Cutting edge

State-of-the-art design revolutionizes forage harvester terminals

Forage harvesters belong to the most powerful agricultural machinery, boasting 585 HP, 15.6 litres cylinder capacity and 6.30 meter wide mowers. Operating such vehicles requires wider cutting edge technology and know-how than simply driving a car. The driver terminal must be able to process information of more than 30 components, such as engine, metal detection or the grinding device, within fractions of a second. Additionally, the terminal includes different alert and diagnostic systems. Krone, industry leader in hay and forage equipment from Germany, has managed to install all these features into touch screen terminals situated in the cabin of its flagship forage harvester Big X 480/580. Engineers at Krone have worked with the Qt software library during the development stage, resulting in an outstanding new design.

"Our driver's cab has been revolutionized", Krone's product manager, Heiner Brüning says. He is responsible for the Big X and Big M forage harvesters. "With our state-of-the-art terminal, we have set new standards in user-friendliness and flexibility, primarily because of the touch screen technology's functionality we used. The production of terminals with integrated touch screen technology increasingly has been re-quested by our drivers."

Krone has always built excellent farm machinery. With the beginning of the smart phone era, however, the company had difficulties to keep up to date with the rapidly changing market. "We are now proud to be ahead of our competitors when it comes to the operational handling via the driver's cab", Brüning emphasizes.

The Graphical User Interface (GUI), the software library Qt and its constituting, synthesized GUI-service description language QML have played a significant part in the development of the new terminals. Qt, which is based on the programming language C++, allows for cross-platform programming of applications with graphical user inter-faces (GUI). QML also permits non-developers such as UI- and Web designers to develop GUIs with the help of Qt. Qt has been employed successfully in various industrial branches. Infotainment systems in airplanes and cars, set top speakers, television sets, audio systems as well as domestic hardware from well-known companies such as Panasonic, Magneti-Marelli, LG, Free, Loewe or Netflix have all been conceptualized with Qt.

Software developed using Qt can be implemented without switching between operating systems such as Windows, Linux and QNX. It can also be used with diverse microprocessors such as Intel or ARM. According to Brüning, "the flexibility of Qt, allowing it to be used with different platforms, enabled us to test the individual progress continuously and to minimize potential errors. From the beginning, we have been able to integrate users and partners, to ensure that the terminal fulfils their specific needs."

The driver terminal serves as an operational hub connecting the conductor to his machine. The driver of the forage harvester Big X 480/580 from Krone has access to more than 30 functions in his cab, which can be controlled and adjusted at a constant pace. The terminal receives up to 1,000 signals per second, which appear on the monitor after being processed. To ensure that the terminal can develop and display the accumulated data, the graphic software OpenGL accelerates the GUI and handles data in a separate thread. Communication between GUI- and thread is achieved by Qt signals and Qt slots, making explicit thread synchronization redundant. The terminal's visible part was developed using the QML software language, whilst non-visual elements are constructed with Qt and C++.

Due to the short harvest period, Krone was faced with considerable time pressure during the development of their terminals. "We had an extremely

tight schedule, as the new terminal had to be completed in time for the corn harvest. By programming in Qt and QML, developing times were reduced. Therefore, we could already test our prototype after three months", explains Burkhard Stubert, the software developer in charge. This extremely fast development could only be achieved by a smooth co-operation between Stubert, the UI-Designer, Alexander Bücken, the Krone Software-Development team and a developer at software provider e-GITS.

The touch screen technology turned out to be particularly challenging. Stubert: „External influences, such as the vibration of machinery with more than 500 HP can only be tested in the field. Touch screen technology in such a large machine cannot be compared to that of a smart phone, because its sensors do not require such high levels of sensitivity, and therefore must only react to significant pressure."

Stubert is delighted with the implementation of Qt in the development of graphical user interfaces. „For agricultural engineering, Qt is perfect. It is inexpensive and can be used flexibly as an open-source-platform. The library is continuously enhanced and augmented by programmers worldwide. If you need help, answers are usually provided by the Qt community within a few hours."

Since spring 2014, The Big X 480/580 has been running successfully with the new and improved terminal technology. Krone also plans to continue to use Qt for further forage harvester developments.

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