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A Groupware System to Support Cooperative Programming: Design and Gests

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ABSTRACT: The advancements in network and collaboration technologies have opened up possibilities for creating robust collaborative environments that can benefit various activities and disciplines. One such discipline is computer programming, which is a complex and creative task that can greatly benefit from the support and enhancement offered by groupware systems and distributed architectures. As software projects become more complex and development teams become geographically dispersed, programming phases often encounter increased problems and difficulties. Collaborative programming (CP) emerges as a solution to address these challenges by enabling distributed programmers to collaborate on the same program or software application. CP finds application in two distinct settings: the software industry and academia

HIGHLIGHTS:

- ▶ We study the goods of using groupware to develop cooperative programming(CP).
- ▶ We've erected CODIRTC, a system to support CP in a coetaneous distributed fashion.
- ▶ We conduct trials for studying the benefits of CP.
- ▶ First, we compare the work of brace programmers with the work of solo programmers.
- ▶ In a alternate study, the influence of the CP in the program quality is analysed.

I. INTRODUCTION

The advances in network and collaboration technologies enable the creation of powerful collaborative environments from which many activities and disciplines can benefit. Computer programming is a complex and creative task that can take advantage of such environments and thus be supported and enhanced using groupware systems and distributed architectures. The increasing complexity of software projects and expanding geographical distribution of the members of the development teams lead to increasing problems and difficulties in the programming phase. Collaborative programming (CP) is facilitating these scenarios by allowing distributed programmers to work jointly on the same program or software application. Having a closer look at CP, it can be seen that this would be of application in two different settings: software industry and academia.

In recent years, Agile software methodologies, particularly Extreme Programming (XP), have gained significant attention in research and industrial environments. Pair programming (PP), one of the key practices of XP, involves two programmers working collaboratively on a single computer. PP has shown promising results, but it requires face-to-face collaboration. To overcome geographical limitations, Distributed Pair Programming (DPP) was introduced, enabling remote collaboration using groupware tools. CP, an extension of DPP, allows collaboration among multiple programmers with the flexibility to establish new rules for efficient collaboration. PP practices force pair programmers to work face-to-face. In contrast, distributed pair programming (DPP) involves two team members collaborating synchronously on a programming task from different geographic locations, utilizing either generic or specialized groupware tools (Baheti et al., 2002). Collaborative programming (CP) extends the concept of DPP by allowing more than two programmers to collaborate and introducing additional rules to ensure efficient collaboration. CP holds promise as a tool for promoting cooperative programming literacy, given the sensitive nature of programming as a subject for both students and instructors to learn and teach. This is due to the fact that academics can usually construct the outcome of a programming problem by visualizing it in their minds or expressing it in a figure, but they find it challenging to transform such a result into a computer program using structure blocks (computer instructions) that are abstract and foreign to them (Karsten and Kaparthi, 1998). Programming languages, design principles, and operational disciplines can all be learned through the process of evaluating and criticizing software artifacts created by others, according to Johnson (1998). As a result, we address the challenges students encounter when learning programming by advocating a computer-supported literacy approach, providing learner-centered environments, and encouraging literacy



by doing through cooperative problem solving conditioning (see, e. G. Bravo, et al. , 2006b).

After considering these concepts, this composition presents a dual ideal. Firstly, it examines certain issues related to CP system design. Secondly, it explores the advantages of utilizing groupware tools to support DPP conditioning. Several design and usability principles are discussed in connection with the first ideal, and controlled studies are conducted for research purposes.

II. SCHEMA OF THE DATABASE

2.1 Oauth Schema

```

+-----+-----+-----+-----+-----+
| id | user_id | name | image_link | create_time |
+-----+-----+-----+-----+-----+
| PK | | | | |
+-----+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| oauth_provider | access_token | refresh_token | expiry_date |
+-----+-----+-----+-----+
| | | | |
+-----+-----+-----+-----+
    
```

2.2 Questions Schema

```

+-----+-----+-----+-----+
| question_id | title | question_title | problem_url |
+-----+-----+-----+-----+
| PK, UQ | UQ | | |
+-----+-----+-----+-----+
    
```

```

+-----+-----+
| difficulty_level | difficulty |
+-----+-----+
| |
+-----+-----+
    
```

2.3 companies schema

```

+-----+-----+-----+-----+-----+-----+
| DE Shaw | Yahoo | Paypal | Walmart | BNY Mellon | LinkedIn | Spotify |
+-----+-----+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+-----+-----+
| DE Shaw | Yahoo | Paypal | Walmart | BNY Mellon | LinkedIn | Spotify |
+-----+-----+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+-----+-----+
| Google | Salesforce | Microsoft | Directi | Goldman Sachs | Twitter | Arce |
+-----+-----+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+-----+-----+
| Cisco | Apple | Flipkart | Adobe | Amazon | Facebook | Oracle |
+-----+-----+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+-----+-----+
    
```

