A Dynamic Decision Support System for the Best-Fitting Blockchain Platform Selection

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***Abstract*—Blockchain technology has been used in a variety of applications due to its security, decentralization, and immutability features, making it an ideal solution for an untrusted environment where multiple parties write data to a shared ledger based on consensus. However, with the exponential growth of blockchain platforms and their increasingly complex selection criteria, it has become difficult to determine the optimal platform for a particular use case or domain. To address this challenge, we propose a dynamic decision support system that enables users to identify the most suitable blockchain platform for their use cases and preferences. The proposed system allows users to add new categories, features, and platforms at any time, providing a flexible and adaptable solution for selecting the most appropriate blockchain platform. To develop this system, we analyzed and categorized the features of 36 blockchain platforms, focusing on Boolean and Non-Boolean characteristics. Then, we developed a decision-support system that prioritizes requirements according to their relevance and importance in the context of the specific use case. Finally, the system has been validated using different blockchain platforms. This system has the potential to significantly improve the decision-making process for selecting a suitable platform, saving time and resources while enhancing the success of blockchain-based solutions across a range of industries by simplifying the platform selection process.**

***Index Terms*—blockchain technology, platforms, suitability, relevance, dynamic decision method**

I. Introduction

The adoption of blockchain technology is rising in numerous domains and use cases due to its security, decentralization, and immutability features, making it an ideal solution for an untrusted environment where multiple parties write data to a shared ledger based on consensus. However, with the exponential growth of blockchain platforms and their increasingly complex selection criteria, it has become challenging to determine the optimal platform for a particular use case or domain. To address this challenge, we propose a dynamic decision support system for selecting the most suitable blockchain platform based on project requirements and preferences. To develop this system, we analyzed and categorized the features of 36 blockchain platforms and conducted a comprehensive review of existing literature on selecting a suitable blockchain platform. Our proposed system allows for adding new categories, features, and platforms at any time, providing a flexible and adaptable solution for selecting the most appropriate blockchain platform for a given use case [1].

The decision-making process for selecting a suitable blockchain solution or platform requires consideration of various factors, including the technology's design features, performance characteristics, security and privacy measures, scalability, and interoperability. Additionally, decision-makers must consider the specific use case, project requirements, and preferences, further complicating the decision-making process.

Given the challenges of selecting the most appropriate blockchain solution or platform, there is a need for effective decision support systems that can facilitate the decision-making process. Such systems should account for each use case's unique features and requirements and provide comprehensive evaluations of available blockchain solutions and platforms [2].

The selection of an optimal blockchain platform is influenced by various Boolean characteristics that can be broadly categorized into eight primary categories: ledger types, consensus algorithms, scalability features, resilience support, interoperability support, programming languages, contract types, and layering support [3]–[9]. These characteristics have a critical role in determining the suitability of a blockchain platform for a specific use case or project requirement.

By considering these primary categories of Boolean characteristics, decision-makers can effectively identify the optimal blockchain platform for a particular use case or project requirement. In addition to the Boolean characteristics, several Non-Boolean Features such as Platform Speed, Market Popularity, Innovations, and Platform Maturity are crucial factors that should be considered when selecting the most suitable blockchain platform for a specific use case or project requirement. These Non-Boolean Features play a vital role in determining a platform's potential for success, its overall market adoption and impact, and its ability to remain relevant and competitive over time.

This study involved a comprehensive analysis of 36 distinct blockchain platforms, focusing on Boolean and Non-Boolean characteristics. After categorizing these characteristics based on the platform's domain, we developed and implemented a decision-support system that prioritizes requirements based on their relevance and importance in the context of the specific use case or project requirement. This approach provides a flexible and adaptable framework for selecting the most appropriate blockchain platform based on assessing Boolean and

Non-Boolean characteristics, ensuring that the selected platform aligns with the specific use case or project requirement.

This paper is structured as follows. Section II provides background information and related work on selecting suitable blockchain platforms. Section III introduces our proposed model and presents the attributes of blockchain platforms that will be utilized to select the best-fit platform. The development of a prototype is described in Section IV. The paper's fifth and final section presents a conclusion and suggestions for future work.

