Mixed initiative argument in public deliberation

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Abstract. This paper aims to demonstrate the connection between argument structures, such as those that are created and manipulated by argument mapping tools, and argumentative dialogues, such as those that form a part of online deliberative processes. Our approach is to use recent advances in argument-based knowledge representation, and to tie these to tools we have developed that support argument mapping activities (specifically, the OVA analysis tool), and argument dialogue (specifically, the Arvina dialogue system, which is built on top of Google Wave). We use as our domain a recent contentious debate in Scottish politics which involved both wide-scale deliberative aspects and politically complex decision making. By explicitly representing argument structure we demonstrate how online debate tools can support *mixed initiative argument*, in which there is a level playing field between the points of view espoused autonomously by software, and those put forward by human participants.

1 Introduction

The purpose of the paper is to demonstrate that two processes, both common in deliberative domains online, can be supported within a single representational framework. On the one hand, arguments online are created, viewed, presented and analysed using systems such as the diagrammatic, highly analytical approach of argument diagramming tools such as Araucaria [14] and Rationale [20]; the discussion facilitation tools such as Compendium [18]; and the semantic sense-making tools such as Cohere [3] and Debategraph[1]. All these systems have more or less explicit conceptions of arguments and their components which facilitate visualisation, manipulation and transformation by machine. In contrast, arguments are also conducted, engaged in and held online. Tools here are much more thin on the ground, and are typically not designed specifically to support argument and debate, but rather to support communication in general, and are often set against a backdrop of explicitly social environments such as Facebook[2] or Twitter[3]. The distinction between these two senses of argument is well known in philosophy [2], and each has generated entire academic industries in Artificial Intelligence (see, for example, the work of Dung [5] and its many adherents for models of the first sense of argument, and, in comparison, see many of the papers appearing at the ArgMAS workshop series [11] for models of the second sense). Little work has been done, however, in trying to connect computational models of the two senses together. Argument in the sense of debate is crucial for deliberation because it is required to execute and control (at least parts of) the deliberative process. Argument in the sense of structured data is also required for deliberation to allow justifications to be recorded and new information to be introduced. So, to build operational models of deliberation, a formal and engineered connection between the two approaches is inescapable.

[1] http://debategraph.org/
[2] http://www.facebook.com
[3] http://www.twitter.com

We have shown previously that such a connection is possible in principle, and have developed a prototype to support that claim [15]. More recently, we have worked with a maturing standard for argument representation, the Argument Interchange Format or AIF [4] to show in theory how it might be extended to support a generalised and robust connection between the two senses of argument [16]. The advance here is to demonstrate how that AIF-based theory can be put into practice with fluid interchange between the two processes enabled by the underlying formal representation. The two systems described here, OVA and Arvina, represent the first example of AIF-based connection of argument-as-debates with the argument-structures they use and create, and the systems aim to serve both as a demonstration of the theoretical robustness of the approach and the practical utility of such tools. Arvina further demonstrates concretely the way in which mixed initiative argument can be supported, allowing stored arguments in the argument-structures sense to be introduced by software agents into new, dynamic arguments-as-debates which also involve human participants.

2 Argument Interchange

2.1 A brief summary of the AIF

The Argument Interchange Format [4] provides a high-level specification for the concepts and their interrelations needed for representing arguments and exchaning those representations between a diverse set of tools in the argumentation technology space. The AIF's *Upper ontology* provides a graph theoretic approach to argument structure which distinguishes units of *information* (loosely, propositions or claims) from *applications of inference*, *conflict* and *preference* that link them. The general forms of inference, conflict and preference are described by *schemes* in a second part of the AIF, the *Forms ontology*.

Reifications of AIF that provide a concrete specification exist in a number of different ontological and representational frameworks including RDF [13], OWL-DL [12] and others.

2.2 Extension to the AIF

Reed et al. [16] propose a model in which moves in dialogues can govern and refer to argumentation structures. The approach is ontologically parsimonious in that it attempts to minimise the amount of new machinery required in the AIF whilst not unreasonably burdening what is already there. The assumption that underlies the approach is that there are strong commonalities between the two senses of argument.

