Liquid Democracy for Rating Systems

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Abstract

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A project to enhance rating systems with liquid democracy features, focusing on implementing and analyzing various delegation mechanisms within the Vodle decision making system.

Contents

Chapter 1

Introduction

1.1 Vodle

Vodle is an online platform where users participate in polls to vote on subjects through user created polls. Each poll contains a set of options, and users provide ratings for each option from 0 to 100, where a larger number means that they prefer the option more, using a slider (below). When the poll ends, the ratings submitted by voters are then aggregated and a result is calculated.

INSERT IMAGE OF SLIDERS

1.2 Liquid Democracy

Liquid democracy is a decision-making system that combines elements of both direct and representative democracy that offers a voter more flexibility than traditional voting models.

In direct democracy, every participant votes individually on each issue. This model offers the most individual input but can become impractical for large-scale decision-making due to the high level of participation required from each individual. As Ford (2002) states, direct democracy assumes that all individuals are both willing and able to engage meaningfully with every decision, which is often not the case in large groups due to the variance in both the interest and knowledge of voters. The cognitive demand of staying informed on all matters, combined with the time commitment necessary for constant participation, makes direct democracy unmanageable at scale.

In a representative democracy, citizens elect officials to deliberate and decide on legislation and policies on their behalf. While this system is more scalable than direct democracy, it introduces certain limitations:

Liquid democracy addresses these limitations by allowing voters to either cast their votes directly or delegate them to someone that they trust or to abstain from voting entirely (Blum and Zuber, 2016). **Talk about lowering bar for participation**These delegations can be updated or revoked at any time, giving users control over how their vote is used. Delegations are also transitive, meaning a vote can be passed through multiple levels of trusted participants. For example, if Alice delegates to Bob who in turn delegates to Charlie, Charlie's vote would then represent three individuals (Alice, Bob and Charlie).

1.3 Motivation

need to add

1.4 Project Goal

The project's main goal is to integrate liquid democracy into the vodle platform.

Key features include ranked delegation and weighted voting ...

1.5 Project Outline

This report is structured to clearly illustrate the project's progression and outcomes:

Chapter 2 presents background research, including existing variations of liquid democracy, real-world implementations, and relevant aspects of vodle's design and system architecture.

Chapter 3 defines the system specifications and outlines the project's objectives in detail.

Chapter 4 discusses the methodology used, including the iterative approach, planning, and risk assessment strategies.

Chapter 5 describes the design and implementation process of integrating liquid democracy into vodle.

Chapter 6 evaluates the implemented system through unit testing, user feedback, and commentary from the project customer.

Chapter 7 covers project management aspects such as legal and ethical considerations, a reflection on risk management, and personal reflections on the

development process.

Chapter 8 concludes the report and discusses potential directions for future work.

Chapter 2

Research

This chapter provides background context for the development of a liquid democracy system within Vodle. It builds on the concepts introduced earlier, focusing on more detailed research into known limitations of liquid democracy and potential solutions proposed in academic literature. Additionally, the technical foundations and design philosophy of Vodle as a platform are explored.

Throughout this chapter, several diagrams are used to illustrate how votes move through a liquid democracy system. To clarify the roles of different voters, the following symbols are used:

- **Circles** indicate voters who delegate their vote to someone else.
- **Squares** represent voters who cast their own vote and do not delegate.
- **Triangles** show voters who abstain - neither voting directly nor delegating to others.

2.1 Liquid Democracy

Liquid democracy, or delegative voting, allows voters to either cast a vote directly, delegate it to someone they trust, or abstain (Blum and Zuber, 2016). A key feature is that delegations are transitive - a chain of users that all delegate to each other sequentially ends with a single final voter who casts their vote on behalf of all those in the chain.

Whilst the transitivity property enables concentration of voting power with trusted individuals, it can also lead to unintended consequences. Chains of delegations may result in cycles that prevent votes from being cast, or allow certain individuals to accumulate an excessive share of influence, creating so-called super-voters. These problems amongst others motivate the need for alternative delegation mechanisms, as discussed in the following subsections.

2.1.1 Issues with Liquid Democracy

Delegation cycles

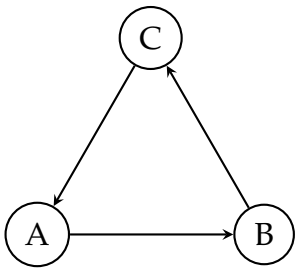

Figure 2.1: Delegation cycle: A delegates to B, B to C, and C back to A.

Delegation cycles occur when a vote is delegated in such a way that it ends

up forming a loop (Brill et al., 2022), preventing the vote from reaching a final, resolvable destination. For example, if Alice delegates her vote to Bob, Bob delegates to Charlie, and Charlie delegates back to Alice, the votes become trapped in a cycle (seen above) and can be treated as a loss of representation (Christoff and Grossi, 2017).

This issue is particularly problematic because it can nullify votes without the affected users ever realising. In systems where cycles are not explicitly detected and handled, these votes are discarded silently, potentially changing the final outcome of the votes.

Delegation cycles are increasingly likely to emerge in dynamic voting systems, where delegations can be added, removed, or modified at any point in time. Delegations that initially did not form part of a cycle may later contribute to one as other voters add a new delegation or alter an existing one.

Paragraph on how size of the system affects the possibility of cycles?