II. Background

The emergence of blockchain technology began with the development of Bitcoin in 2008, which was launched in 2009 by an individual or group using the pseudonym Satoshi Nakamoto [10]. Bitcoin is a form of cryptocurrency, a group of digital currencies that use encryption for secure transactions without the need for a central authority [11].

In 2013, Vitalik Buterin identified several deficiencies in the Bitcoin programming language and proposed a solution in the form of Ethereum, which he introduced in a paper [12]. Ethereum is a Turing-complete, distributed ledger that supports transaction status and other blockchain architecture modifications. It also includes a programming language that allows users to design their own ownership rules, transaction formats, and state transition techniques [13].

Hyperledger, launched by The Linux Foundation in 2016, is an umbrella project aimed at providing business solutions and universal blockchain implementation. It includes several framework projects, such as Hyperledger Fabric, Hyperledger Iroha, Hyperledger Indy, Hyperledger Sawtooth, Hyperledger Cello, Hyperledger Explorer, and Hyperledger Composer, each with unique characteristics suitable for specific use cases [14], [15].

To address the issue of interoperability among different blockchains, several innovative platforms have emerged, including Polkadot, Cosmos, Ark, and Aion [16]. These platforms offer solutions to enable communication and interaction between different blockchain networks.

Overall, the blockchain technology landscape has evolved with the introduction of various platforms aimed at improving the functionality, security, and scalability of blockchain systems. Each platform offers distinct features and capabilities, allowing for greater flexibility and versatility in blockchain applications.

A. Related work

Several studies have investigated the features and selection criteria for choosing an appropriate blockchain platform for various applications. Tien Tuan Anh Dinh proposed a framework for selecting a private blockchain platform and evaluated the features of Ethereum, Parity, and Hyperledger Fabric platforms [17]. Meanwhile, Chowdhury proposed an evaluation framework for selecting a blockchain platform for the Internet of Things (IoT)-based applications by analyzing the requirements of different IoT applications and the suitability of various blockchain platforms to satisfy their underlying requirements [18].

However, many of these studies lack a thorough comparison of the various blockchain platforms, which can make it difficult for decision-makers to choose the best-fit platform. To address this issue, some studies have conducted comprehensive evaluations from multiple dimensions to evaluate public blockchains. For example, a study conducted by Yuan et al. evaluated the public blockchain platforms based on three first-level and eleven second-level indicators, including technology, recognition, and activity [19]. These indicators were used to evaluate the public blockchain platforms as shown in Figure 1.

Other studies have provided frameworks for selecting blockchain platforms by categorizing their features into different types. Siamak and Slinger provided a framework that categorizes blockchain platform features into two types: Boolean and non-Boolean features [5]. Boolean features include consensus mechanism, layer support, authorization and authentication, contracts, and programming language support, while non-Boolean features consist of innovation, platform maturity, popularity in the market, and transaction speed. Similarly, a related study proposed a decision-making framework for evaluating appropriate blockchain platforms for business, consisting of technical criteria, non-technical criteria, and expert views and surveys [20].

In the healthcare domain, Tsung-ting Kuo conducted a systematic review of blockchain platforms and their components, such as hashing chain, timestamp, and consensus mechanism, to support healthcare applications [21]. Ahmed Alkhateeb presented a systematic literature review of the use of hybrid blockchain platforms in the Internet of Things (IoT), revealing that Ethereum is the most commonly used platform in the IoT on hybrid blockchain platforms [22].

Overall, these studies provide useful insights into selecting the most suitable blockchain platform for specific applications, taking into account various factors such as technical features, recognition, activity, consensus mechanism, layer support, authorization and authentication, contracts, programming language support, innovation, platform maturity, popularity in the market, and transaction speed. However, there is a need for more studies that compare the different blockchain platforms comprehensively to facilitate the decision-making process for selecting the best-fit platform.

III. Proposed decision support system

The rapid expansion of blockchain platforms has led to ongoing improvements and advancements in their capabilities. For instance, the original version of Ethereum employed the Proof of Work consensus mechanism, whereas the latest version now supports the Proof of Stake mechanism. Although these platforms are part of a larger category, each use case may require specific preferences and requirements. Moreover, the adoption of blockchain-based systems is becoming more widespread in industries that involve numerous stakeholders.

