7.5 MENTOR - A PERFORMANCE SUPPORT SYSTEM FOR FORECASTERS

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1. INTRODUCTION

Objective guidance used by weather forecasters continues to improve in accuracy, content and range, but for most forecast and warning products the forecast process still includes an element of subjective judgement. Human skill in forecasting is based on experience of a range of weather situations and knowledge of the performance of objective guidance systems. But while guidance data and forecast products are normally archived and available for statistical analysis, the subjective inputs to the forecast process generally are not.

The Mentor system has been developed by the Australian Bureau of Meteorology over the last 2 years, in conjunction with RMIT University, as part of the Cooperative Education for Enterprise Development (CEED) program. The project was inspired by the "Coach" system used at Tulsa Weather Forecast Office (Nelson and Rothfusz, 2001). Mentor's goal is to support forecasters' decision-making by recording their opinions and concerns about a large number of weather situations, and by providing easy access to statistical analyses and individual case data.

Mentor is a web-based system which allows forecasters to record in real-time their assessments of likely meteorological "problems of the day", forecast difficulty and their estimates of the value of objective guidance. Follow-up records, usually made within 24 hours, allow forecasters to record the accuracy of their earlier assessments. These initial and follow-up entries accumulate in the Mentor database, and can be quickly analysed and searched by forecasters to assist in subsequent forecasting decisions. Automatic synoptic type classification is an important element of the system.

Operational trials in Bureau of Meteorology Regional Forecasting Centres (RFCs) are planned for late 2002 before full implementation during 2003. It is hoped that the system will provide useful information in three main areas:

- Operational forecasting – the ability to compare the current situation to similar past situations and review forecasters' opinions about the relevant objective guidance should assist decision-making about how much faith to place in guidance;
- Forecaster training – trainees and inexperienced forecasters should benefit from access to the compilation of local wisdom which will accumulate in the Mentor database;
- Numerical model development – model developers engage in dialogue with forecasters to direct and prioritise their research, and should benefit from the ongoing survey of forecaster opinion, which Mentor provides.

Mentor consists of two modules:

Initial and follow-up data entries: Forecasters log characteristics of the current weather situation and the available guidance. An initial entry is logged for every shift (2 or 3 per day) and a follow-up entry the day after to record the weather conditions and forecast success that eventuated.

Search procedure: The performance support system allows forecasters to search through the database for previous cases that match current weather situations. Descriptions of these cases can then be accessed and the forecaster can see what was predicted and what actually happened. Subjective assessments by forecasters will also be available for guidance. This can be of great assistance when considering local 'rules of thumb'.

2. SYSTEM DESCRIPTION

Mentor is best represented by the system level diagram shown below.

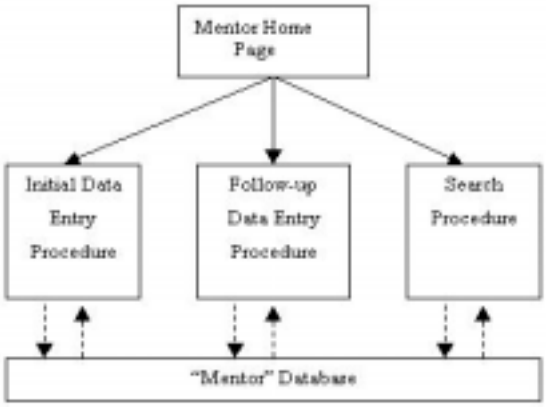

Figure 1: Mentor System Schematic

A 3-tier Internet Application was implemented using Java Server Pages (JSP) and JavaScript technology. The MENTOR Database is implemented on an Oracle platform.

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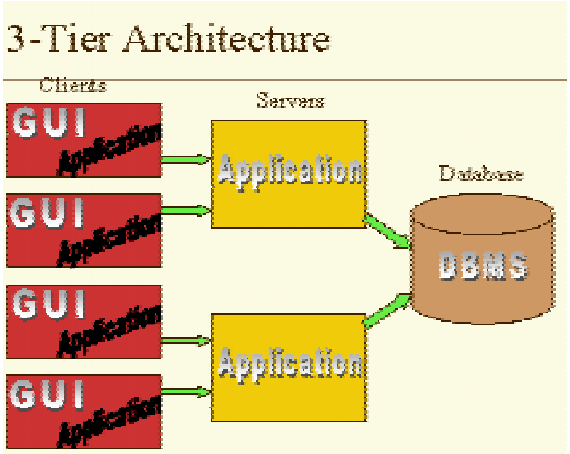

Figure 2: Mentor Architecture

The application and database reside on the server, minimising traffic flow on the network connection. This is because it is not necessary to transfer the application code to the client, but rather, just its output. The use of such a thin client, fat server combination is aimed at increasing application speed. Furthermore, the distributed nature of the application will make it easier to maintain and extend.