Abstentions

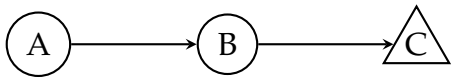

Figure 2.2: Delegation chain ending in abstention: A delegates to B, B to C. C abstains, causing the votes of A and B to be lost.

In liquid democracy, abstention is where a voter neither casts a vote nor delegates their vote to another user (Brill et al., 2022). This includes both deliberate abstention, where a voter knowingly chooses not to participate, and passive abstention, where a voter may be unaware of an ongoing poll or are unable to

engage with it.

Abstentions are especially impactful when they occur at the end of a larger delegation chain, as all votes passed along the chain to that voter are effectively lost (Brill et al., 2022). The voters whose decisions were passed along the chain may also be unaware that their votes have been nullified, worsening the effect of the abstention.

Super-voters

In liquid democracy, a super-voter is an individual who receives a large number of delegated votes, therefore gaining disproportionate influence over decisions (Kling et al., 2015). While this behaviour may reflect voters' genuine preferences, it can lead to a concentration of power that goes against the intended egalitarianism and democratic ideals of liquid democracy.

Although liquid democracy allows users to alter their delegation at any time, in practice, many voters may not actively monitor or even know how their vote is being used. This can allow a small number of super-voters to dominate outcomes, especially in systems with large delegation chains.

Real-world examples of this phenomenon have been documented. In the German Pirate Party's use of LiquidFeedback, certain users received so many delegations that their votes were like "decrees" (Sven Becker, 2012; Kling et al., 2015) even though they were not elected officials. Kling et al. (2015) noted that the super-voters generally voted in line with the majority, therefore not drastically affecting the outcome of the votes and contributed to the stability of the system. However, the potential for individuals to single-handedly influence

the results remained a concern.

This pattern is not limited to traditional online voting platforms. It can also be seen within decentralised autonomous organisations (DAOs) - blockchain-based entities where decisions are made collectively by token holders without central leadership. These organisations use token-based voting to decide on critical issues like protocol upgrades and funding allocations. Hall and Miyazaki (2024) studied 18 decentralised autonomous organisations (DAOs) and found that voting power was often concentrated in the hands of a few delegates. While most did not control a large share of all available tokens, low participation meant that their share of actual votes cast was disproportionately high. In several DAOs, the top five delegates accounted for over 50% of all votes cast, and in the DAO Gitcoin, this figure exceeded 90%.

2.1.2 Variations of Liquid Democracy

Ranked delegation

Allows voters to specify fall-back delegates in order of preference (Brill et al., 2022).

Include different algorithms from Brill paper

Weighted/ vote splitting

Voting power is distributed across multiple delegates to reduce reliance on any single individual (Gölz et al. (2021)).

Backup votes - kinda unneeded

Voters may provide a direct vote to use in case delegation fails.

2.2 Implementations of Liquid Democracy

2.2.1 LiquidFeedback

2.2.2 Google Votes

2.3 vodle

Vodle is a web-based platform for participatory group decision-making. Users participate in polls that allow them to rate a set of options using sliders. When the poll ends, these ratings are aggregated and the MaxParC rating system is used to determine the final result of the poll.

2.3.1 MaxParC

Understanding MaxParC is important for this project because it forms the core of how vodle interprets group preferences. Since this work involves modifying vodle's voting behaviour through the integration of liquid democracy, it is essential to understand how MaxParC processes input ratings. In particular, understanding how changes in individual ratings influence the final outcome of a poll helps to frame the implications of delegating or reweighting votes.

Maximum Partial Consensus (MaxParC), the rating system used by vodle, was introduced by Heitzig et al. (2024). It is a decision-making method designed to address the limitations of traditional voting systems, in particular the potential for majority rule to suppress minority viewpoints. The primary objective of MaxParC is to achieve a balance between fairness, consensus, and efficiency in group decision-making.

Each voter rates an option from 0 to 100 (x), representing their willingness to approve that option if and only if $< x\%$ of users do not approve that option. Therefore, a rating of 0 means "do no approve no matter what" and a rating of 100 means "approve no matter what" or "always approve".

2.3.2 Architecture

Technologies Used

2.3.3 Design Philosophy

2.4 Summary

Chapter 3

Design

In this chapter, we describe the overall design of our solution to the problem identified in Chapter 1, building on work described in Chapter 2.

Chapter 4

Implementation

In this chapter, we describe the implementation of the design we described in Chapter 3. You should **not** describe every line of code in your implementation. Instead, you should focus on the interesting aspects of the implementation: that is, the most challenging parts that would not be obvious to an average Computer Scientist. Include diagrams, short code snippets, etc. for illustration.

Chapter 5

Evaluation

Describe the approaches you have used to evaluate that the solution you have designed in Chapter 3 and executed in Chapter 4 actually solves the problem identified in Chapter 1.

While you can discuss unit testing etc. you have carried here a little bit, that is the minimum. You should present data here and discuss that. This might include *e.g.* performance data you have obtained from benchmarks, survey results, or application telemetry / analytics. Tables and graphs displaying this data are good.

Chapter 6

Conclusions

The project is a success. Summarise what you have done and accomplished.

6.1 Future work

Suggest what projects might follow up on this. The suggestions here should **not** be small improvements to what you have done, but more substantial work that can now be done thanks to the work you have done or research questions that have resulted from your work.

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