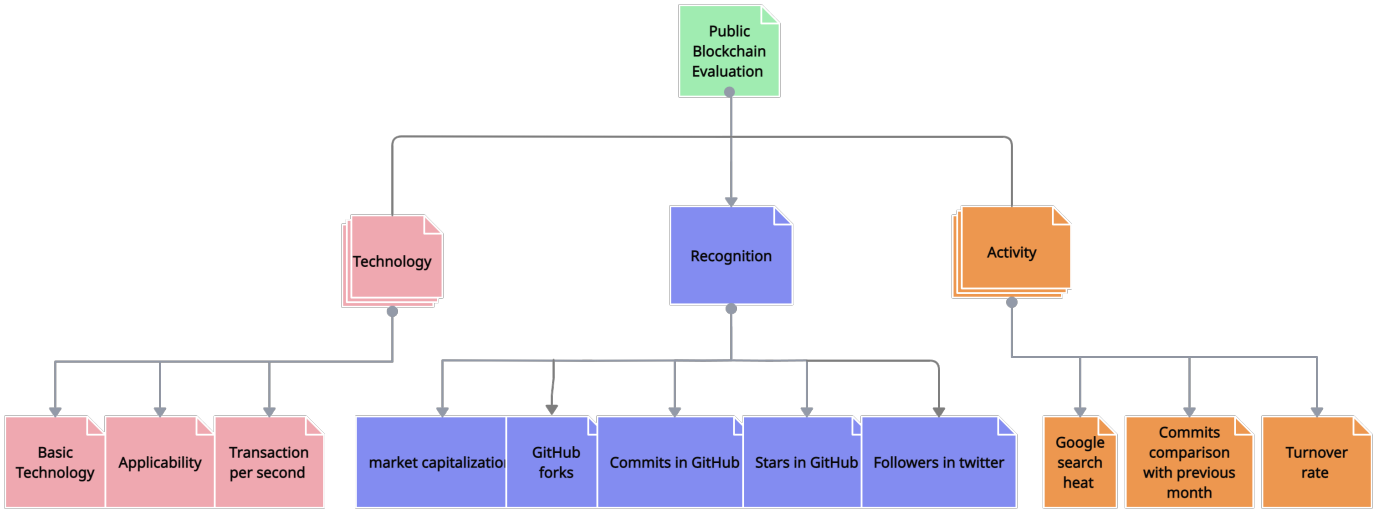

Fig. 1. Blockchain platform evaluation indicators: adopted from [19] : full image

To address these issues, a decision support system (DSS) can be developed to assist with selecting the appropriate blockchain platform. Figure 2 illustrates the proposed classification for this dynamic system.

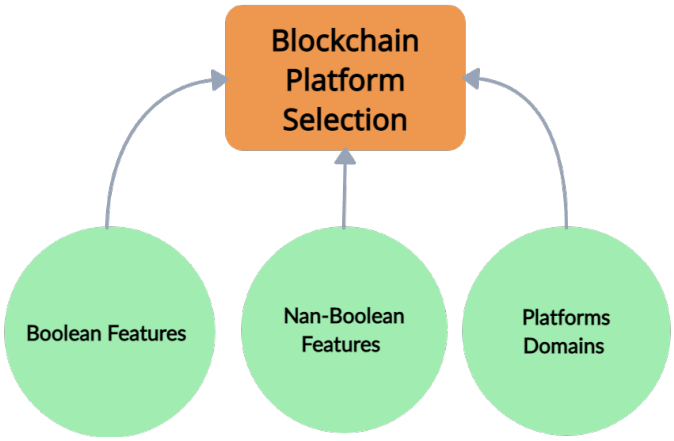

Fig. 2. Proposed work for the dynamic decision support system

To select the most appropriate blockchain platform, a dynamic decision support system is required. The design and development of such a system should prioritize the requirements of the specific use case. As different use cases may require different sets of criteria, a flexible and adaptable system is necessary.

To develop the proposed decision support system, we conducted a thorough analysis of 36 different blockchain platforms. We examined the available features and use cases for each platform in order to identify their strengths and limitations. The list of reviewed blockchain platforms is shown in Table I, which will serve as a key input for the decision-making system.

