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DESIGNING AN OVERVIEW DISPLAY FOR A PROCESS PLANT

From the dashboards in our cars to the visually appealing smartphone screens in our hands, we are all surrounded by different interfaces that allow us to control certain equipment. To measure a smartphone's well being we usually keep track on how much battery is left, how good the reception is and if we have access to Wi-Fi or 3G. How such an interface could look for an entire process plant will be discussed in this article.

In addition to the smartphone's well being, we keep track of incoming calls, messages, new updates and many other things. If you think about it, all of the above things are visually presented in their own way. The battery status for example is shown by a battery-like icon that is partially filled green, depending on how much battery is left. When the battery drops below a certain amount, the filled part becomes red and sometimes a pop-up will tell you that you are running low on battery. With this in mind, imagine an interface that has to present an entire process plant on a computer screen. It has to involve up to a hundred indicators of temperatures, pressures, tank levels, flows and many other measurements. Imagine then that the consequences for overlooking some piece of information can lead to major financial losses for the company. In some cases it can even lead to major damage to the equipment and in the worst case scenario, humans could be harmed. How do you design this kind of interface?

That was the main question the author had in mind when writing the master thesis "Design of a process overview display in a Human-Machine Interface". The thesis explains how a great deal of information can be squeezed into one overview display with the aim of not overwhelming the person monitoring the screen. You might ask yourself, why is the process plant's status not just divided into several displays? In fact, that is how it is done in most plants today. The point I will try to get across is that there is a need for a single display where you can look at all the important measurements at the same time.

THE ARGUMENTS FOR USING A SINGLE OVERVIEW DISPLAY

Providing a quick "at-a-glance" overview
An overview display helps you to form a quick understanding of what is going on in the plant. If you return from a bathroom break, you can quickly know what is happening in the plant by simply looking at the overview display.

Improving work conditions
If you lack an overview display you have to constantly switch between different screens in intervals to stay updated about the plant's status. This can be rather cumbersome and even difficult if you have to remember the status of the screens that are not currently displayed.

Fighting attention tunneling
Attention tunneling means that you lock in on a certain information and only care about that for a period of time. Let us say that a temperature in a tank is 5˚C too hot and you switch to the display where the tank is and try to figure out why that is the case. Meanwhile in another area of the plant, a tank catches fire and the temperature is 100˚C too hot but if you do not have an overview display, you do not have the overall picture. Maybe you get a visual alarm on the bottom of the screen of it

but you are so tangled up with troubleshooting the first temperature that you do not even notice the alarm. On the contrary, with a single overview display at hand, you would know that the temperature in the tank that is on fire is more important because everything would be in your field of view.

ANALOG IS OFTEN BETTER

One way of presenting information is to just show the data. If the temperature is 50˚C in a tank, just write it out on the screen. But what can you really say about 50˚C if you see it on the screen? Is it normal? Or is it too hot? You might have remembered that the upper limit is 40˚C in this particular tank but what if you were to monitor 50 tanks, could you remember all the limits for them? Probably not, there has to be a better way of presenting the data. The analog way is one solution. It appeals to our pattern recognition skill and shows data in an intuitive way.

For demonstration purposes, the following segment presents an example where a veterinary takes a blood test on a cat and returns with some data. The data will be presented in three ways.

Table 1. The following table shows the first presentation of the blood test results. Seven values are shown in a numerical way.

Test	Value
HCT	31.7 %
HGB	10.2 g/dl
MCHC	32.2 g/dl
WBC	9.2×10^9/L
GRANS	6.5×10^9/L
L/M	2.7×10^9/L
PLT	310×10^9/L

As seen in Table 1, are the values from the blood test normal? Is the cat sick? Only if you are an experienced veterinary you could tell if the cat is sick or not in a minute.

Table 2. The following table shows the second presentation of the blood test results. Seven values and their normal ranges are shown.

Test	Value	Normal range
HCT	31.7 %	24.0 – 45.0
HGB	10.2 g/dl	8.0 – 15.0
MCHC	32.2 g/dl	30.0 – 36.9
WBC	9.2×10^9/L	5.0 – 18.9
GRANS	6.5×10^9/L	2.5 – 12.5
L/M	2.7×10^9/L	1.5 – 7.8
PLT	310×10^9/L	175 - 500

Now examine Table 2. Is it possible the determine if the cat is sick? After comparing the values and their normal ranges for a while, you can tell that all values are in the normal range and that the cat is fine, even if you are not a veterinary.

Table 3. The following table shows the third presentation of the blood test results. Seven values are shown in an analog way.
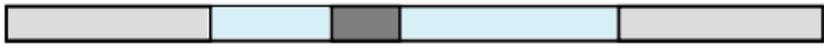
HCT	
HGB	
MCHC	
WBC	
GRANS	
L/M	
PLT	

Finally, examine Table 3. The status of the cat's health is clearly visible "at-a-glance" in this presentation and the numerical values are not even needed. This shows the power of presenting data in an analog and intuitive way. Analog representations are the key to making an effective overview display.