The Mentor database uses one relation for initial data entries and one for follow-up entries. One row in the relation represents an entry for a particular day. This simple structure was important as once the database has grown it can still be searched efficiently.

3. DESIGN AND IMPLEMENTATION ISSUES

The Mentor interface is similar to that used in "Coach" (Nelson and Rothfusz, 2001), but local user input has driven the major design decisions:

- Shift Representative Logins – rather than individuals logging in to Mentor, a representative of each forecasting shift will carry out the initial data entry, summarising the forecast policy in use by the shift team.
- Problems of the Day – the concept of problems of the day (POTD) has been retained from "Coach" and is intended to record the major issues or forecasting decisions facing the shift. At forecasters' request the number of POTD, which can be recorded, has been increased to 6.
- Synoptic Typing – automatic synoptic type matching has been included in Mentor, utilising the objective method of Dahni (2003). It is expected that stratification of the Mentor database on Synoptic Type will be a particularly useful means of identifying similar forecasting situations.
- Ease of use – although Mentor is not yet in operational use, a number of forecasters have provided suggestions on its design. A balance has had to be struck between completeness in the list of synoptic and mesoscale systems and the size of the onscreen forms. The developers are aware that using Mentor is an extra task for busy forecasters and have given priority to making the forms simple and quick to use.

4. USING MENTOR

When using Mentor, the forecasting shift representative first displays the Mentor homepage using any web browser. The homepage shows links to summary statistics from the Mentor database for all of the Regions of responsibility of the Bureau of Meteorology's RFCs, as well as the main Mentor menu options. The forecaster will usually go straight to the Initial Data Entry page, via a login screen. Generic logins are used for all users in an RFC.

The Initial Data Entry screen displays the Synoptic Type, which has been identified automatically for that day and Region, based on the latest Numerical Weather Prediction (NWP) Mean Sea Level Pressure Analysis. A number of links allow the forecaster to view statistics from the Mentor database stratified on Synoptic Type.

The forecaster then begins data entry by filling in the webpage form, which comprises questions on:

- The time of day of the current shift (morning, afternoon or evening);
- Weather Events expected during the next 36 hours, such as precipitation, maximum temperatures more than 3^{o}C from average, frost, fire danger index greater than very high, thunderstorms, conditions below minima at airports, etc;
- Mesoscale features expected to affect the forecast, such as fronts, upper troughs, cold pools, etc;
- Hazardous weather requiring warnings, such as severe thunderstorms, flooding, extreme fire danger, etc., and an estimate of the probability of occurrence;
- Problems of the day (maximum of 6) including precipitation, wind, cloud, etc, and an assessment of the significance of the problem to the day's forecast policy;
- Confidence in the NWP models and the official forecasts;
- Estimated dispersion in the NWP model guidance;
- Perceived difficulty of the forecasting situation; and
- Other subjective analyses.

At some other time during the shift the representative will also complete the Follow-Up Data Entry form, which asks a similar range of questions about the previous day's forecasting situation. An additional question is asked about the forecaster's level of surprise at the actual weather outcome.

In addition to numerous links to statistical summaries and specific cases in the Mentor database shown on the data entry pages, the system provides a separate Search page. Search options available are:

- Most recent entries;
- Specific dates;
- Single or multiple parameters, such as model confidence, synoptic type, chance of warnings, expected weather events, POTD, and level of surprise.