To aid in the selection of the most suitable blockchain platform, a dynamic decision support system has been proposed, which is necessary due to the continuously growing number of blockchain platforms and the evolving capabilities of these platforms. The proposed system follows a requirements priority order and categorizes information into three categories: platform domains, Boolean features, and non-Boolean characteristics.

Boolean features are characteristics of a blockchain platform that are either present or absent. These features can be used to determine whether a platform is suitable for a specific use case by evaluating whether it possesses the necessary attributes. Boolean features include consensus method, support for layers, privacy support, contracts, support for programming languages, support for scalability, robustness, interoperability, and layer support, which are displayed in Figure 3. The system is designed to be dynamic and can accommodate any additional categories or features.

Non-boolean features in the context of blockchain platform selection refer to factors that are not binary or true/false but rather continuous or measured on a scale. Examples of non-Boolean features include platform speed, market popularity, innovation, platform maturity, and transaction speed. These features are crucial for determining a platform's potential for success, its overall market adoption and impact, and its ability to remain relevant and competitive over time. For example, a blockchain platform that is faster in processing transactions or has higher market popularity may be preferred over another platform that is slower or less popular, even if both platforms have the same set of Boolean features.

In the context of selecting a suitable blockchain platform, the domain refers to the specific industry or application area for which the platform is intended. Each blockchain platform is designed with a particular use case in mind, and it may not be suitable for other use cases. Therefore, it is essential to consider the domain of the platform when selecting the most appropriate one for a particular project.

Examples of blockchain domains include finance, health-

TABLE I
ALL PLATFORMS THAT HAVE BEEN STUDIED [10], [23]–[29]

ID	Platform name	Github
1	Ethereum	https://github.com/ethereum
2	R3 Corda	https://github.com/corda
3	Quorum	https://github.com/ConsenSys/quorum
4	Fabric	https://github.com/hyperledger/fabric
5	Bitcoin	https://github.com/bitcoin/bitcoin
6	Lisk	https://github.com/LiskHQ
7	Komodo	https://github.com/KomodoPlatform
8	QTUM	https://github.com/qtumproject
9	LiteCoin	https://github.com/litecoin-project/litecoin
10	ZCash	https://github.com/zcash/zcash
11	Peer Coin	https://github.com/peercoin
12	Dash	https://github.com/dashpay/dash
13	Stellar	https://github.com/stellar
14	Solana	https://github.com/solana-labs/solana
15	EOSIO	https://github.com/EOSIO
16	Tezos	https://github.com/tezos
17	Monero	https://github.com/monero-project/monero
18	Tendermint	https://github.com/tendermint/tendermint
19	Sawtooth	https://github.com/hyperledger/sawtooth-core
20	Bigchain DB	https://github.com/bigchaindb/bigchaindb
21	Neo	https://github.com/neo-project/neo
22	Multichain	https://github.com/MultiChain
23	HydraChain	https://github.com/HydraChain/hydrachain
24	Waves platform	https://github.com/wavesplatform
25	Ripple	https://github.com/ripple
26	Symbiont	https://github.com/symbiont-io
27	Openchain	https://github.com/openchain
28	Vechain	https://github.com/vechain
29	WanChain	https://github.com/wanchain
30	Factom	https://github.com/FactomProject
31	Cosmos	https://github.com/cosmos/cosmos
32	IOTA	https://github.com/iotaledger
33	Neblio	https://github.com/NeblioTeam
34	Zilliqa	https://github.com/Zilliqa
35	Bitshares	https://github.com/bitshares
36	Polkadot	https://github.com/paritytech/polkadot

care, supply chain management, identity verification, and voting systems. Each of these domains has unique requirements and features that a blockchain platform must support to be considered appropriate for use in that domain. For example, a healthcare blockchain platform must support the secure and private sharing of patient health information while maintaining compliance with relevant regulations such as HIPAA. Similarly, a supply chain management platform must support the tracking and verification of goods as they move through the supply chain.

The dynamic decision-support system presents several platforms based on the proportion of features that match those selected in the selection. The system returns the records that fit the criteria based on the submitted features, and the percentage of platforms that match is displayed alongside each platform that is notably matched. Users have the option of clicking on each matched platform to view exclusive information about it.

