Presentations

An Embedded Linux Platform to Collect, Analyze and Store Critical Data for the Navigation of an Autonomous Vehicle

- The motivation of this work is to design an underwater navigation system composed of a low cost Embedded Linux platform and small sized sensors. For air or ground vehicles, a GPS receiver with differential corrections (DGPS) can provide very precise and inexpensive measurements of geodetic coordinates. Unfortunately these GPS radio signals cannot penetrate beneath the ocean's surface, and this poses a considerable constraint as the vehicle must surface to obtain GPS fixes. Therefore, data from a low cost inertial measurement unit are integrated with GPS to produce continuously accurate navigation information [3].
- The primary impetus for this work was to use a Linux-supported processor. Linux is available under the GNU General Public License (GPL) and is a part of the open source software (OSS) community [4]. According to a survey conducted by Venture Development Corporation as part of its Embedded Software Strategic Market Intelligence Program, commercial Embedded Linux owns approximately 50 percent more of the new project market than either Microsoft or Wind River Systems [5].
- Linux is a multi-tasking, multi-user, multi-processor operating system and supports a wide range of hardware processor platforms, such as x86, Alpha, SuperH, PowerPC, SPARC and ARM. After reviewing commercially available Autonomous Underwater Navigation (AUN) systems it was found that none of them utilized the Embedded Linux operating system for data processing.
- Most of the work in embedded Linux has been done in kernel development. Work by Lee [6] proposes to customize Linux as an application specific OS. To achieve this, processes based on reengineering called Call-Graph are implemented. The basic concept used is to construct a kernel's calling structure and to remove the unnecessary code according to each specific application.
- One of the important requirements for implementing real time operations in an operating system is to support scheduling algorithms. Work by Lin and Wang [7] addresses this by designing Red-Linux, which supports real time systems and non real-time jobs with different performance requirements. RT Linux addresses the issue of latency by inserting pre-emption points in the kernel.
- Work by Kato [8] discusses the transition from the conventional RTOS to Linux for mobile phones. The requirements for mobile phone are memory size, stability, boot time/UI response time and power consumption. To reduce the memory size, executable binaries are read directly from the ROM. To reduce the user response time/boot-up time, Prelink was used, which locates the virtual address of each shared library uniquely and resolves symbol references before run time.
- Work by Li and Chiang [9] proposes the implementation of a TCP/IP stack as a self-contained component, which is independent of operating system and hardware. For adapting TCP/IP stack as a self-contained component for embedded systems, zero-copy mechanism has been incorporated for reducing protocol-processing overhead, memory usage and power consumption. In this mechanism data from a Network card is directly received in the user buffer and the data from the user buffer is directly sent to the network card.
- The Inertial Measurement Unit (IMU) consists of an accelerometer and an angular rate sensor (gyro meter) to track the motion of the vehicle. The paper written by Wang, Ding and Zhao [10] proposes a configuration of nine accelerometer based non-gyro inertial measurement unit (NGIMU). Here the authors have expressed the angular acceleration in terms of the linear combination of the accelerometer outputs.

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