The ontological extensions to the AIF are broadly in three areas. First, the concept of information is refined to distinguish a specific sub-type: locutionary information, or simply, *locutions*. These correspond to speech acts (or, more precisely, propositional reports of speech acts). These locutions may be verbal or written, direct or indirect. The proposition *The minister said that the upgrade would unlock Scotland's renewable energy potential* is clearly a report of a locution, but it can also function as propositional information simpliciter (for example, as a premise supporting an argument that ministers sometimes make public statements).

Second, locutions are connected to their propositional content. In our example, there would be a connection from the locution to the information that, *The upgrade would*

unlock Scotland's renewable energy potential. The connection here is captured by a new scheme type. The approach borrows heavily from Speech Act Theory [17] in that the link between a locution and its propositional content is the illocutionary force, which is handled in the AIF extension as an *illocutionary scheme*.

Finally, locutions are themselves interconnected by further schemes. Whereas the inferential connection between general pieces of information is captured by applications of rules of inference, connections that hold between locutions hold in virtue of permitted dialogical transitions, licensed by the dialogue protocol. The schematic nature of the different types of dialogue transition is similar to the schematic nature of the different types of inferential step – the difference is that where schemes of inference are brought together into theories associated with specific authors (see, for example, the argumentation schemes of [22] or [10]), schemes of dialogical transition are brought together as a dialogue protocol (see, for example, RPD [21] or DC [7]). The application of fragments of dialogue protocol in the transition between locutions is captured by *transitional inference* scheme applications.

The AIF underpins, or provides a backdrop to, a number of tools being developed under the umbrella of argumentation technology both because it provides a convenient way of representing resources, and also because it offers the potential for exchanging data resources between different tools and projects. Both OVA and Arvina, introduced below, rely on the AIF, and Arvina further relies on the dialogic extensions to the AIF.

3 Domain Background

The Beauly to Denny power line is a proposed 137-mile long power transmission line [8] through north-central Scotland, which was given planning consent in early January 2010 [9]. The issue was contentious and emotive, both politically and environmentally, because the line runs through areas of outstanding natural beauty including the Cairngorms National Park – but it is seen as an essential part of the country's infrastructure requirement for expansion in renewable power generation.

This provides a good example of public deliberation on an important, contentious and complex topic. A public consultation was held, with submissions invited from local authorities, conservation groups and energy supply companies. There then followed a public inquiry, in which evidence for and against the proposal was heard by a panel, in front of an audience.

In addition to the official process, views on the project were expressed through the media by the various parties involved, including Government ministers, environmental groups and spokespersons for the energy companies.

4 OVA

OVA (Online Visualisation of Argument)[4] is a tool for analysing and mapping arguments online. It is similar in principle to other argument analysis tools, including Araucaria [14] and Rationale [20], but is different in that it is an online application, accessible from a web browser. This web-based access has allowed for built-in support for direct analysis of web pages, while also maintaining the ability to analyse standard text files.