IV. PROTOTYPE

The proposed decision support system is designed to assist users in selecting the most appropriate blockchain platform based on their use case and preferences. The system is dynamic and can accommodate additional categories or features as required. The system is built on the PHP Laravel framework and uses MySql for data storage. The system has two sections: an admin section where new platforms and feature categories can be added and a front-end section where users can select the features they desire for their use case. The system matches the user's selection with the available platforms and returns the percentage of matches and the platform's information that best matches the user's criteria. The system also includes non-Boolean characteristics, domains, and industry-specific applications in its decision-making process. Overall, this proposed dynamic decision support system can be a useful tool for users looking to select the most suitable blockchain platform for their specific use case.

The dynamic decision support system is designed to provide users with a seamless and user-friendly experience, as shown in Figure 4. It enables users to pick and choose from a range of features and attributes and provides them with the necessary information to decide which blockchain platform would be most suitable for their specific use case. By incorporating boolean and non-boolean characteristics, the system can provide a comprehensive overview of each platform and its capabilities.

Moreover, the system has been developed using the PHP Laravel framework, which is known for its robustness and flexibility, and MySql is used for data storage. The back-end interface stores all the information related to each blockchain platform, while the front-end interface displays the features and attributes through a user-friendly interface. The drop-down control in the back-end interface contains a list of all the features that can be selected from multiple choices. The proposed dynamic decision support system provides a comprehensive solution for selecting the most appropriate blockchain platform based on specific use cases. Its user-friendly interface and incorporation of both Boolean and non-Boolean characteristics make it an efficient and effective tool for both technical and non-technical users alike. The system is designed to be flexible and adaptable, enabling the addition of new features and attributes in the future.

The links between the blockchain platforms and feature tables are mostly many-to-many. The dynamic query used in the system is created based on the submitted features, and the server fetches the matching records from the database. To illustrate, consider Listing 1, which shows a dynamic query created from provided features. The query selects all the features that match the submitted features and computes the percentage of matching features using the COUNT function. The WHERE clause uses the OR joined relationship to filter the platforms based on the submitted features. The GROUP BY clause groups the results by platform ID, and the HAVING clause filters the results based on the minimum number of matching features. Finally, the results are sorted in ascending order based on the percentage of matching features.

In this dynamic decision support system, the matching percentage for a blockchain platform is determined based on the features selected by the user. Each featured category has been assigned a certain weight, which can be adjusted based on the user's preferences. The percentage of matching solutions

