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## WATTLE TREE: WHAT'LL IT TELL US? TECHNICAL REPORT 582

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# Wattle Tree: What'll it tell us?

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**Abstract**

In this paper we describe three visualisations we have created to support teams of students learning about eXtreme programming, and various communication and software technologies, in the context of completing a classic capstone group software project. One displays the users' level of activity, the second their level of interaction and the third, our innovative Wattle Tree, displays a timeline of events for each user. We report on how they were used by students and the teaching team in assessing group work processes.

**Keywords**

Collaborative learning, student reflection.

**ACM Classification Keywords**

H.5.3 Group and Organization Interfaces

**Introduction**

In this paper we describe three visualisations that we designed to support self-managed learning groups. Groups communicate and interact across a variety of media, such as chat, wiki and so on. Our approach is to (1) support group reflection and awareness and (2) improve teachers' awareness of group processes through visualization of many activities and interaction patterns. We have designed three visualisations (the Activity Radar, the Interaction Network and the Wattle Tree), most strongly inspired from existing work (Donath 2002; Erickson 2004). We used these with teams of students learning about eXtreme

programming and various communication and software technologies, in the context of completing a classic capstone group software project at the University of Sydney in 2005.

Students formed groups and worked for 13 weeks. They had to define their role within the group and normally maintained it for the duration of the project. They were required to submit reports and give demonstrations throughout the semester, and received marks for these. They were given access to a range of online project management tools, which we refer to as media for the remaining of the paper. In particular they were required to use the following and were told that their activity in these media would be used as the evidence for their assessment:

*Trac Tickets*: assignment of tasks to contribute towards project milestones.

*Trac Wiki*: sharing of documentation and resources.

*Subversion*: version control and distribution of code between members.

At the end of the semester we provided students with seven visualisations of their group: one Activity Radar and one Interaction Network for each medium, and one Wattle Tree. Students were free to use them or not in their final report. Teachers and tutors also used them as indicators for investigating a group's activity in their marking process.

The next section will describe these three different visualisations. We will then describe how students and teachers used these visualisations and report their feedback was on how useful they were. We then conclude the paper.

## Visualisations

We now describe the three visualisations we designed to reflect group work processes: the Activity Radar, the Interaction Network, and the Wattle Tree.

### *Activity Radar*

This representation (shown in Figures 1, 2 and 3) consists of a circle, representing the range of activity, with colored dots, each representing an entity whose we want compare activity performances: often a dot is a team member but it could also be a classroom or a group. Each dot is placed on a radius (always on the same one) and moves to the centre as the member's level of activity increases: a person whose dot is right in the centre has the highest level of activity whilst a person whose dot is on the perimeter has the lowest level of activity. The darker purple circle perimeter represents the average level of activity.

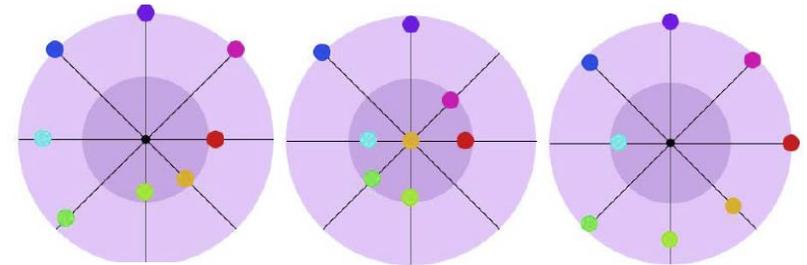


Figure 1 - Activity Radar (SVN)

Figure 2 - Activity Radar (Ticket)

Figure 3 - Activity Radar (Wiki)

The calculation of activity depends on the medium which is why we have three different diagrams associated with the three media: mixing different units in a unique diagram could be irrelevant. For the SVN and for the Wiki media, the amount of activity is the

number of added lines. For the Ticket medium, it is the number of ticket events by the member. The highest activity (the center) and the average (the perimeter of the dark purple circle) values can be defined separately and thus changing the scale. Therefore the scale can be relative to the group only or to the whole class. The appearance is similar to that of the Social Proxies in Babble (Erickson, Smith et al. 1999) and its derivatives (Erickson 2004), except that our dot representation does not capture instant presence and activity in the environment (team awareness) but compiles them over time.

