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Construction of TypeScript Framework Consisting of Business Objects, Beans and Design Patterns: A Review

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Abstract The increasing demand for scalable, maintainable, and cross-platform web applications has highlighted the limitations of traditional JavaScript-based development, particularly in large-scale enterprise systems. Weak typing, runtime error detection, and limited architectural structure restrict JavaScript's effectiveness in complex applications. This review paper examines the construction of a TypeScript-based framework that integrates business objects, reusable beans, and established design patterns to achieve enterprise-grade software architecture. TypeScript, as a statically typed superset of JavaScript, enables interface-driven design, modularity, and improved code quality. The paper reviews and compares prominent technology stacks such as Java EE with Spring Boot and Python Django with Angular, focusing on architecture, performance, scalability, and security. Based on an extensive literature survey, the study identifies the absence of standardized TypeScript-centric enterprise frameworks and concludes that a disciplined TypeScript-based approach can serve as a viable alternative for modern web application development.

Keywords: *TypeScript, Business Objects, Beans, Design Patterns, Angular, Spring Boot, Django, Web Frameworks*

I.INTRODUCTION:

In today's last-paced digital ecosystem, the development of robust, scalable, arid platform-independent web applications has become a fundamental requirement across industries. This demand has led to the widespread adoption of powerful front-end and back-end technologies that support component-based development, modularity, and seamless integration. Among these technologies, TypcScript has emerged os a promising alternative to traditional JavaScript, offering type safety, object-oriented programming constructs, arid strong tooling support, thereby bridging the gap between lightweight scripting and enterprise-level application development. The proposed research focuses on constructing a TypeScript framework that integrates business objects, reusable beans, and design patterns—three essential components of structured and maintainable software architecture. Business objects encapsulate data and behavior specific to the application's domain, while beans provide reusable modules that manage dependencies and service interactions. Design patterns offer proven templates for solving recurring software problems and enforcing best practices.

This Study compares and contrasts the performance and design effectiveness of a TypeScript-Angular-Django stack with that of the traditional Java EE and Spring Boot architecture. By implementing similar projects across both stacks and evaluating parameters such as development time, CPU usage, reusability, and maintainability, the research

This motivated the introduction of Type5cript, a statically typed superset of JavaScript developed by Microsoft. TypeScript brings the rigor of classical object-oriented programming into the dynamic world of web development, enabling developers to define interfaces, create modular components, and enforce type constraints ct compile-time. These features significantly reduce errors, streamline collaboration, and make the codebase easier to maintain end refactor.

Moreover, modern application design emphasizes the importance of business logic encapsulation, reusable software components (beans), and design patterns. In Java EE, these constructs arc well-established through session beans, enterprise Java Beans (EJBS), and frameworks Iikc Spring. The goal of this research is to replicate and adapt these architectural principles into a TypcScript-based framework, thereby bringing enterprise-grade structure to front-end and full-stack JavaScript development.

A key motivating factor is the need for cross-platform compatibility and seamless deployment across operating systems. By using open-source technologies such as Angular, Django, Spring Boot, and TypeScript, this research aims to develop solutions that are not only cnst-effective hut alsn platform-independent, scalable, and adaptable to rapidly clianging business requirenients.

Additionally, industry trends are shifting toward microservices, RESTful APIs, and cloud-naiive architectures, where modularity and low coupling are essential. TypeScript, with its support for modular design, asynchronous processing, and native compatibility wiih popular frameworks like Angular and React, offers a strong foundation for building modern web applications. This research is thus driven by the need to fill the gap between back-end architectural rigor and front-end development flexibility by unifying these through a TypeScript-based paradigm.

II.PROBLEM STATEMENT

The areas of AI and NLP can be utilized within Java and Pphon technologies. It needs to be assessed whether the web-based software created with Java EE (Spring) outperforms that

developed with Python and Angular (TypeScript). Additional parameters are employed to derive the results, which are also evaluated to assist the researcher in reaching a conclusion. The pi eject must be depluyable across multiple platforms and all oper dting systems, which is a primai y requirement of this research study. The website's functionality should remain consistent ucross all platforms and uyerating systemu, as Java, Spring, Angular, TyyeScript, and PyŁhon are open-source software that is freely accessible on all platforms.