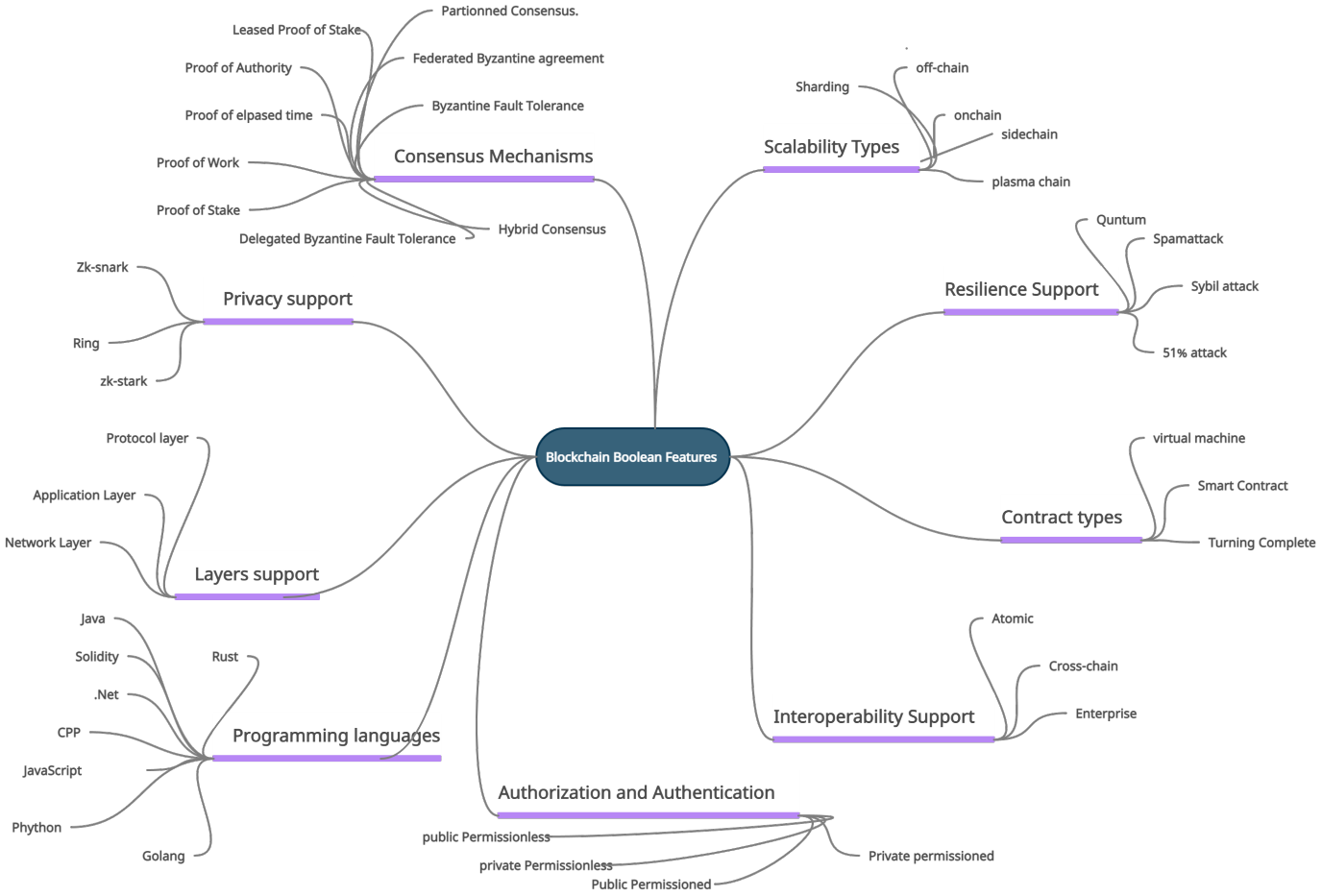

Fig. 3. Blockchain analyzed boolean features: full image

is calculated by adding up the percentage of the matching features and the percentage of the non-selected features as written in Equation 1.

$$Percentage(100\%) = F1 + F2 + F3...Fn \quad (1)$$

Listing 1. Query

```
$allmatchingPlatforms = Platforms::orWhereHas('platformconsense', function($q)
  use($data) {$q->whereIn('platformconsensusmechanism.consensuse_mechanisim_id',
  $this->consensusmechanism_ids);
})
->orWhereHas("platformlanguages", function($q) use($data) {
  $q->wherein('pprogramminglanguages.programminglanguages_id',
  $this->programminglanguages_ids);
})
->orWhereHas("platformcontract", function($q) use($data) {
  $q->wherein('pcontractsupports.contractsupports_id', $this->contractsuport_ids);
})
->orWhereHas("platforminteropability", function($q) use($data) {
  $q->wherein('pinteroperabilitytypes.interoperabilitytypes_id',
  $this->interoperabilitytypes_ids);
})
->orWhereHas("platformprvaciy", function($q) use($data) {
  $q->wherein('platformprivacytypes.privacytypes_id', $this->privacytypes_ids);
})
->orWhereHas("platformresliance", function($q) use($data) {
  $q->wherein('platfromresiliencetypes.resiliencetype_id',
  $this->resiliencetypes_ids);
})
->orWhereHas("platformscalibilty", function($q) use($data) {
  $q->wherein('platformscalabilitytypes.scalabilitytype_id',
  $this->scalabilitytypes_ids);
})
->orWhereHas("platformlayers", function($q) use($data) {
  $q->wherein('platformslayersupports.layersupports_id', $this->layersuport_ids);
})
->orWhereHas("platformdomains", function($q) use($data) {
  $q->wherein('platformsdomains.platformdomains_id',
  array($this->platformdomains_ids));
})
->orwhere('transactionspeed_id', '=', $this->transactionspeed_id)
->orwhere('platformcommunity_id', '=', $this->platformcommunity_id)
->orwhere('platformmaturity_id', '=', $this->platformmaturity_id)
->orwhere('platformpopularity_id', '=', $this->platformpopularity_id)
->get();
```