[4] `http://ova.computing.dundee.ac.uk`

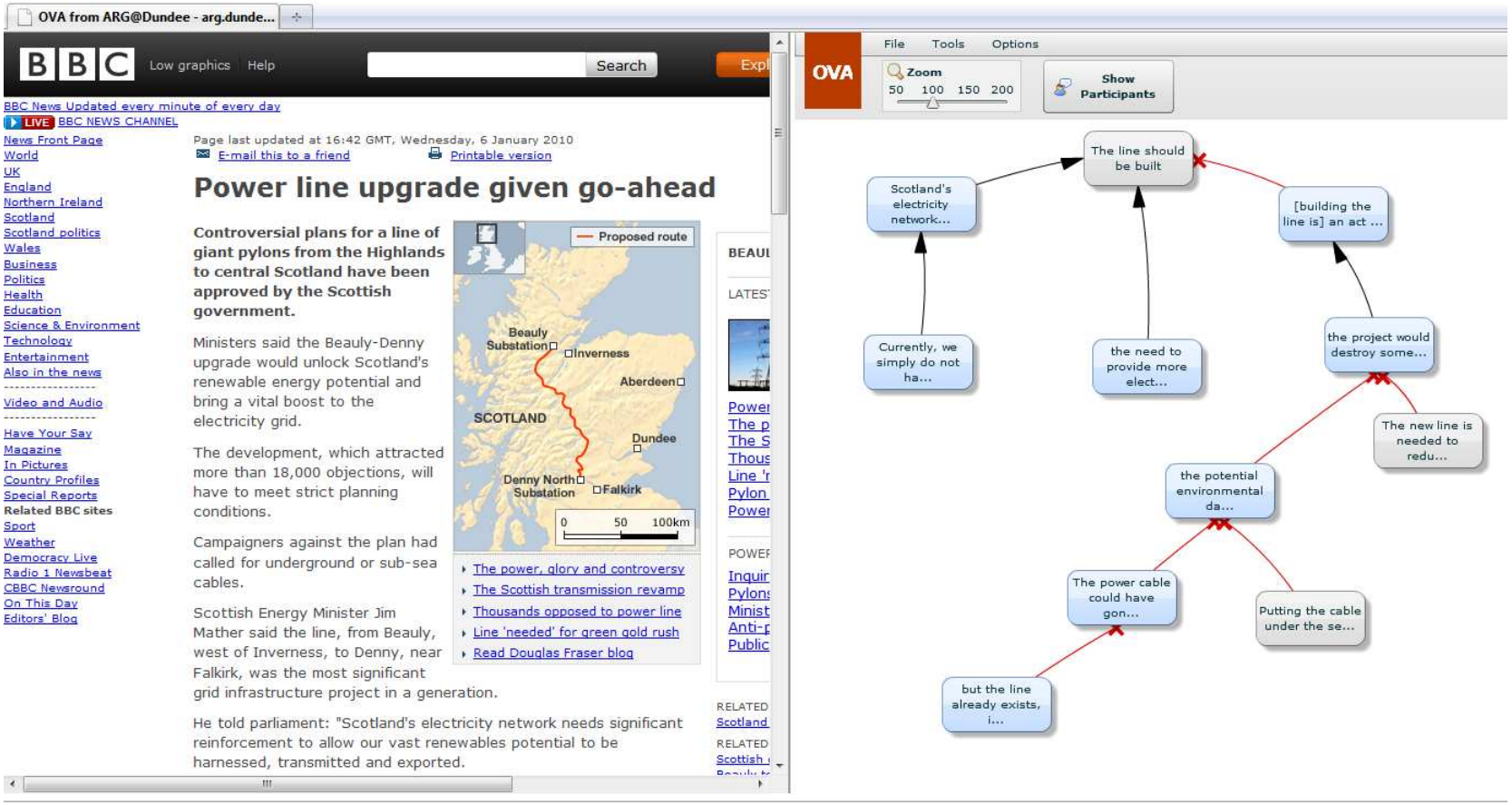

Fig. 1. OVA user interface

4.1 Analysis

A web page is analysed by providing its URL. The page is rendered alongside the main OVA interface, where text can be highlighted and extracted for analysis [Fig. 1].

The main components of the interface are:

- Analysis canvas - the large, white area on the right-hand side
- Web page display - on the left-hand side
- Toolbar - providing tools to manipulate and save the analysis

An analysis is carried out by highlighting text on the web page, then clicking the analysis canvas; this extracts the text into a premise (represented in OVA as a node), which can be used to either support or attack other premises (or indeed, be supported or attacked itself).

Analyses are graph-based, so that cycles and divergent argumentation (in which a single premise supports multiple conclusions) are both allowed.

Missing premises (or enthymemes) can also be added into the analysis, allowing introduction of information that isn't explicit in the text being analysed.