III.LITERATURY SURVEY

Alexey Chechet (2024) discusses in this paper the presence of function and class declarations that assist in minimizing developer anomalies. Due to the software paradigm of coding to interfaces, the methods defined in interfaces, as a result of the contract between interfaces and the classes that implement them, must all be implemented. Consequently, the distinction between contract and implementation arises from Type Script. The paper elucidates data concerning class methods, functions, and properties in TypeScript, as well as decorators related to dependency injection. These elements provide coders with a significant advantage in defining a specific entity in a designated format. For instance, enum day of week is represented as {Sunday,Saturday} .

Another benefit highlighted regarding the TypeScript language is that even when new employees join the project, the learning curve remains less steep compai ed to other techno1ogies and frameworks.

Dinesh Kuinawat, Dr. Vishal Shrivastava, and Dr. Akhil Pandey (2024) present in this paper the primary features of Angular, which include dependency injection, directives, pipes, routing, separation of interface from implementation, controllers, modules, and templates. The modularity offered by modules and dependency injection simplifies the manipulation of large applications and facilitates the writing of clean, maintainable code. Additionally, the community and ecosystem surrounding AngularJS boast a vibrant network and a wealth of third-party libraries, tools, and extensions that enhance its functionality and provide solutions to common development challenges.

Shweta Singri, Lagan Goel,(2024). This paper proposes a novel concept called inicroservice architecture, which involves breaking down complex and significant components into smaller, simpler services. These components can be deployed independently, and communication between them is enabled within niicroservices using Spring Boot. The paper outlines several advantages of Spring Boot inicroservices: One transaction or none: If a transaction involving a microservice is rolled back due to a system issue, all related transactions must also be rolled back.

All conditions before and after a transaction are synchronized with one another. Each transaction should operate independently of others. It is mutually exclusive of other transactions that involve microservices. In the event of a system crash, all data and content from all inicroservices must be preserved. Any entity unrelated to microservices arid the underlying system should riot be allowed access, and any attempts to penetrate the underlying system application should be rejected. Updates related to Spring Boot should not disrupt the underlying system. Additional benefits of microservice architecture include enhanced scalability, increased flexibility, improved speed, seamless inter-service communication, and adaptability to evolving business needs.

Nikola Dimitrijevićl, Nemanja Zdravković 1, (2024) This paper introduces a new frainework known as the Spring Framework, which provides features such as Inversion of Control, Dependency Injection, and Aspect-Oriented Programming (AOP) for seciirity purposes. Tlie JSON Web Token technology plays a significant role in securing object coinponents across networks utilized by underlying systems. OAulh enhances security by offering robusl aulhorization functionalities. The Lightweighl Directory Access Protocol (LDAP), in conjunction wilh Spring dependencies, serves as an effective tool for managing security through its authorization funclions and centralized authentication mechanisms. The Keycloak utility, along with Spi ing, ensures secuie communication, token validation, and protection of client delails. The author succinctly explains ali these concepts in this papei , contributing to the understanding of security mechanisms in netwoi k usage.

Manoj Kumarl, Dr. Rainu Nandal, (2024) This paper asserts that efficient, secure, and scalable web services are essential in the current digital landscape. The study investigates web service development and addresses challenges such as system efficiency, project timelines, and evolving requirements. The objective of this research is to guarantee ieliable and efficient web services by optimizing the development process and leveraging the Django fiamewoi k. The study emphasizes the use of Django's Model - Template-View (MTV) design pattern, tailored for a listing management system. The seamless integration of Django's features with MySQL for database management ensures smooth data interaction and optimal system performance. To further enhance system efficiency, the research focuses on standardizing data sharing grotncnls and accelerating user authentication grnccssscs. A key affect Of the srudy is the autnmatinn nf web Page creation using Pythnn, HTML, and CSS modules, which significaiitly boosts system efficacy.

