for Business to Business (B2B) [21] and Business to Consumer (B2C) [22] communications. As a consequence, security standards should be firmly reviewed and accomplished flawlessly.

Following four HTTP methods are commonly used in REST based architecture.

1. GET – Provides a read only access to an asset.
2. POST – Used to create a new asset.
3. DELETE – Used to remove an asset.
4. PUT – Used to revise current asset or create a new asset.

5.5. PostgreSQL

Focusing on extensibility and SQL conformity, Postgres, is a type of Relational Database System, also abbreviated as, RDBMS, and is, free of cost & available to anyone i.e., open source. The name PostgreSQL was given to present support for SQL; however, it has an alias too, Postgres, which was named after Jean Auguste Dominique Ingres [23].

Foreign keys, triggers, sturdiness properties, atomicity, consistency, mechanically updated views etc., are a few options put forward by PostgreSQL.

The design of PostgreSQL is based on the working principle of handling any sort of workload, ranging from singular running machines in small companies to complex mechanical structure in huge warehouses. It can also handle the internet services that has many users using it simultaneously.

6. Results

The overall result of mall management system is better than other entry level online websites. The parameters used to analyze the performance of the proposed system listed below.

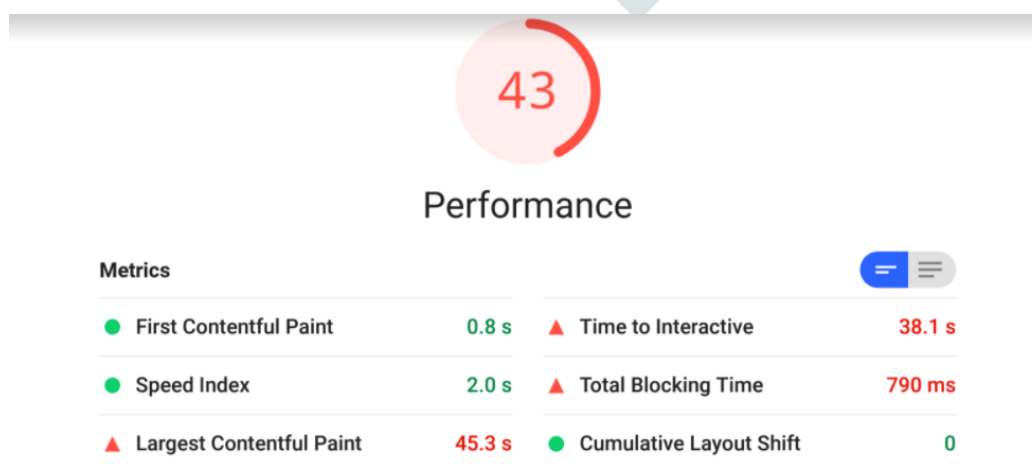


Fig 1.2

The Fig 1.2 shows performance metrics of proposed system tested with online website analyzer tool (<https://web.dev/measure/>)

Performance Metrics: The metrics that is used to measure the overall performance of the website which includes certain key terms listed as:

1. First Contentful Paint (FCP): It is when the browser renders the primary bit of content from the DOM (Document Object Model). It is an essential, user-centric metric for calculating perceived load speed because it marks the initial point in the page load timeline where the user can see something on the screen.
2. Speed Index: It calculates how rapidly content is visually rendered during page load. Lighthouse first captures a video of the page loading in the browser and measures the visual progression between frames.
3. The Largest Contentful Paint (LCP): This metric reports the display time of the largest image or text block visible within the viewport.
4. Time to interactive (TTI): It measures how long it takes a page to become interactive.
5. The Total Blocking Time (TBT): This metric measures the total amount of time between First Contentful Paint (FCP) and Time to Interactive (TTI) where the primary thread was blocked for long enough to avert input responsiveness.
6. Cumulative Layout Shift (CLS): It is an important, user-centric metric for calculating visual stability because it helps to compute how often users experience unexpected layout shifts.