The proposed dynamic decision-support system presents several platforms based on the proportion of features that match those selected in the selection. The system returns the records that fit the criteria based on the submitted features, and the percentage of platforms that match is displayed alongside each platform that is notably matched. Users have the option of clicking on each matched platform to view exclusive information about it. The matching percentage for a blockchain platform is determined based on the features selected by the user. Each featured category has been assigned a certain weight, which can be adjusted based on the user's preferences. The percentage of matching solutions is calculated in Equation 2 by adding up the percentage of the matching features and the percentage of the non-selected features.

Fnsp=Not Selected categories Features Percentage.

Fmp=Matching Features category Percentage.

$$Matching(\%) = Fnsp + Fmp \quad (2)$$

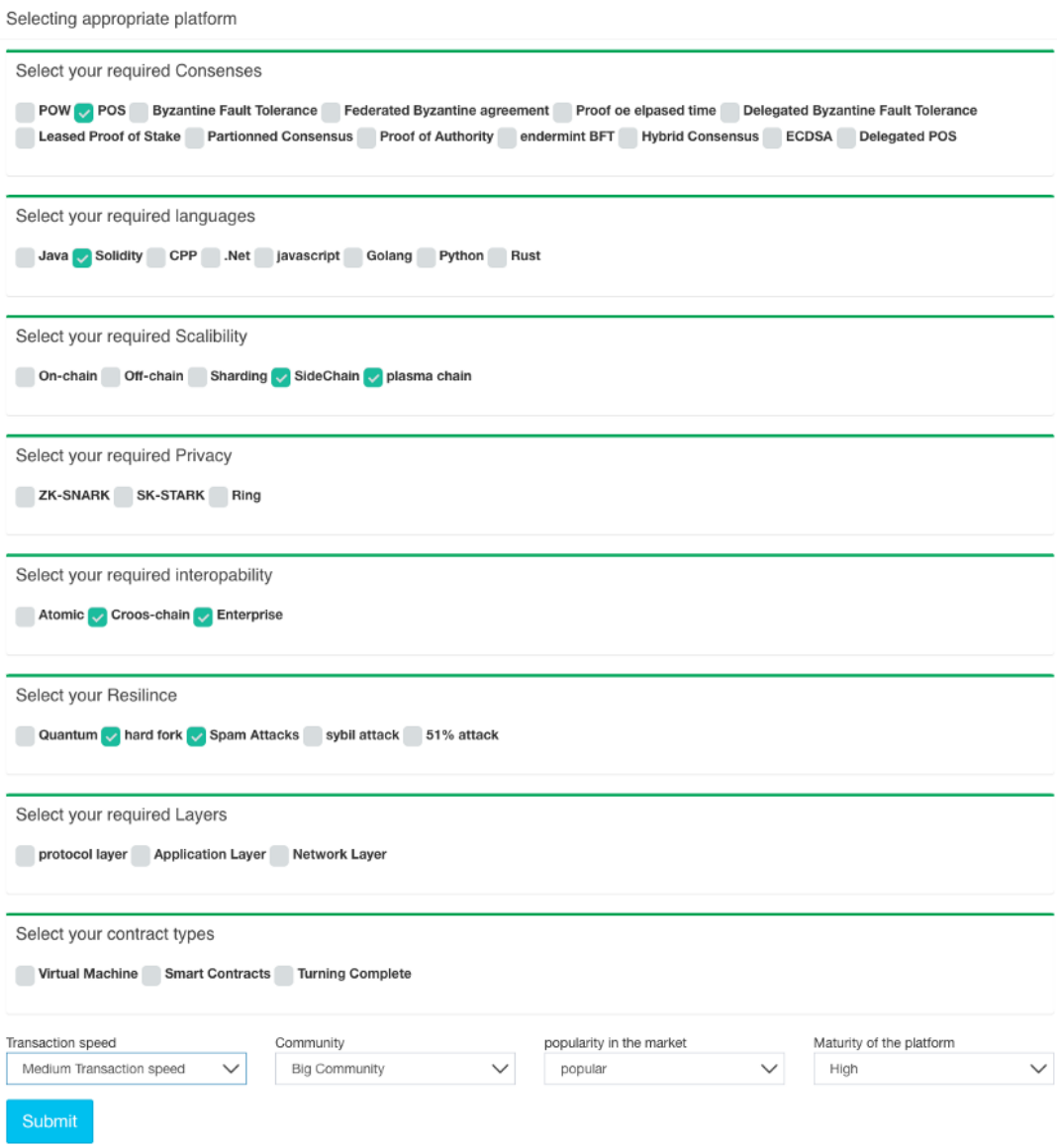

Fig. 4. Front-end of the dynamic system

The matching percentage is calculated for each feature category selected by the user, and the total percentage is computed by summing up the individual percentages. This same principle applies to additional categories, each of which may yield a corresponding matching percentage and contribute to the overall score. The system employs a dynamic query created from the submitted features, and the server fetches the matching records from the database. The query selects all the features that match the submitted features and computes the percentage of matching features using the COUNT function. The WHERE clause uses the OR joined relationship to filter the platforms based on the submitted features. The GROUP BY clause groups the results by platform ID, and the HAVING clause filters the results based on the minimum number of matching features. Finally, the results are sorted in ascending order based on the percentage of matching features.

Listing 2. Percentage of consensus mechanism

```
public function PercentageofConsensusForOnePlatform($platform){
  $oneplatformpercentage=0;
  $consenses= Platforms::where("platforms.id",$platform->id)->WhereHas('platformcons',
  function($q) use($platform) {
      $q->whereIn('pconsensusmechanisms.secondtable_id', $this->consensusmechanisms);
  })->get();
  if($consenses->count()>0){
      $oneplatformpercentage=config('admin.consensusPercentage');
  }
//Not posted this category
  if(sizeof($this->consensusmechanisms)==1 and $this->consensusmechanisms[0]==0){
      $oneplatformpercentage=config('admin.consensusmechanisms');
  }
  return $oneplatformpercentage;
}
```