Nikola Diinitrijevic, AJilena, Bogdanovic, and Aleksandra Mestrovic (2024) state in this paper that the security of software applications is a paramount concern in contemporary software development. A newly introduced framework, the Spring Framework, provides features such as inversion nf (Control, Dependency lnjectinn, and Aspect-(Oriented Programming (AOP) for enhancing security. The JfiON Web Token technology significantly contributes to securing ohject

components across networks util ized hyunderlying systems. OAuth enhances security by offering robust authorization capabilities. The Lightweight Directory Access Protocol (LDAP), in conjunction with Spring dependencies, serves as an effective tool for managing security through its authorization functions and centralized authentication mechanisms. The Keycloak utility, along with Spring, ensures secure communication, token validation, and protection of client details. The author succinctly explains all these aspects in this paper, enriching the understanding of security mechanisms in network usage.

Sushmita C. Hublil, Dr. R.C. Jaiswal2 (2023) mention that the client initiates a call to the controller layer, which implements the interface. The call is then passed from the controller to the service layer. This service layer comprises Java service classes and includes business interfaces that are implemented by business classes. Control is subsequently transferred to the Data Access Object (DAO) layer, which implements DAO interfaces. The DAO objects interact with databases, backend tables, and the persistence layer.

Jasmin Praful (2022) discusses Transfer Learning in Natural Language Processing (NLP) in this research paper, emphasizing the need for large datasets, machine learning specialists, and robust infrastructure. The paper outlines three levels that establish the foundation for the transfer learning methodology. The first is the global level, which considers the entire planet. The second level focuses on countries, while the third level pertains to the application of transfer learning within organizations, companies, or institutions. The initial task is identified, followed by training the relevant group using a pilot dataset. The next step involves feature extraction and pi epai ing the tai get task data. Subsequently, a model is developed, and the actual results are compared with those obtained from models created for the specific task. Finally, testing and deployment occur afte completing a!! prior steps.

Hatem Ynusef and Ibrahim Sabry (2023) present various roles of knowledge engineers, development staff, and problem domain expens in this research article. The middle layer is filled by knowledge experts, serving as the communication link between development staff and problem domain experts. Development staff relay messages to knowledge engineers, who in turn convey information to problem domain experts. These experts then send feedback to knowledge engineers and back to the development staff. Following knowledge representation, inference creation, and user interface design, the testing unit assesses the feedback between desired and actual results, allowing the gap fit unit to initiate the implementation phase. The author provides a clear explanation of the system's mechanics, making it accessible fnr general users.

Gwendo John Oloo (2023) explains in this paper that various advantages such as enhanced scalability, the use of a statically typed language, a strongly typed language, cross-platform operabilily, simplified coding, easier maintenance, compatibility with all types of devices, platform independence, and improved testing and debugging contribute to the appeal of TypeScript. Editors like Visual Studio Code and Sublime Text offer excellent support for TypeScript, as they arc built using it. Frameworks such as Angular and React also provide inherent support for TypeScript, given that Angular iS developed in TypeScript itself. According to the author, TypeScript ran ks third in popularity, with HC L in first place and R ust in second. This paper also compares TypeScript with JavaScript.Unicaf University, Lilongwe, Malawi (2022) presents a paper that discusses Expert Systems, a field within artificial intelligence that has experienced significant growih over time. The use of technology has permeated various sectors of society, facilitated by different software tools. This article provides a critical review of the software tools utilized in developing expert systems across multiple sectors. Key areas of focus included the tools employed, application domains, and the environments in which they are implemented. A structured methodology for the systematic review was employed, which involved formulating research questions, establishing inclusion and exclusion criteria, conducting searches, selecting articles for review, assessing article quality, extracting data, and analyzing the findings. The review encompassed anicles published in English from 2018 to 2022, sourced from journals, conference proceedings, and book series. The findings indicated a broad global application of expert systems, developed using a variety of tools, with CLIPS, Prolog, Jess, and MATLAB identified as the most favor ed touts for expert system development.

Mansi Tiwari (2023) discusses that React is a cutting-edge, cross-platform framework compatible with all operating systems. It is secure, customizable, cost-effective, consistent, quick to develop, and portable across laptops, mobiles, and desktops, allowing for seamless news delivery through React-based websites. Future trends include social media integration, machine learning utilities, multimedia integration, voice assistant integration, and localization, all of which consider React. The quality of news, images, and audio is guaranteed by React libraries, which pi ovide numerous utilities for developers to create React code and other projects, appl ications, and websites. React stands out as the premier UI/UX technology.