THE OVERVIEW DISPLAY

An example of an overview display can be seen in Figure 1. The display involves around 80 different measurements from a Trimethylolpropane plant that operators at the plant considered to have a significant impact on the process. Most of the data is visualized through analog indicators and with pattern recognition it is easy to identify values out of range. Some of the values have trends that show how the value is behaving over time. There are currently four alarms active in Figure 1. The yellow ones are alarms where a first warning limit has been breached and the red alarm is where a critical limit has been breached.
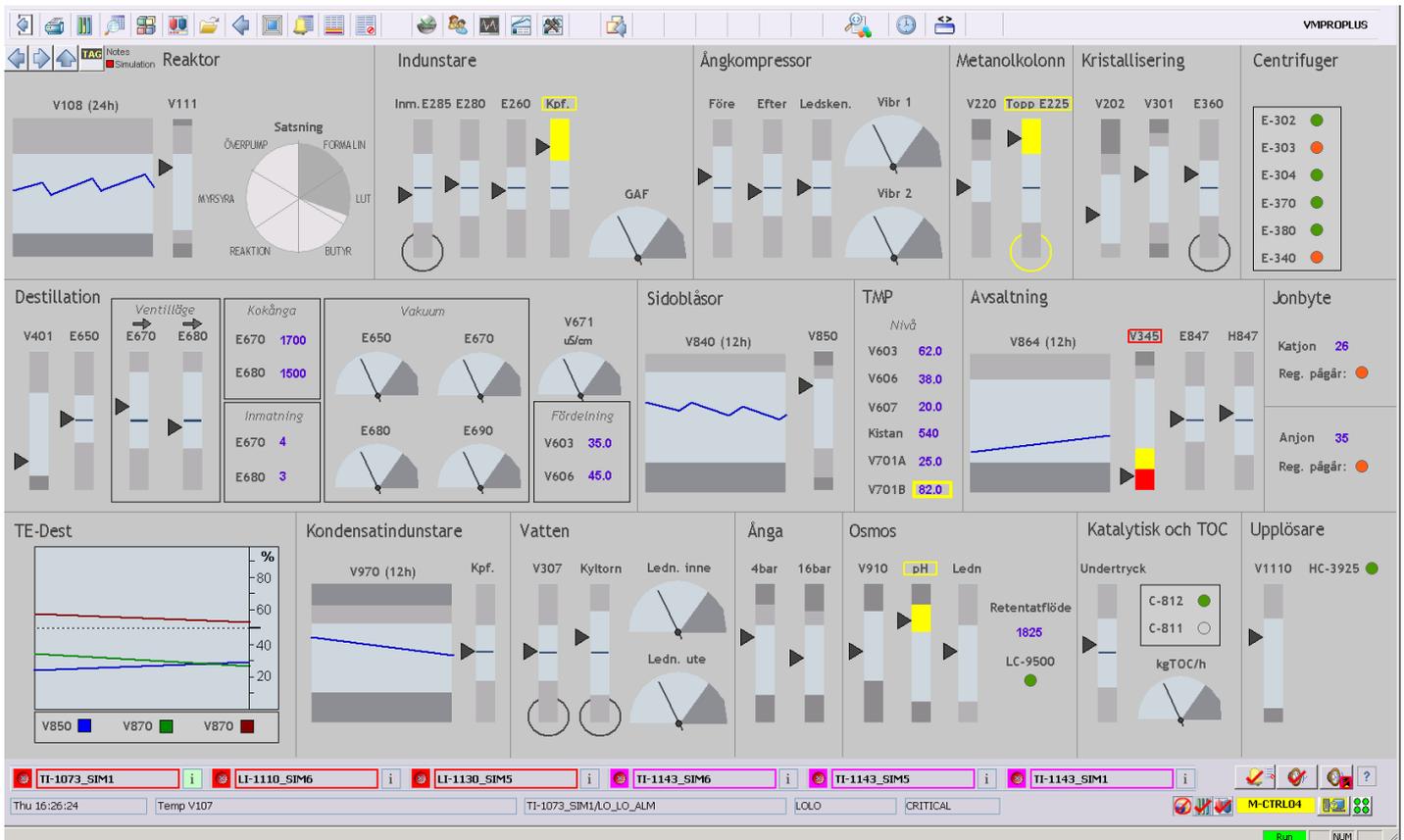
Figure 1. The figure shows an overview display for a Trimethylolpropane (TMP) plant with Swedish terms.

In conclusion, use an overview display to increase the plant operator's performance by providing them with a "at-a-glance" overview of the plant's status. The key to designing a good overview display is to present the data in an analog and intuitive way. For more details and theory, take a look at the master thesis "Design of a process overview display in a Human-Machine Interface".