Figure 1, Figure 2 and Figure 3 display the Activity Radar for the same group across each three different media. The blue and dark blue dots at the top represent tutors. We can see that there is good and well-distributed ticket activity, that three team members had considerable activity with the SVN medium and that their Wiki activity is poor (except for the light blue dot). We also notice a different individual behaviour across media. Note that in the actual Activity Radar, the dots are also labeled with the student's login names. We have anonymized them for this paper.

At this stage, it is important to note that we have designed these displays to facilitate group interaction, NOT to judge or assess individuals or groups: we recognize that a simple measure like lines of code submitted makes it trivial to play the system and increase one's apparent activity.

#### *Interaction Network*

This representation is based on Social Network Analysis [ref], which is concerned with capturing relationships and flows between entities. It assumes that these

relationships reveal some important features of the group. The network is modeled as a unidirectional graph (although we have introduced some direction for one medium), consisting of a set of nodes and edges, where each node represents a user and an edge represents an interaction between the two corresponding users. In our context, we defined the notion of interaction between two members when they modify the same resource (in a specific interval of time or not). The width of the edge is proportional to the number of interactions between them. This number is calculated as the sum of all numbers of interaction for each resource for the current medium. For a given resource, the number of interactions is calculated as  $n = \min(n_1, n_2)$  where  $n_1$  and  $n_2$  are the number of times user1 and user2 modified the resource.

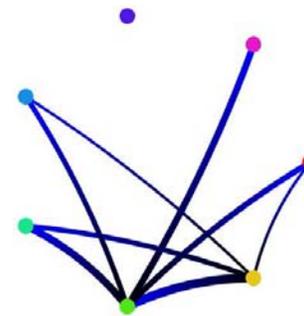


Figure 4 - Ticket interaction

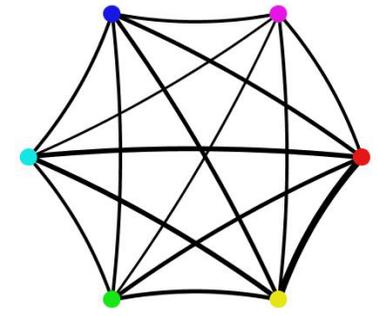


Figure 5 - Wiki interaction

We have three diagrams, one for each medium. For the Ticket medium (Figure 4), we integrated the notion of direction in the interaction because we wanted to show which person is predominantly the initiator of an interaction: if user X assigned 10 tickets to user Y, and user Y assigned 2 tickets to X, then the direction is stronger from X to Y. The strength of that direction is

given by the difference between the number of open tickets (initiation) of the two people among all the shared tickets. It is represented on our diagram by the color density of the edge (darker on the “initiator” side). When the levels are equivalent, the edge is uniform in color.

Figure 4 shows an example of good leadership: the leader (green dot) issues lots of tickets (thick edges, usually dark color on his side of the edge). The purple dot is not a team member but a tutor, which explains why he is not assigned tickets. Note the other team members do not interact a lot. In Figure 5, we can see an example of ideal interaction for the Wiki medium: all team members interact fairly well with everyone.

#### *Wattle Tree: Timeline of events*

Figures 6 and 7 show our novel graphical representation we call the Wattle Tree. Each user’s activity is shown in a climbing vertical “tree” of timeline: the tree starts when the user first does an action on any of the three media considered. The vertical axis shows the day number.

Wiki-related activity is represented by yellow “flowers”, i.e. circles in our current low-key representation, appearing on the left of the trees. SVN-related activity is similarly represented, as (light and dark) orange flowers on the right of the trees. The size of the flower indicates the size of the contribution. Tickets-related actions are represented by leaves (green lines in our current representation): a dark green leaf on the left indicates a ticket was open by the user whilst a light green leaf on the right indicates the user closed a ticket. The length of the left leaf is proportional to the time it remained opened. Those still open are shown at

a standard, maximal size (e.g. the bottom ones in Figure 7). A well-organised, efficient group should have many leaves, of small to medium length, on either side, with lots of activity (wiki and/or svn) in between. A small number of left leaves, especially if they are of maximal length, indicates that users work on very chunky and large tasks, and do not use the ticketing system as intended, (eg. forget to close their tickets).