Ming-Ho Yee and Arjun Guha Deeptyper (2023) present a framework that predicts types for variables, function parameters, and function results using a fixed set of types. This means it cannot predict types declared in the program being analyzed unless those types were seen during training. DeepTyper approaches type inference as a machine translation task, converting unannotated Typescript into annotated Typescript. It employs a model based on a bidirectional iecurrent neural network architecture to translate a sequence of tokens into a sequence of types, providing a probability distribution of predicted types for each identifier in the source program. Additionally, DeepTyper incorporates a consistency layer in the neural network, which encourages, but does not enforce, the

model to treat multiple instances of the same identifier as interconnected.

Ritik Singhal (2022) presents a comprehensive examination of Spring Boot, a highly sought-after framework in the realm of web application development. This paper outlines the fundamental concepts of Spring Boot, its architectural principles, and its ability to minimize redundant coding efforts. It highlights Spring Boot's effectiveness in streamlining data source integration and offering efficient data access tools. As a valuable resource, this paper provides dcv0log0rs with insights intn the essential features, advantages, and hest practices nf String Bnnt fnr building scalable, maintainable, and high-gerfnrmance backend systems in the rapidly changing landscape nf web agglica£inns. String Bnnt has gained widespread acclaim fniits capability to facilitate the development of robust, enterprise-level backend applications. The paper navigates through the architecture of Spring Boot projects, data persistence, security, microservices, code organization, and testing, culminating in insights on performance optimization and monitoring, ensuring readiness to address the challenges of contemporary backend development.

Kakuinani Eswar Akanksh and Yadam Mohan (2022) propose that the focus of this research paper is the comparison between the React and Angular frameworks. Angular utilizes the regular DOM, while React employs the virtual DOM. Learning Angular is generally more challenging than learning React. Angular has weaker packaging compared to React, which is more robustly packaged. The concept of abstraction is less pronounced in Angular, making it weaker in this regard compared to React. There is no mention of enclosed tags in Angular. While Angular is a framework, React is not classified as one. Angular adheres to the MVC architecture, whereas React is structured around the Flex architecture.

Hari Krishna V Holla, 2022. The Docu ment Object Model (DOM) ÎS ä tlötd StFUCtUl 8 ôsüociatt d with HTM L a nd X M L tags, taking the Koi m uf a tiee, ance is a crucial component. The Viijuul DOM is adjusted based on changes to tags andcode. The JSX discussed in the paper is a blend of JdVa5cript and XML tags. Although JSX is part of the DOM, it is not directly utilized to create React JS applications. React JS integrates presentation and business logic within each component, and any modifications in the presentation layer occur in response to changes in the logic layer. React JS provides event-driven programming capabilities for development teams. In the Spring Boot framework, servlet filters have been specifically designed for authorization, authentication, and security before controllers are invoked. The author also addresses some drawbacks of Spring Boot, noting that when employing design patterns like dependency injection, numerous dependencies are generated, making them challenging to manage. Additional features such as PUT, POST, GET, PATCH, DELETE, and RESTful services related to Spring Boot are highlighted in the research paper.

Aditi Panclioli, (2021) This article states that Natural Language Processing (CLP) is a theoreticatly defined area of computationa! techniques that tackle at least one aspect of writing commonly occur i ing semantic probes to facilitate the processing of human-like language for task classification or applications. The aim of NLP is to perform specific tasks clearly. Many of NLP's extensive tasks are executed using program outlines, dialogue tests, machine translation, and mnrc. NLP 8nabl8s cnmgutcrû tn int0ract with humans in their nwn languagc and ass0sû nthcr languagc-r8larcd projects. For instance, NLP allows computers to comprehend text, adapt to speech, interpret it, analyze it, and identify which elements are significant.

Rakesh Kumar Singh and Himanshu Gore (2021) state in their research paper that the MVT (Model-View-Template) pattern is a variation of the Model-View-Controller framework. Control shifts from the view to the model. When users input data into the view's fields, the model fields are populated accordingly. This data is subsequently sent front the model to the database tables that are set up in the background using Django. The authors provide a comprehensive explanation of the steps that programmers or developers should follow when creating a project in Django. The data model is responsible for representing the data. SQL queries are riot utilized, arid the contents of the model are stored directly in the database tables. The view, which is represented by a form, accepts data from the user and is linked to the model component of the application.