2.4 Tags Schema

```

+-----+-----+-----+-----+
| question_id | Binary Search | Divide and Conquer | Dynamic Programm |
+-----+-----+-----+-----+
| PK, UQ | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Heap | Random | Stack | Binary Indexed Tree |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Geometry | Hash Table | Depth-first Search | Rolling Hash |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| String | Suffix Array | Union Find | Math |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Two Pointers | Sliding Window | Greedy | Line Sweep |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Graph | Brainteaser | Dequeue | Reservoir Sampling |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Recursion | Backtracking | Ordered Map | Design |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Minimax | Bit Manipulation | Trie | Queue |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+-----+
| Segment Tree | Binary Search Tree | Meet in the Middle | Array |
+-----+-----+-----+-----+
| NOT NULL | NOT NULL | NOT NULL | NOT NULL |
+-----+-----+-----+-----+
    
```

```

+-----+-----+-----+
| Memoization | Breadth-first Search | Linked List |
+-----+-----+-----+
| NOT NULL | NOT NULL |
+-----+-----+-----+
    
```



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III. SNAPS OF PROJECT

3.1 Login Page

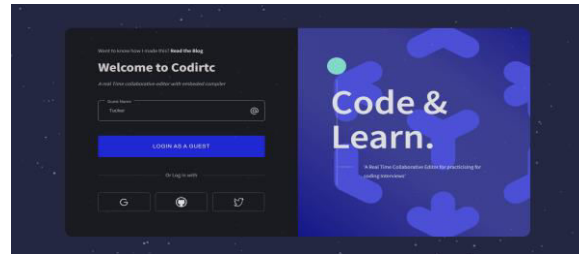


Fig. 1 Login page when user lands on website through which user can login via Oauth.

3.2 Problem List Page

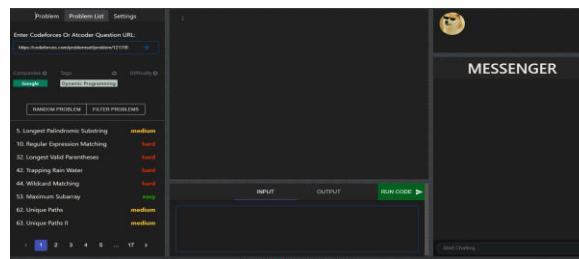


Fig. 2 Problem list page that shows list of problems from leetcode. User can also import problem from codechef and atcoders via importing the URL of the problem in the input bar.

3.3 Problem Page

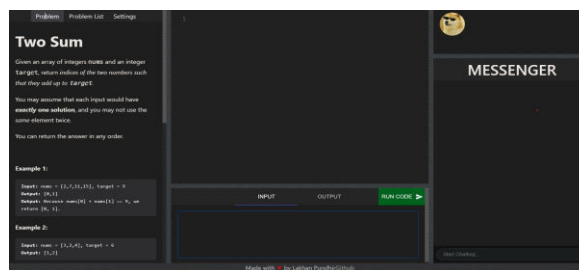


Fig3. Problem page which shows the problem statement. It also shows the input format, output format and some text cases. User can write the code in the real time code editor. User can perform remote code execution in 5 different languages (C++, Java, Python, Javascript and GO). User provides input from the input box and then click the run code button and then can check the output in output box below.

3.4 Settings page

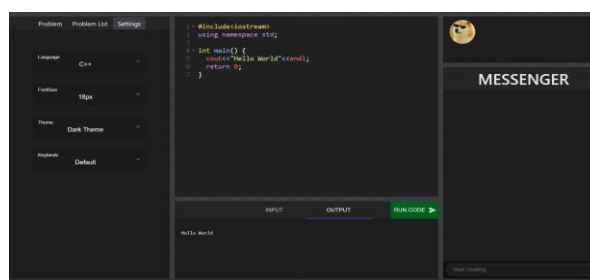


Fig. 4 Settings page show the expansion bars. First expansion allows user to select the language. Second expansion bar allows user to change font. Third expansion bar allows user to change the theme of the code editor. Fourth expansion bar shows the key binds which default initially.

IV. LITERATURE REVIEW

4.1 A survey of MERN Stack Technology

This section conducts an examination of MERN Stack Technology, exploring the foundational elements of MongoDB, ExpressJS, ReactJS, and NodeJS. The focus is on utilizing MERN Stack technology to develop a web operation for product stores and a payment gateway. The composition includes sign-up and subscription pages, dashboards, and product displays, along with admin features for store management, statistics, and reports. Additionally, the objective is to create an online product search website where boardwalk groceries and stores can directly post and manage their products. The website architecture and branding will include a link to the store's own website if available, allowing visitors to quickly search for essential items from nearby stores and communicate with store owners about their desired items based on search results.

A. NODE JS

Node.js is an open source, a computer system, and a place for waiters. With the help of NodeJS, a standalone development environment built on Chrome's JavaScript, we can create swift and fluid network operations. JavaScript machine from Google to carry out the law. Additionally, a significant portion of necessary modules are written in JavaScript 6Node.

