

### What happened

In the original project plan presented to the site visit committee that awarded the Jade strategic grant, human computer interaction research was identified as an important component of the group research. On the project chart, two main aspects were picked out: graphics and multi-modal dialog. An early commitment was made to basing Jade on dialogue based on windows and the use of a mouse -- a paradigm initiated by Doug Englebart at SRI and developed within Xerox PARC during the 70's. This decision was based on the intuition and experience of faculty and staff, together with the obvious fact that one cannot implement a deliverable system based on research that has yet to be done. The HCS group acquiesced in this decision. This was perhaps the most important contribution made directly to Jade, apart from acting as gadfly and software critic since it allowed implementation to proceed with a well understood interface medium known to be suited to the task.

Almost as important, freedom was given to those best qualified to specify the interface -- the users -- and to do so without interference. This was both a hard and an easy decision. Hard because it meant that HCS would receive very little credit directly from Jade. Easy because the users were also the implementors, so that no communication problems could possibly arise between the users and those responsible for implementing the system. Thus, right from the start, responsibility was divided between research and implementation aspects of Jade HCS interests. This truncation of HCS considerations is not uncommon in large projects.

The original project chart showed the HCS group as carrying out the input design (3 months), specifying multi-modal dialogue standards (12 months), and carrying out blue sky research on multi-modal dialogue problems (remainder of project).

The window system was designed on fairly standard lines by Radford Neal in cooperation with others (especially Murray Peterson), and subject to one formal and one informal group discussion of some of the design decisions. The final form was not completed for a long time, but a basic system was one of the first visible achievements of the project. In making choices on the parameters of the window system, a clear philosophy of choosing extremes emerged. Thus, not just pop-up menus, but pop-up stacks of menus, with a mandatory help window in any module generating pop-up menus (1). Not just windows, but unlimited numbers of overlapping windows (2). Other key decisions in the window interface were: (3) the use of dedicated buttons on the mouse, to enforce consistency in the effect of button presses (this had been seen as a problem with systems such as the Macintosh); (4) user control of layout -- in particular, no program action could change the disposition of windows; and (5) a passive mouse -- that is, no action occurs as a result of mouse manipulations unless a button is pressed. In fact, this latter restriction is not strictly true, since a window can be activated and de-activated by moving the cursor using the mouse.

Thus the user interface for Jade was a well designed but fairly standard window and mouse system accessing standard Unix facilities either by menu or directly. Within this framework, a number of applications were developed that had special interfaces suited to the applications (Jaggies, Mona ...). The basic framework provided the main component of consistency and uniformity. More importantly, we had an excellent window system that could later be modified, since we controlled the source -- the other advantage of having written our own.

A document was produced giving specific detailed principles to guide interface design. This material was also incorporated within a paper presented at the CIPS

Session 84, and met the milestone for dialog standards. A review of the literature suggests that there are no more rigorous rules for interface design. However, if these principles were used at all in Jade, their use was not documented, and there are obvious omissions in the finished product.

In this context, the HCS group set out its function within Jade as:

- maintain close communication with other Jade groups
- produce demonstrable intermediate systems
- disseminate results

with some specific concrete objectives:

- to produce a help facility and user manual
- to produce an appropriate division of tasks
- to establish who [were] the potential users and what [were] their need
- to build a screen prototyping facility for end users
- to experiment with forms of interaction

Just as one cannot build a system based on research that is not yet done, so one cannot conduct research on or with a system that is not yet built. If the implementors had problems because the researchers could not supply hard answers to some of their design questions, the researchers had problems trying to carry out research in an unstable operating context. This hardened the functional division between the two groups, although interaction was not inhibited. The research coalesced around a more exploratory project attempting to build a Multimedia Adaptive Workstation for the Disabled (the MAWD project) within the overall context of Jade. In a very real sense, MAWD was not only a look at the research questions that were part of Jade (but had not led to implementable features), but it was also a look at an arbitrary (as opposed to selected) Jade application. In this role, MAWD had an important influence in modifying some of the basic assumptions of Jade. Although, in the end, MAWD was not implemented within Jade, a lot of software passed in both directions. Also, in this role, MAWD has been building up a knowledge of the problems we would need to tackle in a research implementation of Jade, as opposed to a deliverable implementation. The achievements of the MAWD project are documented in Hill (1985).