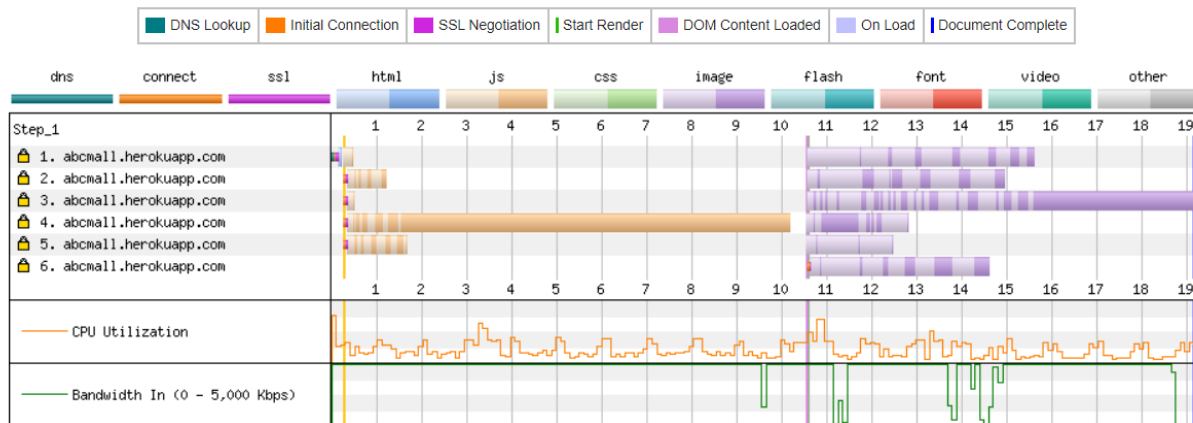


Fig 1.3

The Fig 1.3 shows performance metrics of proposed system, tested and analyzed with online website analyzer tool (<https://www.webpagetest.org/>).

The website analyzer tool used in fig 1.3 analyzed each element used to develop the website that includes hypertext markup language (HTML), cascaded style sheets (CSS), fonts, images, videos and other assets to measure response of the website with respect to time, central processing unit (CPU) utilization and bandwidth used to render the components of website accordingly. The graph shows optimal CPU utilization with maximum bandwidth usage of 5000 kbps is sufficient to render the complete web app.

6. Discussion

6.1. Online shopping

Every application or website or machine or equipment has one major goal associated to it, i.e. to make human life easier and efficient. Now-a-days, the craze of online shopping has exceeded street style buying because of three main reasons: ease, variety and delivery. Consumers can shop sitting at home and fulfil their needs with zero hustle. In order to aid the mall promotion and consumption, the website offers listing of all products of the various shops in the malls on the website, so that the consumer can make purchases sitting just at home. In this fast-paced life, not everyone has time to spend shopping inside the malls, which was the main reason the shopping apps like

amazon shopping, flipkart, etc. became this popular. This feature of online shopping, although is limited to a specific mall, has its own advantages: faster delivery, returns, real & reel experience of the product available and special offers & discounts for regular customers [13].

6.2. Consumer behavior

As this study is based on the malls present in the cities of India, the major issue is with the second-class consumer i.e., vendors and hawkers. As this website offers places that can be booked by the 'feriwalas', education and awareness come in between, as most vendors and hawkers are illiterate and do not know how to use advanced mobile applications which makes the user-base of the website limited to the business associates and professionals. Therefore, not all consumers can be benefitted by the website. To resolve the issue, the website has an added feature of translating the whole page into the national language of India, i.e. Hindi, which is read, written and understood by all citizens of the country, thus, making the user-base slightly more widened [12].

6.3. Promotions and mall atmospherics

Promotions and marketing play a vital role in the management and maintaining the atmosphere of any mall. The additional and unique feature offered by the website allows the user to book the mall for organizing special cultural functions or placing banners or promotional live events or social events. The website will provide complete information about the available dates for booking, rental charge, terms and conditions etc. This will reduce the work of, both, mall management staff and the company [24].

6.4. Practical implication

Many important revelations are proposed in this research. The results of this study show the relative advantages of adoption of mall management systems in public shopping malls, and show that the participants were had a clear understanding of the proposed system.

On the basis of this study, the software developing companies should step forward for creating a proposed system for malls and government should also encourage the concept of smart malls which will indirectly increases the employment of the particular area by promoting lower and weaker sections of our society to start their businesses in a sophisticated and encouraging environment [11]. This study will explain in depth the importance of digitalization of shopping mall management systems. Finally, the findings of this study will provide complete information on the exact meaning to determine whether they should adopt a digital shopping mall management system.

6.5. Limitations and future directions

Although this research has contributed to both theory and practice, it has very few limitations, which is something other researchers need to consider. This study only considered shopping malls that exist in Indian cities. In addition, the proposed system is relatively small and cannot be promoted and used as a product for commercial shopping malls. The proposed system uses fewer resources to build and has almost no cost to perform the recommended results. Therefore, it is called for a study on the future use of shopping mall management systems, which collects data from every province in India and other countries.

7. Conclusion

This research provides some insights. First, there is very little literature on integrated technologies (for example, shopping mall management systems). In particular, as far as we know, in India, there is no documentation on shopping mall management systems, only some websites can list and manage shopping mall assets, but from other perspectives. Therefore, no research in India can provide an understanding related to the digitization of shopping malls and shopping mall management systems. Therefore, it is necessary to fill this gap and provide insights on public sector shopping malls in India and other developing countries. Secondly, as far as we know, there is no research on the establishment or use of the proposed system for empirical research on shopping mall management systems [25]. Therefore, this is an opportunity and time to bridge this gap. In order for the proposed system to be successfully disseminated in the shopping mall industry, this research can make new contributions. In addition, business owners and shopping mall owners can benefit each other mutually.

8. Disclosure statement

No potential conflict of interest was reported by the authors.

9. Notes on contributors

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