B. EXPRESS JS

A framework placed over Node.js that offers advanced features for web and mobile development. It provides crucial support for HTTP and ensures a dependable and straightforward API without compromising Node.js's speed.

C. POSTGRESQL

The relational database management system (RDBMS) PostgreSQL (Postgres), also referred to as Postgres, places a strong emphasis on extensibility and SQL compliance. It was originally given the name POSTGRES in honor of its development as a replacement for the Ingres database created at the University of California, Berkeley. In order to better reflect its support for SQL, the design was given the new name PostgreSQL in 1996. The development platoon chose to keep the names PostgreSQL and Postgres after considering them in 2007.

A few of PostgreSQL's features include triggers, foreign keys, materialized views, thickness, insulation, continuity (ACID) parcels, and stored procedures. It is built to manage a variety of workloads, including those from single machines to data storage systems or Web services that have many concurrent users. There are versions of it for Linux, FreeBSD, OpenBSD, Windows, and it was the dereliction database for Mac OS X Garçon.

D. COMPONENTS

Component React is built around components. A component can be created by creating Class function of the React object, the starting point of accessing this library. ReactJS creates HTML tags unlike we normally write but uses Component to wrap HTML tags into objects to render. Among React Components, render function is the most important It is a function that handles the generation of HTML tags as well as a demonstration of the ability to process via Virtual-DOM.

E. SOCKET.IO

A library for real-time web operations that facilitates bidirectional communication between web users and servers, available for both Node.js and the client-side library.

F. JDoodle

JDoodle Compiler API is a REST and WebSocket API service. It supports Java, C/C++, PHP, Perl, Python, Ruby and 70+ other languages.

G. CONVERGENCE LABS

Convergence Labs was founded in 2017 as the business entity supporting Convergence, an engine for building real-time collaboration features and functionality. We rewrote from scratch software that we had embedded in other production applications offering real-time collaboration features, and hoped it could be useful to a broader audience. Over time we experimented with a few different business models, from a full-fledged Infrastructure-as-a-Service



offering to an open-core paid support model.

4.2 An examination of WebSocket Development techniques and technologies

By T. Wirasingha, N.R. Dissanayake

Since it allows for full-duplex, bidirectional communication between the customer and the server over a single connection, the WebSocket protocol has emerged as a reliable technology in software assiduity for the development of real-time web operations. When it comes to fabrics and libraries for WebSocket-based development, there are many generalizations, approaches, and technologies that are similar. It is difficult to gather the knowledge required for a particular development terrain because there is a lack of focus on these generalities, ways, and technologies. In this essay, we analyze the literature and discuss the generalizations, strategies, and technological options available for WebSocket-based development. The information presented in this paper can be used to shorten knowledge search times for engineering of WebSocket grounded operations, and it can assist inventors in quickly locating the necessary for WebSocket implementation. The information in this paper will be put to use in our ongoing research as we design and create a WebSocket garçon-tool that will aid in rapid-fire development.

4.3 Online peer-to-peer (P2P) advancing current status, developments, and future directions are reviewed in the literature

By Yolli Eka Putri, Sudarso Kaderi Wiryono, Yunieta Anny Nainggolan

Online peer-to-peer lending has been marketed as a way for people who don't have bank accounts to still be eligible for loans. Peer-to-peer (P2P) lending platforms have grown in number, but in the vast majority of cases, controllers have granted licenses without imposing strict restrictions on the kinds of online fiscal institutions that may be registered in accordance with P2P lending regulations. There is currently no literature review article published in peer-reviewed journals that specifically examines online P2P lending. The 141 publications in P2P lending are divided into seven themes and 25 subthemes in this investigation using bibliometric analysis, content analysis, word frequency, and keyword trend analysis. The unexplored topics are default prognostications, transaction process, regulation, and regulation.

V. CRITICAL OBJECTIVES

Expanding sharing, lowering time taken to edit and sharing code via email, and managing access to the codes, collaborative programming incorporated with chatting. Influencing learning experiences for students. Make a useful collaborative tool that allows sharing and editing in a more simple and flexible way as compared to traditional communication methods. Making a chat box to provide additional ways to communicate and collaborate in real time. Also saving the changes of all the user instances editing the document using Cloud. Import problems via url from AtCoders and codechef.

VI. CONCLUSION

In this article we have approached collaborative programming. We firstly presented CODIRTC, a synchronous distributed collaborative system we developed for supporting programming tasks (edit, compile and run).

CODIRTC has been put to the test in teaching-learning and industry settings through some studies. Some of the specific tools incorporated or some design decisions have not provided the expected benefits. This project is build on a technology stack called MERN stack which works as the backend and frontend of the projects, socket.io for real time editing of the documents and WebRTC which facilitates the chatting , saving of the documents using cloud and managing access of the documents.

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