Figure 6 - Wattle Tree of a good group

Figure 7 - Wattle Tree of a dysfunctional group

Figure 6 shows a group whose members used the

ticket system in an average fashion (some still to be completed). Early in the project they mainly used the Wiki medium, whilst the SVN activity kicks in a third of the way into the project. The overall activity is fairly well distributed over time (with a week's interruption corresponding to the semester break). The workload seems to be heavier and more consistent for the first two members but is solid for the other members. This is consistent with a normal, well functioning group.

Figure 7, in contrast, offers a very different landscape. The activity is much scarcer across all media. The only burst of activity appears exactly the week of deadlines. Not many tickets are closed. The activity and interaction diagrams for that group also show minimal activity and almost no interaction between users. This is an example of a dysfunctional group.

## Results

The diagrams were made available to students in the week before the final deadline. They were introduced in a lecture, with explanations of their meaning and advice on how to use them as a foundation for reflecting on the whole semester and on each person's activity. Students were invited to make use of the diagrams as part of the final report, which included a section for each student to reflect on their learning and performance through the semester. There were a total of 10 groups, each with five to seven members. Due to an error, the visualisations were not provided to one of the groups. Of the remaining 9 groups, 6 made use of them in their reports.

### *Student perspective*

In each of these six groups, the person who used the visualisations was either the most active, top student or

the team leader (and often these roles overlapped). In three groups, this was the only person to make use of the visualisations and they used them to point to their own role in three of the cases: in the fourth of these cases, the team leader pointed out that the visualisations were not valid because they had submitted the work of other people who had difficulty with Subversion, even though this was a stated requirement of the course. In one group, there were three areas where the visualisations were used: in the main group reflection, pointing to high levels of interaction, in the individual reflections of the team leader and by one other strong group member. In one group, the visualisations were used by the two most active students and in another group, they were used by a top student as well as student in the middle of the group, as evidence that they were in the middle in terms of contribution.

### *Teaching team perspective*

For the lecturer (one of the authors), as a person outside the group, the Wattle Tree was far more useful than the Activity Radar since it had much of the activity level as well as temporal details. The Interaction Network was somewhat useful, particularly for seeing who was isolated from others and seeing activity of the effective leaders who had much stronger interactions with all.

These overview visualisations served as a starting point for detailed scrutiny of what was actually happening. In the grading process of the individual contributions, the Wattle Tree, in particular, served as an initial impression of the level of activity and the consistency of work. However, from there, any meaningful assessment of contributions required careful follow up

of the actual work. The Wattle Tree plays an important, indeed critical, role in making it far easier to choose how and where to check through details. As it turned out, the overall impression of effort given by the diagrams correlates to actual marks for most, but certainly not all, students.

### Discussion

It appears that group members would gain far more from all the displays than the lecturer can. In particular, each individual would have a real understanding of what their own Wattle Tree meant (and if they forgot the details, the diagram makes it very clear which medium has the details).

The diagrams would be an excellent starting point for a leader to check progress, as well as others to monitor progress. We believe, however, that they would use the diagrams only as a starting point for more careful examination of the details in Subversion and Trac.

Finally, the way we used the visualisations was to offer them at the end of the projects, as a possibly useful tool for student reflection, one of the elements of the final reports. In this mode, as students did not know earlier that the visualisations would be available, they had no reason to play the system as they could have easily done. For this reason, we see the main role of these diagrams as an aid for the groups to use to support their own activity. Given the simplicity of the activity analysis, it would be very easy to play the system to make a person look very active when they were not. In our intended role for the diagrams, this should not be a serious problem: if a team member did add trite and voluminous contributions to `svn/wiki/tickets`, this would be evident to the other

group members. It would be, essentially, damaging a tool for the group to monitor its performance. Our students showed that they had real understanding of the importance of tracking performance, maintaining communication and managing work allocation. So, there would be strong social pressures against playing the system where the visualisations were used, not for assessment, but as an aid for the group's own management.

We have described our set of three visualizations which provide an overview of a huge amount of information distributed across three media used as part of group work. Our goal is provide tools for groups to improve their effectiveness by being better able to the trees and the woods: the big picture and the details.

### Acknowledgements

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