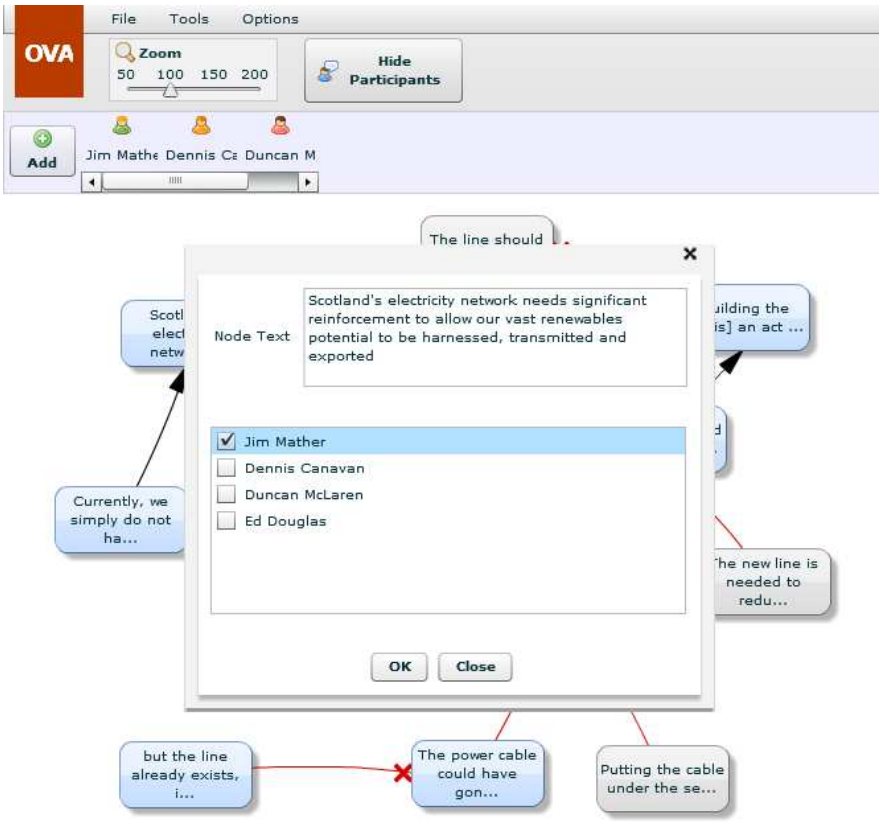

Fig. 2. Premise properties in OVA showing participants

4.2 Participants

Once an analysis has been carried out, participants can be added. The participants represent the real people who promoted (or uttered) the premises used in the analysis.

Participants are added by clicking the "Show Participants" button, then clicking "Add". Premises can then be assigned to participants by viewing the properties of the node that represents it [Fig. 2].

Assignment of participants plays a key role in exporting an analysis to Arvina. By assigning a participant to a premise, that premise becomse part of the knowledge base of the agent that represents them, which in turn allows that agent to express opinions.

4.3 Interchange

Once an analysis is complete, the resultant diagram can be exported as a JPEG image or an SVG description, which is convenient for presentation, but of little use from a data manipulation point of view.