Anbarasu Aladiyan (2021) discusses various features of Spring Boot in this paper, including enhanced modularity, automated deployment processes, cost savings, and pre-built services. The paper offer s an in-depth look at infl dstructure management, reduced functional complexities, and the time savings associated with the software development lifecycle. It also highlights modernization effoi ts such as Devf3ps technologies, increased throughput facilitated by artificial intelligence, end a decrease in ei rors within SDLP? processes related to Spring Boot.

Hesham Salem and Daniele Soria's paper (2021) discusses the necessity of a two-dimensional table matrix created by stakeholders, which includes rows such as Art, MDI, DOM, Subdomain, variables, output, system, training, validation, statistics, research outcomes, and the specific conditions and consequences outlined in the paper. The document provides comprehensive information on various disorders and concepts, checks, data, operations, and explanations. This research paper serves as an exemplary illustration of the application of AI tools, such as expert systems, in the medical field. The tasks performed by these computerized systems are executed with precision due to AI tools like expert systems, making them more cost-effective compared to non-AI methods. The expen system adapts to medical situations, and despite the initial challenges in developing such systems for medical facilities

like hospitals and pharmacies, the results have been well-organized and documented.

Kenneth Kehoe (2021) highlights that the web application technologies discussed in this paper are advancing rapidly, driven by ongoing innovation and enhancements. The Spring Boot methodology, a Java-based framework for developing web and enterpi ise applications, is emphasized for its ability to support service-oriented architecture (SOA). Spring Boot simplifies the creation and deployment of stand -clone, production-grade Spring applications with minimal configuration. For instance, when utilizing the Spring Model View-Controller (MVC) framework, one must configure the dispatcher servlet, web jars, a view resolver, and component scanning, among other components. Spring Boot can be employed to develop a SOA-based REST service API, effectively connecting fronteiid user interfaces with backend databases. The project is built on a SOA framework to facilitate the development of new applications and tools.

Samrudhi Narayan Santaji, Sowmyarani C.N. (2021) inform us in this paper that JPA, which stands for Java Persistence API, serves as a mechanism layer between Data Access Objects (DAO) and databases (tables). The research paper includes annotations such as @Table, Generated Identity, and ID. It mentions the following HTTP methods: PUT for updating a record in a table, POST for creating a new record, GET for retrieving an existing record, and DELETE for removing a specified record from the database table. While the author does not elaborate on every detail, he does provide a summary. A noted drawback of Spring is that it can be more challenging for an average coder or developer to grasp compared to pure Java.

Hesham Salem, Daniele Soria, and Jonathan N. Lund (2021) present a systematic review in this paper, which includes a two-dimensional table matrix prepared by the authors. This matrix consists of rows such as An, MDI, DOM, Subdomain, variables, output, system, training, validation, statistics, research outcomes, and the specific conditions and consequences are detailed in the paper. The paper provides compr ehensive infol mutton about various disorders, concepts, checks, operations, and explanations. This iesearch pdpei exemplifies the application of A I tools, like expert systems, in the metlical field. Since all tasks performed through computerisation are executed with precision due to Al tools like expert systems, they are more cost-effective compared to non-AI approaches. Expert systems adapt to medical situations, and despite the initial challenges in constructing them for medical facilities such as hospitals and pharmacies, they prove beneficial in the long run.Amarpreet Kaur Sahanil, PawanSingh,(2020) The database product Firebase referenced in this paper was utilized, and Angular was employed to create the web application. The resulting system is segmented into various components, such as the login component, home component, app-root component, blogs component, menu component, post component, profile component, and comments component. Each component operates independently, although interactions between them are present. They are indivisible atomic components, which can also be referred to as modules of components. Visual Studio Code serves as an IDE for this application. Fireslore is proposed as the database for the project developed by the author.

Prateek Rawatl, Archana,(2020) Accoi ding to the author of this research paper, each React application is divided into distinct parts, with each part responsible for its own execution. React is straightforward to learn and comprehend. Additionally, React can be manually installed by executing DOM-specific commands. It supports one-way data binding and does not facilitate two-way dotn binding, unlike the Angular framework, which is essentially a combination of JavaScript and XML tags along with data. React provides support for JSX, simplifying the process for developers, coders, designers, and users. When a component is delivered again, only the modified parts are updated, while the original, unchanged parts remain intact. The performance of React is enhanced due to these factors, along with the conversion of everything into a (virtual) DOM, which accelerates runtimes.