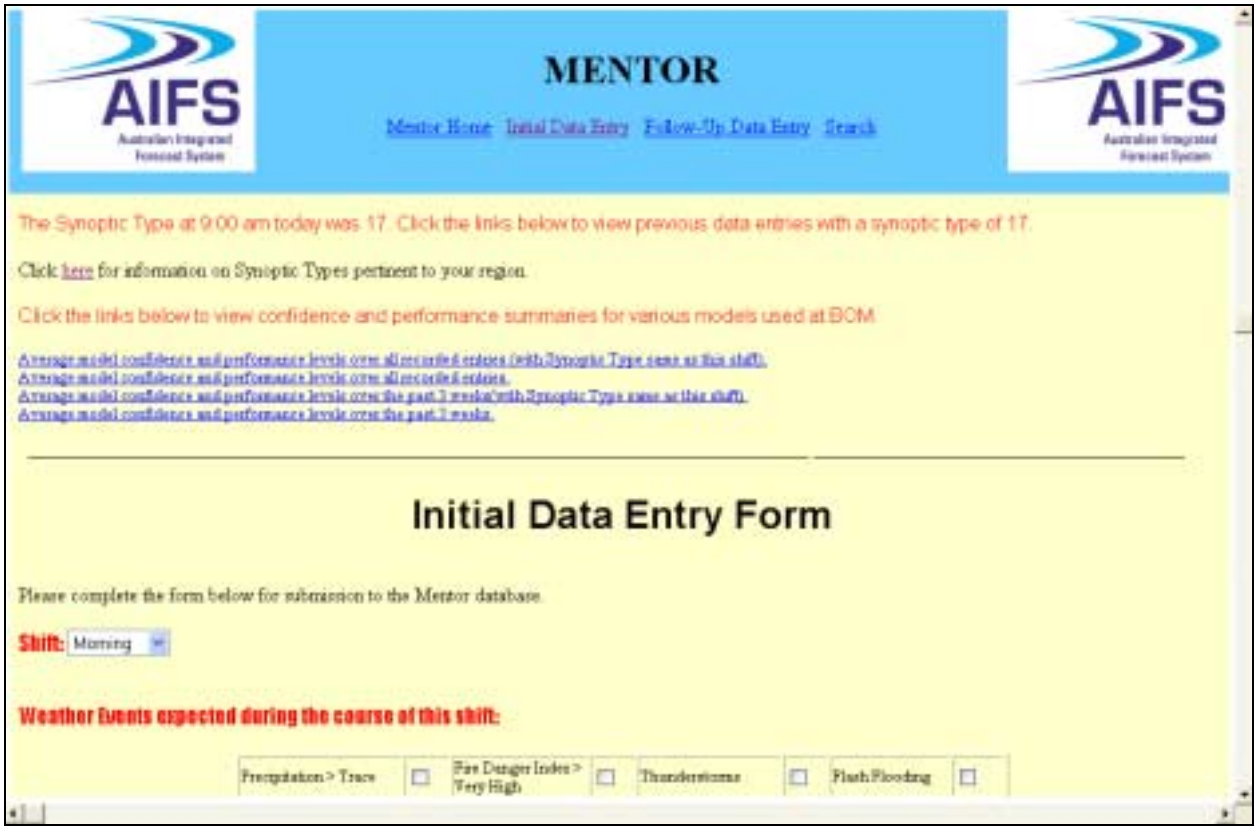

Figure 3: Part of the Initial Data Entry Page

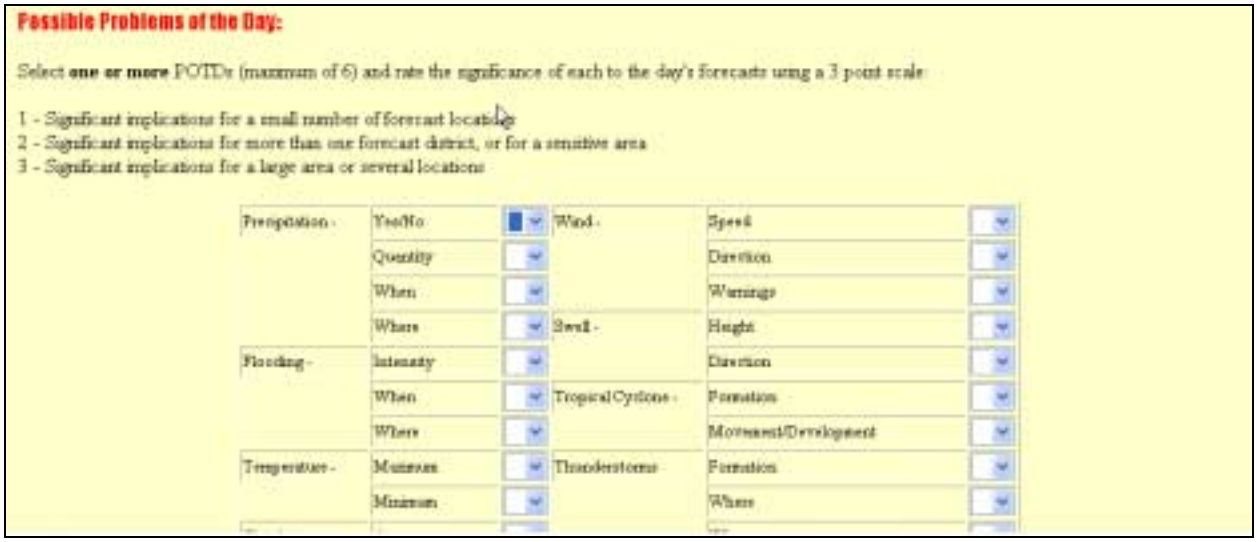

Figure 4: Part of the Problem of The Day data entry form

5. FUTURE DEVELOPMENTS

Operational trials planned for late 2002 will provide guidance on refining the Mentor interface. A period of operational use during the first half of 2003 is then planned to begin populating the Mentor database, after which it will be possible to assess the usefulness of the data to the forecasting process.

6. ACKNOWLEDGEMENT

Lans Rothfusz and Steve Nelson generously provided advice and suggestions, and permission to base this work on “Coach”.

7. REFERENCES

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