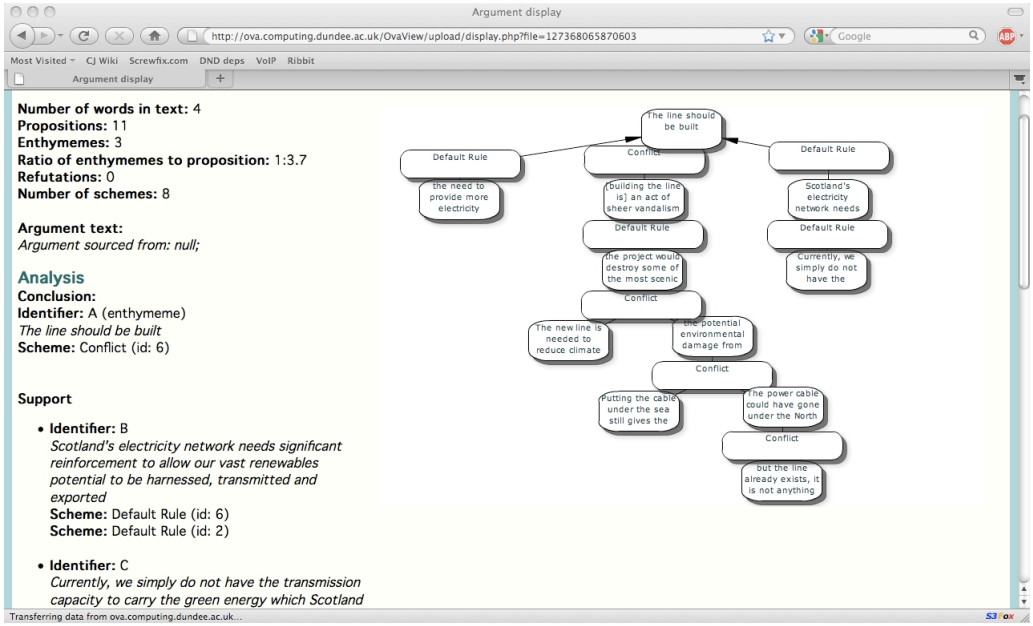

Fig. 3. The web interface to ArgDB, with text processing and OVAview graph

OVA saves its analyses to AIF, either to a local file, or to an AIF repository such as *ArgDB*.[5] AIF files can then be processed in a number of ways: ArgDF allows navigation (and expansion) of argument structure through a web interface [13]; ArgDB has components that provide textual summaries of arguments (based on XML transformations) and simple visualisations (based on a graph layout widget that is available to reuse as a component known as OVAview) – these two components are shown in the screenshot of the web interface to ArgDB [Fig. 3]; OVAgen supports automated computation of defeat status according to a number of different argument semantics [5] and also provides

[5] *ArgDB* is an online corpus of argumentation, hosted at the University of Dundee and is available at `http://argdb.computing.dundee.ac.uk`

access to ArgKit [19] which provides further computation services; and finally, the AIF representations in ArgDB are also used by Arvina for providing a dialogic interface to argument resources.

5 Arvina

5.1 Google Wave

In 2009, Google made available a new platform by limited invitation. Google described this new web based communication service, *Wave*, as an "online tool for real-time communication and collaboration" [6]. Designed to merge e-mail, instant messaging, social networking and wiki technology, Wave offers a large number of possible uses augmented by extensions that can provide, for example, spell checking, automated translation among 40 languages, and numerous other applications.

Wave includes a rich API that allows developers to use and build on the platform by way of extensions and gadgets, applications users can participate with, and robots, automated participants within a wave.

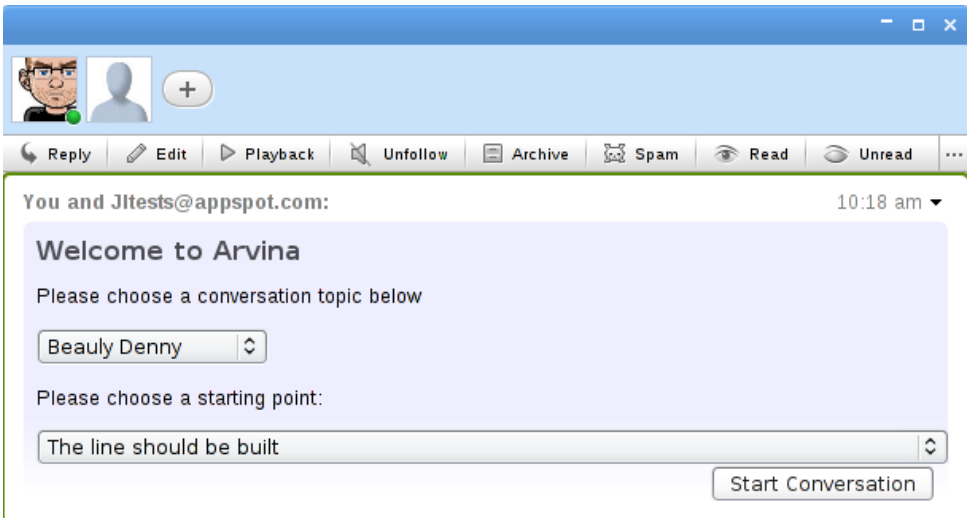

Fig. 4. Starting a dialogue

5.2 Using Google Wave for argument

Arvina is a Wave application which builds upon the Google API to offer a rich dialogic interface to argument resources. Arvina's basic dialogue protocol is similar in scope to that offered by Magtalo [15], however using the Wave platform as a base allows a greater interaction between large groups of both virtual and real life participants.