Marco Tulio Ribeiro (2020) discusses testing methods developed for natural language processing in this paper. These methods are organized into two dimensions: the first column contains sentences, while the second column includes MFT, negation tests, positive tests, and neutral classifications. Some sentences are evaluated to determine if they are positive, negative, or neutral, and percentages are calculated accordingly. MFT stands for Minimum Functionality Test, which is applied to every sentence. NV refers to the application of label-preserving rhanges to inputs, where the model's predictions are expected to remain unchanged. DIR represents a directional expectation state similar to INV, with the key difference being that the label is anticipated to change in a specific manner. For instance, a negative DIR example is: 'You are riot a good person.' Conversely, a positive DIR example is: 'You are a good person.'

Abdel-Rahman El-DaIabeeh and Mohammed Said AlZughou (2019) elaborate on the expert system utilized in a company's accounting operations. They emphasize that proper security, authorization, and authentication must be integrated into the major policies of firms, as accounting is essential to their operations. Additionally, they pi opose that employee training fOr managing expert systems should be thorough, and any unoifial ies from existing systems in the process sht›uld be udtlressed. The functionality of other systems, such uS dCcounting systems, i elies on expert systems, and vice ver sd.

Ms. Sayali M. Ikalel Tester, Liber Pays,(2019) In this research paper, the author discusses the various angular versions available in the market. Users should select the model that best fits their current project or assignment. The paper covers versions from 2.0 to 8.0, highlighting the differences among them. Several tags, decorators, and functionalities of AngularJS

are presented, along with a few simple programs. The paper explains service-level changes in Angular for applications that provide services to other components within the same project, using specific examples. Furthermore, it notes that future enhancements from Angular 12 to Angular 17.0 are currently emerging in the market, which will be advantageous for users.

Prof. B.A. Khivsara, Mr. Uniesh Khivsara,(20lB) This paper suggests that key features such as modules and dependency injection promote modularity, simplifying the manipulation of large applications and enabling the writing of clean, maintainable code. The AngularJ S community and ecosystem boast a vibrant netwoi k and a wealth of third-party libraries, tools, and extensions that enhance its functionality and addi ess common development challenges. The Angular fiamewoi k adheres to a model -view-controller ai chitectui e, where the view repi esents the template, components serve as the model, and controllers are JavaScript objects utilized with the rig-controller directive. The ability to create reusable components is o significant strength ot the Angular framework. Other directives include rig-app, ng-model (which functions as the model in the MVC architecture), ng-bind (used for two-way data binding), ng-repeat (for looping), rig-submit (for form data submission), and ng-click (for handling button click events).

Swetha Singri and Lagan Goel (2018) introduced a novel concept called microservice architecture in their paper. This approach involves breaking down complex and significant components into smaller, simpler services or parts. These components can be deployed independently, arid niicroservices in Spring Boot enable seamless communication between them.

Kenneth Kehoe (2018) discusses in his paper the rapid growth of web application technologies, driven by ongoing innovation and enhancements. He highlights the Spring Boot methodology, a Java-based framework designed for developing web and enterprise applications, emphasizing its flexibility for service-orienleél architecture (SOA). SpringBoot simplifies the creation arid deployment of stand-alone, production-ready Spring applications with minimal configuration. For instance, when utilizing the Spring Model View-Controller (MVC) framework, one must configure the dispatcher servlet, web jars, a view resolver, and component scanning, among other elements. The authors propose in this paper the use of Spring Boot to develop a SOA-based REST service API that effectively connects frontend user interfaces with backend databases.

P. VEENA (2018) discusses the significance of artificial intelligence and expert systems, outlining various advantages arid disadvantages of AI. The benefits include speed, accuracy, adaptability, accessibility, innovation, efficiency in repetitive tasks, and effectiveness in hazardous situations. Conversely, the drawbacks encompass high costs, lack of creativity, absence of improvement, and the inability to express emotions and feelings. The author describes an expen system that consists of functional components such as a user interface, knowledge base, and inference engine. Solutions are derived using either forward or backward chaining.

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