We have developed a prototype of the system, and it is now deployed on the following domain name[1]. Users can access the system and select their desired features and preferences to receive a list of matching blockchain platforms that meet their requirements. The system is designed to be user-friendly

[1]https://platforms.blockchainprocessmodel.com

and customizable, allowing users to adjust the weighting of different feature categories based on their preferences.

The proposed dynamic decision support system provides a comprehensive solution for selecting the most appropriate blockchain platform based on specific use cases. Its user-friendly interface and incorporation of both Boolean and non-Boolean characteristics make it an efficient and effective tool for both technical and non-technical users alike. The system is designed to be flexible and adaptable, enabling the addition of new features and attributes in the future. Additionally, the system has been validated using 36 different blockchain platforms and has been shown to be effective in selecting the most suitable platform based on a specific use case. This system has the potential to significantly improve the decision-making process for selecting a suitable blockchain platform, saving time and resources while enhancing the success of blockchain-based systems.

V. Conclusion

The rapid growth of the blockchain industry has resulted in an extensive range of available blockchain platforms. However, choosing the right platform that meets a use case's specific needs and preferences can take time and effort. This paper proposed a dynamic decision support system that enables users to identify the most suitable blockchain platform based on their individual requirements. The system leverages a database of blockchain platforms and their associated features and a user-friendly interface for users to specify their preferred features. The developed system computes the percentage of matching features between the user's specified requirements and the available blockchain platforms. This dynamic feature selection approach provides users with flexibility in the weighting of different feature categories based on their preferences. The system also considers the many-to-many relationships between blockchain platforms and feature tables, enhancing the accuracy of the platform recommendations. Overall, the proposed decision support system has the potential to facilitate the adoption of blockchain-based solutions across a range of industries by simplifying the platform selection process. In future developments, it will be necessary to further refine the system's functionality by identifying the most critical features for choosing an ideal blockchain platform. This will ensure the system's recommendations are optimized for users' needs and preferences.

Acknowledgment

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