An *Arvina Wave* is created by adding the Arvina robot to any existing Wave. Upon addition the Arvina robot will insert a gadget into the Wave allowing the user to choose a topic from any previously analysed AIF resources [Fig. 4]. Once selected, the AIF resource is examined to determine the participants involved in the dialogue represented and a new robot is added to the wave representing each of these participants [Fig. 5].

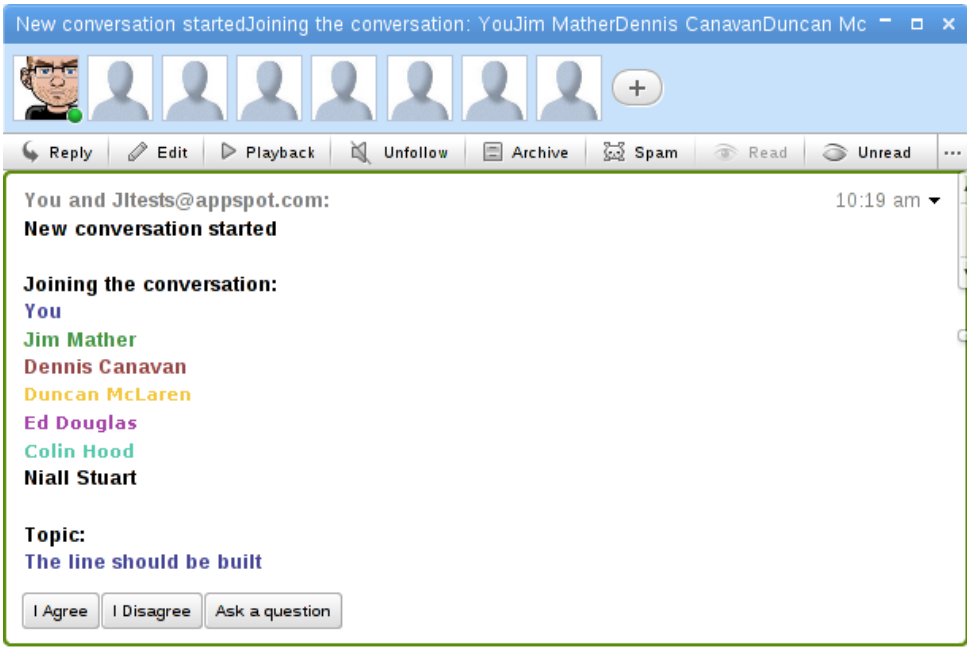

Fig. 5. Automatically added robots reflect the participants from the AIF resource

In the example of the The Beauly to Denny power line, the original OVA analyses (and their subsequent representation in the ArgDB backend to which Arvina connects) involve the indication of points of view of six participants:

- Dennis Canavan – president of Ramblers Association Scotland
- Ed Douglas – traveller and writer, writing for The Guardian
- Colin Hood – chief operating officer of Scottish and Southern Energy
- Duncan McLaren – Friends of the Earth Scotland
- Jim Mather – Scottish Minister for Enterprise, Energy and Tourism
- Niall Stuart – chief executive of Scottish Renewables

Following topic selection, the user must choose a starting point (an AIF information node from which the dialogue can progress) and having done so is then given two options for each statement, to either ask a question and get the opinion of the artificially represented participants, or to offer their own view by either agreeing or disagreeing with the point being made.

Each time a new point is put forward by either a human or a software participant, the wave is updated to show the new point, and to provide controls for interacting with that new point – i.e., to allow the user to challenge it, support it, or ask for views on it from other participants.

Google Wave encourages an interaction model which is mostly linear, but is also structured. So whilst many use case examples of Wave have a conversational style in which new material is added on at the end, there are also several which rely more on a structural model (rather like the threading model of bulletin boards) or a collaborative working model (rather like working on a Google Docs document simultaneously with other co-authors). These features are preserved in Arvina waves. So, a user can either follow a traditional conversational model and interact, for the most part, with the most