The help facility was built into the window system, and the details to be filled in depended on the modules implemented. Hearsay suggests that the help facility is very little used, and many help menus are blank. This is almost certainly arises because all the users are Jade experts, and probably represents a defect of the system.

The user manual, and especially "knowing the user", represents a fundamental principle of interactive system design agreed by every person who has written on the subject. A signal failure of the HCS group was its inability to pin down the characteristics and needs of potential users of the Jade system. By the same token, an allocation of tasks between system and users was not done. If having Jade would have made it much easier to build Jade, so having Jade would also have allowed better estimates of the user population characteristics and needs. This failure was really a reflection of the novelty of the system. It showed up in other ways as well (for example, the project has been criticised as having ill-defined goals, but you can't create something new in a top-down, structured manner, that is the second stage: the first stage is exploring possibilities). However, coupled with this signal failure was a third signal success. By nagging everyone on and on about the importance of a user manual, a high quality user manual was made a high priority in time for a very good document to be produced by

the end of the project. The document was post hoc, and thus did not serve as a useful source of design control, but it does fully document the system as it has evolved, and is an important component of the system's "deliverability".

A dialogue prototyping facility has been built (the IDD), and it represents a fundamentally important research line (Hill & Irving 1984). It requires considerable further development before becoming a Jade facility but has proved to be a powerful focus and idea generator for other aspects of the HCS research interest. Evaluation of the system was carried out at a low level (by questionnaire) for an early prototype, and users found the tool helpful in dialogue design, speeding and simplifying the process.

Experiments have been conducted with a number of innovative interface techniques including: speech input (a voice operated Emacs was constructed); electromyographic control of cursor motion (a pilot experiment showed that even under quite adverse conditions, users were able to use the device); multi-modal speech and touch dialogue (a full scale evaluation showed superior performance for blind and blindfolded-normal subjects compared to conventional key-based control); and speech output (a novel approach to text-to-speech conversion is in the course of being implemented). Richard Esau has been an important contributor in this area, and in the research discussions and design of an operating system geared for reconfigurability and easy dialogue design. The speech and touch work has been published (Hill, Dohrn, Darragh, Esau et al. 1984).

#### A review

Jade was too big and underfunded. Also, information on NSERC policy was hard to tie down and the balance between deliverability and research was never adequately resolved. This is in part because NSERC policy is largely dictated by peer review, and there are many peers and hence many opinions. In the event, deliverability became the key goal for Jade, agreed by all, since it was felt that research could only occur within a working Jade system. This, I still believe, was a good decision based on sound reasoning. However, it had the effect of introducing a hidden agenda. The Jade project was, at least in part, an exercise in producing a research environment for researchers at the U of Calgary. Nevertheless, Jade forged ahead of the Eden project at Washington and Eden, after an even more grandiose start, has fallen back to following in Jade's footsteps. It is ironic that we may well lose our lead time over Eden due to failure of the recent strategic grant application. However, as already noted, deliverability and the associated priority of implementation caused the division of HCS effort, with research becoming MAWD. Direct Jade support was confined to implementation issues.

It has been suggested that Jade should have been frozen and re-implemented after about 18 months, rather than continuing to build on what was complete all the time. That might have resolved the HCS involvement, although it is not certain. It almost certainly would have prevented the success Jade has enjoyed in getting a beta test site. It was a difficult decision and who knows which way was best. The way chosen has been effective, in some respects.

The Jade project ran at a time when Faculty and support staff were spread extremely thinly, within mushrooming enrolments and less than adequate staffing levels. Everyone was overcommitted, and, apart from getting Jade going, the infrastructure also had to be created. This definitely affected Jade adversely. It is a tribute to all concerned that relations remained so good. Brian Unger's leadership had a lot to do with that, but everyone contributed. For Jade technical

staff, an impression of lack of faculty involvement was, perhaps, created. It was an unfair impression. In any case, it is sometimes a lot harder to guide and suggest than to dictate. You don't keep a dog and bark, as the old saying goes, and the Jade staff were certainly very carefully selected for their ability to contribute.