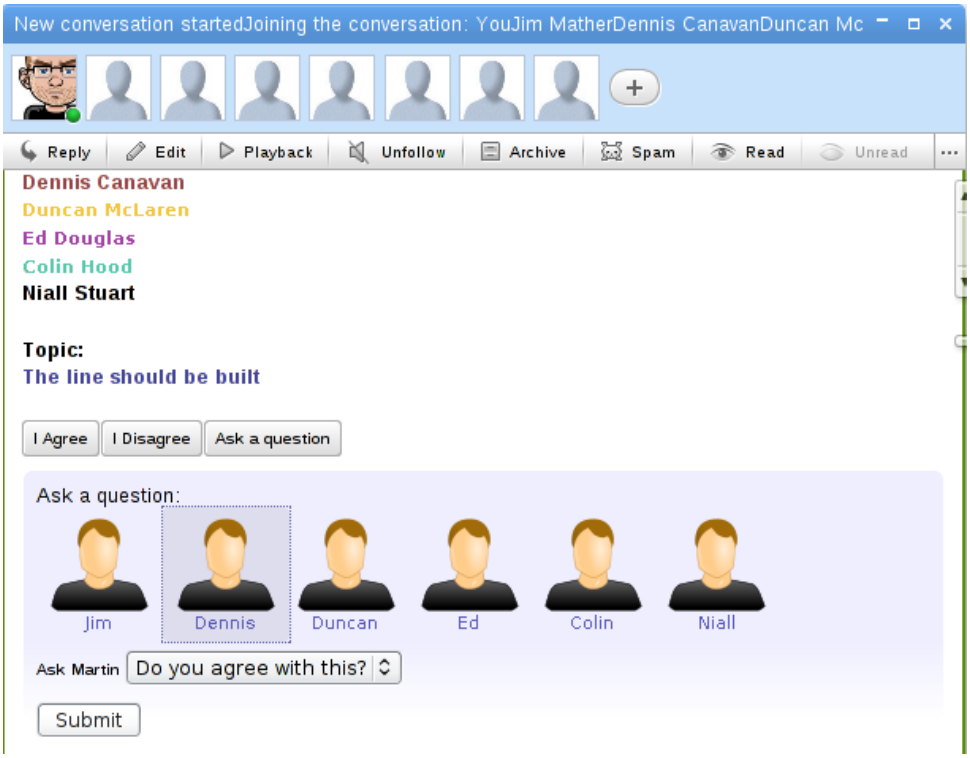

Fig. 6. Asking a question of a virtual participant

recent contribution to the wave; or alternatively, they can dot around, returning to earlier points in the dialogue, or skimming forward to later ones, demanding (perhaps additional) supports or points of view, or adding in further supports and counters of their own, thus exploiting the argumentative structure of the data directly.

Another feature of Wave is also supported explicitly by Arvina waves: the history mechanism. Google shows examples of tracking changes to collaborative documents by moving a slider along from left to right to replay how a document has evolved. In the context of Arvina, the history of a debate can similarly be replayed, showing the blow by blow updates that participants (both human and artificial) have made.

5.3 Mixed Initiative Argumentation Dialogues

Arvina allows for an open mix of both artificially represented participants using knowledge assigned in an AIF resource and real life participants. Any real life participant may ask questions of the artificially represented participants in the form of either "Do you agree with this?", or, "Why is that the case?" [Fig. 6] and so uncover, in a natural way, the participants' views. This method allows a user to direct the course of the conversation and as such, rather than just being presented with a list of claims, they can instead concentrate on the areas which interest them most.

With the first of these questions, "Do you agree with this?", it is possible to discover a participant's position on any point, either agreement or disagreement. When stating whether or not they agree a participant robot will also offer a supporting reason if they have one available. Further supporting reasons can be discovered by the second question,

"Why is that the case?", which will cause the robot to offer a reason if all the reasons they have for that point have not already been expressed.

This same interface can be used to pose questions to real life users, which they can then enter their own answers for. This mechanism allows a full and seamless conversation to take place between real time users and those being represented virtually. In this way even a very simple dialogue protocol provides an interface that exploits a naturalistic style of interaction to provide and intuitive user-driven navigation of a complex interconnected web of arguments.

5.4 Eliciting Further Knowledge

A key feature of Arvina is the ability for participants to engage in a discussion rather than just an interrogation. This is achieved by allowing a user at any stage in the discussion to state their own agreement or disagreement with a particular point and to provide supporting reasons for their view [Fig. 7].

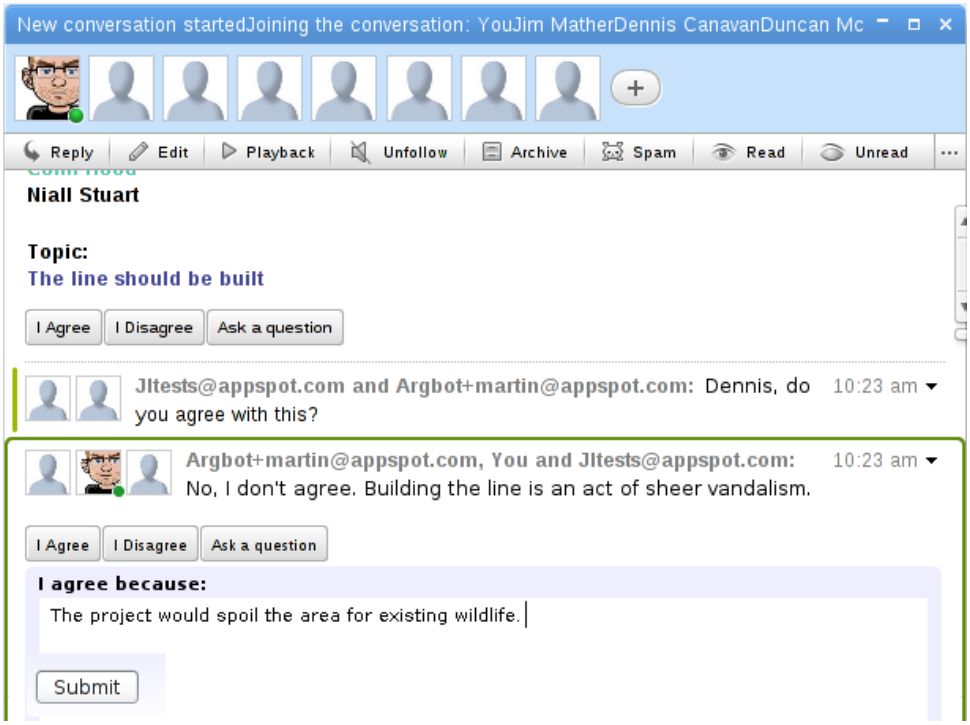

Fig. 7. Building the knowledge base

This interaction is not limited to the original Wave creator and indeed any number of participants can offer their own opinions and comment on each others views. Although this ability is available by default as a part of Wave, by providing a lightweight structure for these interactions, Arvina is able to harvest these opinions, inserting them into the AIF resource with which it is working and offering them for interaction at a later date. In this way it is possible to build as well as query the knowledge base, growing a resource that can then be used in later conversations as well as any other software which is compatible with AIF. This opens up the exciting possibility of using tools such as Arvina for conducting

public consultation processes and immediately integrating the responses into the overall network of arguments.

6 Conclusions

Our goal here has been to show how the newly emerging AIF standard can support flexible interchange between two predominant styles of interacting using argumentation in deliberative domains. Tools such as OVA focus on the argument-mapping or issue-based exploration of a deliberation space that concentrates on the inferential structure of the arguments, whilst its debate-oriented counterpart, Arvina, focuses on the process of dialogue and the execution of argumentative deliberation protocol as a structuring metaphor.

One strong example of this flexibile interchange is in the way in which structured information can be extracted from the dialogic interface through a lightweight constaint on normal linguistic behaviour imposed by the protocol.

Much remains to be done. The protocols that Arvina executes need to be expanded and refined (a good example of this in the deliberation space is the protocol employed by PARMENIDES [1]). The AIF itself needs to be revised and updated to ensure that the dialogical extensions discussed here remain consistent across its constituency. And finally, the argumentative components in both debate and knowledge structure need to be integrated with other parts of the public deliberative process, such as inquiry and decision making. But what these tools clearly demonstrate is that the formally describable processes of deliberation can be effectively and precisely linked to the formally describable structures of knowledge around which deliberation turns. This link is a vital precursor to large-scale deployment of argumentation technologies in this domain.

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