A number of specific criticisms of HCS performance were raised by individual committee members. A number of these have been worked into or answered in the material presented so far. There was some element of irreconcilable conflict in looking at the issues and considering what went right and what went wrong. For example, it was suggested that there was not enough small-scale experimentation (e.g. pop-up versus pull-down menus). Apart from the question of resource allocation and conservation (don't waste resources answering less important questions), there was the counter point that now Jade is built, we have the facilities (including source control) to do that sort of thing.

Another point concerns communication. The faculty did not tell the staff how to design the window system. Given the decision to base Jade on a window system, the main directive was to keep it flexible and provide hooks to allow timing of operations, experimentation, and the monitoring of performance. That faculty and staff did not always see eye to eye was an inevitable result of their conflicting goals (research versus implementation) and was resolved by establishing two parallel activities. The staff were entirely competent to implement a window system. Indeed, it was also stated as a plus that the staff were allowed to get on with the implementation without interference. The window system may be deficient in respect of the point noted, but it would not, now, be a big task to re-implement it. Some informal alternatives have been tried out along the lines of simple software to support what amount to workbenches (Esau) within Unix but such work is really for the future.

It has been suggested that we bought inappropriate hardware, especially the Corvus workstations. However, at the time, the issue was hotly debated at great length. There is no point in rehashing the old arguments, but the factors that won out were (a) we write our own software (source control); (b) we have the highest resolution screens we could have afforded in the required numbers; (c) we have enough workstations to support a community of sufficient size to test and develop the system under realistic conditions. One thing that didn't help was our being led astray by Orcatech on the availability and readiness of their supposedly more powerful workstation. We did get a Dolphin as a high end workstation, with exciting software already written, but we could only afford one of them and that decision has also been criticised. In fact, the Dolphin was used quite a lot as a source of inspiration, which was one reason for buying it. In the end, those concerned with resource allocation in Jade felt that other things were of higher priority. The Dolphin is slightly embarrassing now as it is connected to nothing and cannot be reloaded if it goes down -- a further inhibition to serious use. Also, with no network connection, there is not enough space for snapshots and work spaces. These problems are being resolved.

Another criticism that seems more serious is the fact that no effort was devoted to building low level tools to support interfaces. This is valid, and reflects priorities in resource allocation as well as student and faculty interest. Saul Greenberg put a fair amount of effort into building and documenting a toolbox, but one person can only do so much, especially when he is not full time on the work.

It has been pointed out that the workstation/window manager is heavily dependent on Unix -- an operating system knowing nothing about windows. This is fair in some ways, but the interface is for Unix programmers, at present, and

one has to build a base. A similar criticism can be made of the IDD, for now. It does mean that the question of what sort of environment and interface the developer of a distributed system really needs has not been addressed, as previously noted. In fact the attempt was made very early on, by Laurie Kramer, but she met with a singular lack of success in getting distributed system developers to describe what they needed.

#### In conclusion

Despite all the odds, Jade worked. It was completed and delivered well within the project time frame. This is perhaps the greatest achievement of Jade, but has precious little to do with HCS activity except insofar as that group did not impede the process, and *did* participate fully in all the early heart-wrenching debate and decision. We did subject ourselves to external evaluation. That was a plus, and gained us publicity as well as useful criticism. The various groups did co-operate, despite the damage to individual research programs. All of these are probably unique to the Jade project as far as university research goes. Jade was not only delivered to the US government, but has attracted enquiries from the Esprit project in Europe, and is currently on a short list for adoption, despite stiff competition.

The HCS group did, despite the staff view, conduct research as planned in the project proposal. That it did not impact the Jade project directly was a logical consequence of the very early decisions and has been explained. However, research results in all areas planned were published, and a useful synergy was established between the research group (MAWD) and mainstream Jade work. A number of research lines were started, are already bearing fruit, and will bear more fruit in the future. Most importantly, the HCS group, through Richard Esau in particular, knows enough about Jade this environment can now be exploited for more applied HCS research. The more practical members of the original HCS grouping (notably Radford and Murray) did a fine job of implementing a window-mouse system with a definite character and value of its own. A user manual was also produced, by prodigious effort. Overall, the HCS group made the best contribution it could within the constraints and conflicting goals of Jade.

#### References

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